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Strategies for the removal of short-term indwelling urethral catheters in adults (Review)

Ellahi A, Stewart F, Kidd EA, Griffiths R, Fernandez R, Omar MI

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TABLE OF CONTENTS

ABSTRACT 1
PLAIN LANGUAGE SUMMARY 2
SUMMARY OF FINDINGS 4
BACKGROUND 9
OBJECTIVES 11
METHODS 11
RESULTS 14
Figure 1. 15
Figure 2. 19
Figure 3. 20
Figure 4. 25
Figure 5. 28
Figure 6. 30
DISCUSSION 34
AUTHORS' CONCLUSIONS 37
ACKNOWLEDGEMENTS 37
REFERENCES 38
CHARACTERISTICS OF STUDIES 53
DATA AND ANALYSES 227
Analysis 1.1. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 1: Number needing to be recatheterised 231
Analysis 1.2. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 2: Number needing to be recatheterised: subgroup analysis based on sex 232
Analysis 1.3. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 3: Symptomatic catheter-associated urinary tract infection (number of participants) 232
Analysis 1.4. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 4: Asymptomatic bacteriuria (number of participants) 233
Analysis 1.5. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 5: Incidence of urinary retention 233
Analysis 1.6. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 6: Difficulty in passing urine 233
Analysis 1.7. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 7: Loin pain 234
Analysis 1.8. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 8: Fever 234
Analysis 1.9. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 9: Incontinence 234
Analysis 1.10. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 10: Dysuria (number of participants) 235
Analysis 1.11. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 11: Volume of the first void (mL) 236
Analysis 1.12. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 12: Volume of first void (median and range) 236
Analysis 1.13. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 13: Time to first void (hours) 237
Analysis 1.14. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 14: Time to first void (median) 237
Analysis 1.15. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 15: Post-void residual volume 238
Analysis 1.16. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 16: Length of hospitalisation in days 238

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Analysis 1.17. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 17: Length of hospitalisation in days 238
Analysis 1.18. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 18: Time between removal of catheter to discharge 239
Analysis 2.1. Comparison 2: Shorter versus longer duration of catheter, Outcome 1: Number needing to be recatheterised 244
Analysis 2.2. Comparison 2: Shorter versus longer duration of catheter, Outcome 2: Number needing to be recatheterised: subgroup analysis based on type of surgery 246
Analysis 2.3. Comparison 2: Shorter versus longer duration of catheter, Outcome 3: Number needing to be recatheterised: subgroup analysis based on sex 248
Analysis 2.4. Comparison 2: Shorter versus longer duration of catheter, Outcome 4: Number needing to be recatheterised: subgroup analysis based on antibiotic prophylaxis 250
Analysis 2.5. Comparison 2: Shorter versus longer duration of catheter, Outcome 5: Symptomatic catheter-associated urinary tract infection (number of participants) 252
Analysis 2.6. Comparison 2: Shorter versus longer duration of catheter, Outcome 6: Symptomatic catheter-associated urinary tract infection: post-hoc subgroup analysis by antibiotic prophylaxis 254
Analysis 2.7. Comparison 2: Shorter versus longer duration of catheter, Outcome 7: Asymptomatic bacteruria (number of participants) 255
Analysis 2.8. Comparison 2: Shorter versus longer duration of catheter, Outcome 8: Incidence of urinary retention 257
Analysis 2.9. Comparison 2: Shorter versus longer duration of catheter, Outcome 9: Delayed voiding after catheter removal ... 258
Analysis 2.10. Comparison 2: Shorter versus longer duration of catheter, Outcome 10: Chronic urinary retention 258
Analysis 2.11. Comparison 2: Shorter versus longer duration of catheter, Outcome 11: Other complications of catheterisation: fever 259
Analysis 2.12. Comparison 2: Shorter versus longer duration of catheter, Outcome 12: Other complications of catheterisation: epididymitis 259
Analysis 2.13. Comparison 2: Shorter versus longer duration of catheter, Outcome 13: Pain or discomfort (dichotomous) 260
Analysis 2.14. Comparison 2: Shorter versus longer duration of catheter, Outcome 14: Pain or discomfort: 0-10 VAS (higher score = greater pain) 261
Analysis 2.15. Comparison 2: Shorter versus longer duration of catheter, Outcome 15: Patient satisfaction 261
Analysis 2.16. Comparison 2: Shorter versus longer duration of catheter, Outcome 16: Urinary incontinence 262
Analysis 2.17. Comparison 2: Shorter versus longer duration of catheter, Outcome 17: Dysuria 263
Analysis 2.18. Comparison 2: Shorter versus longer duration of catheter, Outcome 18: Volume of first void (mL) 263
Analysis 2.19. Comparison 2: Shorter versus longer duration of catheter, Outcome 19: Time to first void (hours) 264
Analysis 2.20. Comparison 2: Shorter versus longer duration of catheter, Outcome 20: Post-void residual volume (mL) 264
Analysis 2.21. Comparison 2: Shorter versus longer duration of catheter, Outcome 21: Post-void residual volume (median and range) (mL) 264
Analysis 2.22. Comparison 2: Shorter versus longer duration of catheter, Outcome 22: Length of hospitalisation in days 265
Analysis 2.23. Comparison 2: Shorter versus longer duration of catheter, Outcome 23: Length of hospitalisation in days: subgrouping based on type of surgery 266
Analysis 2.24. Comparison 2: Shorter versus longer duration of catheter, Outcome 24: Length of hospitalisation in days (median and range) 267
Analysis 2.25. Comparison 2: Shorter versus longer duration of catheter, Outcome 25: Frequency of micturition 267
Analysis 2.26. Comparison 2: Shorter versus longer duration of catheter, Outcome 26: Time to first ambulation (hours) 268
Analysis 3.1. Comparison 3: Clamping versus free drainage, Outcome 1: Number needing to be recatheterised 270
Analysis 3.2. Comparison 3: Clamping versus free drainage, Outcome 2: Number needing to be recatheterised: subgroup analysis based on type of surgery and sex 271
Analysis 3.3. Comparison 3: Clamping versus free drainage, Outcome 3: Symptomatic catheter-associated urinary tract infection (number of participants) 272
Analysis 3.4. Comparison 3: Clamping versus free drainage, Outcome 4: Incidence of urinary retention (number of participants) 272
Analysis 3.5. Comparison 3: Clamping versus free drainage, Outcome 5: Dysuria (number of participants) 273
Analysis 3.6. Comparison 3: Clamping versus free drainage, Outcome 6: Volume of first void (mL) 273
Analysis 3.7. Comparison 3: Clamping versus free drainage, Outcome 7: Time to first void (minutes) 273
Analysis 3.8. Comparison 3: Clamping versus free drainage, Outcome 8: Length of hospitalisation (median days) 273
Analysis 3.9. Comparison 3: Clamping versus free drainage, Outcome 9: Length of hospitalisation (days) 274

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Analysis 3.10. Comparison 3: Clamping versus free drainage, Outcome 10: Time required to return to normal bladder function (hours) 274
Analysis 4.1. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 1: Number of participants needing to be recatheterised 275
Analysis 4.2. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 2: Symptomatic catheter-associated urinary tract infection (number of participants) 275
Analysis 4.3. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 3: Incidence of urinary retention (number of participants) 275
Analysis 4.4. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 4: Post-void residual volume 276
Analysis 4.5. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 5: Length of hospitalisation in days 276
Analysis 4.6. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 6: Length of hospitalisation in days (median, range, N) 276
ADDITIONAL TABLES 276
APPENDICES 298
WHAT'S NEW 302
HISTORY 303
CONTRIBUTIONS OF AUTHORS 304
DECLARATIONS OF INTEREST 304
SOURCES OF SUPPORT 304
DIFFERENCES BETWEEN PROTOCOL AND REVIEW 304
INDEX TERMS 305

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[Intervention Review]

Strategies for the removal of short-term indwelling urethral catheters in adults

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ABSTRACT

Background

Urinary catheterisation is a common procedure, with approximately 15% to 25% of all people admitted to hospital receiving short-term (14 days or less) indwelling urethral catheterisation at some point during their care. However, the use of urinary catheters is associated with an increased risk of developing urinary tract infection. Catheter-associated urinary tract infection (CAUTI) is one of the most common hospital-acquired infections. It is estimated that around 20% of hospital-acquired bacteraemias arise from the urinary tract and are associated with mortality of around 10%.

This is an update of a Cochrane Review first published in 2005 and last published in 2007.

Objectives

To assess the effects of strategies for removing short-term (14 days or less) indwelling catheters in adults.

Search methods

We searched the Cochrane Incontinence Specialised Register, which contains trials identified from CENTRAL, MEDLINE, MEDLINE In-Process, MEDLINE Epub Ahead of Print, CINAHL, ClinicalTrials.gov, WHO ICTRP, and handsearching of journals and conference proceedings (searched 17 March 2020), and reference lists of relevant articles.

Selection criteria

We included all randomised controlled trials (RCTs) and quasi-RCTs that evaluated the effectiveness of practices undertaken for the removal of short-term indwelling urethral catheters in adults for any reason in any setting.

Data collection and analysis

Two review authors performed abstract and full-text screening of all relevant articles. At least two review authors independently performed risk of bias assessment, data abstraction and GRADE assessment.

Main results

We included 99 trials involving 12,241 participants. We judged the majority of trials to be at low or unclear risk of selection and detection bias, with a high risk of performance bias. We also deemed most trials to be at low risk of attrition and reporting bias. None of the trials reported on quality of life. The majority of participants across the trials had undergone some form of surgical procedure.

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Thirteen trials involving 1506 participants compared the removal of short-term indwelling urethral catheters at one time of day (early morning removal group between 6 am to 7 am) versus another (late night removal group between 10 pm to midnight). Catheter removal late at night may slightly reduce the risk of requiring recatheterisation compared with early morning (RR 0.71, 95% CI 0.53 to 0.96; 10 RCTs, 1920 participants; low-certainty evidence). We are uncertain if there is any difference between early morning and late night removal in the risk of developing symptomatic CAUTI (RR 1.00, 95% CI 0.61 to 1.63; 1 RCT, 41 participants; very low-certainty evidence). We are uncertain whether the time of day makes a difference to the risk of dysuria (RR 2.20; 95% CI 0.70 to 6.86; 1 RCT, 170 participants; low-certainty evidence).

Sixty-eight trials involving 9247 participants compared shorter versus longer durations of catheterisation. Shorter durations may increase the risk of requiring recatheterisation compared with longer durations (RR 1.81, 95% CI 1.35 to 2.41; 44 trials, 5870 participants; low-certainty evidence), but probably reduce the risk of symptomatic CAUTI (RR 0.52, 95% CI 0.45 to 0.61; 41 RCTs, 5759 participants; moderate-certainty evidence) and may reduce the risk of dysuria (RR 0.42, 95% CI 0.20 to 0.88; 7 RCTs; 1398 participants; low-certainty evidence).

Seven trials involving 714 participants compared policies of clamping catheters versus free drainage. There may be little to no difference between clamping and free drainage in terms of the risk of requiring recatheterisation (RR 0.82, 95% CI 0.55 to 1.21; 5 RCTs; 569 participants; low-certainty evidence). We are uncertain if there is any difference in the risk of symptomatic CAUTI (RR 0.99, 95% CI 0.60 to 1.63; 2 RCTs, 267 participants; very low-certainty evidence) or dysuria (RR 0.84, 95% CI 0.46 to 1.54; 1 trial, 79 participants; very low-certainty evidence).

Three trials involving 402 participants compared the use of prophylactic alpha blockers versus no intervention or placebo. We are uncertain if prophylactic alpha blockers before catheter removal has any effect on the risk of requiring recatheterisation (RR 1.18, 95% CI 0.58 to 2.42; 2 RCTs, 184 participants; very low-certainty evidence) or risk of symptomatic CAUTI (RR 0.20, 95% CI 0.01 to 4.06; 1 trial, 94 participants; very low-certainty evidence). None of the included trials investigating prophylactic alpha blockers reported the number of participants with dysuria.

Authors' conclusions

There is some evidence to suggest the removal of indwelling urethral catheters late at night rather than early in the morning may reduce the number of people who require recatheterisation. It appears that catheter removal after shorter compared to longer durations probably reduces the risk of symptomatic CAUTI and may reduce the risk of dysuria. However, it may lead to more people requiring recatheterisation. The other evidence relating to the risk of symptomatic CAUTI and dysuria is too uncertain to allow us to draw any conclusions.

Due to the low certainty of the majority of the evidence presented here, the results of further research are likely to change our findings and to have a further impact on clinical practice. This systematic review has highlighted the need for a standardised set of core outcomes, which should be measured and reported by all future trials comparing strategies for the removal of short-term urinary catheters. Future trials should also study the effects of short-term indwelling urethral catheter removal on non-surgical patients.

PLAIN LANGUAGE SUMMARY

What are the best strategies for removing drainage tubes (urinary catheters) from the urinary bladder after 14 days or less?

Key messages

• Removing drainage tubes late at night instead of early in the morning might reduce the number of people who need to have the drainage tube reinserted.

• Removing drainage tubes sooner rather than later probably reduces the risk of infection caused by the drainage tube and painful urination. However, it may lead to more people needing to have the tube reinserted.

• We need future studies to research the effects of drainage tube removal for people who did not have surgery.

What are urinary catheters?

Urinary catheters are flexible, hollow tubes that are used to empty the urinary bladder and collect urine in a bag. They are often used for short periods of time for people who cannot pass urine themselves, for example during or after surgery, or when healthcare staff need to measure someone's urine. One harmful effect of catheters is the risk of developing urinary tract infections (UTIs). If catheters are removed quickly, the risk of infection is reduced, but if they are removed too soon, they may need to be reinserted.

What did we want to find out?

We wanted to investigate the effects of different strategies on the risk of:

• needing to have the catheter reinserted;
• developing a urinary tract infection (UTI);
• experiencing pain when urinating.

What did we do?

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We searched for studies that looked at the use of short-term urinary catheters in adults. We defined 'short-term' as 14 days or less. Studies could take place anywhere and participants could have any condition or illness.

We compared and summarised the results of the studies and rated our confidence in the evidence, based on factors such as study methods and sizes.

What did we find?

We found 99 studies with 12,241 participants. Most participants were surgical patients and many of the studies (50) assessed women only.

The studies investigated:

• removing the catheter early in the morning compared with late at night (13 studies);
• retaining the catheter for shorter or longer times (68 studies);
• clamping catheters or allowing them to drain freely (7 studies); and
• giving men treatment (alpha blockers) to relax the prostate compared to no treatment before removing the catheter (3 studies). The prostate is a small gland located between the penis and the bladder.

Early-morning compared to late-night removal

Late-night catheter removal might reduce the risk of needing to have the catheter reinserted compared with early-morning removal. We are uncertain if there is any difference between early-morning and late-night removal for developing UTI or painful urination.

Shorter compared to longer use of catheters

People who have their catheters removed after a shorter length of time are probably less likely to develop UTIs and may be less likely to experience painful urination compared with those who have their catheters for longer. However, we also found that people may be more likely to need the catheter reinserting if they have the catheter for a shorter compared with a longer time.

Clamping

There may be little to no difference between clamping and free drainage on the risk of needing the catheter to be reinserted. We are uncertain if there is any difference in the risk of UTIs or painful urination.

Treatment to relax the prostate

We are uncertain whether giving alpha-blockers before the catheter is removed has any effect on the need to have catheters reinserted or the risk of developing UTIs. There was no evidence about the risk of experiencing painful urination.

What are the limitations of the evidence?

Many of the included trials had design flaws, did not recruit enough people, or did not report enough information about their results. This means our confidence in the evidence is limited.

How up-to-date is this evidence?

The evidence is current up to 17 March 2020.

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Summary of findings 1. Removal of short-term indwelling urethral catheters in adults at one time of day (6 am to 7 am) versus another time of day (10 pm to midnight)

Removal of short-term indwelling urethral catheters in adults at one time of day (6 am to 7 am) versus another time of day (10 pm to midnight)

Patient or population: adults with short-term indwelling urethral catheters that need to be removed
Setting: secondary care
Intervention: removal of indwelling urethral catheters at 10 pm to midnight
Comparison: removal of indwelling urethral catheters at 6 am to 7am

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (trials)	Certainty of the evidence (GRADE)	Comments
	Risk with removal of IUC at 6 am to 7 am	Risk with removal of IUC at 10 pm to midnight				
Number of participants requiring recatheterisation	**Trial population**		**RR 0.70** (0.52 to 0.94)	1920 (10 RCTs)	⊕⊕⊖⊖ **Low** [a]	
	94 per 1000	**66 per 1000** (50 to 90)				
Symptomatic catheter-associated urinary tract infection (CAUTI)	**Trial population**		**RR 1.00** (0.61 to 1.63)	41 (1 RCT)	⊕⊖⊖⊖ **Very low** [b,c]	
	611 per 1000	**611 per 1000** (373 to 996)				
Dysuria	**Trial population**		**RR 2.20** (0.70 to 6.86)	170 (1 RCT)	⊕⊕⊖⊖ **Low** [c]	
	48 per 1000	**105 per 1000** (33 to 327)				
Condition-specific QoL or generic QoL measure	-	-	-	-	-	Not reported

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IUC:** indwelling urethral catheter; **QoL:** quality of life; **RCT:** randomised controlled trial; **RR**: risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

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Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded two levels for risk of bias (random sequence generation, allocation concealment and blinding of outcome assessors are all unclear).
[b]Downgraded one level for risk of bias (random sequence generation and blinding of outcome assessors are unclear).
[c]Downgraded two levels for imprecision: few participants and 95% confidence interval is consistent with possible benefit and possible harm.

Summary of findings 2. Removal of short-term indwelling urethral catheters in adults after shorter versus longer durations

Removal of short-term indwelling urethral catheters in adults after shorter versus longer durations

Patient or population: adults with short-term indwelling urethral catheters that need to be removed
Setting: secondary care
Intervention: shorter durations of IUC
Comparison: longer durations of IUC

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (trials)	Certainty of the evidence (GRADE)	Comments
	Risk with longer durations of catheterisation	Risk with shorter durations of catheterisation				
Number of participants requiring recatheterisation	**Trial population**		**RR 1.81** (1.35 to 2.41)	5870 (44 RCTs)	⊕⊕⊖⊖ **Low** [a,b]	
	75 per 1000	**136 per 1000** (102 to 182)				
Symptomatic catheter associated urinary tract infection (CAUTI)	**Trial population**		**RR 0.52** (0.45 to 0.61)	5759 (41 RCTs)	⊕⊕⊕⊖ **Moderate** [a]	
	126 per 1000	**66 per 1000** (57 to 77)				
Dysuria	**Trial population**		**RR 0.42** (0.20 to 0.88)	1398 (7 RCTs)	⊕⊕⊖⊖ **Low** [a,b]	
	118 per 1000	**50 per 1000** (24 to 104)				
Condition-specific QoL or generic QoL measure	-	-	-	-	-	Not reported

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

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CI: confidence interval; **IUC:** indwelling urethral catheter; **QoL:** quality of life; **RCT:** randomised controlled trial; **RR**: risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded one level for risk of bias (unclear risk of selection bias and detection bias).
[b]Downgraded one level for inconsistency (heterogeneity in direction and size of effect).

Summary of findings 3. Removal of short-term indwelling urethral catheters in adults: clamping compared to free drainage

Removal of short-term indwelling urethral catheters in adults: clamping compared to free drainage

Patient or population: adults with short-term indwelling urethral catheters that need to be removed
Settings: secondary care

Intervention: clamping of indwelling urethral catheter
Comparison: free drainage of indwelling urethral catheter

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (trials)	Certainty of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Risk with free drainage	Risk with clamping regimes				
Number of participants requiring recatheterisation	**Trial population**		**RR 0.82** (0.55 to 1.21)	569 (5 RCTs)	⊕⊕⊖⊖ **Low** [a,b]	
	160 per 1000	**131 per 1000** (88 to 193)				
Symptomatic catheter associated urinary tract infection (CAUTI)	**Trial population**		**RR 0.99** (0.60 to 1.63)	267 (2 RCTs)	⊕⊖⊖⊖ **Very low** [c,d]	
	195 per 1000	**193 per 1000** (117 to 318)				
Dysuria	**Trial population**		**RR 0.84** (0.46 to 1.54)	79 (1 RCT)	⊕⊖⊖⊖ **Very low** [d,e]	
	385 per 1000	**323 per 1000**				

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		(177 to 592)				
Condition-specific QoL or generic QoL measure	-	-	-	-	-	Not reported

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IUC:** indwelling urethral catheter; **QoL:** quality of life; **RCT:** randomised controlled trial; **RR**: risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded one level for risk of bias (unclear random sequence generation, allocation concealment and blinding of outcome assessors).
[b]Downgraded one level for imprecision (95% CI is consistent with possible benefit and possible harm).
[c]Downgraded one level for risk of bias (unclear random sequence generation and high risk due to lack of blinding of outcome assessors.
[d]Downgraded two levels for imprecision (few participants and 95% CI is consistent with possible benefit and possible harm).
[e]Downgraded one level for risk of bias (high risk for randomisation and allocation concealment).

Summary of findings 4. Removal of short-term indwelling urethral catheters in adults: prophylactic use of alpha blocker versus no drug or intervention

Removal of short-term indwelling urethral catheters in adults: prophylactic use of alpha blocker versus no drug or intervention

Patient or population: adults with short-term indwelling urethral catheters that need to be removed
Settings: secondary care

Intervention: prophylactic use of alpha blocker
Comparison: no drug or intervention

Outcomes	**Anticipated absolute effects* (95% CI)**		**Relative effect (95% CI)**	**№ of participants (trials)**	**Certainty of the evidence (GRADE)**	**Comments**
	Assumed risk	**Corresponding risk**				
	Risk with no alpha blocker	**Risk with prophylactic alpha blocker**				
Number of participants requiring re-catheterisation	**Trial population**		**RR 1.18** (0.58 to 2.42)	184 (2 RCTs)	⊕⊖⊖⊖ **Very low** [a,b]	

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	120 per 1000	**141 per 1000** (69 to 289)				
Symptomatic catheter associated urinary tract infection	**Trial population**		**RR 0.20** (0.01 to 4.06)	94 (1 RCT)	⊕⊝⊝⊝ **Very low** [a,b]	
	43 per 1000	**9 per 1000** (0 to 173)				
Dysuria	-	-	-	-	-	Not reported
Condition-specific QoL or generic QoL measure	-	-	-	-	-	Not reported

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **IUC:** indwelling urethral catheter; **QoL:** quality of life; **RCT:** randomised controlled trial; **RR**: risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded one level for risk of bias (unclear random sequence generation, allocation concealment and blinding of outcome assessors).
[b]Downgraded two levels for imprecision: few participants and wide 95% confidence interval that is consistent with possible benefit and possible harm.

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BACKGROUND

This is an update of a Cochrane Review first published in 2005 and last published in 2007. See Appendix 1 for a glossary of medical terms.

Description of the condition

Catheterisation is an important and common clinical procedure. Approximately 15% to 25% of all people who are hospitalised will be catheterised at some point during their management (CDC 2016). However, it should be noted that not every patient who has a urethral catheter inserted requires one. Trials have shown that it is common for catheters to be placed in patients without an appropriate indication (Loeb 2008; Meddings 2014). Catheterisation could be for the short term (up to 14 days) or long term (14 days or longer). The indications for short-term catheterisation include monitoring of urine output during the perioperative stage or in acutely unwell patients, as part of a urological procedure, or the treatment of patients with acute urinary retention. Short-term catheterisation could also be used for investigative purposes, such as imaging of the urinary tract and urodynamic trials (Dunn 2000a). Long-term catheterisation is usually a last resort option in people with recurrent urinary retention, reduced bladder contractility or urinary incontinence.

Retention of urine has been reported as a common problem following the removal of indwelling urethral catheters, particularly following surgery and anaesthesia, where post-operative urinary retention has a reported incidence between 5% and 70% (Baldini 2009). The risk factors associated with an increase the risk of developing post-operative urinary retention have been thoroughly researched and include age (over 50 years), sex (male), type of surgery, duration of surgery, type of anaesthesia (general or regional, e.g. epidural), analgesia (use of opiates) and the amount of intravenous fluids used. Post-operative urinary retention may lead to urinary tract infections, abnormal autonomic responses (e.g. cardiac arrhythmias) as well as over-distension of the bladder resulting in permanent detrusor muscle damage (Baldini 2009; Madersbacher 2012; Rosseland 2002; Zaouter 2009). For hospital inpatients, the duration of catheterisation in the peri-operative period remains controversial and is one that is ultimately down to the preference of the surgeon or anaesthetist responsible for the patient. Removal too early, however, may result in the patient developing urinary retention again and thus risking requiring recatheterisation alongside the complications associated with it (Baldini 2009).

The procedure of indwelling urethral catheterisation is associated with complications such as catheter-associated urinary tract infection (CAUTI), bacteruria, stricture formation, structural damage to the urinary tract, bleeding, cystitis or prostatitis, and patient discomfort (Igawa 2008; Fisher 2017). CAUTI is the most common cause of hospital-acquired infections with some 70% to 80% of these associated with the use of indwelling urethral catheters (Lo 2014; Nicolle 2014). CAUTI arise from the formation of a biofilm on both the extraluminal and intraluminal portal surfaces of the catheter. This biofilm mainly consists of extraluminal organisms, which adhere to the surfaces of the catheter as soon as it has been inserted. It has the ability to defend microbes from the host's defences as well as antimicrobials (Haque 2018; Nicolle 2014). It is estimated that around 20% of hospital-acquired bacteraemias arise from the urinary tract and are associated with a mortality of around 10%. The incidence of bacteraemia following a single catheterisation episode has been shown to be as high as 8%, with the duration of catheterisation being the most important risk factor (EAU 2020). Development of symptomatic CAUTI can have serious consequences in some patients and has been shown to increase the length of hospital stay, worsen patient renal function, increase patient mortality and lead to increased costs for healthcare providers. However, with aseptic technique during placement of the catheter, the risk of CAUTI can be reduced (Baldini 2009; EAU 2020; Fisher 2017; Gould 2009; Lo 2014; NICE 2012).

Indwelling urethral catheters are prone to various other complications that prevent effective drainage of urine. The most common non-infective cause is due to urethral stricture formation. Urethral strictures can develop after repeated urethral catheterisation with long-term urinary catheter use, as well as after urethral trauma. The most common infective cause is the development of encrustation within the catheter. This is when crystalline compounds (such as calcium phosphate and struvite) precipitate in the alkaline conditions of urine to form solid deposits in the catheter lumen. This process is accelerated in the presence of micro-organisms such as *Proteus mirabilis* which resides in the body's own bowel flora. These micro-organisms produce the enzyme urease, allowing the production of ammonia, which causes further alkalinisation of the urine and catalyses the encrustation process. Catheter encrustation and blockage is thought to be experienced by roughly 50% of patients with long-term catheters (Stickler 2010). Once a urethral catheter is failing to drain properly, flushing them with saline can often help in trying to relieve the obstruction. However, if this fails it is likely that the urethral catheter will need to be removed and the patient's need for a urinary catheter reassessed (Cravens 2000).

There are two routes of infection through which symptomatic urinary tract infections (UTIs) occur: endogenous and exogenous. Endogenous infections are due to bacteria naturally present in the human body. Typical routes of infection of the urinary tract are rectal, vaginal and meatal (bodily passages). Exogenous sources of infection include contamination by healthcare workers or non-sterile equipment.

Pathogens typically gain access to the urinary tract either by migrating alongside the exterior surface of the lumen, or by movement alongside the inner lumen of the catheter via contaminated urine collection bags. Thus, maintenance of a sterile, closed urinary drainage system is key to prevent symptomatic CAUTIs. Clinical features of symptomatic UTIs include dysuria, urinary frequency or urgency, haematuria, suprapubic pain or tenderness, loin or flank pain, rigors, fever, altered mental status (e.g. confusion, particularly in the elderly), and nausea and vomiting (CDC 2016; Gould 2009; Grabe 2015; Hollingsworth 2013).

The Centers for Disease Control and Prevention (CDC) has defined symptomatic CAUTI as a UTI in the presence of an indwelling catheter which is in place for two or more calendar days on the date of the UTI, where day one was the date upon which the catheter was placed; or, the catheter was in place on the date of the UTI or the day before and then removed. The patient's urine culture (from a mid-stream or catheter bag sample) must also contain no more than two species of organisms, where one of which has a bacterial colony count of $\geq 10^5$ colony forming unit (cfu)/mL. The CDC criteria

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for symptomatic UTI must also be met, which states that the patient must also have at least one of the following signs or symptoms: fever (> 38 °C); suprapubic tenderness; urinary urgency; increased urinary frequency or dysuria (pain during voiding) (CDC 2016; Gould 2009).

The Infectious Disease Society of America (IDSA) definition differs slightly according to their published guidelines. The IDSA considers symptomatic CAUTI as any UTI associated with a catheter in the presence of clinical features consistent with UTI, with no other identified sources of infection and a bacterial count of ≥ 10^3 cfu/mL of ≥ 1 bacterial species in a single midstream urine (MSU) or catheter specimen. The IDSA definition of symptomatic CAUTI covers patients with indwelling, intermittent and suprapubic catheters, unlike the CDC definition, which excludes intermittent catheterisation (Hooton 2010).

Patients who do not meet this criterion may still meet the various criteria for asymptomatic bacteraemic urinary tract infections (ABUTI), which is defined by the CDC as people who are asymptomatic but have a urine culture of at least 10^5 cfu/mL of a bacterial species in their urine sample. Between 75% to 90% of people who have ABUTIs have been shown not to produce a systemic inflammatory response or other indications, which would indicate infection (Gould 2009). The decision on how to monitor and treat these individuals is still undecided and varies amongst health providers. The CDC guidelines on symptomatic CAUTI state that the treatment of ABUTI has not been shown to provide any clinical benefit.

Description of the intervention

For the purpose of this review, we only considered short-term indwelling urethral catheterisation. We defined short term as an intended duration of urethral catheterisation of 14 days or less. While there is extensive literature on the type, maintenance and techniques for insertion of urinary catheters, limited attention has been given to the policies and procedures for their removal. Although the insertion, removal and management of the catheter are usually undertaken by nurses, decisions about the removal of the catheter often remain with the medical practitioner. While the importance of short-term urethral catheter management is recognised, there is no consensus among clinicians about the optimal time and method for removal of indwelling urethral catheters. Policies are likely to be based on personal preference and established practices rather than on research evidence (Irani 1995). While clinicians have established policies, there has been no objective and systematic examination of the effect of the time of day the catheter is removed, the length of time the catheter is left in place or if clamping the catheter prior to removal influences patient outcomes.

Indwelling urethral catheters are catheters that are inserted into the bladder, via the urethra, to allow continuous drainage of urine into a closed urine collection system. In some clinical contexts, valves may also be used as an alternative to continuous drainage. The urethral route is most commonly used by health professionals. Other routes of urinary catheterisation include intermittent urethral and suprapubic urinary catheterisation. However, these routes of urinary catheterisation are outwith the scope of this systematic review. Urethral catheterisation usually requires the use of a lubricant gel, which often contains a local anaesthetic, and can be used both in short-term and long-term catheterisation. The length of duration of urethral catheterisation is commonly associated with the development of complications, the most common being UTI (Nicolle 2014). Around 60% to 80% of hospitalised patients with indwelling catheters will require antibiotics at some stage of their care, although this is usually for reasons other than UTI (Durojaiye 2015; Foxman 2003). A recent prevalence survey published in *The New England Journal of Medicine* found that urinary catheters are the most common indwelling device in hospitals, used in 23.6% of patients in 183 hospitals in the USA and roughly 17.5% of patients in 66 European hospitals (Magil 2014).

As a result, the bacteria present in urine are continuously exposed to antimicrobials, thus aiding the development of antimicrobial-resistant organisms. This rise in antimicrobial-resistant organisms has proven to be a huge burden for healthcare providers from both an economic and medical standpoint, with many providers struggling to control devastating outbreaks. There is limited evidence for the use of antibiotic prophylaxis in short-term indwelling urethral catheters (Lusardi 2013).

How the intervention might work

Some investigators have hypothesised the potential advantage of morning or midnight removal of catheters. One argument for the removal of urethral catheters early in the morning is that reduced staff at night might fail to respond to complications, such as urinary retention, that can develop following the removal of the catheter (Blandy 1989; Crowe 1993; Ganta 2005; Kelleher 2002; Webster 2006). Other suggested benefits of removing the catheter early in the morning include allowing the patient to rest through the night and then to adjust back to their normal voiding pattern during the day (Gross 2007).

Researchers have also reported that patients whose catheters were removed in the night had larger volumes at first void compared to other people whose catheters were removed in the morning (Chillington 1992; Noble 1990; Webster 2006). It has been suggested that the timing of catheter removal may affect a patient's length of stay in hospital with consequent resource implications. In one trial it was found that removal of catheters at midnight resulted in patients being discharged a mean of 14 hours earlier than patients whose catheters were removed in the morning (Chillington 1992), thus resulting in economic benefits related to a shorter length of hospitalisation and efficient discharge planning (Kelleher 2002).

There has been some debate about whether flexible policies are better than relatively fixed policies for catheter removal (Wyman 1987). However, practice is known to vary. For example, local clinical audits for catheter removal have indicated that 49% of catheters are removed either at the discretion of the nurse or at the time of the medical rounds and only 34% were removed at midnight (Watt 1998). Of those indwelling urethral catheters that were scheduled for removal in the morning, only 70% were removed on time (Noble 1990; Watt 1998).

Practice also varies with respect to the length of time the catheter is left in situ and the procedure for its removal. The factors that influence this decision include: the condition/reason for which the patient is catheterised; clinician/surgeon preference; patient tolerance; and hospital policy (EAUN 2012). Various international guideline panels agree that indwelling urethral catheters should be removed as soon as they are no longer necessary (CDC 2016;

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EAU 2020; Grabe 2015; Hooton 2010; NICE 2012). The removal of indwelling urethral catheters after shorter durations may prove to be beneficial, as it has the potential to reduce hospital stays and the number of patients developing symptomatic CAUTIs, thus saving healthcare costs and improving patient outcomes (Baldini 2009; Lo 2014).

Bladder dysfunction and post-operative voiding impairment has been documented following catheterisation and can lead to infections of the urinary tract. The intermittent clamping of the indwelling urethral catheter draining tube prior to withdrawal has been suggested on the basis that this simulates normal filling and emptying of the bladder (EAUN 2012). While clamping catheters might minimise post-operative neurogenic urinary dysfunction, it could also result in bladder infection or distension if the clamps are not released as scheduled (Roe 1990; Wang 2016).

Another strategy practised prior to removal of urethral catheters is the use of alpha adrenergic blocker drugs. It is thought that post-operative urinary retention is potentially linked to the stress-induced, high sympathetic activity occurring around the peri-operative period. Counteracting its activity with the inhibition of alpha receptors located in the bladder and urethra may potentially reduce the risk of acute urinary retention (Ghuman 2018; Madani 2014; Patel 2018). It has also been reported that alpha blockers are effective in the treatment of voiding dysfunction by enhancing detrusor contractibility and lowering urethral resistance in patients with underactive bladder (Yamanishi 2004). Thus, prophylactic usage of alpha blockers in people with indwelling urethral catheters could reduce the episodes of developing voiding dysfunction after catheter removal.

Why it is important to do this review

This systematic review summarises the evidence from randomised controlled trials (RCTs) related to alternative approaches to the removal of short-term indwelling urethral catheters. The findings of this review will help determine the safest method of short-term catheter removal as well as potentially help reduce the risks associated with catheterisation for patients. Since the last version of this review was published (Griffiths 2007), the evidence base has grown substantially and it is important to incorporate findings from new trials into the review in a manner that will enable clinicians to develop evidence-based policies for practice.

OBJECTIVES

To assess the effects of strategies for removing short-term (14 days or less) indwelling catheters in adults.

METHODS

Criteria for considering studies for this review

Types of studies

We included RCTs and quasi-RCTs that evaluated the effects of strategies for removing short-term indwelling urethral catheters.

For the purposes of this review, we defined 'indwelling catheterisation' in accordance with the European Association of Urology (EAU), which states that it is the passage of a urinary catheter into the bladder via the urethra and held in place by an inflatable balloon (EAU 2020; Grabe 2015; Tenke 2008). We defined as 'short-term' cases where the intended duration of catheterisation was 14 days or less (Dunn 2000a; Kidd 2015; Lam 2014).

Types of participants

We included trials of adults requiring short-term indwelling urethral catheterisation in any setting (hospital, community, nursing home) for any reason. These included individuals who were acutely unwell, required surgery, had urinary retention or women during childbirth.

Types of interventions

We included all interventions involving short-term indwelling urethral catheterisation and made the following comparisons.

- Removal of indwelling urethral catheters at one specified time of day (6 am to 7 am) versus another specified time of day (10 pm to midnight)
- Shorter durations of indwelling urethral catheterisation versus longer durations of indwelling urethral catheterisation e.g. immediate/early removal versus removal of the indwelling urethral catheter one day post-surgery
- Flexible durations of indwelling urethral catheterisation versus fixed duration of indwelling urethral catheterisation
- Clamping of indwelling urethral catheterisation versus free drainage of indwelling urethral catheterisation prior to removal
- Prophylactic use of alpha blocker prior to indwelling urethral catheter removal versus no intervention or placebo

We defined early removal of catheters as the removal of an indwelling urethral catheter up to eight hours post-operatively.

We have not considered the following interventions as they are either covered in separate Cochrane Reviews or do not meet the objectives of this review:

- Suprapubic or intermittent urethral catheterisation (Kidd 2015)
- Long-term catheterisation (Cooper 2016)
- Differing catheter insertion techniques (e.g. use of aseptic liquid/cream based agents or topical antibiotic creams)
- Meatal care management techniques
- Types of catheter materials for short-term catheters (e.g. latex, silicone) (Lam 2014)
- Types of catheter coatings for short-term catheters (e.g. antibiotic coating, silver) (Lam 2014)
- Types of drainage container
- Treatment of drainage bag with antiseptic/antibiotic
- The use of antibiotic prophylaxis as a primary or secondary outcome (Foon 2012; Lusardi 2013)
- The use of reminders or protocols for catheter removal, for example, stop-orders

It should be noted that the use of alpha blockers prior to urethral catheter removal in acute urinary retention (AUR) is covered by another Cochrane Review (Fisher 2014). Our review only looks at the use of prophylactic alpha blockers in short-term indwelling urethral catheters in instances other than AUR. We excluded trials that looked at the use of antibiotic prophylaxis as a primary or secondary outcome on the basis that this is covered by another Cochrane Review and is not related to the intervention of interest

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of this review (Lusardi 2013). We did not exclude trials that used antibiotic prophylaxis for both intervention and control groups as part of their hospital policy.

Types of outcome measures

We analysed the following outcomes in this review. It should be noted that we did not use them as a basis for including or excluding trials.

Primary outcomes

- Number of participants who required recatheterisation following removal of indwelling urethral catheter

Secondary outcomes

- Complications/adverse effects
  - Incidence of UTI
    - symptomatic CAUTI
    - asymptomatic bacteriuria
  - Incidence of urinary retention
  - Other complications of catheterisation (or recatheterisation), for example, haemorrhage, stricture formation, fever
- Patient-reported
  - Patient pain or discomfort
  - Patient satisfaction
  - Urinary incontinence
  - Number of patients reporting dysuria
- Clinician-reported
  - Volume of first void (mL)
  - Time to first void (hours)
  - Post-void residual volume (mL)
  - Length of hospitalisation (days)
  - Time between removal of catheter to discharge (days)
- Health status/quality of life
  - Condition-specific or generic quality-of-life measures (e.g. Short Form 36 (Ware 1992))
  - Psychological outcome measures (e.g. Hospital Anxiety and Depression Scale (Zigmond 1983))

Main outcomes for summary of findings tables

- Number of participants requiring recatheterisation
- Symptomatic CAUTI
- Dysuria
- Condition-specific or generic quality-of-life measures (e.g. Short Form 36)

Search methods for identification of studies

We did not impose any language or other restrictions on any of the searches described below.

Electronic searches

We identified relevant trials from the Cochrane Incontinence Specialised Register. For more details of the search methods used to build the Specialised Register, please see the Group's webpages where details of the Register's development (from inception) and the most recent searches performed to populate the Register can be found. The Register contains trials identified from the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, MEDLINE In-Process, MEDLINE Epub Ahead of Print, CINAHL, ClinicalTrials.gov, WHO ICTRP, Be Part of Research and handsearching of journals and conference proceedings. Many of the trials in the Cochrane Incontinence Specialised Register are also contained in CENTRAL.

The date of the last search was: 17 March 2020.

The terms used to search the Cochrane Incontinence Specialised Register are given in Appendix 2.

For an earlier version of this review update we searched CINAHL (on EBSCO), covering December 1981 to 11 May 2016 (searched on 12 May 2016). For the most recent update of the search (17 March 2020) only the Cochrane Incontinence Specialised Register was searched, as this now incorporates the CINAHL search. The search strategy used in CINAHL is given in Appendix 3.

The search strategies used to search for the previous version of this review (Griffiths 2007) are given in Appendix 4.

Searching other resources

We also searched the reference lists of all relevant articles.

Data collection and analysis

For this update, we used the following methods to assess the new reports that were identified as a result of the updated search. For methods used in the previous version of this review, see Griffiths 2007.

Selection of studies

Two review authors (AE and IO) independently screened the titles and abstracts of each trial using Covidence before obtaining the full text for all potentially eligible trials. If the title and abstract were inconclusive, we obtained the full text for further assessment. We attempted to obtain any missing trial data by contacting the trial authors for further information. Duplicate trials that had been reported in more than one publication were included only once. We reached decisions about trial eligibility by a discussion between the author team and resolved any disagreements by consulting an independent third party.

Data extraction and management

Four review authors (AE, FS, EK, IO) extracted data independently using a standardised form and AE compared their results. If the data in trials had not been fully reported, we attempted to contact the trial authors for further classification. We entered the extracted data into Review Manager 5 software (Review Manager 2020).

We have only reported those outcomes that were pre-specified in the Types of outcome measures. However, there were occasions where the outcomes reported were worded differently despite belonging to the same underlying theme - for example, asymptomatic bacteriuria was also reported as positive urine culture. As these are the same underlying concepts, omitting this information was not appropriate. We therefore chose to collate all data from trials that reported positive urine culture with asymptomatic bacteriuria if they met the CDC definition for asymptomatic bacteriuria.

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Assessment of risk of bias in included studies

Four review authors (AE, FS, EK, IO) assessed the included trials for risk of bias using Cochrane's 'Risk of bias' tool (Higgins 2011). We assessed the following domains: random sequence generation (selection bias); allocation concealment (selection bias); blinding of participants and personnel (performance bias); blinding of outcome assessment (detection bias); blinding of microbiological outcome (detection bias); incomplete outcome data (attrition bias); selective reporting of outcomes (reporting bias); and other potential sources of bias.

Two of the review authors (AE and one of either IO, FS or EK) independently assessed each of the trials and rated each as 'low risk', 'unclear risk' or 'high risk'. We resolved any difference in opinion by discussion or by consulting an independent third party.

Measures of treatment effect

We processed all trial data as outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Li 2021). Where appropriate, we undertook meta-analysis. We combined outcome data by using a fixed-effect model to calculate pooled estimates and their 95% confidence intervals (CI). We considered the random-effects model only when there were concerns about heterogeneity affecting the analysis. For categorical outcomes, we related the numbers reporting an outcome to the numbers at risk in each group to calculate a risk ratio (RR) with 95% CI. For continuous variables, we used means and standard deviations to derive the mean difference (MD) with 95% CI.

Unit of analysis issues

In parallel-group trials, the primary analysis was per participant randomised. Where there were trials that involved a variation of this type of randomisation, for example, cross-over trials or cluster-randomised trials, we performed analysis as outlined by the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2021).

Dealing with missing data

We analysed the data on an intention-to-treat (ITT) basis where possible, meaning that all participants were analysed according to the group they were randomised in irrespective of whether they received their assigned intervention.

Where participants were excluded after allocation or withdrew from the trial, we reported any details provided in full. If there were data missing, we attempted to contact the original trial authors to obtain the missing trial data. If there was evidence of differential dropout between the groups, the review authors imputed data for the missing results once we had contacted the trial authors. Where trials reported mean values without standard deviations (SDs) but with P values or 95% CI, we used a conversion Excel document designed by a statistician to obtain the SDs. In cases of missing SDs with no P values or 95% CIs, we estimated the SD from another trial in the same meta-analysis.

Assessment of heterogeneity

We only combined trials if there was evidence that they were clinically similar. We assessed heterogeneity by visual inspection of forest plots, the Chi^2 test for heterogeneity and the I^2 statistic (Higgins 2003). If significant heterogeneity existed, we used a random-effects model. We considered statistical heterogeneity significant if either the P value for the Chi^2 test was low ($P < 0.10$) or if the I^2 statistic suggested heterogeneity. We used the following thresholds for interpreting the I^2 statistic (Deeks 2021):

- 0% to 40%: heterogeneity might not be that important
- 30% to 60%: moderate heterogeneity
- 50% to 90%: substantial heterogeneity
- 75% to 100%: considerable heterogeneity

Assessment of reporting biases

In view of the difficulties associated with the detection and correction of publication bias, as well as various other reporting biases, we employed a comprehensive search strategy involving multiple databases and sources. We assessed the likelihood of any potential publication bias by using funnel plots.

Data synthesis

We combined trials for analysis if the interventions were considered to be clinically similar and used a fixed-effect approach to carry out meta-analysis. We considered using a random-effects model if there was substantial statistical heterogeneity (as judged by the Chi^2 test or I^2 statistic).

For illustrative purposes, we displayed data in subgroups in the meta-analysis to help identify the different types of surgery and catheter durations participants were undergoing.

Subgroup analysis and investigation of heterogeneity

We performed the following subgroup analyses for the primary outcome for each comparison.

- The type of surgery (urological versus non-urological) that participants underwent is likely to have an impact with regard to infection, dysuria, haemorrhage and stricture formation etc. If a participant was to be admitted for surgery involving the urological tract (e.g. transurethral resection of the prostate (TURP)), it is likely that the passage of a urethral catheter in these participants would have a potentially worsening impact than those participants with urethral catheters who did not have any urological surgery. This is because the urological tract is likely to have sustained some damage as a result of the trauma involved during the surgery.
- The sex of an individual can impact the intervention being studied. Women are more prone to urinary tract infections due to their shorter urethra when compared to the anatomy of men. However, the passage of urethral catheters in women is likely to be less challenging than men. Many men in this review were hospitalised for TURP, implying that passing a urethral catheter is likely to be more technically difficult in men.
- Antibiotic prophylaxis: the use of antibiotic prophylaxis for participants with short-term indwelling urethral catheters is likely to impact outcomes looking at infections (e.g. the number of participants developing symptomatic CAUTI and asymptomatic bacteriuria). Attitudes towards antibiotic prophylaxis in short-term urethral catheterisation vary, as their use is also associated with an increased risk of developing a hospital-acquired infection by *Clostridium difficile*.

Where data were available, we performed post hoc subgroup analysis to assess the impact of prophylactic antibiotics on the

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number of participants developing symptomatic CAUTI. The use of prophylactic antibiotics is a confounding factor in the number of participants developing CAUTI. We also conducted post hoc subgroup analysis for the outcome of length of hospitalisation to explore the effect of type of surgery as a possible explanation for very high heterogeneity in the meta-analysis.

For outcomes other than the primary outcome and CAUTI, we used the subgroup function for illustrative purposes only to show the different types of surgery that participants underwent and the different catheter durations. It should be noted that, in these cases, we did not report any results of subgroup analysis in relation to the statistical test for subgroup differences.

Sensitivity analysis

Where data were available, we conducted sensitivity analyses for our primary outcome by excluding trials we judged as high risk of bias for the domains relating to random sequence generation and allocation concealment.

Summary of findings and assessment of the certainty of the evidence

We prepared summary of findings tables for our main comparisons and presented the results for the outcomes prespecified in the Types of outcome measures.

We assessed the certainty of the body of evidence using the GRADE approach. When choosing which outcomes to select, we looked at previous Cochrane Reviews involving urethral catheterisation, the review teams for which had conducted group discussions with people who had undergone short-term indwelling urethral catheterisation to assist with the selection of appropriate outcomes for inclusion in the summary of findings tables (Kidd 2015; Lam 2014; Omar 2013). We classified the primary and secondary outcomes as critical, important or not important from the patients' perspective for decision-making.

RESULTS

Description of studies

Results of the search

We screened 1583 records, which were identified by the literature search for this review, and retrieved the full texts of 223 reports of trials to assess their eligibility for inclusion. We included 124 reports of 99 trials in this review, and excluded 89 reports of 85 trials from the review. There are nine reports of eight ongoing trials, details of which can be located in the Characteristics of ongoing studies. One trial is still awaiting classification after we obtained further information regarding the trial during the final stages of this review (NCT02602132). Please see the Characteristics of studies awaiting classification for more details. The flow of literature through the assessment process is shown in the PRISMA diagram (Page 2020; Figure 1).

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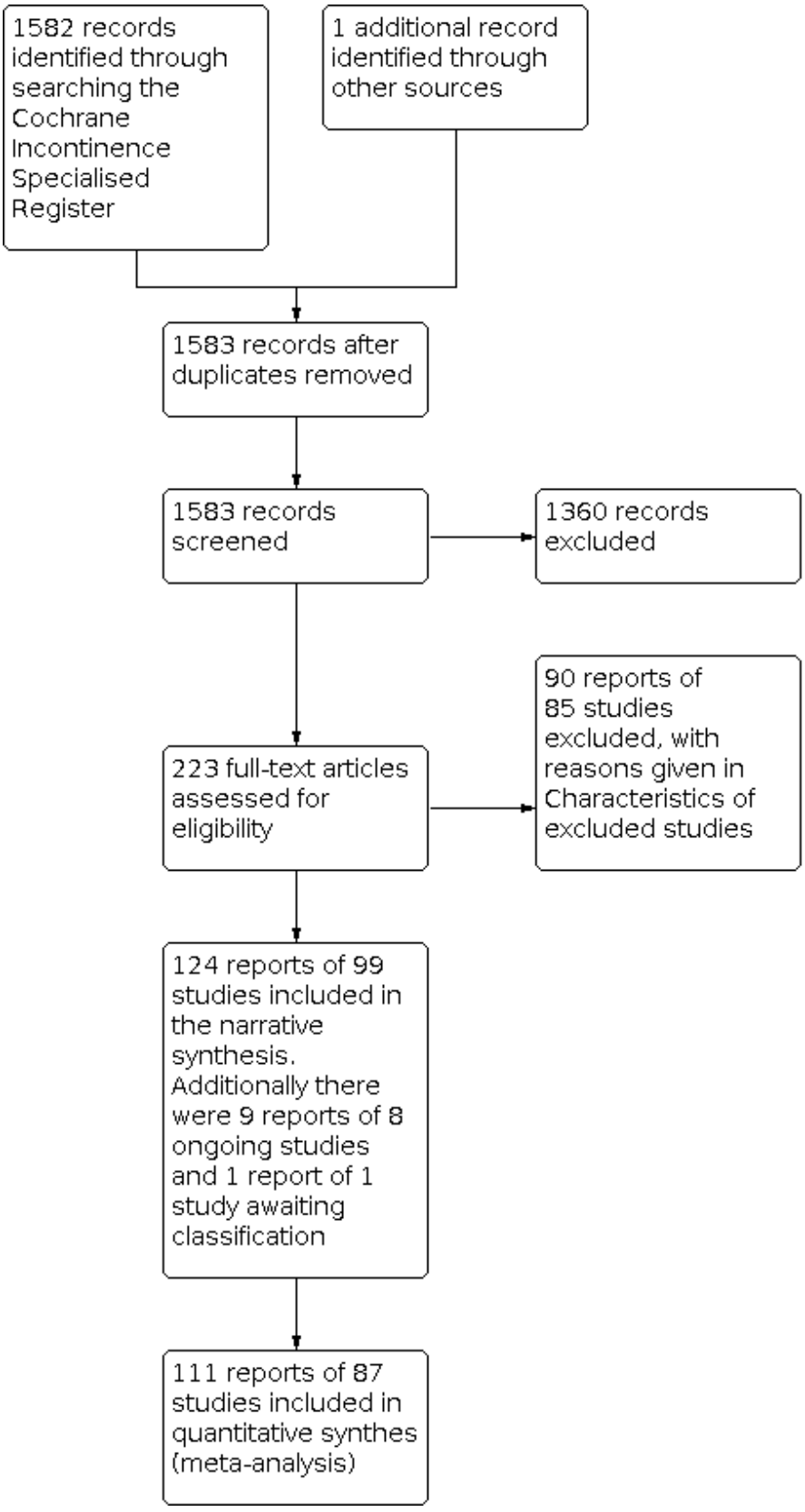
Figure 1. PRISMA flow diagram



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Newly included trials

In this update, we re-assessed the 26 trials included in the previous version of this review and re-extracted their data (Griffiths 2007). We also evaluated their risk of bias. After performing a new search, we identified a further 73 eligible trials.

Included studies

The trials are detailed in the Characteristics of included studies. We were unable to include 12 trials (13 reports) in the meta-analysis because they reported data in insufficient detail (Azarkish 2005; Bristoll 1989; Dunn 1999; Dunn 2000b; Iversen Hansen 1984; Nguyen 2012; Ruminjo 2015; Talreja 2016; Wilson 2000; Yee 2015), or they were single trials reporting an outcome for a particular comparison (Liu 2015; Williamson 1982), or reported zero events for a particular outcome and so the result was not estimable (Liu 2015). We contacted the trial authors by email to request further data.

Design

Ninety-four trials included in the review were RCTs and five trials were quasi-RCTs (Li 2014; Liu 2015; Noble 1990; Valero Puerta 1998; Zhou 2012).

Sample sizes

The number of participants randomised in the included trials ranged from eight (Williamson 1982), to 501 (Barone 2015). In total, the 99 trials randomised 12,241 participants.

Reason for hospitalisation/catheterisation

The reasons for catheterisation varied between the trials (see Table 1).

- Urological or urogenital surgery (Chillington 1992; Durrani 2014; Ganta 2005; Han 1997; Hewitt 2001; Irani 1995; Jeong 2014; Jun 2011; Kelleher 2002; Kim 2012; Koh 1994; Li 2014; Lista 2020; Lyth 1997; Matsushima 2015; McDonald 1999; Noble 1990; Pervaiz 2019; Sahin 2011; Souto 2004; Talreja 2016; Toscano 2001; Valero Puerta 1998; Wilson 2000; Wyman 1987)
- Urethrotomy and urethral strictures (Iversen Hansen 1984; Nguyen 2012; Nielson 1985)
- Obstetric and gynaecological surgery (Ahmed 2014; Alessandri 2006; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Azarkish 2005; Barone 2015; Basbug 2020; Carter-Brooks 2018; Chai 2011; Dunn 1999; Dunn 2000b; Dunn 2003; El-Mazny 2014; Glavind 2007; Gong 2017; Gungor 2014; Guzman 1994; Hakvoort 2004; Huang 2011; Ind 1993; Joshi 2014; Kamilya 2010; Kokabi 2009; Lang 2020; Liang 2009; Mao 1994; Naguimbing-Cuaresma 2007; Onile 2008; Ouladsahebmadarek 2012; Popiel 2017; Rajan 2017; Ruminjo 2015; Nathan 2001; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Sun 2004; Tahmin 2011; Vallabh-Patel 2020; Weemhoff 2011; Yaghmaei 2017; Yee 2015
- Management of acute urinary retention (Lau 2004; Taube 1989; Wu 2015)
- Major abdominal or thoracic surgery, or both (Allen 2016; Chia 2009; Zaouter 2009)
- Colon or rectal surgery (Benoist 1999; Coyle 2015; Jang 2012; Lau 2004; Oberst 1981; Zmora 2010)
- Women undergoing any surgery (Williamson 1982)
- Stroke (Gross 2007)
- Orthopaedic surgery (Carpiniello 1988; Nyman 2010)
- Urology ward (Crowe 1993)
- Intensive care unit (Chen 2013; Zomorrodi 2018)
- Medicine and cardiology patients (Cornia 2003)
- General medical or surgery ward (Hall 1998; Webster 2006)
- Neurosurgery (Liu 2015)

Sex

Fifty trials included women only (Ahmed 2014; Alessandri 2006; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Azarkish 2005; Barone 2015; Basbug 2020; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Dunn 1999; Dunn 2000b; Dunn 2003; El-Mazny 2014; Glavind 2007; Gong 2017; Gungor 2014; Guzman 1994; Hakvoort 2004; Huang 2011; Ind 1993; Joshi 2014; Kamilya 2010; Kokabi 2009; Lang 2020; Liang 2009; Mao 1994; Naguimbing-Cuaresma 2007; Nathan 2001; Onile 2008; Ouladsahebmadarek 2012; Popiel 2017; Rajan 2017; Ruminjo 2015; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Sun 2004; Tahmin 2011; Vallabh-Patel 2020; Weemhoff 2011; Williamson 1982; Yaghmaei 2017; Yee 2015; Zhou 2012).

Twenty-two trials included men only (Chillington 1992; Durrani 2014; Ganta 2005; Han 1997; Hewitt 2001; Irani 1995; Jeong 2014; Kim 2012; Koh 1994; Li 2014; Lista 2020; Matsushima 2015; McDonald 1999; Pervaiz 2019; Sahin 2011; Souto 2004; Talreja 2016; Taube 1989; Toscano 2001; Valero Puerta 1998; Wilson 2000; Wyman 1987).

Twenty-one trials included participants of both sexes (Allen 2016; Benoist 1999; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Crowe 1993; Gross 2007; Hall 1998; Jang 2012; Jun 2011; Lau 2004; Liu 2015; Noble 1990; Nyman 2010; Oberst 1981; Webster 2006; Wu 2015; Zaouter 2009; Zmora 2010; Zomorrodi 2018).

Six trials did not report participants' sex (Bristoll 1989; Iversen Hansen 1984; Kelleher 2002; Lyth 1997; Nguyen 2012; Nielson 1985).

Age

A wide range of ages was reported in the included trials (see Table 2). Twenty-three trials did not report the age of participants (Aslam 2019; Azarkish 2005; Bristoll 1989; Chillington 1992; Cornia 2003; Crowe 1993; Dunn 1999; Dunn 2000b; Dunn 2003; Hall 1998; Hewitt 2001; Kelleher 2002; Kim 2012; Kokabi 2009; Lyth 1997; Mao 1994; Naguimbing-Cuaresma 2007; Nguyen 2012; Noble 1990; Popiel 2017; Ruminjo 2015; Wilson 2000; Yee 2015). In trials that did report age of participants, reported it for each trial arm, overall or both.

In eight trials participants were less than 35 years old (Aref 2020; Azarkish 2003; Barone 2015; Basbug 2020; El-Mazny 2014; Onile 2008; Yaghmaei 2017; Zhou 2012). In 49 trials, participants were 35 to 65 years old (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Benoist 1999; Carter-Brooks 2018; Chai 2011; Chia 2009; Coyle 2015; Dunn 2003; Glavind 2007; Gong 2017; Gungor 2014; Guzman 1994; Huang 2011; Ind 1993; Jang 2012; Jeong 2014; Joshi 2014; Kamilya 2010; Lang 2020; Lau 2004; Liang 2009; Lista 2020; Liu 2015; Nathan 2001; Nielson 1985; Oberst 1981; Ouladsahebmadarek 2012; Rajan 2017; Sahin 2011; Sandberg 2019; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Talreja 2016; Valero Puerta 1998; Vallabh-Patel 2020; Webster 2006; Weemhoff 2011; Williamson 1982; Wu 2015; Zaouter 2009; Zmora 2010; Zomorrodi 2018).

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Nineteen trials had participants between 65 to 75 years old (Carpiniello 1988; Chen 2013; Durrani 2014; Ganta 2005; Gross 2007; Hakvoort 2004; Han 1997; Irani 1995; Iversen Hansen 1984; Jun 2011; Koh 1994; Li 2014; Matsushima 2015; McDonald 1999; Pervaiz 2019; Schiotz 1995; Taube 1989; Toscano 2001; Wyman 1987). The participants of one trial were more than 75 years old (Nyman 2010).

Participants who received antibiotics during hospitalisation

There was considerable variation between trials in participants receiving antibiotic prophylactic therapy (see Table 3). We think this is most likely due to the reasons for hospitalisation.

Sixty trials did not report whether antibiotic prophylaxis was given to participants or not (Allen 2016; Aslam 2019; Azarkish 2003; Azarkish 2005; Bristoll 1989; Carter-Brooks 2018; Chillington 1992; Cornia 2003; Coyle 2015; Crowe 1993; Dunn 1999; Dunn 2000b; Ganta 2005; Gong 2017; Gross 2007; Gungor 2014; Hakvoort 2004; Hall 1998; Han 1997; Hewitt 2001; Ind 1993; Jeong 2014; Jun 2011; Kelleher 2002; Kim 2012; Kokabi 2009; Li 2014; Lista 2020; Liu 2015; Lyth 1997; Mao 1994; Matsushima 2015; McDonald 1999; Naguimbing-Cuaresma 2007; Nathan 2001; Nguyen 2012; Nielson 1985; Noble 1990; Nyman 2010; Oberst 1981; Onile 2008; Pervaiz 2019; Popiel 2017; Rajan 2017; Ruminjo 2015; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Souto 2004; Tahmin 2011; Taube 1989; Webster 2006; Williamson 1982; Wilson 2000; Wu 2015; Wyman 1987; Yee 2015; Zhou 2012; Zomorrodi 2018).

Participants received antibiotic therapy in 33 trials (Ahmed 2014; Alessandri 2006; Aref 2020; Basbug 2020; Benoist 1999; Carpiniello 1988; Chia 2009; Dunn 2003; Durrani 2014; El-Mazny 2014; Glavind 2007; Guzman 1994; Huang 2011; Irani 1995; Jang 2012; Joshi 2014; Kamilya 2010; Koh 1994; Lang 2020; Lau 2004; Liang 2009; Ouladsahebmadarek 2012; Sekhavat 2008; Shrestha 2013; Sun 2004; Talreja 2016; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Weemhoff 2011; Yaghmaei 2017; Zaouter 2009; Zmora 2010).

Participants did not receive routine prophylactic antibiotic therapy in five trials (Alonzo-Sosa 1997; Barone 2015; Chai 2011; Chen 2013; Shahnaz 2016). Some participants received antibiotic therapy when others did not (Iversen Hansen 1984).

Interventions

We split the trials into five different interventions with the following comparisons for the removal of indwelling urethral catheters:

1. Thirteen trials (1506 participants) compared the removal of indwelling urethral catheters at one specified time of day (6 am to 7 am) versus another specified time of day (10 pm to midnight) (Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Hall 1998; Ind 1993; Kelleher 2002; Lyth 1997; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006; Wyman 1987);
2. Sixty-eight trials (9247 participants) compared shorter durations of indwelling urethral catheterisation versus longer durations of indwelling urethral catheterisation (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Barone 2015; Basbug 2020; Benoist 1999; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Dunn 2003; Durrani 2014; El-Mazny 2014; Glavind 2007; Gungor 2014; Guzman 1994; Hakvoort 2004; Han 1997; Hewitt 2001; Huang 2011; Irani 1995; Joshi 2014; Kamilya 2010; Kim 2012; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Mao 1994; Matsushima 2015; Naguimbing-Cuaresma 2007; Nguyen 2012; Nielson 1985; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Taube 1989; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Weemhoff 2011; Yaghmaei 2017; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018);
3. No trials compared flexible durations of indwelling urethral catheterisation versus fixed duration of indwelling urethral catheterisation;
4. Seven trials (714 participants) compared clamping of indwelling urethral catheterisation versus free drainage of indwelling urethral catheterisation prior to removal (Gong 2017; Guzman 1994; Liu 2015; Nyman 2010; Oberst 1981; Williamson 1982; Wu 2015);
5. Three trials (402 participants) compared prophylactic use of alpha blocker prior to indwelling urethral catheter removal versus no intervention or placebo (Jang 2012; Jeong 2014; Jun 2011).

Guzman 1994 reported data for both clamping regimes as well as shorter versus longer durations of catheters and is therefore included in both comparisons.

Outcome measures

Thirty-five of the 99 included trials did not report our primary outcome of number of participants who required recatheterisation (Azarkish 2003; Azarkish 2005; Barone 2015; Benoist 1999; Bristoll 1989; Coyle 2015; Crowe 1993; El-Mazny 2014; Gross 2007; Gungor 2014; Han 1997; Iversen Hansen 1984; Jeong 2014; Lang 2020; Li 2014; Liang 2009; Mao 1994; McDonald 1999; Nguyen 2012; Nielson 1985; Noble 1990; Popiel 2017; Ruminjo 2015; Souto 2004; Sun 2004; Taube 1989; Toscano 2001; Valero Puerta 1998; Williamson 1982; Wilson 2000; Wu 2015; Yaghmaei 2017; Yee 2015; Zhou 2012; Zomorrodi 2018).

Forty-four trials reported symptomatic CAUTI (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Barone 2015; Benoist 1999; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Dunn 2003; Durrani 2014; Gong 2017; Gross 2007; Guzman 1994; Huang 2011; Jang 2012; Kamilya 2010; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Sun 2004; Vallabh-Patel 2020; Weemhoff 2011; Zaouter 2009; Zmora 2010; Zomorrodi 2018).

Nineteen trials reported asymptomatic bacteriuria (Ahmed 2014; Aref 2020; Basbug 2020; Carpiniello 1988; Chai 2011; Chen 2013; El-Mazny 2014; Glavind 2007; Hakvoort 2004; Irani 1995; Joshi 2014; Kamilya 2010; Nathan 2001; Onile 2008; Sandberg 2019; Shahnaz 2016; Shrestha 2013; Tahmin 2011; Zmora 2010).

Twenty-four trials reported incidence of urinary retention (Barone 2015; Benoist 1999; Coyle 2015; El-Mazny 2014; Guzman 1994; Han 1997; Irani 1995 ; Jeong 2014; Jun 2011; Kim 2012; Lista 2020; Mao 1994; Nielson 1985; Popiel 2017; Rajan 2017; Schiotz 1995; Sekhavat 2008; Shahnaz 2016; Taube 1989; Toscano 2001; Valero Puerta 1998; Webster 2006; Wu 2015: Zhou 2012).

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Four trials reported data on complications of catheterisation (Dunn 2003; Nielson 1985; Webster 2006; Yaghmaei 2017).

Twelve trials reported data on patient pain or discomfort (Carter-Brooks 2018; Chai 2011; Chia 2009; Dunn 2003; Joshi 2014; Naguimbing-Cuaresma 2007; Nielson 1985; Ouladsahebmadarek 2012; Sandberg 2019; Sekhavat 2008; Webster 2006; Zaouter 2009).

Four trials reported data on patient satisfaction (Chillington 1992; Lyth 1997; Noble 1990; Yaghmaei 2017).

Eight trials reported data on urinary incontinence (Ahmed 2014; Barone 2015; Gungor 2014; Han 1997; Kim 2012; Onile 2008; Souto 2004; Webster 2006).

Nine trials reported dysuria (Ahmed 2014; Aref 2020; Basbug 2020; El-Mazny 2014; Liu 2015; Onile 2008; Ouladsahebmadarek 2012; Webster 2006; Yaghmaei 2017).

Seventeen trials reported volume of first void (Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Gungor 2014; Hall 1998; Huang 2011; Ind 1993; Kelleher 2002; Liu 2015; Lyth 1997; Mao 1994; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006; Yaghmaei 2017).

Sixteen trials reported time to first void (Carter-Brooks 2018; Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Hall 1998; Ind 1993; Kelleher 2002; McDonald 1999; Naguimbing-Cuaresma 2007; Nathan 2001; Noble 1990; Oberst 1981; Webster 2006; Williamson 1982; Yaghmaei 2017).

Six trials reported post-void residual volume (Gross 2007; Gungor 2014; Huang 2011; Jang 2012; Jeong 2014; Nguyen 2012).

Forty trials reported length of hospitalisation (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Basbug 2020; Carter-Brooks 2018; Chillington 1992; Durrani 2014; El-Mazny 2014; Guzman 1994; Hakvoort 2004; Han 1997; Ind 1993; Irani 1995; Jang 2012; Jun 2011; Kamilya 2010; Kim 2012; Koh 1994; Lau 2004; Li 2014; Lista 2020; Naguimbing-Cuaresma 2007; Nathan 2001; Nyman 2010; Onile 2008; Ouladsahebmadarek 2012; Sandberg 2019; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Sun 2004; Tahmin 2011; Valero Puerta 1998; Weemhoff 2011; Yaghmaei 2017; Zaouter 2009).

Two trials reported time between removal of catheter and discharge (Lyth 1997; Webster 2006).

We did not identify any trials that reported condition-specific or generic quality of life measures or psychological outcome measures.

The included trials used a number of different ways to define microbiological outcomes. Sixteen trials reported symptomatic UTI defined in one of the following ways:

- 10^5 cfu/mL or higher and at least one other symptom of UTI (e.g. fever, suprapubic tenderness, dysuria; Ahmed 2014; Aref 2020; Alonzo-Sosa 1997; Chai 2011; Joshi 2014; Kamilya 2010; Onile 2008; Schiotz 1995; Schiotz 1996; Zmora 2010);
- 10^7 cfu/mL or higher, symptoms of UTI (e.g. dysuria, frequency/urgency, suprapubic tenderness) and fever of 38°C or higher (Zaouter 2009);
- CDC criteria for symptomatic UTI (Chen 2013; Gong 2017; Gross 2007; Liang 2009; Vallabh-Patel 2020).

Six trials reported UTI as significant bacteriuria (≥ 10^5 cfu/mL) with or without symptoms of UTI (Benoist 1999; Carter-Brooks 2018; Cornia 2003; Gong 2017; Kamilya 2010; Sekhavat 2008), whilst there were 13 trials that reported UTI as a urine culture of ≥ 10^5 cfu/mL regardless of clinical features of UTI (Alessandri 2006; Basbug 2020; Carpiniello 1988; El-Mazny 2014; Glavind 2007; Guzman 1994; Hakvoort 2004; Pervaiz 2019; Shahnaz 2016; Sun 2004; Tahmin 2011; Weemhoff 2011; Zhou 2012). By following the EAU criteria, these outcomes were classified as asymptomatic bacteriuria.

Four trials defined asymptomatic bacteriuria:

- 10^5 cfu/mL or higher on urine culture with the absence of symptoms (Alonzo-Sosa 1997; Schiotz 1995; Schiotz 1996)
- pus cells greater than 5 per high-power field in routine examination of urine and bacterial culture positive (Shrestha 2013)

Sixty-five trials did not report any clear definitions for symptomatic UTI or asymptomatic bacteriuria (Allen 2016; Aslam 2019; Azarkish 2003; Azarkish 2005; Barone 2015; Bristoll 1989; Chia 2009; Chillington 1992; Coyle 2015; Crowe 1993; Dunn 1999; Dunn 2000b; Dunn 2003; Durrani 2014; Ganta 2005; Gungor 2014; Hall 1998; Han 1997; Hewitt 2001; Huang 2011; Ind 1993; Irani 1995; Iversen Hansen 1984; Jang 2012; Jeong 2014; Jun 2011; Kelleher 2002; Kim 2012; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Lista 2020; Liu 2015; Lyth 1997; Mao 1994; Matsushima 2015; McDonald 1999; Naguimbing-Cuaresma 2007; Nathan 2001; Nguyen 2012; Nielson 1985; Noble 1990; Nyman 2010; Oberst 1981; Ouladsahebmadarek 2012; Popiel 2017; Rajan 2017; Ruminjo 2015; Sahin 2011; Sandberg 2019; Souto 2004; Talreja 2016; Taube 1989; Toscano 2001; Valero Puerta 1998; Webster 2006; Williamson 1982; Wilson 2000; Wu 2015; Wyman 1987; Yaghmaei 2017; Yee 2015; Zomorrodi 2018).

While there was some consistency in the choice of outcome measures amongst trials, the differences in the measures or the way the data were reported limited the possibilities for combining results from individual trials.

Excluded studies

We excluded 89 reports of 85 trials from the review for a variety of reasons, including inappropriate trial design (i.e. not RCTs or quasi-RCTs), or because the intervention was not relevant, as the trial focused on suprapubic or intermittent catheterisation or centred on long-term catheterisation (i.e. intended catheterisation of more than 14 days).

Further details regarding the excluded trials can be found in the Characteristics of excluded studies.

Ongoing studies

We identified eight ongoing trials, details of which can be found in the Characteristics of ongoing studies.

Risk of bias in included studies

We give the details of the risk of bias of each trial included in the review in the Characteristics of included studies. The 'Risk of

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bias' graph and summary figures also provide further information regarding the included trials (see Figure 2 and Figure 3).

Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included trials

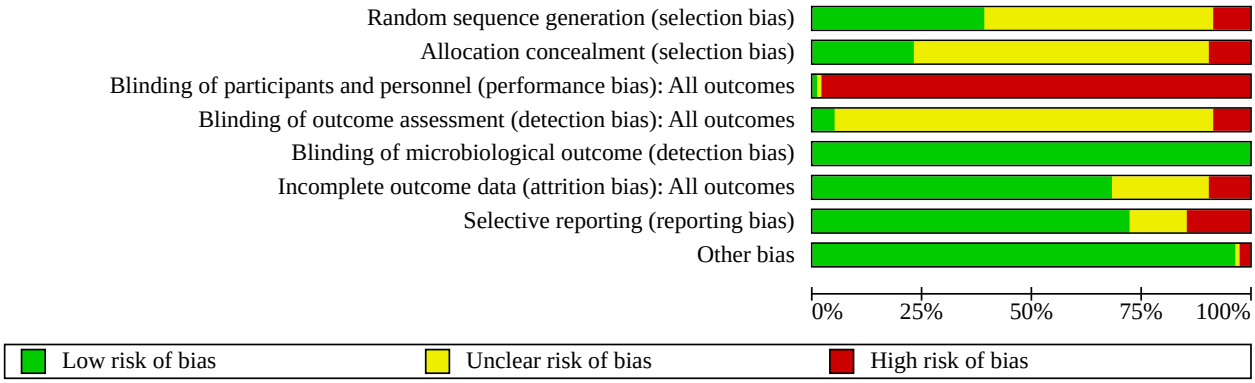

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Figure 3. Risk of bias summary: review authors' judgements about each risk of bias item for each included trial

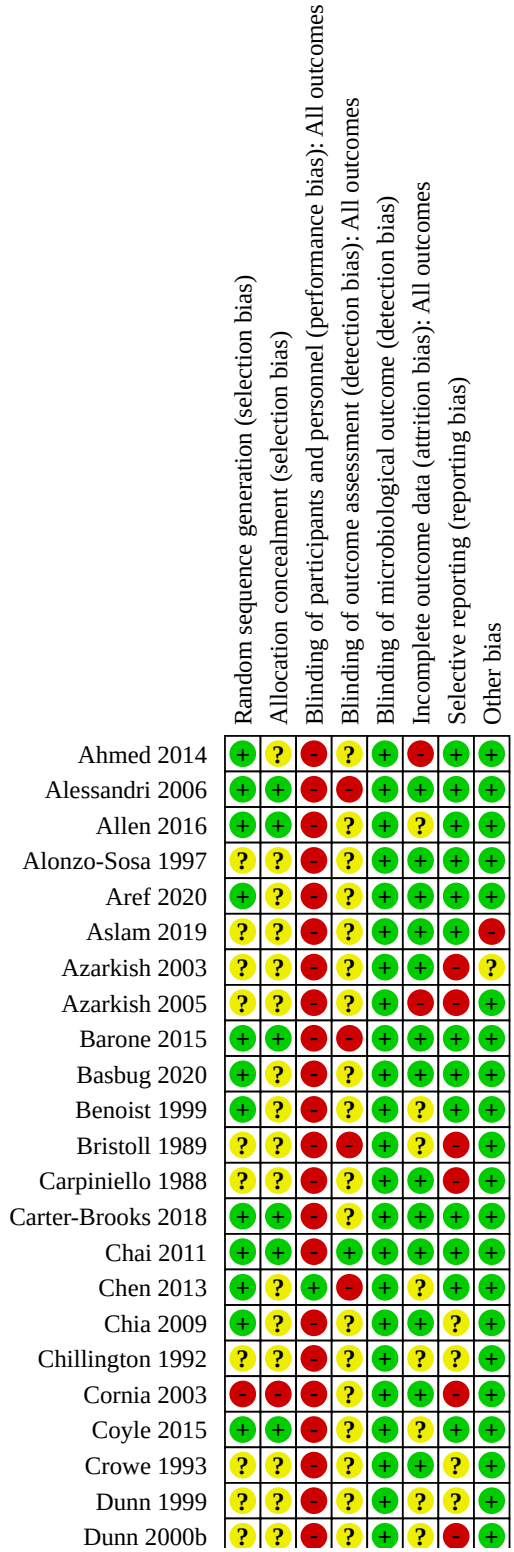

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Figure 3. (Continued)

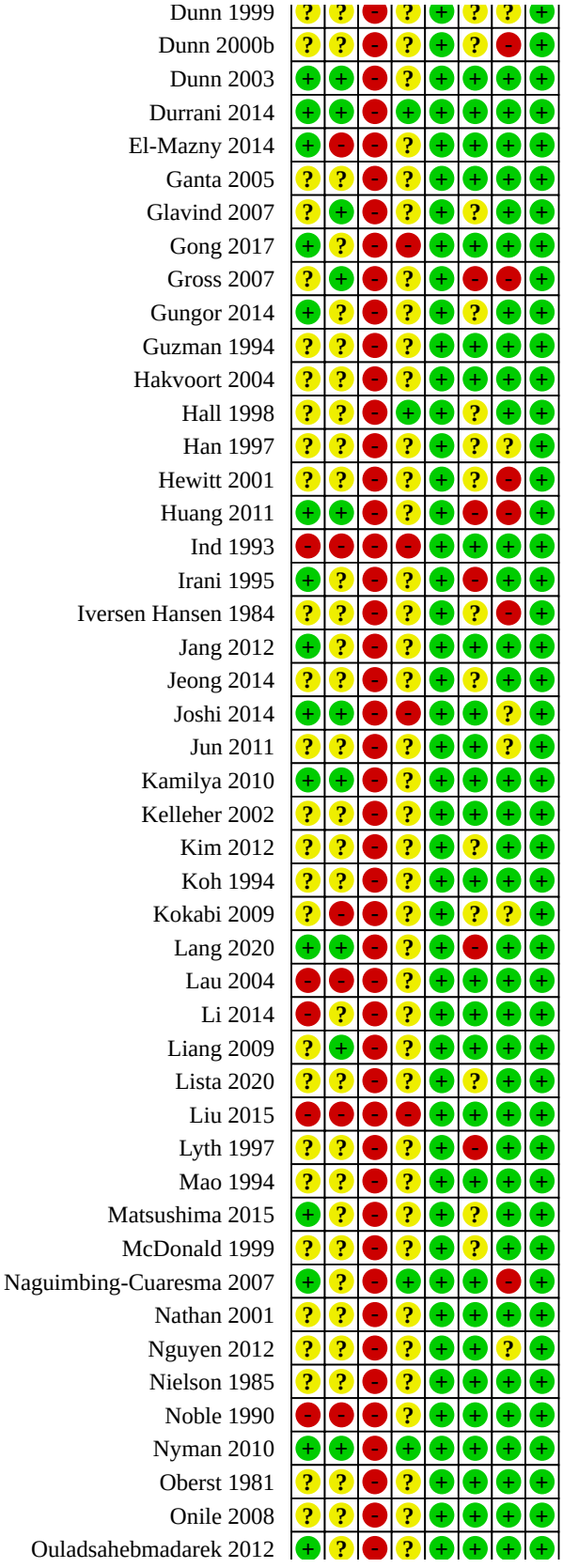

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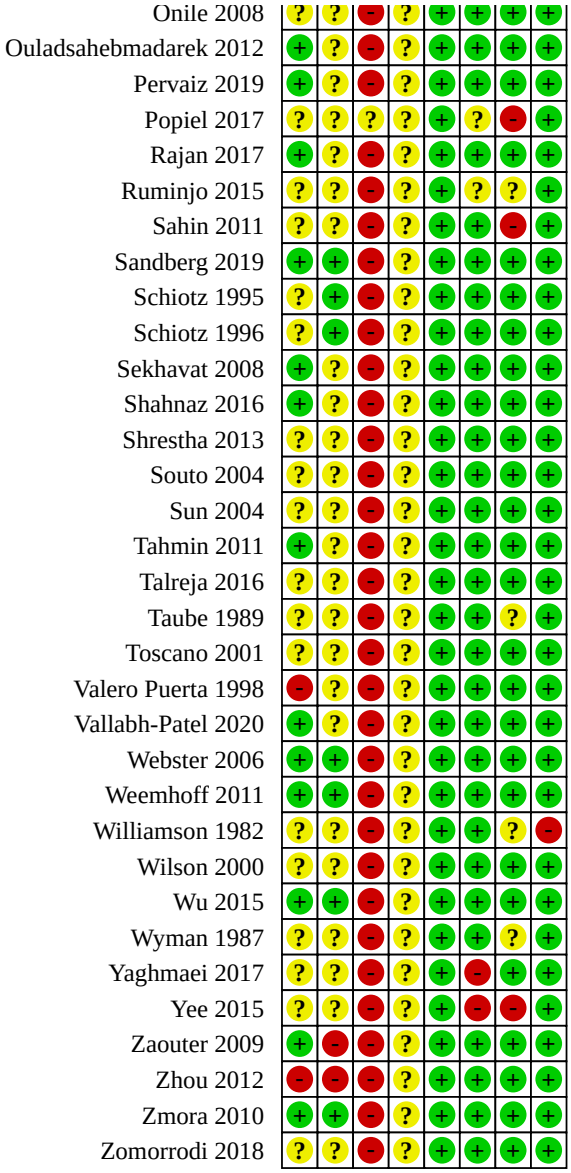
Figure 3. (Continued)



Allocation

Random sequence generation

We judged random sequence generation to be adequate and deemed to be low risk of bias in 39 trials (Ahmed 2014; Alessandri 2006; Allen 2016; Aref 2020; Barone 2015; Basbug 2020; Benoist 1999; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Coyle 2015; Dunn 2003; Durrani 2014; El-Mazny 2014; Gong 2017; Gungor 2014; Huang 2011; Irani 1995; Jang 2012; Joshi 2014; Kamilya 2010; Lang 2020; Matsushima 2015; Naguimbing-Cuaresma 2007; Nyman 2010; Ouladsahebmadarek 2012; Pervaiz 2019; Rajan 2017; Sandberg 2019; Sekhavat 2008; Shahnaz 2016; Tahmin 2011; Vallabh-Patel 2020; Webster 2006; Weemhoff 2011; Wu 2015; Zaouter 2009; Zmora 2010).

There were eight trials that we judged to have inadequate methods of random sequence generation and deemed to be at high risk of bias (Cornia 2003; Ind 1993; Lau 2004; Li 2014; Liu 2015; Noble 1990; Valero Puerta 1998; Zhou 2012). Two of these trials used quasi-randomisation (Liu 2015; Noble 1990).

The remaining 52 trials provided insufficient information regarding the method of random sequence generation so we judged them to be at unclear risk of bias (Alonzo-Sosa 1997; Aslam 2019; Azarkish 2003; Azarkish 2005; Bristoll 1989; Carpiniello 1988; Chillington 1992; Crowe 1993; Dunn 1999; Dunn 2000b; Ganta 2005; Glavind 2007; Gross 2007; Guzman 1994; Hakvoort 2004; Hall 1998; Han 1997; Hewitt 2001; Iversen Hansen 1984; Jeong 2014; Jun 2011; Kelleher 2002; Kim 2012; Koh 1994; Kokabi 2009; Liang 2009; Lista 2020; Lyth 1997; Mao 1994; McDonald 1999; Nathan 2001; Nguyen 2012; Nielson 1985; Oberst 1981; Onile 2008; Popiel 2017; Ruminjo 2015; Sahin 2011; Schiotz 1995; Schiotz 1996; Shrestha 2013; Souto 2004; Sun 2004; Talreja 2016; Taube 1989; Toscano

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2001; Williamson 1982; Wilson 2000; Wyman 1987; Yaghmaei 2017; Yee 2015; Zomorrodi 2018).

Allocation concealment

We judged 22 trials to have used adequate allocation concealment methods and so were at low risk of bias (Alessandri 2006; Allen 2016; Barone 2015; Carter-Brooks 2018; Chai 2011; Coyle 2015; Dunn 2003; Durrani 2014; Glavind 2007; Gross 2007; Huang 2011; Joshi 2014; Kamilya 2010; Lang 2020; Liang 2009; Nyman 2010; Schiotz 1995; Schiotz 1996; Webster 2006; Weemhoff 2011; Wu 2015; Zmora 2010).

We judged 10 trials to have inadequate allocation concealment methods and therefore were at high risk of bias (Cornia 2003; El-Mazny 2014; Ind 1993; Kokabi 2009; Lau 2004; Liu 2015; Noble 1990; Sandberg 2019; Zaouter 2009; Zhou 2012).

The remaining 66 trials had insufficient information to judge allocation concealment so we judged them to be at unclear risk of bias (Ahmed 2014; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Azarkish 2005; Basbug 2020; Benoist 1999; Bristoll 1989; Carpiniello 1988; Chen 2013; Chia 2009; Chillington 1992; Crowe 1993; Dunn 1999; Dunn 2000b; Ganta 2005; Gong 2017; Gungor 2014; Guzman 1994; Hakvoort 2004; Hall 1998; Han 1997; Hewitt 2001; Irani 1995; Iversen Hansen 1984; Jang 2012; Jeong 2014; Jun 2011; Kelleher 2002; Kim 2012; Koh 1994; Li 2014; Lista 2020; Lyth 1997; Mao 1994; Matsushima 2015; McDonald 1999; Naguimbing-Cuaresma 2007; Nathan 2001; Nguyen 2012; Nielson 1985; Oberst 1981; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Ruminjo 2015; Sahin 2011; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Talreja 2016; Tahmin 2011; Taube 1989; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Williamson 1982; Wilson 2000; Wyman 1987; Yaghmaei 2017; Yee 2015; Zomorrodi 2018).

Blinding

Blinding of participants and personnel

We judged one trial to have used adequate blinding methods of participants and personnel, which we therefore assessed as being at low risk of bias (Chen 2013). We judged the remaining 98 trials to have used inadequate methods of blinding of participants and personnel and we therefore assessed them as being at high risk of bias.

Blinding of outcome assessment

Eight trials reported no blinding of outcome assessment, so we deemed them to be at high risk of bias (Alessandri 2006; Barone 2015; Bristoll 1989; Chen 2013; Gong 2017; Ind 1993; Joshi 2014; Liu 2015).

Five trials did report blinding of the principal investigator or the health professional who conducted the outcome assessment on participants (Chai 2011; Durrani 2014; Hall 1998; Naguimbing-Cuaresma 2007; Nyman 2010). As a result, we deemed them to be at low risk of bias.

The remaining 86 trials did not report blinding of the outcome assessors. Thus, we decided to assign them to unclear risk of bias (Ahmed 2014; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Azarkish 2005; Basbug 2020; Benoist 1999; Carpiniello 1988; Carter-Brooks 2018; Chia 2009; Chillington 1992; Cornia 2003; Coyle 2015; Crowe 1993; Dunn 1999; Dunn 2000b; Dunn 2003; El-Mazny 2014; Ganta 2005; Glavind 2007; Gross 2007; Gungor 2014; Guzman 1994; Hakvoort 2004; Han 1997; Hewitt 2001; Huang 2011; Irani 1995; Iversen Hansen 1984; Jang 2012; Jeong 2014; Jun 2011; Kamilya 2010; Kelleher 2002; Kim 2012; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Lyth 1997; Mao 1994; Matsushima 2015; McDonald 1999; Nathan 2001; Nguyen 2012; Nielson 1985; Noble 1990; Oberst 1981; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Ruminjo 2015; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Talreja 2016; Taube 1989; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Webster 2006; Weemhoff 2011; Williamson 1982; Wilson 2000; Wu 2015; Wyman 1987; Yaghmaei 2017; Yee 2015; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018).

Blinding of assessment of microbiological outcomes

We assumed that microbiological outcomes were assessed by a microbiologist who would not be aware of the catheter duration or the fact that participants were involved in a trial. We rated all 99 included trials as being low risk of bias for microbiological outcomes.

Incomplete outcome data

We deemed 68 trials to be at low risk of attrition bias (Alessandri 2006; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Barone 2015; Basbug 2020; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Chia 2009; Cornia 2003; Crowe 1993; Dunn 2003; Durrani 2014; El-Mazny 2014; Ganta 2005; Gong 2017; Guzman 1994; Hakvoort 2004; Ind 1993; Jang 2012; Joshi 2014; Jun 2011; Kamilya 2010; Kelleher 2002; Koh 1994; Lau 2004; Li 2014; Liang 2009; Liu 2015; Mao 1994; Naguimbing-Cuaresma 2007; Nathan 2001; Nguyen 2012; Nielson 1985; Noble 1990; Nyman 2010; Oberst 1981; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Rajan 2017; Sandberg 2019; Sahin 2011; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Talreja 2016; Taube 1989; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Webster 2006; Weemhoff 2011; Williamson 1982; Wilson 2000; Wu 2015; Wyman 1987; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018). These trials either had no dropouts or no differential dropouts.

Nine trials had incomplete outcome data as well as having a differential loss to follow-up (Ahmed 2014; Azarkish 2005; Gross 2007; Huang 2011; Irani 1995; Lang 2020; Lyth 1997; Yaghmaei 2017; Yee 2015). As a result of this, we deemed them to be at high risk of attrition bias.

The remaining 22 trials had insufficient information to make a decision and therefore we judged them to be at unclear risk of attrition bias (Allen 2016; Benoist 1999; Bristoll 1989; Chen 2013; Chillington 1992; Coyle 2015; Dunn 1999; Dunn 2000b; Glavind 2007; Gungor 2014; Hall 1998; Han 1997; Hewitt 2001; Iversen Hansen 1984; Jeong 2014; Kim 2012; Kokabi 2009; Lista 2020; Matsushima 2015; McDonald 1999; Popiel 2017; Ruminjo 2015).

Selective reporting

We assessed selective reporting based on the outcomes mentioned in the Methods section (Types of outcome measures), and the results that were reported, as well as whether the trials reported

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all the expected outcomes in accordance with their objectives. We did not conduct a search for the protocols for each trial due to time constraints.

We deemed 72 trials to be low risk of bias (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Barone 2015; Basbug 2020; Benoist 1999; Carter-Brooks 2018; Chai 2011; Chen 2013; Coyle 2015; Dunn 2003; Durrani 2014; El-Mazny 2014; Ganta 2005; Glavind 2007; Gong 2017; Gungor 2014; Guzman 1994; Hakvoort 2004; Hall 1998; Ind 1993; Irani 1995; Jang 2012; Jeong 2014; Kamilya 2010; Kelleher 2002; Kim 2012; Koh 1994; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Liu 2015; Lyth 1997; Mao 1994; Matsushima 2015; McDonald 1999; Nathan 2001; Nielson 1985; Noble 1990; Nyman 2010; Oberst 1981; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Rajan 2017; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Talreja 2016; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Webster 2006; Weemhoff 2011; Wilson 2000; Wu 2015; Yaghmaei 2017; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018).

We deemed 14 trials to be at high risk of bias for selective reporting (Azarkish 2003; Azarkish 2005; Bristoll 1989; Carpiniello 1988; Cornia 2003; Dunn 2000b; Gross 2007; Hewitt 2001; Huang 2011; Iversen Hansen 1984; Naguimbing-Cuaresma 2007; Popiel 2017; Sahin 2011; Yee 2015).

We assigned the remaining 13 trials to unclear risk of bias for selective reporting (Chia 2009; Chillington 1992; Crowe 1993; Dunn 1999; Han 1997; Joshi 2014; Jun 2011; Kokabi 2009; Nguyen 2012; Ruminjo 2015; Taube 1989; Williamson 1982; Wyman 1987).

Other potential sources of bias

We judged one trial to be at high risk of bias (Williamson 1982). This trial included just eight participants and, as a result, we deemed this trial to be underpowered. The remaining 98 trials included in this review appeared to be free from other sources of bias and we therefore judged them to be at low risk of bias.

Effects of interventions

See: **Summary of findings 1** Removal of short-term indwelling urethral catheters in adults at one time of day (6 am to 7 am) versus another time of day (10 pm to midnight); **Summary of findings 2** Removal of short-term indwelling urethral catheters in adults after shorter versus longer durations; **Summary of findings 3** Removal of short-term indwelling urethral catheters in adults: clamping compared to free drainage; **Summary of findings 4** Removal of short-term indwelling urethral catheters in adults: prophylactic use of alpha blocker versus no drug or intervention

Comparison 1: removal of indwelling urethral catheter at one specified time of day (6 am to 7 am) versus another specified time of day (10 pm to midnight)

Thirteen trials compared catheter removal at different times of the day (Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Hall 1998; Ind 1993; Kelleher 2002; Lyth 1997; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006; Wyman 1987). We were not always able to perform meta-analysis due to either a lack of included trials reporting the same outcome or the presence of considerable clinical heterogeneity between included trials.

Primary outcomes

Number of participants who required recatheterisation following removal of indwelling urethral catheter

Ten trials reported the number of participants who required recatheterisation following removal of indwelling urethral catheters (Chillington 1992; Crowe 1993; Ganta 2005; Hall 1998; Ind 1993; Kelleher 2002; Lyth 1997; Nathan 2001; Webster 2006; Wyman 1987). Removal of indwelling urethral catheters at midnight may slightly reduce the risk of requiring recatheterisation compared with early morning removal (RR 0.70, 95% CI 0.52 to 0.94; I^2 = 0%; 10 trials, 1920 participants; low-certainty evidence; Analysis 1.1; Summary of findings 1).

The asymmetry in the funnel plot could be indicative of bias due to missing results (Figure 4). However, with only ten trials contributing to the analysis, we cannot rule out the play of chance as the source of asymmetry.

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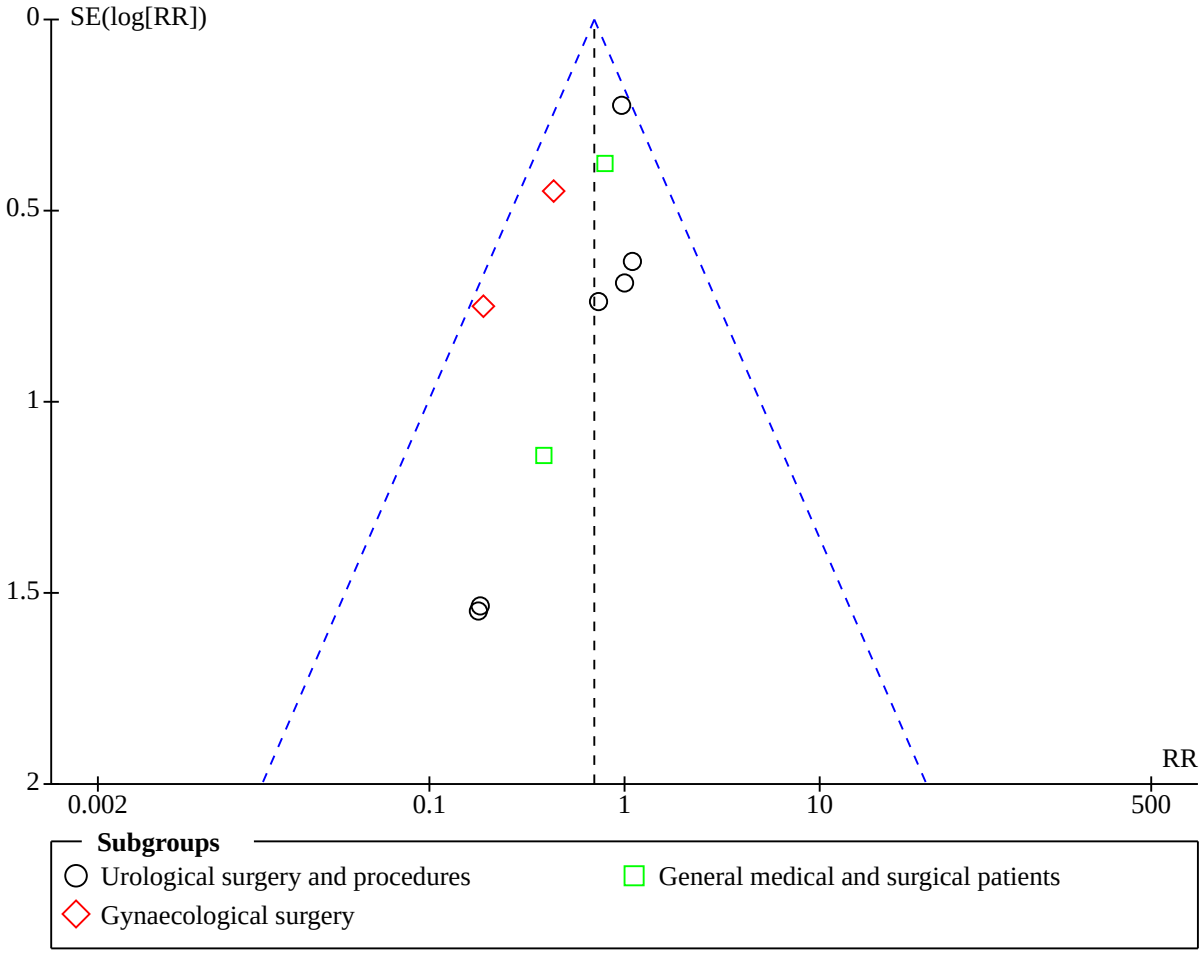
Figure 4. Funnel plot of comparison 1. Removal of indwelling urethral catheter at one time of day (6 am to 7 am) versus another time of day (10 pm to midnight). Outcome 1.1. number needing to be recatheterised



In the sensitivity analysis, we removed the one trial that we judged to be high risk of bias in the randomisation and allocation concealment domains (Ind 1993). This changed the effect estimate and 95% confidence interval slightly (RR 0.75, 95% CI 0.54 to 1.03; I^2 = 0%), which indicates that the overall effect estimate with all trials included may need to be interpreted with caution.

Subgroup analysis based on type of surgery did not suggest evidence that the effect of removing indwelling catheters at midnight versus early in the morning is different in groups of people undergoing different types of surgery (test for subgroup differences: P = 0.07, overlapping confidence intervals; Analysis 1.1).

Subgroup analysis based on sex also did not suggest that the effect of removing indwelling catheters at midnight versus early in the morning on risk of requiring recatheterisation is different between men and women (test for subgroup differences: P = 0.25, overlapping confidence intervals; Analysis 1.2).

No trials reported the use of antibiotic prophylaxis for this outcome.

Secondary outcomes

Complications/adverse events

Incidence of urinary tract infection

- **Symptomatic catheter-associated urinary tract infections (CAUTI):** one trial reported the number of participants with symptomatic CAUTIs (Gross 2007). We are uncertain if removing the indwelling urethral catheter at midnight compared with early morning removal has any effect on the risk of symptomatic CAUTI (RR 1.00, 95% CI 0.61 to 1.63; very low-certainty evidence; Analysis 1.3; Summary of findings 1).
- **Asymptomatic bacteriuria:** one trial (107 participants) reported the number of participants undergoing gynaecological surgery who had asymptomatic bacteriuria as a result of indwelling urethral catheterisation (Nathan 2001). There was insufficient evidence to suggest whether removal of the indwelling urethral catheter at midnight or in the morning affected the number of participants developing this (RR 0.74, 95% CI 0.37 to 1.49; Analysis 1.4).

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Incidence of urinary retention

One trial, Webster 2006, reported on the development of urinary retention following discharge and indicated that eight participants in each group (10%) developed this complication (RR 0.98; 95% CI 0.38 to 2.48; 170 participants; Analysis 1.5).

There was insufficient evidence to suggest any difference between the two groups in terms of difficulty passing urine post-discharge (9/86 versus 8/84; RR 1.10; 95% CI 0.45 to 2.71; 170 participants; Analysis 1.6; Webster 2006).

Other complications of catheterisation (or recatheterisation)

Not reported.

Patient-reported

Patient pain or discomfort

- **Loin pain:** in Webster 2006, four out of 86 participants whose indwelling urethral catheters were removed in the morning experienced loin pain following discharge compared with one out of 84 participants whose catheter was removed in the morning (RR 3.91, 95% CI 0.45 to 34.24; Analysis 1.7).
- **Fever:** Webster 2006 reported the number of participants who developed urinary-related fever post-discharge (7/86 versus 4/84; RR 1.71, 95% CI 0.52 to 5.62; Analysis 1.8). It should be noted that, although the post-discharge fever was indicated as urinary-related in the trial, Webster 2006 did not specify whether this was likely to be a direct result of urethral catheterisation or the procedure that the participant underwent.

Patient satisfaction

One trial reported participant satisfaction and indicated that late night removal of the indwelling urethral catheter was associated with more sleep disturbances (P = 0.004; Ganta 2005). Another trial reported that participants whose indwelling urethral catheters were removed late at night had "disturbed sleep, were tired and confused in the morning and had a delayed establishment of voiding pattern" (Lyth 1997). Five other trials in this review contrasted with Lyth 1997 and reported that late night removal of indwelling urethral catheters did not interrupt the participants' sleep (Chillington 1992; Crowe 1993; Ind 1993; Kelleher 2002; Noble 1990). Some participants went back to sleep immediately after the indwelling urethral catheter was removed, whilst others slept through the removal process. This could be due to the anaesthesia or other medications given to the participants.

When recatheterisation was required, one trial reported that two of the three participants who had their indwelling urethral catheters removed in the morning were recatheterised at "unsocial hours" (8.30 pm and 3 am; Chillington 1992). This was reported to not only be distressing for the participant but also resulted in recatheterisation being performed by a doctor who was on call and not familiar with the case.

Urinary incontinence

In Webster 2006, seven out of 86 participants whose indwelling urethral catheters were removed at night developed urinary incontinence after discharge compared with 11 out of 84 in the morning group (RR 0.62, 95% CI 0.25 to 1.53; Analysis 1.9). Webster 2006 included participants on both medical and surgical wards. The participants on surgical wards were hospitalised for either bladder-related surgery, non-bladder related surgery, gynaecological surgery, general surgery or orthopaedic surgery. The trial also included participants on medical wards. Thus, we found it difficult to ascertain whether the urinary incontinence was due to the urethral catheter or due to another medical or surgical intervention for which the participants were hospitalised.

Number of patients reporting dysuria

One trial reported that fewer participants whose indwelling urethral catheters were removed in the morning developed pain following discharge (9/86 versus 4/84; Webster 2006). We are uncertain if indwelling urethral catheter removal at 10 pm increases the risk of dysuria compared with removal at 6 am because the quality of evidence is low and the 95% CI is consistent with possible benefit and possible harm (RR 2.20, 95% CI 0.70 to 6.86; 1 trial, 170 participants; low-certainty evidence; Analysis 1.10; Summary of findings 1).

Clinician-reported

Volume of first void (mL)

Twelve trials reported data on the volume of the first void following the removal of the indwelling urethral catheter (Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Hall 1998; Ind 1993; Kelleher 2002; Lyth 1997; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006). Ind 1993 reported the median volume of first void (Analysis 1.12), and therefore was not included in the meta-analysis (Analysis 1.11); the difference between medians was 175 mL more in the group who had their catheter removed late at night (P > 0.0001). The remaining nine trials were included in the meta-analysis (Chillington 1992; Crowe 1993; Gross 2007; Hall 1998; Kelleher 2002; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006), along with two trials that reported means but no SDs (Ganta 2005; Lyth 1997).

Participants who had their catheter removed late at night passed larger volumes at first void when compared to those participants who had their catheters removed in the morning (MD 21.98 mL, 95% CI 3.04 to 40.92; I^2 = 80%; 11 trials, 1198 participants; Analysis 1.11). It should be noted that although this result indicates statistical significance, the increase in volume of first void is not likely to be of any clinical importance.

Time to first void (hours)

Eleven trials reported data on the time to first void (Chillington 1992; Crowe 1993; Ganta 2005; Gross 2007; Hall 1998; Ind 1993; Kelleher 2002; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006). Ind 1993 reported the median time to first void (see Analysis 1.14); the difference between medians was 1 hour 40 minutes less in the group who had their catheter removed late at night (P = 0.012). The remaining eight trials were included in the meta-analysis (Chillington 1992; Crowe 1993; Gross 2007; Kelleher 2002; McDonald 1999; Nathan 2001; Noble 1990; Webster 2006), along with two trials that reported means but no SDs (Ganta 2005; Hall 1998).

Those participants who had their catheters removed late at night were found to have a longer time to first void when compared to morning removal (MD 0.71, 95% CI 0.41 to 1.01; I^2 = 0%; 10 trials, 1140 participants; Analysis 1.13).

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Post-void residual volume (mL)

One trial (48 participants) reported post-void residual volume in participants hospitalised to general medical and surgical wards (Gross 2007). There was insufficient evidence to suggest that the removal of an indwelling catheter late at night or in the early morning had any effect on post-void residual volume (MD −25.50, 95% CI −214.40 to 163.40; Analysis 1.15).

Length of hospitalisation (days)

Three trials provided data on the length of hospitalisation of participants (Chillington 1992; Ind 1993; Nathan 2001). Only one trial reported means and SDs, which favoured late night catheter removal as it reduced participant hospital stay (MD −0.60, 95% CI −1.13 to −0.07; 107 participants; Nathan 2001; Analysis 1.16). The remaining trials reported their data in a format unsuitable for meta-analysis (Analysis 1.17). One trial reported the mean but no SDs (Chillington 1992), while the other reported median values only (Ind 1993).

Time between removal of catheter to discharge (days)

Two trials reported the time between removal of catheter to discharge (Lyth 1997; Webster 2006). There was insufficient evidence to suggest that late night or early morning removal of catheters affected the time between catheter removal to discharge (MD 0.08, 95% CI −5.96 to 6.12; I^2 = 0%; 2 trials 272 participants; Analysis 1.18).

Health status/quality of life

Condition-specific or generic quality-of-life measures

Not reported

Psychological outcome measures

Not reported

Comparison 2: shorter versus longer duration of indwelling urethral catheterisation

Sixty-eight trials included in this review investigated the effects of shorter versus longer durations of indwelling urethral catheterisation (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Barone 2015; Basbug 2020; Benoist 1999; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Dunn 2003; Durrani 2014; El-Mazny 2014; Glavind 2007; Gungor 2014; Guzman 1994; Hakvoort 2004; Han 1997; Hewitt 2001; Huang 2011; Irani 1995; Joshi 2014; Kamilya 2010; Kim 2012; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Mao 1994; Matsushima 2015; Naguimbing-Cuaresma 2007; Nguyen 2012; Nielson 1985; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Sun 2004; Tahmin 2011; Taube 1989; Toscano 2001; Valero Puerta 1998; Vallabh-Patel 2020; Weemhoff 2011; Yaghmaei 2017; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018).

We have not yet incorporated data from three trials into the results for outcomes because the trials did not clearly report numbers per group (Dunn 1999; Dunn 2000b; Ruminjo 2015). We have contacted the authors and we are awaiting clarification before we can use the data. We have not incorporated data from Yee 2015 into the results for outcomes as the conference abstract only reported P values. We have contacted the author to provide further information and we are currently awaiting a reply. Iversen Hansen 1984 and Azarkish 2005 reported data in insufficient detail for us to use them for the meta-analysis. We have contacted the author to provide further information and we await their reply.

Outcomes for this comparison reported by trials that were not mentioned in the Types of outcome measures are reported in Appendix 5.

We have used subgrouping for illustrative purposes only according to the following: early removal of urinary catheter versus later; one-day policy versus later; and two to seven-day policy versus later removal.

Primary outcomes

Number of participants who required recatheterisation following removal of indwelling urethral catheter

Forty-four trials reported incidence of recatheterisation in participants undergoing either a shorter duration of indwelling urethral catheterisation or longer duration (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Basbug 2020; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Dunn 2003; Durrani 2014; Glavind 2007; Guzman 1994; Hakvoort 2004; Hewitt 2001; Huang 2011; Irani 1995; Joshi 2014; Kamilya 2010; Kim 2012; Koh 1994; Kokabi 2009; Lau 2004; Lista 2020; Matsushima 2015; Naguimbing-Cuaresma 2007; Onile 2008; Pervaiz 2019; Rajan 2017; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Tahmin 2011; Vallabh-Patel 2020; Weemhoff 2011; Zaouter 2009; Zmora 2010), with one trial comparing three different intervention groups (Irani 1995).

Shorter durations of catheterisation may increase the risk of requiring recatheterisation (RR 1.81, 95% CI 1.35 to 2.41; I^2 = 56%; 44 trials, 5870 participants; low-certainty evidence; Analysis 2.1; Summary of findings 2).

There was evidence of clinical heterogeneity between the trials and so we decided to compare the fixed-effect (RR 1.75, 95% CI 1.51 to 2.04; I^2 = 56%) and random-effects (RR 1.81, 95% CI 1.35 to 2.41; I^2 = 56%) models. We decided to use the random-effects model due to the presence of heterogeneity. The presence of heterogeneity was factored in when we assessed the certainty of evidence.

The symmetry in the funnel plot did not suggest any bias due to missing results or small study effects (Figure 5).

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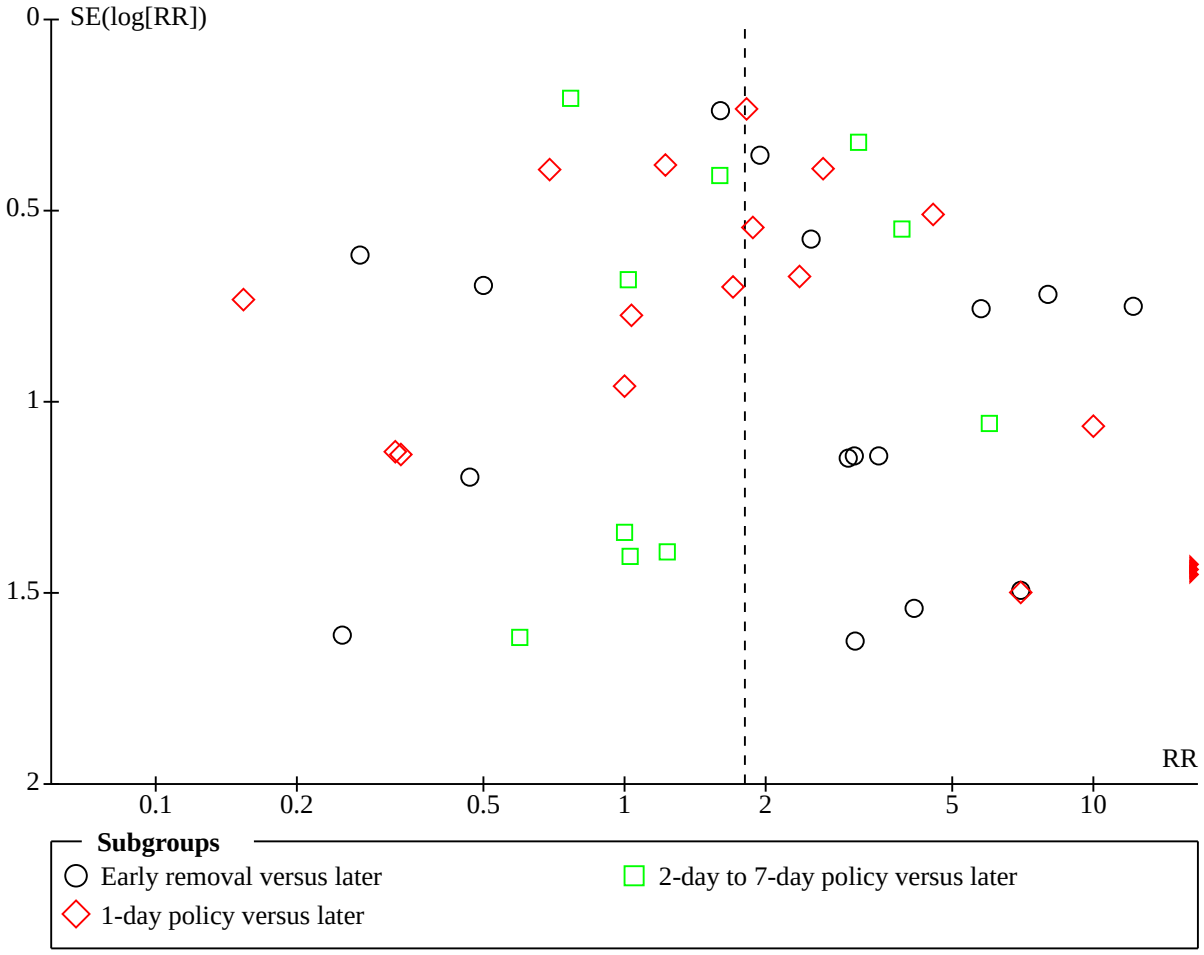
Figure 5. Funnel plot of comparison 2. Shorter versus longer duration of catheter. Outcome: 2.1 number needing to be recatheterised



The sensitivity analysis, in which we removed the one trial that we judged to be high risk of bias in the randomisation and allocation concealment domains (Lau 2004), did not substantially change the effect estimate (RR 1.84, 95% CI 1.37 to 2.46).

The test for subgroup differences based on type of surgery indicated heterogeneity between subgroups (P = 0.03, I^2 = 72.4%). The 95% confidence intervals of the summary effect estimate in the urological surgery subgroup do not substantially overlap with those of the gynaecological or obstetric surgery subgroups, which suggests that the effect of shorter versus longer duration of catheterisation may be different in people undergoing urological surgery in terms of the risk of requiring recatheterisation (Analysis 2.2). For people undergoing urological surgery, it is not certain whether there is a difference between shorter and longer indwelling urethral catheter durations in terms of the risk of requiring recatheterisation (RR 0.91, 95% CI 0.50 to 1.67; 9 trials, 1104 participants).

Subgroup analysis based on sex also suggested that the effect of shorter versus longer duration of catheterisation may be different in men and women (test for subgroup differences: P = 0.009, I^2 = 85%, 95% CIs do not substantially overlap; Analysis 2.3). For men, it is not certain if there is a difference between shorter and longer indwelling urethral catheter durations in terms of the risk of requiring recatheterisation (RR 0.91, 95% CI 0.50 to 1.67; 9 trials, 1104 participants).

Subgroup analysis based on the use of antibiotic prophylaxis did not reveal heterogeneity between the subgroups (test for subgroup differences: P = 0.92, I^2 = 0%, overlapping 95% CIs; Analysis 2.4).

Not all trials could participate in the subgroup analysis by surgery type, either because participants did not undergo surgery or because the type of surgery was too unique to meet the subgroup definitions (Allen 2016; Carpiniello 1988; Chen 2013; Lau 2004; Zmora 2010). The following trials did not mention whether they used antibiotic prophylaxis or not (Aslam 2019; Carter-Brooks 2018; Hakvoort 2004; Hewitt 2001; Kim 2012; Kokabi 2009; Lista 2020; Matsushima 2015; Naguimbing-Cuaresma 2007; Onile 2008; Pervaiz 2019; Rajan 2017; Sahin 2011; Sandberg 2019; Schiotz 1995; Schiotz 1996; Tahmin 2011).

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Secondary outcomes

Complications/adverse events

Incidence of urinary tract infection

- **Symptomatic catheter-associated urinary tract infections (CAUTI):** 41 trials reported CAUTI (Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Barone 2015; Benoist 1999; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Dunn 2003; Durrani 2014; Guzman 1994; Huang 2011; Kamilya 2010; Koh 1994; Kokabi 2009; Lang 2020; Lau 2004; Li 2014; Liang 2009; Lista 2020; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Sun 2004; Vallabh-Patel 2020; Weemhoff 2011; Zaouter 2009; Zmora 2010; Zomorrodi 2018). One trial had two sets of data for CAUTI, as participants underwent either total mesorectum excision or rectal excision (Benoist 1999). Further details regarding each trial's definition of CAUTI can be found in Table 4.
- Shorter durations of catheter probably reduce the risk of developing symptomatic CAUTI compared to later removal (RR 0.52, 95% CI 0.45 to 0.61; I^2 = 31%; 41 trials, 5759 participants; moderate-certainty evidence; Analysis 2.5; Summary of findings 2). The shape of the funnel plot indicates there may be studies missing in areas that would be favourable to the experimental intervention therefore we judged that the asymmetry was not due to non-reporting biases and we did not downgrade the certainty of evidence for suspected publication bias (Figure 6).
- Post-hoc subgroup analysis based on antibiotic prophylaxis did not reveal any heterogeneity between the subgroups (test for subgroup differences: P = 0.26, I^2 = 21%, overlapping 95% CIs; Analysis 2.6).
- The following 16 trials did not report whether they gave antibiotic prophylaxis or not and so we did not include them in the post-hoc subgroup analysis (Aslam 2019; Azarkish 2003; Carter-Brooks 2018; Cornia 2003; Coyle 2015; Kokabi 2009; Li 2014; Lista 2020; Pervaiz 2019; Popiel 2017; Rajan 2017; Sandberg 2019; Schiotz 1995; Schiotz 1996; Sekhavat 2008; Zomorrodi 2018).
- **Asymptomatic bacteriuria:** 18 trials had data related to asymptomatic bacteriuria (Ahmed 2014; Aref 2020; Basbug 2020; Carpiniello 1988; Chai 2011; Chen 2013; El-Mazny 2014; Glavind 2007; Hakvoort 2004; Irani 1995; Joshi 2014; Kamilya 2010; Onile 2008; Sandberg 2019; Shahnaz 2016; Shrestha 2013; Tahmin 2011; Zmora 2010). Irani 1995 compared three different intervention groups. Participants who had indwelling urethral catheterisation for a shorter duration were less likely to develop asymptomatic bacteriuria (RR 0.47, 95% CI 0.38 to 0.58; I^2 = 56%; 18 trials, 2611 participants; Analysis 2.7). One trial reported the total number of participants with asymptomatic bacteriuria (23 participants out of 96) however did not specify the numbers in each group (Schiotz 1996). We attempted to contact the trial authors and await their response.
- Further details regarding asymptomatic bacteriuria definitions from the CDC, ISDA and EAU can be found in Table 5 and Table 6. Heterogeneity amongst how this outcome was reported existed across the trials with some trials choosing to report 'positive urine culture' despite meeting the CDC definition for asymptomatic bacteriuria (Table 7).

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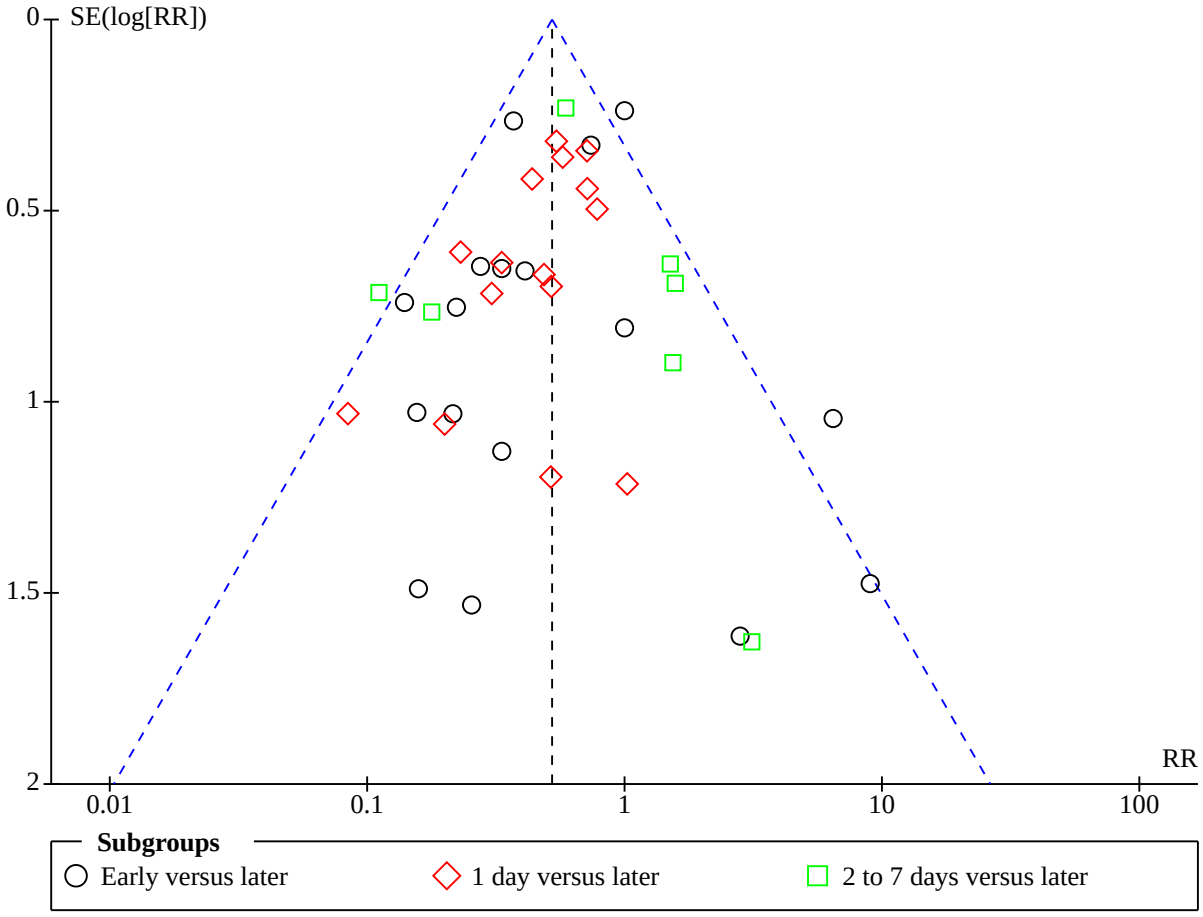
Figure 6. Funnel plot of comparison 2. Shorter versus longer duration of catheter. Outcome: 2.2. symptomatic catheter-associated urinary tract infection (number of participants)



Incidence of urinary retention

Fifteen trials reported data on short-term urinary retention (Barone 2015; Benoist 1999; Coyle 2015; El-Mazny 2014; Han 1997; Kim 2012; Mao 1994; Nielson 1985; Popiel 2017; Rajan 2017; Sekhavat 2008; Taube 1989; Toscano 2001; Valero Puerta 1998; Zhou 2012). One trial had three different intervention groups (Taube 1989), while another trial had participants who had different types of surgery (Benoist 1999). We decided not to pool the results as doing so would involve double counting of Taube 1989 (see Analysis 2.8). We decided to use the random-effects model due to the presence of heterogeneity.

It is uncertain if early catheter removal versus later catheter removal has any effect on incidence of urinary retention (RR 1.07, 95% CI 0.57 to 2.00; I^2 = 70%; 7 trials; 1108 participants; Analysis 2.8.1). Participants who received catheter removal policies involving removal the day after surgery were more likely to develop short-term urinary retention then those whose catheters were removed after longer durations (RR 1.36, 95% CI 1.03 to 1.81; I^2 = 6%; 7 trials; 680 participants; Analysis 2.8.2). It is uncertain if there is any difference in incidence of urinary retention between catheter removal at two days or seven days (RR 1.37, 95% CI 0.88 to 2.12; I^2 = 0%; 6 trials, 881 participants).

Two trials addressed delayed voiding after catheter removal (Schiotz 1996; Sun 2004), with both comparing the removal of indwelling urethral catheters on post-operative day 1 to a longer duration. Schiotz 1996 compared urethral catheter removal on day 1 and day 3, whereas Sun 2004 compared catheter removal on day 1 and day 5 post-operatively. There was no evidence to suggest that shorter or longer durations of catheterisation caused delayed voiding after catheter removal (RR 1.02, 95% CI 0.53 to 1.97; I^2 = 53%; 2 trials, 176 participants; Analysis 2.9). Both trials involved procedures for the treatment of stress urinary incontinence. Sun 2004 used a bladder retraining programme on the third post-operative day, which involved clamping the catheter for 1 hour and 45 minutes. We think that this could likely be the cause of heterogeneity between the two trials.

Two trials reported chronic urinary retention (Benoist 1999; Irani 1995). Irani 1995 reported two sets of results, as participants received either TURP or transurethral incision of prostate (TUIP). From the evidence available, we are unable to ascertain whether earlier or later removal of the indwelling urinary catheter has an effect on the development of chronic urinary retention (RR 0.84, 95% CI 0.29 to 2.44; I^2 = 0%; 2 trials; 339 participants; Analysis 2.10).

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Other complications of catheterisation (or recatheterisation)

It is uncertain whether shorter or longer durations of catheterisation has any effect on the risk of fever (RR 1.17, 95% CI 0.40 to 3.40; I^2 = 0%; 2 trials; 470 participants; Analysis 2.11). Dunn 2003 compared immediate removal of IUC and removal on day 1 post-op in patients undergoing hysterectomy and the other, Yaghmaei 2017, compared IUC removal 6 hours post-op and 12-24 hours post-op in participants undergoing caesarean section. Another trial, which compared immediate removal of IUC and removal on day one post-op in patients undergoing abdominal hysterectomy or laparotomy (Ouladsahebmadarek 2012), reported more fever in the later removal group but the data were not presented in useable form (OR 3.97, 95% CI 1.62 to 9.75).

One trial reported data on epididymitis (Nielson 1985). Of the 20 participants whose catheters were removed 28 days after urethrotomy, two developed epididymitis compared with none of 20 in the three-day removal group (RR 0.20, 95% CI 0.01 to 3.92; Analysis 2.12). There were insufficient data to suggest there was any evidence that early or later removal of urethral catheters affected the incidence of epididymitis.

Patient-reported

Patient pain or discomfort

Eleven trials reported data on pain or discomfort (Carter-Brooks 2018; Chai 2011; Chia 2009; Dunn 2003; Joshi 2014; Naguimbing-Cuaresma 2007; Nielson 1985; Ouladsahebmadarek 2012; Sandberg 2019; Sekhavat 2008; Zaouter 2009). Five trials used a visual analogue scale (VAS) to assess pain (Carter-Brooks 2018; Chai 2011; Chia 2009; Ouladsahebmadarek 2012; Zaouter 2009), whilst the other five trials measured pain as a dichotomous variable (Chia 2009; Joshi 2014; Naguimbing-Cuaresma 2007; Nielson 1985; Sekhavat 2008). Dunn 2003 reported data on pain as a percentage but did not report the number of participants in each group. The authors were contacted for more information.

It is uncertain if early removal has any effect on pain or discomfort measured as a dichotomous outcome (presence/absence of pain or discomfort) (RR 0.52 95% CI 0.21 1.27; I^2 = 82%; 5 trials; 510 participants; Analysis 2.13). Pain scores measured on a 0-10 visual analogue scale (higher score = greater pain) may be reduced with early removal compared with later removal (MD -0.34, 95% CI -0.47 to -0.20; I^2 = 28%; 5 trials; 695 participants; Analysis 2.14). However, the difference may not be clinically meaningful.

Patient satisfaction

One trial reported data on patient satisfaction using a questionnaire and compared IUC removal 6 hours post-op compared to 12-24 hours post-op in females undergoing caesarean section (Yaghmaei 2017). This trial was originally written in Persian and, after being translated, it is unclear when their participants were asked to complete this questionnaire. More women were satisfied or very satisfied in the early removal group than in the later removal group (RR 3.27, 95% CI 2.30 to 4.64; 220 women; Analysis 2.15).

Urinary incontinence

Seven trials addressed this outcome (Ahmed 2014; Barone 2015; Gungor 2014; Han 1997; Kim 2012; Onile 2008; Souto 2004). Fewer participants developed urinary incontinence when their catheter was removed earlier (RR 0.55, 95% CI 0.35 to 0.86; I^2 = 45%; 7 trials, 1195 participants; Analysis 2.16).

Number of patients reporting dysuria

Seven trials reported data on dysuria (Ahmed 2014; Aref 2020; Basbug 2020; El-Mazny 2014; Onile 2008; Ouladsahebmadarek 2012; Yaghmaei 2017). Low-certainty evidence suggests participants may be less likely to report dysuria when their catheters were removed early post-operatively compared to later (RR 0.42, 95% CI 0.20 to 0.88; I^2 = 61%; 7 trials, 1398 participants; Analysis 2.17; Summary of findings 2).

Clinician-reported

Volume of first void (mL)

Three trials reported the volume of the first void (Gungor 2014; Huang 2011; Mao 1994). There was insufficient evidence to suggest that participants who had their catheters removed after a shorter duration of catheterisation tended to have larger volumes of first void (MD 27.02, 95% CI 1.00 to 53.04; I^2 = 31%; 3 trials, 364 participants; Analysis 2.18). Although this result was not statistically significant, the mean volume is not likely to be of any clinical significance.

Time to first void (hours)

Two trials reported time to first void (Carter-Brooks 2018; Yaghmaei 2017). We decided to use the random-effects model due to the presence of heterogeneity. Those participants who had their catheters removed earlier were found to have a shorter time to first void when compared to later removal (MD -5.52, 95% CI -6.08 to -4.95; I^2 = 98%; 2 trials, 277 participants; Analysis 2.19). The heterogeneity may be explained by variations in the type of surgery and level of anaesthesia which are likely to have a substantial impact on an individual's ability to control their bladder.

Post-void residual volume (mL)

Three trials reported data on post-void residual volume (Gungor 2014; Huang 2011; Nguyen 2012). There were insufficient data to suggest post-void residual volume was affected by shorter or longer durations of catheterisation in participants undergoing indwelling urethral catheterisation for two to seven days compared to longer durations (MD 6.37, 95% CI −9.14 to 21.88; I^2 = 0%; 2 trials, 137 participants; Analysis 2.20). No trials included participants having catheters removed early or after a one-day removal policy. Nguyen 2012 reported median and range without SDs and, as a result, could not be incorporated into the meta-analysis (Analysis 2.21).

Length of hospitalisation (days)

Twenty-six trials reported data on length of hospitalisation (Ahmed 2014; Alessandri 2006; Aref 2020; Aslam 2019; Basbug 2020; Carter-Brooks 2018; Durrani 2014; El-Mazny 2014; Hakvoort 2004; Han 1997; Irani 1995; Kamilya 2010; Kim 2012; Koh 1994; Lau 2004; Li 2014; Naguimbing-Cuaresma 2007; Onile 2008; Ouladsahebmadarek 2012; Schiotz 1996; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Sun 2004; Yaghmaei 2017). Six trials did not report SDs (Han 1997; Irani 1995; Koh 1994; Shrestha 2013; Tahmin 2011; Valero Puerta 1998), while six trials reported the median and range values (Allen 2016; Alonzo-Sosa 1997; Lista 2020; Sandberg 2019; Weemhoff 2011; Zaouter 2009; Analysis 2.22; Analysis 2.24). We calculated SDs for two trials by using their reported P values

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and inserting them into a conversion Excel document designed by a statistician (Hakvoort 2004; Schiotz 1996).

Early removal may reduce hospital stay compared with later removal (MD -1.13 days, 95% CI -1.42 to -0.83; I^2 = 98%; 3917 participants; Analysis 2.22). The substantial statistical heterogeneity in this analysis is most likely due to the variation between studies in type of surgery, which in turn has an impact on length of hospital stay. The test for subgroup differences suggests that the type of surgery that the participants underwent could be an effect modifier (P = 0.0006, I^2 = 82.6%; Analysis 2.23).

Time between removal of catheter to discharge (days)

Not reported

Health status/quality of life

Condition-specific or generic quality-of-life measures

Not reported

Psychological outcome measures

Not reported

Comparison 3: flexible versus fixed duration of indwelling urethral catheterisation

We did not find any trials that addressed this comparison.

Comparison 4: clamping versus free drainage before catheter removal

Seven trials involving 714 participants investigated the practices of clamping and release polices versus free drainage of indwelling urethral catheters (Gong 2017; Guzman 1994; Liu 2015; Nyman 2010; Oberst 1981; Williamson 1982; Wilson 2000). All seven trials used different clamping regimes. We used subgrouping to present the analysis according to the following: clamping versus removal (of catheter) at 24 hours; clamping versus removal (of catheter) at 48 hours; and clamping versus removal (of catheter) at 72 hours.

We were unable to include three trials in the meta-analysis (Bristoll 1989; Talreja 2016; Wilson 2000). We do not know the duration of catheterisation in Talreja 2016. We have contacted the author and we are currently awaiting a reply. Two trials reported data that were not relevant to the outcomes measured by this review (Bristoll 1989; Wilson 2000).

Outcomes for this comparison not pre-stated in the Types of outcome measures are reported in Appendix 6.

Primary outcomes

Number of participants who required recatheterisation following removal of indwelling urethral catheter

Five trials addressed this outcome (Gong 2017; Guzman 1994; Liu 2015; Nyman 2010; Oberst 1981). There may be little to no difference between using a clamping regimen and free drainage in terms of the risk of requiring recatheterisation (RR 0.82, 95% CI 0.55 to 1.21; I^2 = 0%; 5 trials, 569 participants; low-certainty evidence; Analysis 3.1; Summary of findings 3).

The test for subgroup differences did not suggest a difference in effect between trials with women only and trials with a mixed population of men and women, or between urological surgery and non-urological surgery (P = 0.64, overlapping confidence intervals; Analysis 3.2). We could not perform subgroup analysis based on antibiotic prophylaxis as only one trial reported it (Guzman 1994).

The sensitivity analysis, in which we removed the one trial that we judged to be high risk of bias in the randomisation and allocation concealment domains (Liu 2015), did not change the effect estimate (RR 0.82, 95% CI 0.55 to 1.21; I^2 = 0%; 5 trials, 490 participants).

Secondary outcomes

Complications/adverse events

Incidence of urinary tract infection

- **Symptomatic catheter associated urinary tract infections (CAUTI):** two trials reported data on symptomatic CAUTI (Gong 2017; Guzman 1994). We are uncertain if there is any difference between clamping regimes and free drainage effects in terms of the risk of symptomatic CAUTI (RR 0.99, 95% CI 0.60 to 1.63; I^2 = 1%; 2 trials, 267 participants; very low-certainty evidence; Analysis 3.3; Summary of findings 3).
- **Asymptomatic bacteriuria:** not reported

Incidence of urinary retention

Two trials reported data on urinary retention (Guzman 1994; Wu 2015). There was insufficient evidence to suggest that the use of clamping regimes versus free drainage affects the incidence of urinary retention in participants (RR 1.18, 95% CI 0.69 to 2.02; I^2 = 0%; 2 trials, 169 participants; Analysis 3.4).

Other complications of catheterisation (or recatheterisation)

Not reported

Patient-reported

Patient pain or discomfort

Not reported

Patient satisfaction

Not reported

Urinary incontinence

Not reported

Number of patients reporting dysuria

One trial reported data on dysuria (Liu 2015). It is uncertain if there is any difference between clamping regimes and free drainage in terms of the risk of dysuria for (RR 0.84, 95% CI 0.46 to 1.54; 1 trial, 79 participants; very low-certainty evidence; Analysis 3.5; Summary of findings 3).

Clinician-reported

Volume of first void (mL)

One trial reported data on the volume of first void (Liu 2015). For participants who had their catheters removed at 72 hours, participants with free drainage catheters tended to have larger volumes of first void when compared to those with clamped catheters (MD 39.60, 95% CI 2.23 to 76.97; 1 trial, 79 participants; Analysis 3.6). Although this result was statistically

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significant in this trial, the increase in mean volume is unlikely to be of any clinical significance.

Time to first void (minutes)

Two trials addressed this outcome (Oberst 1981; Williamson 1982). One trial did not report SDs (Williamson 1982). As a result, we could not perform meta-analysis. One trial found that, on average, there was a shorter duration of time to first void in participants receiving the clamping regime when compared to those with free drainage (MD −118, 95% CI −190.54 to −45.46; Analysis 3.7).

Post-void residual volume (mL)

Not reported

Length of hospitalisation (days)

Two trials reported data on the length of hospitalisation (Guzman 1994; Nyman 2010). One trial presented their data with medians and no SDs (Guzman 1994; Analysis 3.8). This left one trial (Nyman 2010), so we could not perform meta-analysis. There was insufficient evidence to suggest that the use of clamping regimes over free drainage affected the length of hospital stay of participants (Analysis 3.9).

Time between removal of catheter to discharge (days)

Not reported

Health status/quality of life

Condition-specific or generic quality-of-life measures

Not reported

Psychological outcome measures

Not reported

Comparison 5: Removal using prophylactic alpha blocker drugs versus other methods

Three trials investigated the effects of the use of prophylactic alpha blockers in participants undergoing indwelling urethral catheterisation (Jang 2012; Jeong 2014; Jun 2011). All trials differed in the dosage of alpha blocker and the time when alpha blockers were given to participants. Tamsulosin was the alpha blocker of choice across the three trials, with two trials opting to use 0.2 mg (Jang 2012; Jun 2011), and one trial using 0.4 mg (Jeong 2014).

Primary outcomes

Number of participants who required recatheterisation following removal of indwelling urethral catheter

Two trials reported this outcome (Jang 2012; Jun 2011). We are uncertain if prophylactic alpha blockers have any effect on the risk of requiring recatheterisation (RR 1.18, 95% CI 0.58 to 2.42; I^2 = 0%; 2 trials, 184 participants; very low-certainty evidence; Analysis 4.1; Summary of findings 4). We did not perform subgroup analysis due to only two trials reporting this outcome.

Secondary outcomes

Complications/adverse events

Incidence of urinary tract infection

- **Symptomatic catheter associated urinary tract infections (CAUTI):** one trial addressed the incidence of symptomatic CAUTI (Jang 2012). We are uncertain if prophylactic alpha blockers have any effect on the risk of symptomatic CAUTI (0/47 versus 2/47; RR 0.20, 95% CI 0.01 to 4.06; 1 trial, 94 participants; very low-certainty evidence; Analysis 4.2; Summary of findings 4).
- **Asymptomatic bacteriuria:** not reported

Incidence of urinary retention

Two trials reported data on acute urinary retention (Jeong 2014; Jun 2011). Fewer participants developed acute urinary retention in the prophylactic alpha blocker group than in the control group (RR 0.38, 95% CI 0.20 to 0.73; I^2 = 0% ; 2 trials, 308 participants; Analysis 4.3).

Other complications of catheterisation (or recatheterisation)

Not reported

Patient-reported

Patient pain or discomfort

Not reported

Patient satisfaction

Not reported

Incidence of urinary incontinence

Not reported

Number of patients reporting dysuria

Not reported

Clinician-reported

Volume of first void (mL)

Not reported

Time to first void (hours)

Not reported

Post-void residual volume (mL)

Two trials addressed this outcome (Jang 2012; Jeong 2014). There was insufficient evidence to suggest that the use of prophylactic alpha blockers affected post-void residual volumes in participants receiving indwelling urethral catheterisation (MD −2.00, 95% CI −11.42 to 7.42; I^2 = 55%; 2 trials, 301 participants; Analysis 4.4). It should be noted that one trial measured post-void residual volume on post-operative day seven (Jang 2012), whereas the other trial measured post-void residual volume two weeks post-operatively (Jeong 2014).

Length of hospitalisation (days)

Two trials addressed this outcome (Jang 2012; Jun 2011). One trial reported data in a format that we could not use for statistical analysis (Jang 2012; Analysis 4.6). Participants who received prophylactic alpha blockers tended to have shorter stays in hospital when compared to those participants who did not (MD −1.22, 95% CI −1.54 to −0.90; Analysis 4.5).

Time between removal of catheter to discharge (days)

Not reported

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Health status/quality of life

Condition-specific or generic quality-of-life measures

Not reported

Psychological outcome measures

Not reported

DISCUSSION

Summary of main results

This review includes 99 eligible trials that addressed 14 outcome measures (see Appendix 5 and Appendix 6 for a list of additional outcomes reported by trials).

Removal of indwelling urethral catheters at one specified time of day (6 am to 7 am) versus another specified time of day (10 pm to midnight)

Based on summary data from 13 trials, removal of indwelling urethral catheters late at night may slightly reduce the risk of requiring recatheterisation compared with early morning removal (low-certainty evidence; Summary of findings 1). It is uncertain if there is any difference between late night or early morning removal of indwelling urethral catheters in terms of the number of people developing symptomatic CAUTI (very low-certainty evidence; Summary of findings 1) or dysuria (low certainty-evidence; Summary of findings 1). None of the trials that compared late night to early morning removal of indwelling urethral catheters reported data relating to quality of life.

Shorter versus longer durations of indwelling urethral catheterisation

Based on summary data from 68 trials, shorter durations of catheterisation may increase the risk of requiring recatheterisation compared with longer durations (low-certainty evidence; Summary of findings 2). However, shorter durations of catheterisation probably reduce the risk of symptomatic CAUTI (moderate-certainty evidence; Summary of findings 2) and may reduce the risk of dysuria (low-certainty evidence; Summary of findings 2).

Subgroup analysis suggested that the effect of shorter versus longer indwelling urethral catheterisation duration may be more uncertain in men undergoing urological surgery compared with women or with people undergoing other types of surgery.

None of the trials comparing shorter to longer indwelling urethral catheterisation duration reported data relating to quality of life.

Clamping regimes compared to free drainage

Summary data from seven trials revealed there may be little to no difference between clamping regimes and free drainage in terms of the number of participants who required recatheterisation (low-certainty evidence; Summary of findings 3). Two trials reported data on the number of participants with symptomatic CAUTI. We are very uncertain whether the use of clamping regimes compared with free drainage has any effect on the risk of symptomatic CAUTI or dysuria (both very low-certainty evidence; Summary of findings 3). Condition-specific or generic quality of life measures were not reported for this comparison.

Use of prophylactic alpha blocker therapy versus no drug or intervention before catheter removal

Based on summary data from three trials, we are uncertain if the use of prophylactic alpha blockers has any effect on the risk of requiring recatheterisation, risk of symptomatic CAUTI (both very low-certainty evidence) or risk of dysuria (Summary of findings 4). Trials did not report dysuria and condition-specific or generic quality of life measures for this comparison.

Overall completeness and applicability of evidence

The comprehensive search strategy, along with the increased efforts made to obtain unpublished data, means that we can be confident that the evidence presented in this review is as complete as possible. We did not conduct a search for the protocols for each trial due to time constraints. We found that the population in each of the included trials tended to vary considerably due to participants being catheterised for a variety of different indications. The majority of participants included in this systematic review had some form of surgical procedure. Additionally, the type of surgery that participants underwent varied significantly across the trials, with the most common being gynaecological surgery. It is likely that this heterogeneity between the trial populations had an impact during the analysis of the trials.

Despite the large number of trials identified, uncertainties still remain regarding the effects different indwelling urethral catheter removal strategies. Two of our most important participant-centred outcomes (recatheterisation and CAUTI) were generally well reported but dysuria was less commonly reported and no trials at all reported any quality-of-life data.

Ten trials included in this review did not provide data that could contribute to meta-analysis. We contacted their authors for further information and we await their reply. It should be noted that we identified very few trials that involved non-surgical populations.

Diagnostic criteria for symptomatic UTI and recatheterisation

For this review, we chose to use the definition of symptomatic UTI outlined by the CDC. The reasoning for using this definition was that various international guideline committees such as the AUA and EAU also use this definition (Gould 2009; Trautner 2010). The IDSA has also outlined definitions for symptomatic UTI in their guidelines. However, these recommendations are tailored for other types of catheterisation, such as suprapubic or intermittent catheterisation and, as a result, we did not use it (Hooton 2010). The current definitions for symptomatic UTI and asymptomatic bacteriuria outlined by various guideline committees can be found in Table 5 and Table 6.

The definition for symptomatic UTI used in each trial was down to the trial authors' preference, as no international agreement exists as to which definition should be used in trials assessing symptomatic UTI. However, this is an important outcome and future trials should use standardised definitions of CAUTI (see Table 5). Only seven trials in this review stated that symptomatic CAUTI was defined using the CDC guidelines (Ahmed 2014; Aref 2020; Chai 2011; Chen 2013; Gong 2017; Joshi 2014; Kamilya 2010). Six trials reported UTI that met the definition for symptomatic UTI by the CDC (Alonzo-Sosa 1997; Gross 2007; Liang 2009; Vallabh-Patel 2020; Zaouter 2009; Zmora 2010). Similar issues have been encountered by the EAU guideline committee, who have found assessing the

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urinary catheter literature problematic due to this lack of definition by trials (EAU 2020).

As the primary outcome of this review was the number of participants requiring recatheterisation, it was noted that very few trials provided a definition for recatheterisation or information regarding the circumstances that led participants to be recatheterised. Given that the insertion of catheters is associated with its own complications and risks (urethral trauma, urethral stricture formation, increased patient pain or discomfort, and bladder perforation (Hollingsworth 2013; Igawa 2008; Fisher 2017)), it may be useful for future trials to report whether any of these complications occurred in participants who were recatheterised. Future trials should aim to improve the reporting of complications of catheterisation (or recatheterisation) as this will help improve future recommendations for recatheterisation as an intervention.

Other strategies to prevent CAUTI

Emerging literature has shown that other strategies can be devised in an attempt to reduce both the placement and the duration of urethral catheters.

Meddings 2014 has explored the use of various other strategies to help reduce unnecessary indwelling urethral catheter use. One of these methods includes stop-orders, which prompt healthcare workers to remove an indwelling urethral catheter after a certain time has elapsed or a specific condition has occurred. Stop-order protocols tended to be similar in that they would all generally include a list of appropriate circumstances for which patients should be catheterised, as well as state a default time period before the catheter had to be removed. Meddings 2014 argued that the use of protocols designed to reduce inappropriate catheter placement or prompting their removal can result in reduced catheter usage and rates of CAUTI. By reminding clinicians and nurses of the catheter's existence, stop-orders and other strategies could potentially help reduce the number of patients developing problems associated with prolonged or unnecessary urinary catheterisation. Although the use of stop-orders does not meet the inclusion criteria for this review, it should be noted that other methods are available to help not only reduce the duration of catheterisation but also potentially reduce the need for them in the first place.

Quality of the evidence

Despite a large number of trials in this review, we found the certainty of evidence for most outcomes to be low or very low. This was primarily due to many of the included trials suffering from methodological flaws as well as insufficient reporting. This subsequently affected the risk of bias domains of trials, resulting in them being assigned to unclear risk of bias and consequently downgrading the certainty of evidence. We judged the risk of selection bias through randomisation and allocation concealment to be unclear due to inadequate reporting. We generally deemed the risk of performance and detection bias to be high for most trials as it became clear that it was not possible in many instances for the outcome assessor or healthcare professionals to be adequately blinded due to the nature of the intervention. As a result, we downgraded the certainty of evidence due to serious concerns about risk of bias.

In addition to downgrading for risk of bias, we also downgraded the certainty of evidence for some outcomes for imprecision due to the low numbers of participants in the included trials. Higher numbers of participants give the trials more power and consequently, the effect estimate is more precise and more likely to be closer to the true effect of the intervention.

Potential biases in the review process

We searched all relevant databases during our search process without imposing any language restrictions. This allowed our search to identify as many relevant trials as possible. The search also included ongoing trials, which are registered in trial registries. However, even with this rigorous search strategy, it is possible that we did not identify all eligible trials. Although challenging for older trials, we contacted trial authors when more data were required, with no replies received to our emails. We did not conduct a search for the protocols for each trial due to time constraints.

To reduce the risk of bias in the review process, two or more review authors independently undertook study selection, data extraction, risk of bias assessment and GRADE assessments. Another potential source of bias may have occurred during the process of determining the certainty of evidence when we chose the critical GRADE outcomes. We attempted to reduce the risk of bias in the selection of outcomes for inclusion in the GRADE evidence profile. We took into account patients' views obtained through focus groups, as well as advice from clinical experts.

Agreements and disagreements with other studies or reviews

We found the following reviews or guidelines, or both, to be related to this systematic review. We noted that the GRADE certainty of evidence framework was not performed by any other review. Some overlap was found to exist between this update and another Cochrane Review (Phipps 2006). Their review evaluated the use of urinary catheters after urogenital surgery and looked at various outcomes to establish the optimal use of urinary catheters post-surgery.

Comparison 1: removal of indwelling urethral catheter at one time of day (6 am to 7 am) versus another time of day (10 pm to midnight)

Number of participants requiring recatheterisation

- One systematic review conducted by Fernandez 2003a found that the removal of indwelling urethral catheters late at night had no effect on recatheterisation rates in participants undergoing TURP or urological surgery. These findings are similar to the findings in this review.
- An earlier Cochrane Review looked at short-term indwelling urethral catheterisation policies and found that removing the indwelling urethral catheter late at night resulted in fewer participants requiring recatheterisation (Phipps 2006).
- The CDC acknowledged that further research is required into the removal of indwelling urethral catheters at different times of the day in their guidelines on symptomatic CAUTI (Gould 2009).

Comparison 2: shorter versus longer duration of indwelling urethral catheterisation

Number of participants requiring recatheterisation

- Zhang 2015 found similar results in their meta-analysis when comparing early versus delayed catheter removal in women

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following uncomplicated hysterectomy. Removal of the catheter early resulted in a significant increase in recatheterisation in participants (RR 3.32, 95% CI 1.48 to 7.46).

- Phipps 2006 also looked at shorter post-operative catheter durations compared to longer durations. However, their review only involved 12 trials, whereas this systematic review involved 98. Phipps and colleagues reported that there was insufficient evidence to conclude whether shorter durations of catheterisation affected recatheterisation rates in participants. Phipps 2006 did not perform an analysis of the quality of this evidence.
- The CDC guidelines acknowledge that there is an increased risk of recatheterisation in shorter durations of catheterisation compared to longer durations (Gould 2009).

Number of participants with symptomatic CAUTI

- Zhang 2015 found that early removal of the indwelling urethral catheters resulted in a significant reduction in symptomatic UTI (RR 0.23, 95% CI 0.10 to 0.52). Although this result is similar to this review, we found a larger effect due to more trials being included in our meta-analysis. A reduction in asymptomatic bacteriuria was also found by Zhang 2015 in the early removal group, which we also saw in our review (RR 0.60, 95% CI 0.40 to 0.88).
- Phipps 2006 also reported a reduction in UTI when catheters were removed after a shorter duration versus longer duration (RR 0.50, 95% CI 0.29 to 0.87), which agrees with the findings of this review.
- Our findings relating to shorter compared with longer indwelling urethral catheterisation duration and the risk of CAUTI are consistent with existing literature on catheter duration and the risk of developing symptomatic CAUTI (CDC 2016; EAU 2020; Gould 2009; Grabe 2015; Hooton 2010; NICE 2012; Tenke 2008; Tiguert 2004).

Comparison 3: clamping regimes compared to free drainage

Number of participants requiring recatheterisation

- The CDC guidelines report that there is no benefit from clamping short-term indwelling urethral catheters before removal (CDC 2016; Gould 2009). This was classified as a weak recommendation based on evidence reported by two Cochrane Reviews, one of which is the previous version of this review (Fernandez 2003b), the other being Phipps 2006.
- A systematic review conducted by Fernandez 2005 found that there was no statistically significant difference in the number of patients requiring recatheterisation between both the clamped and unclamped groups. The results of this trial are similar to the findings in this review.
- A systematic review and meta-analysis conducted by Wang 2016 found that there were no significant differences between clamping and unclamping groups in reference to risk of recatheterisation, urinary retention, rate of UTI or subjective symptoms related to voiding.

Number of participants with symptomatic CAUTI

- The CDC guidelines have outlined that clamping policies should not be used in short-term catheterisation as it has been shown that clamping policies do not provide any benefit with regards to bacteriuria (CDC 2016; Gould 2009).
- The EAU has made a slightly different recommendation, however. Upon their evaluation of the evidence, they concluded that the literature was of poor methodological quality and, as a result, no clinical recommendations could be made as to whether or not there is any benefit from the use of clamping policies. It concludes by stating that further research is required to fully determine the value of clamping regimes in short-term catheterisation (EAUN 2012; Grabe 2015).
- Fernandez 2005 found no statistically significant difference between the clamped and free drainage groups with regards to the number of patients developing UTIs at 72 hours (RR 0.55, 95% CI 0.15 to 2.01).

Comparison 4: use of prophylactic alpha blocker therapy versus no drug or intervention before catheter removal

Number of participants requiring recatheterisation

- Another Cochrane Review has evaluated the use of alpha blockers in short-term indwelling urethral catheters in men with AUR (Fisher 2014). However, their prophylactic use has not been studied in a Cochrane Review.
- A RCT conducted by Patel 2018 looked at the use of alpha blockers in participants undergoing colorectal surgery below the peritoneal reflection. Their trial compared indwelling urethral catheter removal on day 1 post-operatively in combination with an alpha blocker versus standard removal of the catheter at 3 days post-operatively with no alpha blocker. There was no significant difference in the number of participants requiring recatheterisation between both groups. There was significant reduction in symptomatic CAUTI and length of stay in the early catheter removal group. Their trial was excluded from this systematic review as the trial compared both shorter versus longer durations of catheterisation (comparison 2) and the use of alpha blockers in their participants (comparison 5).
- A systematic review and meta-analysis performed by Ghuman 2018 assessed the use of prophylactic alpha blockers on the prevention of post-operative urinary retention. Their systematic review did not define duration of catheterisation (short or long-term indwelling urethral catheterisation) and also included intermittent catheterisation. The administration of prophylactic alpha blockers varied across their trials from one week before surgery to four to six hours post-operation. Two of the trials in their review were also included in our meta-analysis. The use of prophylactic alpha-1 adrenergic blockers resulted in a significant reduction in the risk of post-operative urinary retention (RR 0.48, 95% CI 0.33 to 0.70; P = 0.001; I^2 = 65.49%); however, their results showed substantial heterogeneity. Further subgroup analysis revealed a strong risk reduction in men (RR 0.33, 95% CI 0.23 to 0.47; P < 0.001, I^2 = 10.58%) and participants receiving spinal anaesthesia (RR 0.26, 95% CI 0.14 to 0.46; P < 0.0001, I^2 = 0%).

Number of participants with symptomatic CAUTI

- Ghuman 2018 found no evidence to suggest the use of alpha blockers had any effect on the number of participants with symptomatic CAUTI (RR 0.64, 95% CI 0.30 to 1.37; P = 0.25).

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AUTHORS' CONCLUSIONS

Implications for practice

The available evidence suggests that the removal of short-term indwelling urethral catheters late at night, in comparison to early in the morning, may reduce the risk of requiring recatheterisation and the risk of dysuria. The same evidence was uncertain about the effect on the risk of symptomatic catheter-associated urinary tract infections (CAUTI).

In addition, using a catheter for a shorter length of time may increase the risk of requiring recatheterisation compared with longer durations, but probably reduces the risk of symptomatic CAUTI. It may reduce the risk of dysuria.

Current evidence remains uncertain about the effect of clamping compared to free drainage or the use of prophylactic alpha blockers. We did not identify any trials comparing flexible duration versus fixed duration of catheter use and so we could not draw any conclusions.

Due to the low certainty of the majority of the evidence presented here, the results of further research are likely to change our findings and to have a further impact on clinical practice.

More research is needed to study the effects of short-term indwelling urethral catheterisation removal on non-surgical patients.

Implications for research

This review highlights the need for adequately powered, well-designed and well-reported trials, which should measure the following important outcomes: the number of participants requiring recatheterisation; the number of participants developing symptomatic CAUTI; dysuria; and quality of life.

Future trials should ensure that the CONSORT statement is followed and that clinically relevant outcomes are measured. The development of a clearly defined core outcome set, such as those facilitated by the Core Outcome Measures in Effectiveness Trials initiative (COMET), for research relating to short-term catheterisation would assist trialists in identifying and investigating clinically important questions. This would allow systematic reviewers more scope for the meaningful synthesis of the evidence and, in turn, lead to more robust clinical recommendations made by guideline panels and decision makers.

In addition, patients consider clinically important outcomes important for decision-making. By measuring these outcomes, improved recommendations can be made on the basis of higher quality evidence, which could improve the overall care of patients.

Future trials should aim to report the size of the catheter used as well as the use of antibiotic prophylaxis. This review highlighted how poorly both these outcomes were reported across the included trials and will allow future subgroup analysis to be more informed.

With regard to how data should be collected and measured, the complications associated with recatheterisation should be reported in more detail. When measuring outcomes such as symptomatic urinary tract infection and asymptomatic bacteriuria, future trials should adopt a standard definition, which has been outlined by a well-recognised international guideline panel (Table 5; Table 6; Table 7). The reporting of the critical GRADE outcomes was particularly lacking across the RCTs. This resulted in a lack of evidence for dysuria and quality of life. Trials should use a standardised form that assesses the domain of dysuria in patients with short-term catheters and report this in a systematic format. Quality of life should be measured by using a validated health questionnaire that is universally recognised (for example, SF-36). All continuous data should also be measured and reported as means and standard deviations so the statistical significance of the results can be established.

Future trials should also aim to have adequate allocation concealment and blinding methods, as well as improve on their reporting of random sequence generation. More trials that investigate each of the comparisons discussed in this review are also needed as, more often than not, the cause for insufficient evidence was a lack of trials. The most common surgical procedures in this review were transurethral resection of prostate and vaginal hysterectomy. Future research should aim to include trial populations who have not undergone a surgical procedure or involve types of surgeries that are not already seen in this review. This will allow a better understanding of the effects of short-term catheter removal in both surgical and non-surgical patients. Future considerations should also involve mixed populations to help ascertain whether the strategies discussed benefit both sexes equally, or whether it favours one sex over another.

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* Indicates the major publication for the study

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CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Ahmed 2014

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** April 2010-December 2012
Participants	**Number of participants:** 233 eligible; 221 randomised; 221 reported **Setting:** Ismailia **Country:** Egypt **Population:** women **Age (mean (SD)):** A 59.1 (8.3); B 58.3 (6.9); C 61.3 (10.5) **Inclusion criteria:** women undergoing total abdominal hysterectomy with or without bilateral salpingo-oophorectomy for various benign gynaecological diseases (uterine fibroids, abnormal uterine bleeding) **Condition for hospitalisation:** hysterectomy **Exclusion criteria:** known history of neurological disorders, women who had UTI pre-operatively confirmed by urine analysis ± culture and sensitivity, women for whom a complicated procedure was encountered during hysterectomy so that an IUC had to be kept post-operatively on surgeon's decision, women had spinal anaesthesia by choice or when general anaesthesia was contraindicated, women who had urge incontinence, women who refused to participate in study **Use of antibiotic prophylaxis:** on the morning of surgery, all participants received a single dose of prophylactic antibiotic in the form of ceftriaxone 1 g IM
Interventions	**A (n = 73):** IUC removed immediately after surgery **B (n = 81):** IUC removed 6 h post-operatively **C (n = 67):** IUC removed 24 h post-operatively **Size and type (e.g. silver-coated/PTFE) of catheter used:** 12F Foley catheter, latex **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: immediately after surgery; B: 6 h post-operatively; C: 24 h post-operatively
Outcomes	Urine retention and re-catheterisation (%) Symptomatic UTI (%) Post-operative urine culture First ambulation Hospital stay Urinary symptoms 1 week post-operatively Fever Dysuria

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Ahmed 2014 *(Continued)*

	Frequency Urgency Loin pain Positive urine culture 1 week post-operatively
Definition of CAUTI or bacteriuria	The diagnosis of symptomatic UTI was based on the following criteria: significant bacteriuria with at least one of the following symptoms; dysuria, frequency of micturition, urgency, suprapubic pain or burning sensation at micturition
Sponsorship/funding	Not reported
Ethical approval	The study was carried out in accordance to the ethical principles for medical research involving human subjects included in Helsinki declaration and was approved by the Suez Canal University (SCU) Ethical Committee.
Notes	All participants had continuous bladder drainage during the surgery The time to ambulation was defined as the period between the end of surgery and the time when the patient first walked supported by a nurse or relative. The length of hospital stay was defined as the time between the end of surgery and hospital discharge Patients were recatheterised with a disposable female catheter if they were not able to empty their bladders 6 h after catheter removal. If unable to empty bladder 12 h after catheter removal, an indwelling catheter was inserted

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The remaining 221 women were divided into three groups by simple randomization using computer-generated random numbers" Comment: adequate method of randomisation used
Allocation concealment (selection bias)	Unclear risk	Not reported Comment: probably not done
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Comment: unlikely blinding was possible due to the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported Comment: no information given. Outcomes such as urinary symptoms could be affected by detection bias
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: likely urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	High risk	Quote: "Twelve patients were finally excluded from the study; five patients had intra-operative complications (iatrogenic bladder injury)… while seven did not complete the postoperative follow-up…"

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Ahmed 2014 *(Continued)*

		Comment: patients should have been analysed according to ITT analysis of patients lost to follow-up.
Selective reporting (reporting bias)	Low risk	All pre-specified outcomes have been accounted for in both the methods and results
Other bias	Low risk	Appears to be free from other sources of bias

Alessandri 2006

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** September 2003-March 2004
Participants	**Number of participants:** 96 eligible; 96 randomised; 94 reported **Setting:** Genova **Country:** Italy **Population:** women **Age (mean (SD), N):** A 51 (4.3), 32; B 49 (3.7), 30; C 47 (5.0), 32 **Inclusion criteria:** women having hysterectomy for benign diseases (fibroids, abnormal uterine bleeding, and persistent cervical dysplasia) **Condition for hospitalisation:** vaginal hysterectomy **Exclusion criteria:** anticipated complicated surgical procedure (e.g. uterine prolapse, bladder suspension or colporrhaphy, diagnosis suspicious for malignant disease or severe endometriosis); recurrent UTIs (significant bacteriuria, determined by urine culture and defined as at least 10^5 cfu/mL of urine) and/or urinary incontinence; neurological disorders **Use of antibiotic prophylaxis:** women received a single dose of antibiotic prophylaxis before operation
Interventions	**A (n = 32):** immediate removal of IUC in the operating room **B (n = 30):** removal of IUC at 6 h after the operation **C (n = 32):** removal of IUC at 12 h after the operation **Size and type (e.g. silver-coated/PTFE) of catheter used:** 16F latex catheters with a 10 mL balloon **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group (h):** A: Duration of surgical procedure B: Duration of surgical procedure + 6 h C: Duration of surgical procedure + 12 h
Outcomes	Number of women requiring re-catheterisation after operation Number of women with symptomatic UTIs

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Alessandri 2006 *(Continued)*

	Time to first ambulation Length of hospital stay
Definition of CAUTI or bacteriuria	Significant bacteriuria, determined by urine culture and defined as at least 10^5 cfu/mL of urine
Sponsorship/funding	Not reported
Ethical approval	Informed consent obtained. Protocol approved by hospital's ethics committee
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed by using a computer-generated randomization list drawn up by a statistician and concealed by keeping it with the nurse." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "Before entering the operating room, the surgeon received from the theatre nurse a sealed opaque envelope that contained the randomization assignment. In all cases, the envelope was opened at the end of the surgical procedure." Comment: adequate method of concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Not possible - Although our findings are strengthened by the fact the surgeon was made aware of the randomization only at the end of the operation, a limitation of our study may consists in the fact that the observers of outcome were not blinded to the randomization" Comment: blinding of participants was not possible due to the intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "the observers of outcome were not blinded to the randomization" Comment: blinding of outcome assessment not possible
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: likely samples were sent to a laboratory and thus unlikely that microbiologist knew which patient was in the study
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Two patients in group B were excluded from the study because of the necessity of an unanticipated complicated surgical procedure (bladder suspension during VH)" Comment: low attrition and not differential
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods and reported in full in the results section. However, protocol was not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

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Allen 2016

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2012-August 2014
Participants	**Number of participants:** 374 eligible; 374 randomised (217 (58%) men and 157 (42%) women), 247 reported **Setting:** Minnesota **Country:** USA **Population:** mixed **Age (median and range)**: median age 61.5 (21-87); A 61.1 (31–85); B 61.7 (21–87) **Inclusion criteria:** patients undergoing a general thoracic surgical procedure, in whom an epidural catheter was placed for analgesia **Condition for hospitalisation:** general thoracic surgical procedure, in whom an epidural catheter was placed for analgesia **Exclusion criteria:** patients aged < 18 years, those who died in the hospital within 30 days of the operation, length of stay was < 48 h, epidural catheter was removed before post-operative day 2, with suprapubic catheter or no bladder, required a urologist or a urologic technician to insert the IUC at the time of the operation, intermittently catheterised pre-operatively, known UTI pre-operatively, and who required the IUC to be kept in place because of the need for close monitoring of urinary output **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 121)**: IUC removed within 48 h post-op **Group B (n = 126)**: IUC removed within 6 h after epidural removal **Size and type and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removal within 48 h post-op Group B: IUC removal 6 h after epidural removed
Outcomes	Number of participants requiring recatheterisation Incidence of UTI Length of hospitalisation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	
Risk of bias	

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Allen 2016 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "A computerized random number generator and double-blinded envelope system were used to randomize patients 1:1 to removal of the urinary catheter within 48 hours of leaving the operating room or to removal 6 ± 4 hours after the epidural catheter was removed." Comment: computer randomisation used
Allocation concealment (selection bias)	Low risk	Quote: "A computerized random number generator and double-blinded envelope system were used to randomize patients 1:1 to removal of the urinary catheter within 48 hours of leaving the operating room or to removal 6 ± 4 hours after the epidural catheter was removed." Comment: double-blinded envelope system used
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely this is possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: likely samples were sent to a laboratory and thus unlikely that microbiologist knew which patient was in the study
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No ITT analysis, explanations given for data deemed ineligible for analysis but numbers not reported per randomised group
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Alonzo-Sosa 1997

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** March-November 1994
Participants	**Number of participants:** eligible, not reported; 50 randomised; 50 reported **Country:** Mexico **Population:** women **Age (mean (range)):** A 53.5 (37-63); B 47.1 (37-67) **Inclusion criteria:** women booked for elective corrective surgery of the pelvic floor (anterior colporrhaphy, anterior and posterior colporrhaphy with or without vaginal hysterectomy)

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Alonzo-Sosa 1997 *(Continued)*

	Condition for hospitalisation: pelvic floor surgery with or without vaginal hysterectomy **Exclusion criteria:** patients with UTI were not included **Use of antibiotic prophylaxis:** "Antibiotic prophylaxis was not given"
Interventions	**Group A (n = 25)**: IUC for 1 day post-op **Group B (n = 25)**: IUC for 3 days post-op **Size of catheter used:** 16F catheter **Type of indwelling catheter**: not reported **Study definition of short-term catheterisation (days)**: not reported **Intended duration of catheterisation for each group (h):** Group A: 1 day Group B: 3 days
Outcomes	AUR/number needing re-catheterisation (%) UTI (%) Duration of catheterisation Length of hospital stay
Definition of CAUTI or bacteriuria	A positive urine sample was defined as the presence of > 100,000 cfu/mL if taken mid-stream and 10,000 cfu/mL in a sample taken by catheterisation. UTI was defined as positive sample associated with dysuria, polyuria, incomplete emptying, pain, fever or sepsis. Asymptompatic bacteriuria was defined as a positive sample in the absence of symptoms.
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	"After removing the catheter, the volume of residual urine was measured and if greater than 50mL was considered urinary retention and another foley catheter was inserted, with patients removed from the study and brought to restoration of normal bladder function"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomised controlled blinded clinical trial ..." Comment: unclear as to how randomisation was performed
Allocation concealment (selection bias)	Unclear risk	Not reported Comment: unclear as to whether allocation concealment was performed
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Randomised controlled blinded clinical trial ..." Comment: unclear as to who was blinded and how blinding was performed. Unlikely blinding was possible due to the type of intervention

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Alonzo-Sosa 1997 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: assume microbiologist would be blinded as samples would be sent to a laboratory where the microbiologist would not know which patient belonged to the trial.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No evidence of incomplete outcome data bias
Selective reporting (reporting bias)	Low risk	No evidence of selective reporting bias
Other bias	Low risk	No evidence of other bias identified

Aref 2020

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** September 2016–April 2018
Participants	**Population:** women **Setting:** Taif, Saudi Arabia **Inclusion criteria:** pregnant women with term singleton pregnancy prepared for term elective CS either primary or repeated **Condition for hospitalisation:** elective CS **Exclusion criteria:** women who had UTIs pre-operatively, confirmed by urine analysis ± culture and sensitivity, women with iatrogenic bladder injury so that IUC had to be kept post-operatively on the surgeon's decision, women with severe pre-eclampsia or eclampsia and/or any other conditions requiring post-operative monitoring of urinary output, and women who had spinal anaesthesia by choice or contraindicated for general anaesthesia **Number of participants:** 238 eligible; 221 randomised; 221 reported **Age (mean and SD):** A 26.1 ± 4, B 25.3 ± 2, C 25.6 ± 3 **Use of antibiotic prophylaxis:** all participants received a single dose of prophylactic antibiotic in the form of ceftriaxone 1 g IM
Interventions	**Group A (n = 73)**: IUC removal immediately after surgery **Group B (n= 81)**: IUC removal 6 h post-op **Group C (n = 67)**: IUC removal 24 h after operation **Size and type of catheter used:** size 12 silicone, 2-way Foley's catheter **Study definition of short-term catheterisation (days):** up to 24 h **Intended duration of catheterisation for each group:**

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Aref 2020 *(Continued)*

	Group A: immediate removal after surgery (n = 73) Group B: removal 6 h post-op (n = 81) Group C: removal 24 h post-op (n = 67)
Outcomes	Number of participants requiring recatheterisation Symptomatic UTI (number of participants) Time to first ambulation (h; mean ± SD) Length of hospital stay (days; mean ± SD) Positive urine culture Fever Dysuria
Definition of CAUTI or bacteriuria	"The diagnosis of symptomatic UTI was based on the following criteria: significant bacteriuria with at least one of the following symptoms; dysuria, frequency of micturition, urgency, supra pubic pain, or burning sensation at micturition."
Sponsorship/funding	Not reported
Ethical approval	"This study was carried out in accordance with the ethical principles for medical research involving human subjects included in Helsinki declaration and was approved by Ethical Committee."
Notes	"Urinary retention defined as: inability for spontaneous micturition within 6 h after the removal of urinary catheter" "Seventeen patients were finally excluded from the study; five patients had intraoperative complications (iatrogenic bladder injury) and therefore an indwelling catheter had to be kept postoperatively on the surgeon's request while 12 did not complete the postoperative follow-up."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "were divided into three groups by simple randomization using computer-generated random numbers." Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported. Unlikely outcomes are affected by non-blinding however.
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume microbiologist was blinded to participants of the study

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Aref 2020 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	No incomplete outcome data
Selective reporting (reporting bias)	Low risk	Appears to be free form reporting bias
Other bias	Low risk	Appears to be free from other sources of bias

Aslam 2019

Study characteristics	
Methods	**Study design:** RCT (multicenter trial) **Dates study conducted**: not reported
Participants	**Population:** women **Setting:** USA **Inclusion criteria:** participants undergoing minimally invasive pelvic organ prolapse surgery **Condition for hospitalisation:** pelvic organ prolapse **Exclusion criteria:** not reported **Number of participants:** 73 eligible (planned to recruit 100); 73 randomised; 73 reported **Age (mean and SD):** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 32)**: IUC removal immediately after surgery **Group B (n = 41)**: IUC removal day 1 post-op **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: immediate removal Group B: day 1 post-op
Outcomes	Length of hospital stay (h ± SD) Number of participants requiring recatheterisation UTI Patient satisfaction Pain scores Patient responses on whether they would use the same treatment

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Aslam 2019 *(Continued)*

Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Conference abstract

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Given nature of intervention, unlikely to be possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume microbiologist blinded to trial participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	No incomplete outcome data
Selective reporting (reporting bias)	Low risk	Appears to be free from reporting bias
Other bias	High risk	Trial stopped early due to poor recruitment resulting in an imbalance across the 2 groups

Azarkish 2003

Study characteristics	
Methods	**Study design:** RCT **Setting:** Iran **Dates study conducted:** not reported
Participants	**Population:** women **Inclusion criteria**: pregnant women age 18-35, gravid 0-4, gestational age 37-42 with normal urine culture, colony count, gram staining) before surgery and taken 3 litres IV fluid during 24 h after surgery

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Azarkish 2003 *(Continued)*

	Exclusion criteria: women with urinary incontinence, frequent urination and dysuria more than twice, diabetes. History of kidney stone, fever/chills, secondary kidney disorder over the past year, history of smoking, rupture of chorionic membranes for > 6 h during labour, stimulation or acceleration of labour over 6 h, and oral temperature > 38 C in labour. In addition, mothers who have had a bladder injury during CS, uterine incision expansion, longitudinal uterine incision, prolonged operation for > 60 min, or haematocrit < 33% after surgery, acute bleeding, re-catheterisation more than twice **Condition for hospitalisation:** CS **Number of participants:** 60 eligible; 60 randomised; 60 reported **Age (mean and SD):** A 24.96 ± 4.88; B 27.06 ± 5.56 **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 30)**: IUC removal 2-3 h after surgery **Group B (n = 30)**: IUC removal morning after surgery **Size and type of catheter used:** Foley catheter 14 gauge (5-10 cc balloon) **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 2-3 h after surgery Group B: morning after surgery
Outcomes	UTI Microscopic pyuria
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Original trial report in Farsi. Data extraction performed by Persian translator

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported. Unlikely given nature of intervention

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Azarkish 2003 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	Data reported in full
Selective reporting (reporting bias)	High risk	Baseline data collected however not reported by authors in results section
Other bias	Unclear risk	Appears to be free from other sources of bias

Azarkish 2005

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** May 2001-September 2001
Participants	**Population:** women **Setting:** Mashahd, Iran **Inclusion criteria:** emergency CS, age 18-35 years old, pregnancy 1-4, pregnancy period 37-42 weeks, no UTIs **Exclusion criteria**: diabetic mothers, women with fever and trembling 24 h before surgery **Condition for hospitalisation:** emergency CS **Number of participants:** 333 eligible; 60 randomised; 56 reported **Age (mean and SD):** not reported **Use of antibiotic prophylaxis:** perineum wash by povidone iodine 10% before catheter insertion
Interventions	**Group A (n = 30)**: IUC removal 2-3 h post-op **Group B (n = 30)**: IUC removal 24 h post-op **Size and type of catheter used**: size 14 **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removal 2-3 h post-op Group B: IUC removal 24 h post-op
Outcomes	Average pain severity of IUC insertion on pain VAS (mean ± SD) Average pain severity of IUC removal on pain VAS (mean ± SD)
Definition of CAUTI or bacteriuria	Not reported

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Azarkish 2005 *(Continued)*

Sponsorship/funding	Dr. Fazli Bazzaz (Research vice chancellor at Mashad Medical University)
Ethical approval	Not reported
Notes	Paper written in Farsi. Translation provided by a translator

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote from translator: "2 groups, 30 persons each, randomised totally by chance" Comment: unclear method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	High risk	Quote from translator: "number of participants is 56 person, but there is no explanation for that in the paper" Comment: translator could not identify reason for missing pain data for four participants in the pain on removal of catheter group
Selective reporting (reporting bias)	High risk	No baseline data reported despite authors mentioning data was collected
Other bias	Low risk	Appears to be free from other sources of bias

Barone 2015

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** March 2012-May 2013
Participants	**Countries:** Democratic Republic of the Congo, Ethiopia, Guinea, Kenya, Niger, Nigeria, Sierra Leone, and Uganda **Population:** women **Condition for hospitalisation:** vaginal fistula repair

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Barone 2015 *(Continued)*

	Number of participants: 1007 eligible; 524 randomised; 501 reported **Age (mean and SD):** A 31.9 ± 11.5; B 30.6 ± 11.7 **Use of antibiotic prophylaxis:** "…did not receive prophylactic antibiotics" **Inclusion criteria:** women who had a simple fistula, established by the surgeon after repair surgery; had a closed fistula at completion of surgery and up to 7 days after surgery on the basis of negative dye test results; understood study procedures and requirements; agreed to return for 1 follow-up 3 months after surgery; and provided informed consent for study participation **Exclusion criteria:** women were excluded if their fistula was deemed not simple, radiation-induced, associated with cancer, or due to lymphogranuloma venereum, or if they were pregnant. Women with multiple fistulas were later excluded
Interventions	**Group A (n = 261)**: IUC removal at day 7 post-op **Group B (n =262)**: IUC removal at day 14 post-op **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** 7 days **Intended duration of catheterisation for each group:** Group A: 7 days post-op; IUC removed on the day of randomisation, which was 7 days after surgery Group B: 14 days post-op; IUC removed after an additional 7 days (i.e. IUC is in place for 14 days in total) Both groups: "We scheduled participants to stay at the facility for 7 days after catheter removal"
Outcomes	Breakdown between 8 days after IUC removal and 3 months after surgery Breakdown between IUC removal and 3 months after surgery Urinary retention during hospital stay UTI Febrile episode Extended hospital stay Catheter blockage Residual urinary incontinence at 3 months
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	"This study was funded by the Office of Health, Infectious Diseases and Nutrition, and the Office of Population and Reproduction Health, at the US Agency for International Development under the terms of associate cooperative agreement GHS-A-00–07–00021–00 to Engender Health and grant GHA-G-00–09–00003 to WHO."
Ethical approval	"The protocol received technical and ethical approval from the WHO Research Project Review Panel (RP2) and Research Ethics Review Committee, respectively"
Notes	"We declare no competing interests"

Risk of bias

Bias	Authors' judgement	Support for judgement

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Barone 2015 *(Continued)*

Random sequence generation (selection bias)	Low risk	Quote: "The allocation sequence was computer generated centrally at WHO and enrolment and randomisation was done by a research assistant based at each study site. Randomisation was in a 1:1 ratio, stratified by country, and restricted with randomly varying block sizes of 4–6." Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: "We concealed allocation through sealed opaque envelopes." Comment: adequate allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Because of the nature of fistula repair services and low availability of clinical staff at study sites, we could not mask participants, coinvestigators, those assessing outcomes, or other study staff to treatment allocation" Comment: blinding not performed. Lack of blinding can influence outcomes.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "Because of the nature of fistula repair services and low availability of clinical staff at study sites, we could not mask participants, coinvestigators, those assessing outcomes, or other study staff to treatment allocation" Comment: blinding not performed. Lack of blinding can influence outcomes.
Blinding of microbiological outcome (detection bias)	Low risk	Assume microbiologist was blinded to the participants of the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low attrition and not differential: 11/261 and 11/263 lost to follow-up. ITT analysis was done for our outcomes of interest.
Selective reporting (reporting bias)	Low risk	Outcomes prespecified in published protocol are reported in full.
Other bias	Low risk	Appears to be free from other sources of bias

Basbug 2020

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** December 2015-December 2016
Participants	**Population:** women **Setting:** Duzce, Turkey **Inclusion criteria:** women who were accepted for primary or recurrent elective CS **Condition for hospitalisation:** elective CS **Exclusion criteria**: patients with UTI (evaluated by urine examination), severe vaginal bleeding, severe pre-eclampsia, eclampsia, and any other conditions requiring post-operative monitoring of urinary output were excluded from the trial. **Number of participants:** 172 eligible; 136 randomised; 136 reported **Age (mean and SD):** A 30.13 ± 5.83; B 29.96 ± 4.71

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Basbug 2020 *(Continued)*

	Use of antibiotic prophylaxis: "All patients received 1 g IV cefazolin as prophylaxis"
Interventions	**Group A (n = 62)**: IUC removal 2 h after procedure **Group B (n = 72)**: IUC removal 12 h after procedure **Size and type of catheter used:** French size 16 silicone-covered latex Foley catheters **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 2 h Group B: 12 h
Outcomes	Number of participants requiring recatheterisation Dysuria Asyptomatic bacteriuria Urinary frequency Urgency Length of hospitalisation stay (h) Fever Time to first void (h; mean ± SD)
Definition of CAUTI or bacteriuria	Significant microscopic bacteriuria was defined as ≥ 100,000-bacteria/mL urine in a midstream sample
Sponsorship/funding	Not reported
Ethical approval	The study was approved by the Ethics Committee of the Duzce Medical Faculty (IRB No. 000021705, Approval No. 2015/174)
Notes	Recatheterisation was performed if spontaneous micturition was not possible or urinary retention was detected in the suprapubic region by either abdominal examination or measurement of post-voiding residual (PVR) volume by ultrasound The definition of urinary retention was, lack of spontaneous micturition 6 h after the removal of catheter or PVR volume > 200 mL measured by transabdominal ultrasound

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Patients were randomly allocated by a computer program in a 1:1 ratio to the early or delayed catheter removal groups" Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Quote: "Patients were randomly allocated by a computer program in a 1:1 ratio to the early or delayed catheter removal groups." Comment: not reported

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Basbug 2020 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Likely blinding not possible for this outcome
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	'As-treated' analysis carried out. 4/68 participants in 1 group were analysed in the other group but unlikely to have substantial impact
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Benoist 1999

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 1994-June 1997
Participants	**Number of participants:** eligible: not reported; 132 randomised; 126 reported **Setting:** Paris **Country:** France **Population:** mixed **Age (mean (SD)):** A 55 (18); B 56 (17) **Inclusion criteria:** patients undergoing extensive rectal resection (total or subtotal proctectomy) **Condition for hospitalisation:** rectal resection **Exclusion criteria:** patients receiving pre-operative therapeutic antibiotics; suspected bladder tumour or urinary tract malignancies; previous IUC that ended < 48 h before insertion of the current catheter **Use of antibiotic prophylaxis:** as prophylaxis for bowel surgery, all patients were injected IV with a single dose of antibiotics on the induction of anaesthesia.
Interventions	**Group A (n = 64):** IUC removal 1 day post-op **Group B (n = 62):** IUC removal 5 days post-op **Size of catheter used:** 14F catheter **Type of indwelling catheter:** not reported **Study definition of short-term catheterisation (days):** not reported

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Benoist 1999 *(Continued)*

	Intended duration of catheterisation for each group: A: removal of IUC 1 day after surgery B: removal of IUC 5 days after surgery
Outcomes	AUR Chronic urinary retention UTI Long-term urinary complications Patients undergoing total mesorectum excision
Definition of CAUTI or bacteriuria	Urinary infection was diagnosed if a culture yielded > 10^5 cfu/mL, with or without clinical symptoms
Sponsorship/funding	Not reported
Ethical approval	"…which was approved by the hospitals ethics committee"
Notes	AUR defined as absence of spontaneous micturition 12 h after catheter removal or after single intermittent catheterisation. Catheters were never clamped and were maintained on a closed drainage system.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "… patients were randomized into 1-day or 5-day urinary drainage groups according to the following computer-generated randomization sequence." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported Comment: unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "… urine samples from both groups were sent to a laboratory for culture" Comment: cultures were sent to a laboratory so it is unlikely that the microbiologist knew which samples corresponded to patients in the trial.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Quote: "...1 patient died postoperatively, 2 had postoperative complications requiring early reoperation, 2 inadvertently removed catheters, 1 required prolonged urine output monitoring because of transient respiratory failure requiring prolonged artificial ventilation." Comment: unclear what effect this has an the outcome of interest

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Benoist 1999 *(Continued)*

Selective reporting (reporting bias)	Low risk	All outcomes reported in methods was reported in results. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

Bristoll 1989

Study characteristics	
Methods	**Study design**: not reported. Described as "small multiple single case study" and "single case experimental design" **Dates study conducted**: not reported
Participants	**Setting:** St Joseph's Hospital, Milwaukee **Country**: USA **Number of participants:** eligible – not reported; 6 randomised; 6 reported **Population**: adults (no further information given) **Condition for hospitalisation**: not reported **Age (mean and SD):** not reported **Use of antibiotic prophylaxis:** not reported **Inclusion criteria:** "Patients who had not voided for 6 hours or more, appears to have more than 1000mLs of urine in their bladder, requiring catheterisation for retention according to physicians request" **Exclusion criteria: "**Obstetric patients, spinal cord injuries, patients undergone urological procedures in the past 6 months"
Interventions	**Group A (n = 3)**: threshold clamping **Group B (n = 3)**: complete drainage **Size and type of catheter used:** Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** not reported
Outcomes	Blood pressure Pulse rate Haematuria "Patients were monitored for any untoward reactions to the procedure, such as pain, diaphoresis, or frank bleeding, which would be expected to occur within 30 min of catheterization. Each patient's urine was also cultured for the presence of infection, which might explain any hematuria
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported

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Bristoll 1989 *(Continued)*

Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Participants were randomised" Comment: no description of how randomisation was performed
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible. Lack of blinding could have an impact on the outcome
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "While one investigator took each patient's blood pressure and pulse at predetermined intervals, the nurse caring for the patient inserted a Foley catheter, and a second investigator took urine samples at one-minute intervals. Each sample was tested for blood using a Hemastix reagent strip. One investigator and the patient's nurse verified the results" Comment: outcome assessors do not appear to be blinded
Blinding of microbiological outcome (detection bias)	Low risk	Not reported but likely that the urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No data reported
Selective reporting (reporting bias)	High risk	No data reported for any outcomes
Other bias	Low risk	Appears to be free from other sources of bias

Carpiniello 1988

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** November 1985-March 1986
Participants	**Number of participants:** 218 eligible; 77 randomised; 77 reported **Setting:** Philadelphia, Pennsylvania **Country:** USA **Population:** women

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Carpiniello 1988 *(Continued)*

	Age (mean and SD): A 73 (6.6); B 70 (8.3); C 70 (8.6) **Inclusion criteria:** consenting elderly women who underwent treatment for urinary complications post-total joint replacement **Condition for hospitalisation:** total joint replacement (hip or knee) **Exclusion criteria:** men excluded to avoid confusion of influence of prostatic disease; non-primary total joint replacement; positive pre-operative urine cultures; general anaesthesia and on bed rest post-operatively **Use of antibiotic prophylaxis:** prophylactic cefazolin sodium or clindamycin on post-operative day 3
Interventions	**Group A (n = 31):** IUC in recovery room **Group B (n = 23):** no IUC **Group C (n = 23):** IUC inserted immediately pre-operatively and removed 24 h post-operative **Size and type of catheter used:** not reported **Type of indwelling catheter:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: not clear. Catheterisation in recovery room only B: no catheterisation C: Foley catheter inserted immediate pre-operatively and removed 24 h post-operatively
Outcomes	UTIs Time catheter in place Recatheterisation post-catheter removal Postive urine culture
Definition of CAUTI or bacteriuria	“100,000 colonies/millimetre”
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: “… patients were randomly assigned to one of three groups” Comment: randomisation method unclear
Allocation concealment (selection bias)	Unclear risk	Not reported

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Carpiniello 1988 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported Comment: unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: the midstream clean-catch urine cultures would be sent to a laboratory where the microbiologist would not know which patient belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants completed the study i.e. no withdrawals
Selective reporting (reporting bias)	High risk	Group C seems to be missing catheterisation volume in recovery room and after recovery room.
Other bias	Low risk	Appears to be free from other sources of bias

Carter-Brooks 2018

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2016-March 2017
Participants	**Number of participants:** eligible not reported, 57 reported **Setting:** Connecticut **Country:** USA **Population:** women **Age (mean and SD):** A 64.9 ± 11.5; B 65.2 ± 10.3 **Inclusion criteria**: surgical management of pelvic organ prolapse requiring an overnight hospital admission **Condition for hospitalisation**: pelvic organ prolapse **Exclusion criteria:** same-day surgery, non-ambulatory (allowed to use an assistive device), inability to provide informed consent, age < 21 years, pregnancy or desire for future pregnancy, systematic disease known to affect bladder function (Parkinson's disease, multiple sclerosis, spina bifida, spinal cord injury or trauma and neurogenic bladder), known pre-operative urinary retention (defined as a post-void residual > 100 mL), an untreated UTI at the time of surgery, treatment at the time of surgery for UTI, symptoms of UTI on the day of surgery **Use of antibiotic prophylaxis**: not reported
Interventions	**Group A (n = 27)**: IUC removal 4 h post-op **Group B (n = 30)**: IUC removal 6 am on post-op day 1

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Carter-Brooks 2018 *(Continued)*

	Size and type of catheter used (e.g. Foley 16F): not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: voiding trial 4 h post-operatively Group B: voiding trial at 6 am day 1 post-operative
Outcomes	Number of participants requiring recatheterisation* Incidence of UTI Patient comfort or discomfort VAS pain scores** Time to first void (h) Length of hospitalisation (h) Psychological outcome measures e.g. Hospital Anxiety and Depression Scale. Anxiety measured by State-Trait Anxiety Inventory state subscale (STAI-S)
Definition of CAUTI or bacteriuria	"Defined as a positive culture or symptoms and antibiotic treatment"
Sponsorship/funding	"This project was supported by the Clinical Research Trainee Award from Magee-Womens Research Institute and the National Institutes of Health through grant number UL1-TR-000005."
Ethical approval	"This study was approved by the Institutional Review Board of the University of Pittsburgh (PRO15100653 approved 1/14/16)"
Notes	*Derived from outcome "Spontaneous void after 1st voiding trial attempt" **Pain scores were measured using the VAS, a continuous scale comprising a horizontal line 10 cm in length, anchored by the verbal descriptors "no pain" and "worst imaginable pain".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was computer generated with 1:1 group allocation to an early or standard voiding trial in fixed blocks of 6." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "Randomization was concealed by a research assistant not involved in trial enrolment using consecutively numbered opaque envelopes" Comment: adequate method of concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Carter-Brooks 2018 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	ITT analysis and per-protocol analysis reported. No withdrawals
Selective reporting (reporting bias)	Low risk	Outcomes appear to be reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Chai 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** November 2007-September 2009
Participants	**Number of participants:** 112 eligible; 70 randomised; 70 reported **Setting:** Hong Kong, China **Population:** women **Age (mean (SD)):** A 46.4 (3.9); B 46.4 (4.0) **Inclusion criteria:** women undergoing total abdominal hysterectomy + bilateral salpingo-oophorectomy for various benign gynaecological diseases **Condition for hospitalisation:** hysterectomy **Exclusion criteria:** known history of neurological disorder; known history of urinary incontinence; women who had recurrent UTI or positive urine culture (> 10^5 cfu/mL) pre-operatively; women for whom a complicated procedure was encountered during hysterectomy so that an indwelling catheter had to be kept in post-operatively on surgeon's decision; women who had spinal anaesthesia by choice or received patient-controlled analgesia as post-operative pain relief **Use of antibiotic prophylaxis:** routine prophylactic antibiotics were not given
Interventions	**Group A (n = 35):** immediate removal of IUC post-op **Group B (n = 35):** removal of IUC 24 h post-op on day 1 **Size and type of catheter used:** 12F with a 10 mL balloon Foley catheter, latex **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 0 h (duration of operation) B: 24 h after the end of the operation
Outcomes	Pain at urethral site (pain assessment was performed using a VAS (0 to 100) to assess the level of pain at the urethral site: nil to 33 on the scale was categorised as mild pain; 34-66 as moderate, and 67-100 as severe pain. Patients were asked to complete the scale on post-operative day 1)

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Chai 2011 *(Continued)*

	Post-operative positive urine culture Symptomatic UTI Recatheterisation rate
Definition of CAUTI or bacteriuria	Positive urine culture (> 10^5 cfu of an identified single uropathogen per mL of urine) Symptomatic UTI: fever (> 38) and dysuria + positive urine culture
Sponsorship/funding	Department of Obstetrics and Gynaecology, University of Hong Kong
Ethical approval	Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The randomization schedule for each surgeon was generated from the computer in a block of four." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	"…sealed, opaque envelopes. The randomization envelope was opened and the patient had the catheter removed according to the randomization allocation" Comment: adequate method of concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported; not possible
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"A reviewer who was blinded to the study assignment evaluated the pain assessment." Comment: blinding used so pain scores were not likely to be affected.
Blinding of microbiological outcome (detection bias)	Low risk	"… urine sample for culture and microscopy." Comment: urine samples were sent to a laboratory where the microbiologist is unlikely to know which patient belongs to the study.
Incomplete outcome data (attrition bias) All outcomes	Low risk	"42 women excluded from final analysis; 39 women had patient-controlled analgesia after operation and three women postoperatively required an indwelling catheter at the surgeon's request" – patients excluded prior to randomization, no patients lost after randomization." Comment: all withdrawals and exclusions are accounted for
Selective reporting (reporting bias)	Low risk	All outcomes measured in results was the same as was mentioned in the methods section
Other bias	Low risk	Appears to be free from other sources of bias

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Chen 2013

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** April-November 2008
Participants	**Number of participants:** 509 eligible; 278 randomised; 278 reported **Setting:** Taiwan **Population:** mixed **Age (mean (SD):** A 77 (12.7); B 78 (10.5) **Inclusion criteria:** all adult patients admitted to respiratory ICU **Condition for hospitalisation:** multiple. Most of the patients in the study had respiratory failure and were being treated with mechanical ventilation. **Exclusion criteria:** had not had IUC; did not stay in respiratory ICU for > 2 days **Use of antibiotic prophylaxis:** not used. Antibiotics were only given to symptomatic patients
Interventions	**A: Intervention group – use of IUC removal reminder protocol (n = 147)** Group 1 (n = 86): IUC removed ≤ 7 days Group 2 (n = 61): IUC removed > 7 days **B: Control group i.e. no IUC removal reminder policy (n = 131)** Group 1 (n = 48): IUC removed ≤ 7 days Group 2 (n = 83): IUC removed > 7 days **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: intervention group – use of catheter removal reminder protocol Group 1 (catheter removed ≤ 7 days) Group 2 (catheter removed > 7days as clinically indicated) B: control group i.e. no catheter removal reminder policy Group 1 (catheter removed ≤ 7 days) Group 2 (catheter removed > 7days as clinically indicated)
Outcomes	Total CAUTIs Asymptomatic bacteriuria Symptomatic UTI Catheter-associated asymptomatic bacteriuria Catheter-associated symptomatic UTI Duration of catheterisation (mean, SD)

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Chen 2013 *(Continued)*

	Recatheterisation
Definition of CAUTI or bacteriuria	Determination of CAUTI was performed in accordance with criteria of the CDC and the National Healthcare Safety Network, including symptomatic UTI and asymptomatic bacteriuria. A CAUTI is a UTI that occurs in a patient who had an IUC in place within the 48 h before the onset of the UTI.
Sponsorship/funding	"This study was supported in part by a research grant from Taipei Veterans General Hospital (Taipei VGH-V97A-055)"
Ethical approval	The study was approved by the appropriate institutional review board before implementation.
Notes	Patients whose IUCs were removed later than planned were excluded from the per-protocol analysis and were moved to a treatment-contamination group. Protocol was not followed

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Quote: "Computer-generated random numbers were used …" Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Quote: "These professionals had no knowledge of which group (control or intervention) a patient was assigned to ... most patients had respiratory failure and were being treated with mechanical ventilation." Comment: adequate method of blinding. Unlikely participants knew due to being in ICU
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "The investigator responsible for the daily identification and assessment of all patients with indwelling urinary catheters, however, knew which group each patient was assigned to" Comment: outcome assessment was not blinded
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "… all samples were sent to the laboratory…" Comment: unlikely laboratory staff knew which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear. 278 patients were randomised but in table 3 there are 180 in group A and 181 in group B
Selective reporting (reporting bias)	Low risk	All outcomes are reported in both methods and results sections
Other bias	Low risk	Appears to be free from other sources of bias

Chia 2009

Study characteristics	
Methods	**Study design:** RCT

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Chia 2009 *(Continued)*

	Dates study conducted: not reported
Participants	**Number of participants:** eligible – not reported; 80 randomised (40 in each group); 78 reported **Setting:** Taiwan **Population:** mixed **Age (e.g. mean and SD):** A 54.7 ± 11.2; B 55.7 ± 10.3 **Inclusion criteria:** patients of ASA physical status I–III undergoing thoracotomy **Condition for hospitalisation**: thoracotomy **Exclusion criteria:** urological/spinal/cardiopulmonary/neurological diseases; coagulopathy and/or any medication that might interfere with the sympathetic nervous system or micturition were excluded from this study **Use of antibiotic prophylaxis:** a single dose of prophylactic antibiotic was given IV in all participants
Interventions	**Group A:** IUC removed on the 1st post-operative day (n = 38) **Group B:** IUC removed after discontinuation of PCEA (3rd post-operative day) (n = 40) **Size and type and type of catheter used:** 14F Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed on the 1st post-operative day B: IUC removed on the 3rd post-operative day
Outcomes	Recatheterisation for urinary retention CAUTI Average duration of bladder drainage Pain intensity at rest (VAS) Urethral pain intensity (VAS)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"After obtaining approval from the Human Investigation Committee at Kaohsiung Veterans General Hospital and written informed consent from all patients."
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "…the eligible patients were randomly assigned into two groups according to a table of random numbers generated by a computer." Comment: adequate method of randomisation

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Chia 2009 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely, blinding was not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No information given, but can assume urine sample was assessed by microbiologist who would not know allocation of participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "two patients in group 1 were excluded due to inadequate pain relief by postoperative PCEA" Comment: low number of participants excluded
Selective reporting (reporting bias)	Unclear risk	Data reported graphically in way that did not allow precise data extraction – VAS scores were reported as significant without P values or the mean VAS scores presented in the figures
Other bias	Low risk	Appears to be free from other sources of bias

Chillington 1992

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Setting:** Hereford **Country:** UK **Population:** men **Age (mean (SD)):** not reported **Inclusion criteria:** patients undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria:** not reported **Number of participants:** eligible, not reported; randomised, not reported; 100 reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 35):** removal of IUC at midnight **Group B (n = 48):** removal of IUC at 6 am **Size and type of catheter used:** not reported

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Chillington 1992 *(Continued)*

	Study definition of short-term catheterisation (days): not reported **Intended duration of catheterisation for each group:** A: IUC removed at midnight B: IUC removed at 6 am
Outcomes	Time to first void Volume of first void Number needing to be recatheterised Length of hospital stay Percentage of participants achieving acceptable voiding within 24 h of catheter removal
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Information from a letter in British Journal of Urology accessible. Full text not available

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported Comment: unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: not much information reported in letter, difficult to ascertain whether outcome assessor was blinded
Blinding of microbiological outcome (detection bias)	Low risk	Not reported Comment: urine samples would be assessed in a laboratory, who would not know allocation of participant
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information provided
Selective reporting (reporting bias)	Unclear risk	No information on outcomes intended to be measured was given. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

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Cornia 2003

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** 15 November 2000-6 March 2001
Participants	**Setting:** Washington **Country:** USA **Population:** mixed **Age:** not reported **Inclusion criteria:** all patients admitted to the medicine and cardiology services **Condition for hospitalisation:** mixed **Exclusion criteria:** patients who were transferred to a non-medicine or non-cardiology service, or to a ward other than the second or fourth floor, were removed from the study. **Number of participants:** 742 eligible; 648 randomised (70 patients received IUCs); 70 reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A:** had the choice to use a designated computer study order, enter standard written order or not enter an order for IUC **Group B:** did not have a designated computer study order **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: computer study order had default stop date of 72 h after placement (either renew or discontinue catheter order) B: not reported
Outcomes	Mean duration of catheterisation CAUTI Catheter reinsertion
Definition of CAUTI or bacteriuria	CAUTI: growth from a urine specimen aseptically aspirated from the catheter of ≥ 100 cfu of a predominant pathogen or ≥ 10 leukocytes per high-power field on urinalysis in a patient with a clinical diagnosis of UTI
Sponsorship/funding	Not reported
Ethical approval	Human Subjects Committee of the University of Washington and the Research and Development Committee of the VA Puget Sound Health Care System
Notes	“Written informed consent was not required from patients or providers as the standard of care was to not use computerized urinary catheter orders”
Risk of bias	

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Cornia 2003 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "During the first 8 weeks of the study, the fourth floor served as the study ward and the second floor served as the control ward; during the second 8 weeks, the second floor became the study ward and the fourth floor became the control" Comment: method of randomisation not truly random
Allocation concealment (selection bias)	High risk	Comment: method of randomisation means that allocation concealment would not be possible
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported Comment: unlikely that blinding was possible due to intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Urine samples were sent away to a laboratory, where the allocation of the participant would not be known
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "94 patients excluded as moved wards or the treating specialty not included in study" Comment: adequate reason for exclusion
Selective reporting (reporting bias)	High risk	Quote: "Of the 5 patients who required reinsertion of a urinary catheter, only 1 had received an automatic computer order to remove the previous catheter" Comment: not reported based on allocation, cannot interpret significance of results
Other bias	Low risk	Appears to be free from other sources of bias

Coyle 2015

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2012-July 2013
Participants	**Number of participants:** 46 eligible; 44 randomised (22 in each arm); 35 reported (7 participants in Group A did not receive intervention, 1 participant from Group A excluded from analysis (catheter reinserted); 2 participants from Group B excluded from analysis due to medical necessity) **Setting:** Galway **Country:** Ireland **Population:** mixed (30 male, 14 female) **Age (mean):** A 63.5; B 62

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Coyle 2015 *(Continued)*

	Inclusion criteria: 18 years old; competent to consent for research purposes; plan to undergo elective transabdominal colectomy, proctectomy or coloproctectomy with post-operative epidural analgesia **Condition for hospitalisation:** elective transabdominal colectomy, proctectomy or coloproctectomy **Exclusion criteria**: Pre-operative: prior surgery to lower urinary tract; pre-existing lower urinary tract disease; intermittent self-catheterisation; neurogenic bladder; pregnancy; prior transabdominal pelvic surgery; known enterovesical fistula; planned; synchronous urinary tract surgery; anticholinergic therapy; IPSS ≥ 20; urethral catheter indwelling > 24 h prior to surgery Post-operative: epidural analgesia withdrawn ≤ 12 h post-operatively; surgical instrumentation of or dissection involving the urinary tract; delay in removal of IUC due to medical necessity; pelvic sepsis at surgery; unexpected finding of entero- or rectovesical fistula at surgery; premature dislodgement of urethral catheter; failed epidural catheterisation **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A:** urethral catheter removal 48 h post-op (n = 13) **Group B:** urethral catheter removal within 12 h of withdrawal of epidural analgesia (n = 20) **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 48 h B: 12 h after withdrawal of epidural analgesia (median duration of catheterisation was 85.5 h)
Outcomes	Development of post-operative urinary retention (total) Bacteriuria (UTI)
Definition of CAUTI or bacteriuria	Symptomatic or asymptomatic bacteriuria used. Unclear which definition is used however
Sponsorship/funding	None
Ethical approval	"Ethical approval given by the local Clinical Research Ethics Committee (CA 661)"
Notes	In total, 9 participants (20.5%) were excluded from analysis during the post-operative period. In SG1, 7 patients were excluded due to the following reasons: premature accidental dislodgement of IUC (n = 2); epidural catheter dislodgement < 24 h post-operatively (n = 2), unplanned instrumentation of the urinary tract at surgery (n = 1); IUC re-inserted post-operatively due to oliguria (n = 1); withdrawal of consent for patient participation (n = 1). In SG2, 2 participants were excluded due to IUC removal being delayed as a result of medical necessity.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "… were randomised using a computer generated randomisation system" Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "The operator was blinded as to the allocated arm, which was contained in a sealed envelope, at the time of catheter insertion."

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Coyle 2015 *(Continued)*

		Comment: adequate method of allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported – unlikely it was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely however that samples were sent to a laboratory where the microbiologist would be unaware of the study
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Flowchart indicates that group A reported on 14 patients and group B on 20 patients – but in table there are only 13 patients in group A
Selective reporting (reporting bias)	Low risk	All outcomes in methods are reported in full in results.
Other bias	Low risk	Appears to be free from other sources of bias

Crowe 1993

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** October 1990-November 1991
Participants	**Number of participants:** eligible, not reported; 242 randomised; 242 reported **Setting:** Melbourne **Country:** Australia **Population:** mixed **Age (mean (SD)):** not reported **Inclusion criteria**: patients admitted to the urology ward with IUCs or who were catheterised during their inpatient stay **Condition for hospitalisation:** patients admitted to the urology ward **Exclusion criteria:** patients with permanent indwelling catheters; self-catheterisation; functioning urinary diversions e.g. nephrostomy tube or suprapubic catheter **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 127):** removal of IUC at 6 am **Group B (n = 115):** removal of IUC at midnight **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported

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Crowe 1993 *(Continued)*

	Intended duration of catheterisation for each group: not reported
Outcomes	Number needing to be recatheterised (derived from failed trial of void) Failed trial of void requiring recatheterisation Mean volume of first void (mL) Mean time to first void (min) Discharged same day as catheter removed
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Another trial published in 1993

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… patients were randomized…" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Comment: unlikely that blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No patients lost to follow-up, none withdrew
Selective reporting (reporting bias)	Unclear risk	Outcomes measured are the same in methods and results section. Recatheterisation rates and UTI rates were not measured.
Other bias	Low risk	Appears to be free from other sources of bias

Dunn 1999

Study characteristics

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Dunn 1999 *(Continued)*

Methods	**Study design:** RCT **Dates study conducted:** 1 July1996-1 July 1997
Participants	**Number of participants:** not reported how many were eligible or analysed, states "100 women entered the trial", no further information **Setting:** Denver **Country:** USA **Population:** women **Age:** not reported **Inclusion criteria:** patients undergoing Obs-Gynae surgery **Condition for hospitalisation:** obstetric and gynaecological surgery **Exclusion criteria:** pre-eclampsia; bladder injury; surgery for incontinence; vaginal vault prolapse; anterior/posterior colporrhaphy **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A:** immediate removal of IUC post-operatively (n = not reported) **Group B:** delayed IUC removal post-operatively (n = not reported) **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:**
Outcomes	Pain post-op Recatheterisation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Foley catheterisation increases the amount of pain without a clear benefit. Further subgroup analysis by type of surgery, hospital length and UTI is still underway All information obtained from a conference abstract

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported

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Dunn 1999 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No information given. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No data given, only preliminary results
Selective reporting (reporting bias)	Unclear risk	Not enough information in abstract to assess for elective reporting
Other bias	Low risk	Appears to be free from other sources of bias

Dunn 2000b

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; randomised, not reported; 78 reported **Setting:** Denver **Country:** USA **Population:** women **Age (mean (SD)):** not reported **Inclusion criteria:** all patients undergoing hysterectomy or CS, not requiring bladder suspension or strict fluid management **Condition for hospitalisation:** hysterectomy or CS **Exclusion criteria:** requiring bladder suspension or strict fluid management **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A:** Foley catheter removed immediately (n= not reported) **Group B:** Foley catheter removed post-operatively (n= not reported) **Group C:** Foley catheter removed on the first post-operative day (n= not reported) **Size and type of catheter used**: not reported **Study definition of short-term catheterisation (days)**: not reported **Intended duration of catheterisation for each group:**

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Dunn 2000b *(Continued)*

	A: immediate removal B: post-operative removal C: first operative day
Outcomes	Fever Infection (UTI) Recatheterisation Level of pain (measured by using a standardised scale split into mild, moderate and severe)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Abstract, data not presented in a format which is compatible for meta-analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information given
Allocation concealment (selection bias)	Unclear risk	No information given
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely that urine samples were sent to a laboratory
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No data are presented in tables. Very brief sets of data in results section. Unclear which outcome related to which group
Selective reporting (reporting bias)	High risk	Outcomes reported in way that data could not be extracted – unclear if due to unsatisfactory results or because an abstract
Other bias	Low risk	Appears to be free from other sources of bias

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Dunn 2003

Study characteristics	
Methods	**Study design:** RCT **Setting:** Denver, Colorado, USA **Dates study conducted:** January 1998-December 2001
Participants	**Number of participants:** 323 eligible; 250 randomised; 250 reported **Setting:** Denver, Colorado **Country:** USA **Population:** women **Age (median, range):** 47 (25-72) **Inclusion criteria:** consenting women undergoing hysterectomy for various benign diseases (e.g. fibroid tumours, abnormal uterine bleeding, chronic pain, and persistent cervical dysplasia or micro invasive cervical cancer) **Condition for hospitalisation (e.g. hysterectomy or TURP):** hysterectomy **Exclusion criteria:** women for whom a complicated surgical procedure was anticipated (i.e. patients who underwent bladder suspension or colporrhaphy, diagnosis suspicious for severe endometriosis or for whom strict fluid treatment was required) **Use of antibiotic prophylaxis:** single dose of antibiotic prophylaxis before operation
Interventions	**Group A (n = 125):** immediate removal of the IUC in the operating room **Group B (n = 125):** removal of IUC on post-operative day 1 **Size and type of catheter used (e.g. Foley 16F):** 16F with 10 cc balloon, latex **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: duration of operation, removal in the operating room after operation finished Group B: post-op day 1
Outcomes	Post-operative fever UTI Recatheterisation Pain (data cannot be incorporated as trial reports percentages without information on the number of participants in each group)
Definition of CAUTI or bacteriuria	Determined by either microscopic abnormality or any patient symptoms
Sponsorship/funding	Not reported
Ethical approval	Institutional Review Board of the University of Colorado
Notes	Pain was assessed with a pictorial questionnaire Post-operative fever = temperature > 38.5 °C

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Dunn 2003 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "… computer generated randomisation" Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: "… sealed opaque envelopes" Comment: adequate concealment method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported, can assume blinding was not performed/possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported, VAS may be prone to bias and misinterpretation
Blinding of microbiological outcome (detection bias)	Low risk	UTI was diagnosed with either microscopic abnormality or any patient symptoms. If only microscopic abnormality was used, would be low risk of bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or exclusions/dropouts
Selective reporting (reporting bias)	Low risk	All outcomes in methods are reported in results. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

Durrani 2014

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** 1 September 2009-31 July 2011
Participants	**Number of participants:** eligible, not reported; 320 randomised; 320 reported **Setting:** Peshawar **Country:** Pakistan **Population:** men **Age (mean and SD):** 71.32 ± 5.94 **Inclusion criteria**: patients with bladder outflow obstruction due to benign prostatic enlargement undergoing TURP **Condition for hospitalisation:** TURP

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Durrani 2014 *(Continued)*

	Exclusion criteria: large post-void urine volume; urethral stricture; patients undergoing simultaneous internal urethrotomy and TURP; comorbidities such as uncontrolled diabetes mellitus, spinal cord problem, cerebro-vascular accident or any condition that might result in neurogenic urinary bladder; intra-operative complications like capsular or bladder perforation, severe haemorrhage during or immediately after surgery **Use of antibiotic prophylaxis**: cephalosporin 1 gm was administered IV at the time of induction of anaesthesia
Interventions	**Group A (n = 163):** delayed IUC removal (conventional) **Group B (n = 157):** early IUC removal **Size and type of catheter used:** 22 Fr catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: removal of IUC after > 1 day post-op (usually 4th or 5th day) Group B: removal on the 1st day post-op
Outcomes	Mean catheter removal day Mean length of hospital stay in group Recatheteristaion Mild dilutional hyponatraemia Emergency re-admission Reoperation, clot evacuation and diathermy of bleeding/oozing points UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"Written informed consent was taken from all the patients before including them in the study."
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Patients were divided into the two groups by randomly selecting from a pile of sealed opaque envelopes containing assignment as A or B group as the patients came and were included in the study." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "Sealed opaque envelopes were kept in a box in equal proportion and patients were asked to select one sealed envelope. Fifty envelopes with 25 for each group, A and B, were kept in the box initially and when 10 would remain, another 50 with the same proportions would be added." Comment: adequate method of concealment

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Durrani 2014 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely participants were not blinded as to when their catheter was removed.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The box was kept locked all the time and under the supervision of the principal investigator … a doctor who did not know the actual grouping of patients collected all the data." Comment: adequate method of blinding of outcome assessment
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assumed microbiologist was blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	No report number of patients excluded or number of dropouts. All participants who were included in the study completed the study.
Selective reporting (reporting bias)	Low risk	Outcomes mentioned in methods are reported in results section. Protocol was not available for assessment
Other bias	Low risk	No other sources of bias apparent

El-Mazny 2014

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** November 2012-March 2014
Participants	**Number of participants:** 335 eligible; 300 randomised; 300 reported **Setting:** Cairo **Country:** Egypt **Population:** women **Age (mean and SD):** Group A: 24.5 ± 4.2; Group B: 23.8 ± 3.9 **Inclusion criteria:** women admitted to the prenatal wards for primary or repeat elective CS were screened to determine eligibility for inclusion. **Condition for hospitalisation:** primary or elective CS **Exclusion criteria:** urinary infection (assessed clinically and by midstream urinalysis); significant vaginal bleeding; severe pre-eclampsia or eclampsia; and/or any other conditions requiring post-operative monitoring of urinary output; contraindications for general anaesthesia **Use of antibiotic prophylaxis**: cefazolin 2 g IV single dose 30 min before surgery
Interventions	**Group A (n = 150):** IUC removed immediately after the procedure **Group B (n = 150):** IUC removed 12 h post-operatively **Size and type of catheter used:** 16F

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El-Mazny 2014 *(Continued)*

	Study definition of short-term catheterisation (days): not reported **Intended duration of catheterisation for each group:** Group A: IUC removed immediately post-op Group B: IUC removed 12 h post-op
Outcomes	Significant bacteriuria Urinary retention Dysuria Urinary frequency Urgency Time to post-op ambulation (h) Time to first void post-op (h) Hospital stay (h)
Definition of CAUTI or bacteriuria	Significant bacteriuria = > 10^5 bacteria per mL urine in a midstream sample collected 24 h post-operatively
Sponsorship/funding	Not reported
Ethical approval	The study protocol was approved by the Scientific Research Committee, and informed consent was obtained from all participants.
Notes	If patient still had difficulty in passing urine after 6 h and/or if abdominal examination showed palpable urinary bladder, recatheterisation was done

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "A total of 300 women were allocated into two groups in a 1:1 ratio by block randomisation using computer-generated random numbers." Comment: adequate method of randomisation
Allocation concealment (selection bias)	High risk	Not reported. Unlikely that allocation concealment was performed
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. It is likely that urine samples were sent to a laboratory where the microbiologist would be unlikely to know if patients were in a trial or not

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El-Mazny 2014 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	All outcomes are reported in both the methods and results section and are fully accounted for
Other bias	Low risk	Nothing to indicate any other source of bias

Ganta 2005

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Setting:** West Bromwich **Country:** UK **Population:** men **Age (mean and SD):** overall: 68.9; Group A: 68.2, Group B: 69.9 **Inclusion criteria:** patients undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria:** not reported **Number of participants:** eligible, not reported; 84 randomised; 84 reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 40):** removal of catheter at 6 am **Group B (n = 44):** removal of catheter at midnight **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: removal of catheter at 6 am Group B: removal of catheter at midnight
Outcomes	Mean volume of first void (mL) Mean time to first void (min) Incidence of recatheterisations Discharged same day as IUC removal Comfort rated on 0-5 scale

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Ganta 2005 *(Continued)*

Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… were randomised" Comment: randomisation method unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	No information given, unlikely that participants and personnel were blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported in study
Incomplete outcome data (attrition bias) All outcomes	Low risk	No patients lost to follow-up/dropouts
Selective reporting (reporting bias)	Low risk	All outcomes reported in the methods section are accounted for in the results section
Other bias	Low risk	Appears to be free from other sources

Glavind 2007

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** December 2004-April 2006
Participants	**Number of participants:** eligible, not reported; 140 randomised; 134 reported **Setting:** Aalborg **Country:** Denmark **Population:** women

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Glavind 2007 *(Continued)*

	Age (mean and range): 61 years (31-88) **Inclusion criteria:** women consenting to undergo any type of vaginal prolapse surgery **Condition for hospitalisation (e.g. hysterectomy or TURP):** vaginal surgery for genital prolapse **Exclusion criteria:** 1 patient due to bladder perforation during procedure **Use of antibiotic prophylaxis:** all participants who had a vaginal hysterectomy or high uterosacral suspension operation performed received 1 pre-operative injection of Cefuroxime. No antibiotic prophylaxis was used in the remaining participants
Interventions	**Group A (n = 66):** IUC removed after 3 h post-operatively **Group B (n = 68):** IUC removed next morning **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 3 h post-op Group B: IUC removed the next morning after operation
Outcomes	Minimal bleeding Menstrual bleed Heavier bleed Haematoma Recathetersation Positive urine culture
Definition of CAUTI or bacteriuria	A positive urine culture was defined as the presence of ≥ 10^5 cfu/mL.
Sponsorship/funding	Not reported
Ethical approval	All patients who underwent any kind of vaginal prolapse surgery were included in the study after informed consent
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomisation was performed with sealed envelopes opened at the end of the operation." Comment: method of randomisation unclear
Allocation concealment (selection bias)	Low risk	Quote: "… sealed enveloped opened at the end of the operation" Comment: adequate method of concealment

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Glavind 2007 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Patients were surveyed by the nurses in the department" Comment: does not report whether participants or nurses were blinded. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Patients were contacted by telephone after 3 weeks to be informed about the urine culture after 14 days, and questioned about bleeding and retention." Comment: likely urine samples were sent to a laboratory where the microbiologist would be unaware which patient belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Quote: "One patient was excluded from the study because of bladder perforation during the operation. Five patients were excluded because of violation of the protocol, both because they had to have the vaginal pack and catheter removed before time due to pain or because, in error, they did not have the catheter and vaginal pack removed until the next day in spite of belonging to Group 1." Comment: effect on relevant outcomes unclear
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are the same in the results
Other bias	Low risk	Appears to be free from other sources of bias

Gong 2017

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2012-April 2015
Participants	**Number of participants:** 210 eligible; 198 randomised; 198 reported **Setting:** First Affiliated Hospital of Chongqing Medical University (FAH-CMU) **Country:** China **Population:** women **Age (mean ± SD):** A 46.14 ± 8.33; B 45.70 ± 9.63 **Inclusion criteria:** patients with cervical cancer FIGO stage IB-IIB **Condition for hospitalisation:** radical hysterectomy **Exclusion criteria:** patients were excluded if they had urinary incontinence, interstitial cystitis, cognitive impairment or difficulties in completing the training sheet **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 70):** IUC for 48 h with intermittent clamping

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Gong 2017 *(Continued)*

	Group B (n = 128): IUC for 48 h without intermittent clamping **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 48 h B: 48 h
Outcomes	Recatheterisation Residual urine volume 24 h after removal CAUTI Duration of first catheterisation (days)
Definition of CAUTI or bacteriuria	Symptomatic UTI was defined as bacteriuria with fever, frequent or painful urination or burning on urination
Sponsorship/funding	None
Ethical approval	The Institutional Review Board of Chongqing Medical University approved the study (File No.: 2012045), and all patients provided written informed consent.
Notes	In the clamping group, bladder reconditioning was performed 2 days before IUC removal. The participants did the intermittent clamping, while the nurses performed the catheter insertion and removal. A designed training sheet was handed to the participants, who were educated on how to clamp the IUC and finish the sheet. In detail, IUCs were clamped for 4 h or until participants had urination desire, followed by a 5-min urinary drainage, a cycle repeated in the daytime for 2 days. The schedule was chosen because it appeared to mimic a normal pattern of bladder filling and emptying

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "All patients were randomised on 2:1 using a computer-generated list into two groups, the clamping group and the control group" Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Both the researchers and the patients were not blind to the group assignment due to the procedure of the study" Comment: not possible to blind participants due to type of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "Outcome assessors were not blinded in the study..." Comment: outcome assessors not blinded
Blinding of microbiological outcome (detection bias)	Low risk	Urine samples would be sent to a laboratory where the allocation of a participant would not be known

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Gong 2017 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Five patients were excluded from the clamping group (three failed to record the training sheet, two had severe urine leakage during clamping because of the unfitted catheters and the catheters were removed without training). Seven patients in the control group dropped out because the catheters were removed in other hospitals and the data were missing." Comment: adequate reasons for exclusion
Selective reporting (reporting bias)	Low risk	Outcomes mentioned under Methods section are reported in Results. All outcomes expected from the objective of this trial are reported.
Other bias	Low risk	Appears to be free from other sources of bias

Gross 2007

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Setting:** Kentucky **Country:** USA **Population:** mixed **Age (mean (SD)):** 70.3 (11.7) **Inclusion criteria**: presence of IUC on admission or inserted during rehabilitation programme; age ≥ 18 years; medical order for catheter removal **Condition for hospitalisation:** stroke **Exclusion criteria:** not reported **Number of participants:** eligible, not reported; 45 randomised; 45 reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 26):** IUC removal at 10 pm the day the order for removal was written **Group B (n = 19):** IUC removal at 7 am the day after the order form for removal was written **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removal at 10 pm Group B: IUC removal at 7 am
Outcomes	Time to first void Post-voided residual urine Volume of first void

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Gross 2007 *(Continued)*

	UTI
Definition of CAUTI or bacteriuria	The CCD criteria for UTI provided the defining characteristics to determine the presence of infection on admission to rehabilitation
Sponsorship/funding	Not reported
Ethical approval	"Institutional review board approval was obtained."
Notes	IUCs had been in place an average of 18.2 days (SD = 19.3), a time interval closely corresponding to the length of time since stroke onset (mean 20.5 days, SD 21.3)

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Quote: "Subjects were randomized to groups by drawing sealed envelopes indicating group designation." Comment: unclear as to how randomisation was done
Allocation concealment (selection bias)	Low risk	Quote: "…by drawing sealed envelopes …" Comment: adequate method of allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported, unlikely to have been blinded as to which participant belonged to which intervention. Not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Urine samples would be sent to a laboratory where the allocation of a participant would not be known
Incomplete outcome data (attrition bias) All outcomes	High risk	Recatheterisation data are not presented in the results table 2 (summary of outcomes)
Selective reporting (reporting bias)	High risk	Recatheterisation is mentioned as an outcome in the methods section but it is not represented in the results section.
Other bias	Low risk	Appears to be free from other sources of bias

Gungor 2014

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** January 2012-January 2014
Participants	**Number of participants:** eligible, not reported; 58 randomised; 58 reported

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Gungor 2014 *(Continued)*

	Setting: Istanbul **Country:** Turkey **Population:** women **Age (mean ± SD):** A 55.7 ± 8.8; B 58.8 ± 10.1; C 55.8 ± 9.0 **Inclusion criteria:** patients who had applied with the complaints of pelvic organ prolapse and/or urinary incontinence and had undergone anterior colporrhaphy **Condition for hospitalisation (e.g. hysterectomy or TURP):** colporrhaphy **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 21):** IUC removal 2 days post-op **Group B (n = 17):** IUC removal 3 days post-op **Group C (n = 20):** IUC removal 4 days post-op **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 2 days post-op B: 3 days post-op C: 4 days post-op
Outcomes	Urinary incontinence (stress and mixed combined) Micturition volume (mL) Residual urine volume (mL)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	No funding or grant was used
Ethical approval	Ethics approval was obtained from the Istanbul University Ethics Committee
Notes	Residual urine volume was measured with 10Fr catheter after micturition

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “Patients were randomized using www.randomization.com programme.” Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported

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Gungor 2014 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that this was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Urine samples would be sent to a laboratory where the allocation of the participant would not be known.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	As only an abstract, inadequate information to know about attrition bias
Selective reporting (reporting bias)	Low risk	Outcomes in methods are reported in results also
Other bias	Low risk	Appears to be free from other sources of bias

Guzman 1994

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 1990-December 1991
Participants	**Number of participants:** eligible, not reported; 106 randomised; 106 reported **Setting:** Gynaecology Unit of Valdivia Regional Hospital **Country:** Chile **Population:** women **Age (mean and range):** Group A 56 (40-75); Group B 58 (8-79); Group C 57 (36-75) **Inclusion criteria:** women undergoing vaginal surgery **Condition for hospitalisation (e.g. hysterectomy or TURP):** vaginal conditions (74 had complete genital prolapse of grade 2 or 3 and 32 had grade 2 or 3 cystoceles) **Use of antibiotic prophylaxis:** all patients received Quemicetina as antibiotic prophylaxis
Interventions	**Group A (n = 37):** removal of IUC within 24 h **Group B (n = 36):** removal of IUC at 72 h **Group C (n = 33):** removal of IUC at 72 h plus bladder re-training, which involved intermittent clamping of the catheter **Size and type of catheter used (e.g. Foley 16F):** 14F with 10 mL balloon, latex **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:**

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Guzman 1994 *(Continued)*

	Group A: 1 day (no clamping regime)
	Group B: 3 days (no clamping regime)
	Group C: 3 days (with clamping regime)
Outcomes	Urinary retention
	Re-installation of Foley catheter
	Urine culture > 100,000 cfu
	Average days spent in hospital (median)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not mentioned
Ethical approval	Not specified
Notes	Urinary retention defined as residual urine volume of > 100 mL for 2 consecutive micturitions
	UTI defined by urine cultures
	All participants were administered prophylactic antibiotics
	Size of urethral catheter 14F Foley

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Comment: method of randomisation not specified
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding was possible due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume cultures were sent to a laboratory and so microbiologist would not know which patient belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No evidence to suggest incomplete data
Selective reporting (reporting bias)	Low risk	No evidence for selective reporting
Other bias	Low risk	No other source of bias identified

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Hakvoort 2004

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2000-July 2001
Participants	**Country:** Netherlands **Population:** women **Inclusion criteria:** patients undergoing anterior colporrhaphy **Condition for hospitalisation (e.g. hysterectomy or TURP):** vaginal prolapse surgery (anterior colporrhaphy) **Exclusion criteria:** patients with UTI pre-operatively **Number of participants:** 100 eligible; 100 randomised; 94 reported **Age (median and range):** Group A 66 (33-87); Group B 67 (36-86) **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 46):** IUC was removed on the 5th post-operative day **Group B (n = 48):** IUC removed the morning after surgery **Size and type of catheter used (e.g. Foley 16F):** 14F Foley catheter **Study definition of short-term catheterisation (days):** "short term catheterisation" – morning after surgery **Intended duration of catheterisation for each group:** Group A (standard prolonged) = catheter removal on the 5th post-operative day Group B (not prolonged catheterisation) = catheter removed the morning after surgery
Outcomes	Repeated catheterisation Mean catheterisation days per participant Asymptomatic bacteruria Mean hospital stay (days)
Definition of CAUTI or bacteriuria	Signs of a UTI pre-operatively was defined as having > 10 white blood cells per high-power field and significant microscopic bacteriuria (one per high-power field) in the urine sediment A UTI was defined as the presence of > 10^5 cfu/mL in the culture.
Sponsorship/funding	Not reported
Ethical approval	The study design was approved by the institutional medical ethical committee.
Notes	All participants with imminent overfilling, defined as a post-voiding residual volume of 200 mL or more, had another transurethral catheter inserted for a period of 3 days (recatheterisation).
Risk of bias	

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Hakvoort 2004 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… patients were randomised by the use of closed non-diaphane envelopes" Comment: unclear how the randomisation was done
Allocation concealment (selection bias)	Unclear risk	Quote: "… use of closed non-diaphane envelopes" Comment: unclear what these envelopes are
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Suggestive that urine cultures were sent to laboratory and assessed by staff who would not know if patients were in a trial or not.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Only 6 patients not included in analysis (4 in group A, 2 in group B). 4 patients excluded in group 1 (2 for UTI, 2 only having posterior colporraphy). 2 patients excluded in group 2 (UTI)" Comment: valid reasons for excluding patients from analysis
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are also reported in results section. Protocol is not available
Other bias	Low risk	Appears to be free from other sources of bias

Hall 1998

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 123 randomised; 123 reported **Setting:** Huddersfield **Country:** UK **Population:** mixed **Age:** not reported **Inclusion criteria:** all patients in the general surgery ward with short-term IUC **Condition for hospitalisation:** hospitalisation for surgery (general) **Exclusion criteria:** not reported

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Hall 1998 *(Continued)*

	Use of antibiotic prophylaxis: not reported
Interventions	**Group A (n = 66):** IUC removal between 7 am and 9 am **Group B (n = 57):** IUC removal between 9 pm and 11 pm **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: removed between 7 am and 9 am B: removed between 9 pm and 11 pm
Outcomes	Time to first void (mean; min) First void volume (mean; mL) Recatheterisation for retention
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	The majority of those in the late group had their first void before 6 am, and therefore had a disturbed night's sleep. This is a conference abstract with limited information. Data were collected from a conference abstract

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "prospectively randomised" Comment: no further information given
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely participants were blinded due to intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Not reported. Outcomes are objective and unlikely to be affected by blinding
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias)	Unclear risk	Only an abstract, unable to assess withdrawal rates and dropouts

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Hall 1998 *(Continued)*

All outcomes		
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are reported in results
Other bias	Low risk	Appears to be free from other sources of bias

Han 1997

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 1994-December 1995
Participants	**Number of participants:** eligible, not reported; 118 randomised; 101 reported **Country:** Korea **Population:** men **Age (mean and range):** A 64.6 (50-86); B 68.2 (50-90) **Inclusion criteria:** patients with benign prostatic hyperplasia **Condition for hospitalisation:** TURP **Exclusion criteria:** chronic urinary retention history; neurogenic bladder; urethral stricture **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 48):** IUC removed within 48 h following TURP **Group B (n = 53):** IUC removed on ≥ post-op day 3 **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: < 48 h B: IUC removed after 3 days
Outcomes	Average catheter indwelling time (days) (range) Average length of hospital stay (days) (mean (range)) Failure to void Fever TUR syndrome Delayed bleeding Urethral stricture Incontinence (> 3 months)

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Han 1997 *(Continued)*

	Pre-op UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	None reported
Ethical approval	Not reported
Notes	Excluded: 17 (bladder injury during TURP, injury of prostatic capsule during TURP, chronic urinary retention history, patient with neurogenic bladder, patients with urethral stricture) Lost to follow-up: none (they only did the research during hospitalisation)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Trial authors just reported that the trial was a randomised trial, with no further details
Allocation concealment (selection bias)	Unclear risk	Trial authors did not report on allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Trial authors did not report on blinding. Unlikely blinding was possible in this study
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Trial authors did not report on blinding
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely samples were sent to a laboratory and so unlikely the microbiologist knew which patient was in the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Trial authors excluded the patients after surgery and individualised number of cases in each group was not reported
Selective reporting (reporting bias)	Unclear risk	Trial authors did not report some important characteristics in the results part that are in the methods, such as prostate volume and PSA.
Other bias	Low risk	Appears to be free from other sources of bias

Hewitt 2001

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 20 randomised; 20 reported **Setting:** Tauranga

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Hewitt 2001 *(Continued)*

	Country: New Zealand **Population:** men **Age:** not reported **Inclusion criteria:** men requiring radical perineal prostatectomy **Condition for hospitalisation:** radical perineal prostatectomy **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Intervention for each group (e.g. catheter removal, bladder infusion) with times (e.g. midnight catheter removal):** Group A: early IUC removal (n = 10), catheter removed 4-6 days post-op Group B: delayed IUC removal (n = 10), catheter removed at 14 days post-op **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported
Outcomes	Anastomotic leakage at time of urethrogram Recatheterisation Ureteral stenosis developed Use of medication following surgery Catheter-related symptoms (none – unbearable) (reported for Group B only)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Patients in the early group had a retrograde urethrogram and voiding cystogram performed 4-6 days post-op to assess their anastomosis for extravasation.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… twenty patients were randomised …" Comment: randomisation method not clear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported, unlikely that blinding was possible

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Hewitt 2001 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear as to whether there were any dropouts or exclusions
Selective reporting (reporting bias)	High risk	Catheter-related symptoms only reported for group B participants. Protocol not available so not assessed
Other bias	Low risk	Appears to be free from other sources of bias

Huang 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** 90 eligible; 90 randomised; 79 reported **Setting:** London **Country:** UK **Population:** women **Age (mean (SD)):** A 61.21 (10.17); B 63.93 (10.43); C 63.7 (12.55); overall: 62.90 (10.93) **Inclusion criteria:** women with cystocele of at least stage II, who were symptomatic and desired operative treatment with anterior vaginal repair with or without other concomitant pelvic surgeries **Condition for hospitalisation:** anterior vaginal wall repair **Exclusion criteria:** diabetes mellitus; pre-operative lower UTI; unpredicted complications occurred during the surgery; history of cervical cancer who had undergone radical hysterectomy or those who had ever received radiation therapy **Use of antibiotic prophylaxis**: ciprofloxacin used during all days of hospitalisation in all three groups
Interventions	**Group A (n = 30):** 2-day IUC **Group B (n = 30):** 3-day IUC **Group C (n = 30):** 4-day IUC **Size and type of catheter used (e.g. Foley 16F):** Foley catheter (no size reported) **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 2 days

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Huang 2011 *(Continued)*

	B: 3 days C: 4 days
Outcomes	Recatheterisation Volume of first time voiding (morning) (mL) Post-void residual urine UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	The study design was approved by the Institutional Review Board of Changhua Christian Hospital.
Notes	There was no significant difference in subjective urine frequency, overflow incontinence, and objective urine retention between the 3 groups of participants. Although our data suggest that post-operative catheterisation for 4 days may carry more risk of discomfort than a shorter duration, 2 days of post-operative catheterisation may potentially be even longer than necessary and may contribute to patient discomfort and bacteriuria

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “Patients were randomly allocated to three groups at the day of admission and surgery by letting each participant choose one of 90 envelopes in a large box.” Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: “Each questionnaire was concealed in a white non-transparent envelope.” Comment: adequate concealment method used
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Likely that blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely that samples were sent to a laboratory where the microbiologist would not know which patient belonged to the study
Incomplete outcome data (attrition bias) All outcomes	High risk	11/90 not included in analysis Group A: 2/30 (incomplete data collection) Group B: 2/30 (incomplete data collection) Group C: 7/30 (requested early termination from the study secondary to intolerance of catheter discomfort)

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Huang 2011 *(Continued)*

		Differential attrition, reason for withdrawal in 1 group directly related to catheter
Selective reporting (reporting bias)	High risk	Stated that aim was "to determine the optimal duration of indwelling urethral catheterization to minimize co-morbidity" but comorbidities not defined or measured
Other bias	Low risk	Appears to be free from other sources of bias

Ind 1993

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 101 randomised; 95 reported **Setting:** London **Country:** UK **Population:** women **Age (mean and SD):** Group A 49.59 (14.2); Group B 49.84 (16.6) **Inclusion criteria:** patients who had a urethral Foley catheter inserted at operation **Condition for hospitalisation (e.g. hysterectomy or TURP):** hysterectomy, posterior exenteration, colposuspension, anterior colporrhaphy, total/radical vulvectomy, radical oophorectomy, ovarian cystectomy, adhesiolysis myomectomy **Exclusion criteria:** patients who had suprapubic catheters **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 46):** removal of IUC at 6 am **Group B (n = 49):** removal of IUC at midnight **Size and type of catheter used (e.g. Foley 16F):** Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed at 6 am following operation B: IUC removed at midnight following operation
Outcomes	Median length of hospital stay Median time to first void Median volume of first void Urinary retention (number of participants who developed urinary retention and required recatheterisation following removal of the catheter)

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Ind 1993 *(Continued)*

Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	6 participants were excluded from the study: 5 for UTI and 1 for taking distigmine

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "Catheter removal was randomized by hospital number …" Comment: method of randomisation not truly random
Allocation concealment (selection bias)	High risk	Quote: "Patients with odd hospital numbers had their catheter removed at 6:00 am (group A) and patients with even numbers had their catheters removed at midnight (group B)." Comment: patients and hospital staff can easily tell which patient belongs to which group
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely to have occurred
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "age, use of night sedation, incidence of urinary retention, length of hospitalisation and incidence of UTIs were subsequently audited from the hospital notes" Comment: all information regarding each patient was easily available from the notes
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "All patients had midstream, urine analysis before operation, and had catheter specimen urine culture on removal" Comment: likely that urine samples were sent to a laboratory for analysis
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Six patients were not included in the analysis (5 with pre-existing postoperative UTIs and 1 patient on distigmine)." Comment: reasons for exclusion of patients is relevant
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are reported in results. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

Irani 1995

Study characteristics

Methods	**Study design:** RCT

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Irani 1995 *(Continued)*

	Dates study conducted: 1 August 1991-15 December 1993
Participants	**Number of participants:** eligible, not reported; 213 randomised; 213 reported **Setting:** Poitiers **Country:** France **Population:** men **Age (mean and range):** A 70.7 (42-88); B 70 (58-85) **Inclusion criteria:** patients undergoing transurethral prostatic surgery for urinary outflow obstruction due to benign hyperplasia **Condition for hospitalisation (e.g. hysterectomy or TURP)**: transurethral prostatic surgery for urinary flow obstruction due to benign prostate hyperplasia **Exclusion criteria:** simultaneous bladder neck resection or cystolithotripsy, patients with clinically apparent prostatic carcinoma **Use of antibiotic prophylaxis:** antibiotics (quinolones) were given from the day of operation until the patient was discharged home.
Interventions	**A**: **removal of IUC at 24 h who received TUIP** Group 1 (n = 52): IUC removal at 24 h Group 2 (n = 52): IUC removal at surgeons' discretion **B**: **removal of IUC at 48 h who received TURP** Group 1 (n = 54): IUC removal at 48 h Group 2 (n = 55): removal of IUC according to surgeons' discretion **Size and type of catheter used (e.g. Foley 16F):** 20F, 3-way irrigating latex catheter with a 30 cc balloon, latex with hydrophilic coating **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A (TUIP) Group 1: 24 h, Group 2: at surgeons' discretion B (TURP) Group 1: 48 h, Group 2: at surgeons' discretion
Outcomes	Number of participants requiring recatheterisation after TUIP Number of participants requiring recatheterisation after TURP Mean length of hospital stay after TUIP Mean length of hospital stay after TURP Complete urinary retention at 3 months after TUIP Complete urinary retention at 3 months after TURP Mean flow at 3 months after TUIP Mean flow at 3 months after TURP Asymptomatic UTI 3 months after TUIP (done via urinalysis at 3-month follow-up)

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Irani 1995 *(Continued)*

	Asymptomatic UTI 3 months after TURP (done via urinalysis at 3-month follow-up)
Definition of CAUTI or bacteriuria	Not reported: "Urinary infections at 3 months were asymptomatic and discovered by urinalysis"
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	4 participants lost to follow-up UTI detected using urinalysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Immediately postoperatively the patients were randomly divided into 2 groups using a permutation table" Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "The catheter was withdrawn according to the usual criteria of the surgeon …" Comment: unlikely that the participants or the personnel were blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "All patients were reviewed 3 months postoperatively with a PSA level and urine culture" Comment: likely that samples were sent to a laboratory and so unlikely that the microbiologist knew which patients would be in the trial
Incomplete outcome data (attrition bias) All outcomes	High risk	Quote: "Results excluding 24 patients whose hospitalisation was prolonged for social reasons" Comment: social reasons are not given, thus patients have been excluded for no valid reason.
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are also reported in results.
Other bias	Low risk	Appears free from other sources of bias

Iversen Hansen 1984

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** not reported

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Iversen Hansen 1984 *(Continued)*

Participants	**Number of participants:** 66 eligible; randomised, not reported; 43 reported **Country:** Denmark **Population:** unclear **Age (median and range):** 70 (24-85) **Inclusion criteria:** patients with urethral strictures **Condition for hospitalisation (e.g. hysterectomy or TURP):** urethral strictures **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** antibiotics were not administered routinely but patients with urinary infections pre- or post-operatively were treated with antibiotics according to urine culture.
Interventions	**Group A (n = 21):** IUC treatment for 1 day **Group B (n = 22):** IUC treatment for 14 days **Size and type of catheter used (e.g. Foley 16F):** unclear. Retrograde urethrography was performed with a 10F Foley catheter with balloon **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC treatment for 1 day post-op B: IUC treatment for 14 days post-op
Outcomes	Complication rate Recurrence of strictures using maximal flow rate ≤ 12 (mL/second) Recurrence of strictures using urethrography Restenosis Patient satisfaction
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	All participants had voiding interview, flowmetry and retrograde urethrography performed pre-operatively as well as 3 and 6 months post-operatively. A Disa flowmeter, type 517B was used for flowmetry Antibiotics were administered only to participants with UTI 23 participants did not complete the operative and post-operative programme Information regarding reasons for withdrawals and losses to follow-up provided

Risk of bias

Bias	Authors' judgement	Support for judgement

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Iversen Hansen 1984 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Quote: "For the operation, patients were randomly allocated into two groups …" Comment: randomisation performed although method of randomisation is not stated
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Blinding of participants unlikely to be possible in this situation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Urinary infections pre- or postoperatively were treated with antibiotics according to urine culture …" Comment: suggests that urine samples were sent to a laboratory. Unlikely the microbiologists knew which patient belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Quote: "Of the 66 patients admitted to the study, 23 patients did not complete the operative and post-operative programme." Comment: large withdrawal numbers. Reasons for withdrawal given but not reported in relation to intervention group
Selective reporting (reporting bias)	High risk	Outcomes are not reported in methods and are reported in the results section only. Protocol not available for assessment
Other bias	Low risk	Appears to not be at risk of any other bias

Jang 2012

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** May 2007-September 2010
Participants	**Number of participants:** 113 eligible; 94 randomised (abstract reports 105 randomised); 94 reported (abstract reports 105) **Country:** Korea **Population:** mixed **Age (mean and range):** A 54.0 (48.0-62.0); B 59.0 (54.0-66.0) **Inclusion criteria:** rectal cancer patients 20-80 years old in general good health, willing to participate in the study, understand and accept to sign the informed consent form, receiving proctectomy for rectal cancer located ≤ 15 cm of the anal verge **Condition for hospitalisation:** surgery for rectal cancer

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Jang 2012 *(Continued)*

	Exclusion criteria: documented problem of pre-operative urinary dysfunction, any post-surgery change in patient condition that requires insertion of IUC after surgery, past history of recurrent UTI or malignancy of urinary system organs, past history of surgery for urinary system organs, current administration of Finasteride or Dutasteride Liver dysfunction (SGOT or SGPT ≥ 100 IU/L), kidney dysfunction (serum creatinine ≥ 3 mg/dL) **Use of antibiotic prophylaxis:** all patients were given IV injections of a single dose of antibiotic during anaesthesia induction and before the operation
Interventions	**Group A (n = 47 (abstract reports 51)):** tamsulosin 0.2 mg/day orally from the day of the operation to post-operative day 7 **Group B (n = 47 (abstract reports 54)):** no intervention **Size and type of catheter used (e.g. Foley 16F):** 16F or 18F Foley **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Groups A and B: 3 days after operation. On post-operative day 3, the maximum and average flow rates were checked after removing the IUC. Voided volume, residual urine volume, and IPSS* were checked on post-op day 7. A IUC was reinserted if the patient failed to void successfully after removing the catheter. Unsuccessful voiding was defined as follows: (1) no voiding sensation for > 6 h after removing the catheter; (2) voided volume < 100 mL; or (3) residual urine volume < 200 mL
Outcomes	N requiring recatheterisation on post-op day 3 Voided volume on post-op day 7 (mL) Residual volume on post-op day 7 (mL) Hospital stay (days) (median, IQR, N) Other complications (excluding acute voiding difficulty) Wound problem Chylous ascites Ileus Intraluminal bleeding UTI Rectovaginal fistula Anastomotic leakage IPSS (post-op day 7) QoL due to urinary symptoms
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Approved and overseen by the institutional review board of our hospital (approval no. B-0702-042-006) (Seoul National University Bundang Hospital)

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Jang 2012 *(Continued)*

Notes	*Scores for individual domains of IPSS also reported, if needed (0–35 scale, higher score = more severe symptoms. QoL component of IPSS (0-6 scale, higher score = lower QoL)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “patients were randomized (1:1)… using computer generated numbers” Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Control group gets no intervention at all. Protocol is available on Clinicaltrials.gov record states "double blind (Subject, Caregiver, Investigator)" but there is no description of placebo intervention. Lack of blinding or lack of placebo could influence the care provided or the perception of symptoms.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported in published version of the report. Protocol is available on Clinicaltrials.gov record states "double blind (Subject, Caregiver, Investigator)"
Blinding of microbiological outcome (detection bias)	Low risk	Not reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	Outcomes specified in clinicaltrials.gov record are reported
Other bias	Low risk	Nothing to indicate any other source of bias

Jeong 2014

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** April 2010-July 2011
Participants	**Number of participants:** eligible, not stated; 236 randomised; 218 reported in primary analysis, 207 in secondary analysis **Setting:** Seoul **Country:** Korea **Population:** men **Age (e.g. mean and SD):** Group A (intervention) 63.6 (6.6); Group B (control) 63.4 (8.0) **Inclusion criteria:** localised or locally advanced prostate cancer; undergoing robot-assisted laparoscopic radical prostatectomy (RARP); able to provide written informed consent

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Jeong 2014 *(Continued)*

	Condition for hospitalisation: RARP **Exclusion criteria:** patients must not have a history of treatment with alpha blockers within 4 weeks; patients must not have previously undergone transurethral resection, laser therapy, or other surgery of the prostate; patients must not have previously been diagnosed with neurogenic bladder; patients must not have hypersensitivity to trial drug or other alpha-blockers; patients must not have the participation of other clinical trial within the past 3 months **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 118):** treatment with 0.4 mg of tamsulosin from the day before RARP up until 14 days after surgery (tamsulosin group) **Group B (n = 118):** no tamsulosin treatment (control group) **Size and type of catheter used (e.g. Foley 16F):** 20 FR Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** IUC was removed on the 5th post-op day for both groups
Outcomes	ICS male short-form questionnaire 2 weeks after surgery: voiding sum, incontinence sum, frequency score, nocturia score, QoL item Postvoid residual volume, 2 weeks after surgery (mL) IPSS 2 weeks after surgery (including total score, storage subscale, voiding subscale, IPSS QoL item) AUR (participants with AUR on post-op day 5 (defined as a painful, palpable or percussable bladder, with the patient unable to pass any urine) Adverse events
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	This study was supported by Astellas Pharm, Co.
Ethical approval	The study was approved by the local institutional review board and registered at the ClinicalTrial.gov website (ID: NCT01209988)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… randomly assigned" Comment: mentions randomised but does not specify method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not possible to blind participants

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Jeong 2014 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No differential attrition. Per-protocol analysis only
Selective reporting (reporting bias)	Low risk	Outcomes in methods also presented in results section
Other bias	Low risk	Appears to be free from other sources of bias

Joshi 2014

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** July 2008-December 2009
Participants	**Number of participants:** eligible, not reported; 70 randomised; 70 reported **Setting:** Chandigarh **Country:** India **Population:** women **Age (mean ± SD):** A 46.80 ± 6.90; B 45.09 ± 6.44 **Inclusion criteria:** women undergoing uneventful abdominal hysterectomy with or without salpingo-oophorectomy **Condition for hospitalisation:** abdominal hysterectomy with or without salpingo-oophorectomy **Exclusion criteria:** anticipated complicated surgical procedure requiring strict fluid replacement post-operatively; bladder suspension or colporrhaphy surgery; positive or unavailable pre-operative urine culture report; comorbid illness requiring strict intake output monitoring **Use of antibiotic prophylaxis:** all patients received 1 dose of antibiotic prophylaxis at the time of surgery and continued post-operatively as per department protocol
Interventions	**Group A (n = 35):** immediate removal of IUC in the operating room **Group B (n = 35):** IUC removal after 24 h **Size and type of catheter used (e.g. Foley 16F):** standard 16F Foley's catheter with 10 cc balloon **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: immediate removal of IUC in the operating room

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Joshi 2014 *(Continued)*

	B: removal of IUC 24 h post-operatively
Outcomes	Recatheterisation (defined as inability to pass urine at the end of 12 h, or failure to void after 2 attempts) Positive urine culture on day 2 post-op Positive urine culture 2 weeks post-op Febrile morbidity Pain perception
Definition of CAUTI or bacteriuria	"The diagnosis of symptomatic UTI was based on the presence of significant bacteriuria accompanied by at least one of the following symptoms: Fever, dysuria, increased frequency of urination, urinary urgency, suprapubic pain, and burning micturition."
Sponsorship/funding	Not reported
Ethical approval	"Informed consent was obtained from enrolled patients and protocol was approved by the Institute's Ethical Committee."
Notes	Pain was assessed with a pictorial questionnaire that assessed the level of pain and location of pain, that is, bladder or urethra versus surgical site. The questionnaires were site-specific for the pain. All patients were given same analgesia in the post-operative period. Febrile morbidity was defined as 2 consecutive oral temperatures of > 100.4 °F (37.78 °C) measured 6 h apart. Of 12 culture-positive most common organism was *Escherichia coli*. None of these had repeat culture-positive at 2 weeks. 3/9 culture-positive cases in late removal group had symptoms of UTI and fever.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed by using a computer generated randomization table" Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: "Allocation group was kept in sealed envelope. The operating surgeon was made aware of randomization and accordingly the patient was assigned to one of the two groups. In all cases, the envelope was opened at the end of the surgical procedure" Comment: adequate concealment method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Blinding not possible due to intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "a limitation of our study may exist in the fact that the observer of outcome was not blinded to the randomization" Comment: observer was not blinded to randomisation
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "A clear voided midstream urine specimen was obtained on the second postoperative day for culture and sensitivity."

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Joshi 2014 *(Continued)*

		Comment: urine samples likely were sent to a laboratory and so microbiologist is unlikely to know which patients belong to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported, all participants who were randomised were included in analysis
Selective reporting (reporting bias)	Unclear risk	Symptomatic UTI does not seem to be reported
Other bias	Low risk	Appears to be free from other sources of bias

Jun 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** from June 2008-February 2010
Participants	**Number of participants:** 90 eligible; 90 randomised; 90 reported **Setting:** Shanghai **Country:** China **Population:** mixed **Age (mean ± SD):** Group A 68.71 ± 7.60; Group B 71.40 ± 7.85 **Inclusion criteria:** lower urinary tract symptoms such as urinary tract stimulation or urinary tract obstruction; enlarged prostate gland diagnosed with rectal examination or B-mode ultrasonography; aged between 55-86 years **Condition for hospitalisation:** TURP **Exclusion criteria:** gastric retention; glaucoma; prostatic cancer; detrusor muscle weakness; diabetes; abnormal liver function; severe UTI **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A:** IUC until the urine turned clear in conjunction with 0.2 mg tamsulosin hydrochloride once a day and 200 mg celecoxib twice a day for a week. **Group B:** IUC for 5 days post-op **Size and type of catheter used (e.g. Foley 16F):** not mentioned **Study definition of short-term catheterisation (days):** not mentioned **Intended duration of catheterisation for each group:** Group A: 1 day Group B: 5 days
Outcomes	Success rate of the first time catheter removal i.e. participants not requiring recatheterisation Length of hospitalisation Incidence of urinary retention

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Jun 2011 *(Continued)*

	Cystospasm Haemorrhage
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	Appears to be no withdrawals or dropouts. All participants were accounted for in the results section.
Selective reporting (reporting bias)	Unclear risk	Not reported
Other bias	Low risk	Not reported

Kamilya 2010

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** August 2005-December 2007
Participants	**Setting:** Kolkata **Country:** India

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Kamilya 2010 *(Continued)*

	Population: women **Inclusion criteria:** patients undergoing vaginal prolapse surgery **Condition for hospitalisation:** vaginal prolapse surgery **Exclusion criteria:** women for whom complicated surgical procedure was anticipated (patient with long-standing prolapse with severe fibrosis); prolapse surgery associated with plan of bladder or vault suspension or repair by mesh; only posterior colporrhaphy **Number of participants:** 200 eligible; 200 randomised; 197 reported **Age (mean ± SD):** A 46.9 ± 12.02; B 47.9 ± 12.78 **Use of antibiotic prophylaxis:** all participants received 2 doses of antibiotic injection ceftriaxone (1 g). 1 just before the operation and another dose 12 h after the 1st dose
Interventions	**Group A (n = 98):** IUC removal on the 1st post-op day **Group B (n = 99):** IUC removal in the 4th post-op day **Size and type of catheter used (e.g. Foley 16F):** no.16 Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 1 day after surgery, plus 3 days if not able to void or when there was no urge within 8 h after catheter removal, or plus 3 days if residual urine volume > 150 mL B: 4 days after surgery, plus 3 days if not able to void or when there was no urge within 8 h after catheter removal, or plus 3 days if residual urine volume > 150 mL
Outcomes	Mean catheter days Number of participants requiring recatheterisation (if not able to void or when there was no urge within 8 h after the catheter removal, or residual urine volume > 150 mL) (%) Mean hospital days (defined as the time interval between the completion of surgery and hospital discharge) Mean hospital days of recatheterised patients UTI UTI asymptomatic UTI symptomatic Post-op fever Post-op antibiotic treatment other than UTI
Definition of CAUTI or bacteriuria	The presence of UTI was defined as positive urine culture of > 10^5 cfu/mL. plus one of the following: dysuria, fever > 38.5°C or rigors
Sponsorship/funding	Not reported
Ethical approval	"Ethical approval for the study was obtained from hospital institutional review board. A written informed consent was obtained from all patients before the randomization process."
Notes	

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Kamilya 2010 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed by using a computer generated randomization list drawn up by a statistician." Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: "Assignments were placed in sealed serially numbered opaque envelopes and were revealed only after the end of operative procedure." Comment: adequate concealment method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible due to intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Sample of urine was sent for culture during catheter removal." Comment: urine samples were sent to a laboratory for analysis. Unlikely that microbiologist knew which patient was in the trial and which was not
Incomplete outcome data (attrition bias) All outcomes	Low risk	No differential attrition. Adequate explanation for withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in methods are identical to those presented in the results section
Other bias	Low risk	Appears to be free from other sources of bias

Kelleher 2002

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 160 randomised; 160 reported **Country:** Australia **Population:** not reported **Age (mean and SD):** not reported **Inclusion criteria:** patients admitted to urology or renal unit **Condition for hospitalisation:** urological surgery

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Kelleher 2002 *(Continued)*

	Exclusion criteria: patients with suprapubic catheters, those admitted for trial of void, undergone open prostatic or bladder surgery, with dementia or psychiatric illness **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 80):** removal of IUC at 6 am **Group B (n = 80):** removal of IUC at midnight **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: removal of catheter at 0600 h the day after the surgery B: removal of catheter at midnight the same day as the surgery
Outcomes	Time to first void Volume of first void Discharge same day as catheter removal Patients requiring recatheterisation IUC not removed on time
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Majority (61%) of the patients had TURP Patients in the midnight group were catheterised within 12 h of catheter removal while patients in the morning removal group were catheterised 24 h-30 h after catheter removal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… randomly allocated to one of two groups using a computer generated random number table. The odd numbers were allocated to group 1 … the even numbers were allocated to group 2." Comment: randomisation used however method of randomisation doesn't seem truly random
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely it was possible to blind participants
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported

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Kelleher 2002 *(Continued)*

All outcomes		
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcomes are reported for all participants. No withdrawals or dropouts reported
Selective reporting (reporting bias)	Low risk	All outcomes are reported in both the methods section and the results section
Other bias	Low risk	Appears to be no other sources of bias.

Kim 2012

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 67 randomised; 67 reported **Country:** South Korea **Population:** men **Age:** not reported **Inclusion criteria:** patients who underwent extraperitoneal laparoscopic radical prostatectomy **Condition for hospitalisation:** radical prostatectomy **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 30):** IUC removed on post-op day 3, 4 **Group B (n = 37):** IUC removed on post-op day 7, 8 **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 3 or 4 days post-op B: 7 or 8 days post-op
Outcomes	Recatheterisation Continence at 3 months (defined as ≤ 1 pad per day) Time to acquisition of continence (months) Complications

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Kim 2012 *(Continued)*

	Hospital duration
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	All information is from a conference abstract

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… randomly categorised…" Comment: mentions randomised but randomisation method is not defined
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely it is possible to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No withdrawals reported. As only abstract, full data check is not possible
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full.
Other bias	Low risk	Appears to be free from other sources of bias

Koh 1994

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** September 1992-December 1992
Participants	**Setting:** Leeds **Country:** UK **Population:** men

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Koh 1994 *(Continued)*

	Inclusion criteria: patients undergoing TURP for bladder outflow obstruction **Condition for hospitalisation:** TURP **Exclusion criteria:** patients whose urine was still darkly blood-stained or whose temperature was above 38 °C. In addition, 1 patient was excluded because he had sustained an iatrogenic injury and 5 others because they had chronic retention of urine and a longer period of catheterisation was considered to be beneficial **Number of participants:** 96 eligible; 59 randomised; 59 reported **Age (mean (SD)):** Group A 68.8 (7.3); Group B 73.0 (7.6) **Use of antibiotic prophylaxis:** "Antibiotics were given at induction to patients with indwelling catheters or proven urinary tract infections"
Interventions	**Group A (n = 29):** IUC removed on 1st post-op day **Group B (n = 30):** IUC removed on 2nd post-op morning **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removal on the 1st post-op morning B: IUC removal on the 2nd post-op morning
Outcomes	Average length of hospital stay Incidence of recatheterisation Incidence of UTI Incidence of secondary haemorrhage Incidence of DVT
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	31 patients excluded prior to randomisation because urine was still darkly blood stained or had a temperature above 38 degrees centigrade 1 patient excluded because he had iatrogenic injury 5 others excluded because they had chronic retention of urine and required a longer period of catheterisation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomized into two groups …" Comment: unclear how randomisation was performed

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Koh 1994 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely it was possible in this respect to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "… patients who were found to have positive urine cultures in specimens taken at the time of catheter removal: as they had already been discharged by the time the results were available this information was communicated to their general practitioners who treated them appropriately" Comment: suggests that microbiologist would have received the samples at the laboratory like every other patient
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Excluded were 31 patients whose urine was still darkly blood-stained or whose temperature was above 38°C …" Comment: no withdrawals reported. All those who were randomised went on to complete the trial. Any participant excluded was excluded with valid reason
Selective reporting (reporting bias)	Low risk	All outcomes in methods section accounted for in the results sections. Protocol not available.
Other bias	Low risk	No indications of other bias

Kokabi 2009

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 189 randomised; 189 reported **Country:** Iran **Population:** women **Age:** not reported **Inclusion criteria:** patients who had undergone anterior colporrhaphy due to pelvic organ prolapse and stress incontinence **Condition for hospitalisation:** anterior colporrhaphy for pelvic organ prolapse **Exclusion criteria:** > 1 surgery at the time of colporrhaphy were excluded **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 62):** removal of IUC after 1 day **Group B (n = 64):** removal of IUC after 2 days

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Kokabi 2009 *(Continued)*

	Group C (n = 63): removal of IUC after 4 days "In all three groups, the catheter Foley were clamped every 4 hrs for 3 times" **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 1 day B: 2 days C: 4 days
Outcomes	Number requiring recatheterisation Post-void residual volume > 68% Post-void residual volume < 33% Post-void residual volume between 33% and 68% UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Financial support from Department of Research and Education of Fasa Medical University for their financial supports
Ethical approval	Not reported
Notes	In all 3 groups, the catheter Foley was clamped 3 times every 4 h to keep bladder ready for urination. Finally, before opening the Foley clamp, the catheter was removed from the bladder and the participants were guided for immediate urinary evacuations. In the meantime, the residual urine was collected and measured. The ratio of the post-void residual urine volume and the total urine volume of each participant were measured.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… selected randomly and divided into three different groups … the patients were divided in three groups according to their post void residual volume of less than 33%, between 33 to 68% and more than 68%." Comment: unclear how randomisation process occurred. It seems that patients were randomised into 3 groups and then further stratified after their post-void residuals were obtained.
Allocation concealment (selection bias)	High risk	Quote: "The patients were divided in three groups according to their post void residual volume of less than 33%, between 33 to 68% and more than 68%." Comment: concealment did not occur as investigator needs to know which participant belongs to which group in order to do this.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding occurred due to the type of intervention

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Kokabi 2009 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist knew patients belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Quote: "The patients who had more than one surgery at the time of Colporrhaphy were omitted" Comment: unclear what this refers to e.g. were they excluded before or after randomisation?
Selective reporting (reporting bias)	Unclear risk	Some outcomes in methods not reported in results fully e.g. post-void residual volume (mL) and total urine volume (mL)
Other bias	Low risk	Appears to be free from other sources of bias

Lang 2020

Study characteristics	
Methods	**Study design:** RCT **Setting:** The Christ Hospital, Cincinnati, USA **Dates study conducted:** November 2014-August 2017
Participants	**Population:** women **Inclusion criteria**: all women presenting to The Christ Hospital for gynaecologic surgery anticipated to require at least a 1-night stay and who would be expected to have an IUC overnight **Condition for hospitalisation:** benign gynaecological surgery **Exclusion criteria**: patients with a current UTI being treated with antibiotic(s), or anticipated to undergo concomitant prolapse or incontinence surgery, or a pre-operative diagnosis of gynaecologic malignancy, or a history of chronic IUC use, or a history of renal transplant or current dialysis use, or intraoperative lower urinary tract injury necessitating prolonged post-op catheter use **Number of participants:** 200 eligible; 200 randomised; 164 reported **Age (mean and SD):** 44.4 ± 8.8 years **Use of antibiotic prophylaxis**: all participants received pre-operative antibiotics with either The American College of Obstetricians and Gynecologists approved dosing of cefazolin (78%) or a combination of gentamicin and clindamycin (22%) with no difference between fast-track or conventional Foley management groups (P = 0.54).
Interventions	**Group A (n = 81)**: IUC removal 4-h post-op ("fast track") **Group B (n = 83)**: IUC removal day 1 post-op ("conventional") **Size and type of catheter used**: not reported **Study definition of short-term catheterisation (days):** 1 day **Intended duration of catheterisation for each group:**

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Lang 2020 *(Continued)*

	Group A: 4 h post-op Group B: 1 day post-op
Outcomes	Median dwell time for Foley catheters Voiding trial failure rate Incidence of UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	The institutional review board at The Christ Hospital approved this trial investigating 2 catheter management strategies among postgynaecologic surgery patients
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “Permuted block randomization was performed, via “Microsoft Excel,” with a block size of 4 used to ensure balanced enrolment.” Comment: adequate method of restricted randomisation
Allocation concealment (selection bias)	Low risk	Quote: “The allocation sequence was concealed from the researcher enrolling patients through the use of sequentially numbered, opaque sealed envelopes” Comment: adequate allocation method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assumed microbiologist was blinded
Incomplete outcome data (attrition bias) All outcomes	High risk	Quote: "In addition, our study had a dropout rate of 38%. This is likely due to the fact that postoperative follow-up was obtained via phone calls and not in-person at the time of a clinic visit." Comment: 124 participants included in the final analysis from the original 200 participants who were randomised. Large dropout due to loss to follow-up
Selective reporting (reporting bias)	Low risk	Outcomes mentioned in methods are reported in results section. Protocol not available for assessment

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Lang 2020 *(Continued)*

Other bias	Low risk	Appears to be free from other sources of bias

Lau 2004

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2002-June 2003
Participants	**Number of participants:** eligible, unclear; 60 randomised; 60 reported **Setting:** Hong Kong **Population:** mixed **Age (mean and SD):** overall mean 63.3 (14.9) **Inclusion criteria:** all patients who underwent inpatient elective general surgery **Condition for hospitalisation:** all elective patients in general surgery **Exclusion criteria:** ambulatory surgery, endoscopic procedures, procedures performed under local anaesthesia, urological procedures, as well as abdominal operations that required pre-operative IUC **Use of antibiotic prophylaxis:** "In the present study a single dose of parenteral antibiotic was given upon induction of general anaesthesia in most cholecystectomies, hernia repairs, gastrointestinal and anorectal operations. This could account for the low incidence of urinary tract infection."
Interventions	**Group A (n = 31):** in-out catheterisation **Group B (n = 29):** IUC overnight **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: "in-out catheterization" B: IUC until 24 h after surgery
Outcomes	Recatheterisation after removal of IUC Positive urine culture Mean length of hospital stay
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	This project was partly supported by The Tung Wah Group of Hospitals Research Fund
Ethical approval	The research protocol was approved by the Hospital Ethics Committee of Tung Wah Hospital
Notes	Urinary retention was defined as the requirement of IUC, which was performed only if the patient failed to pass urine and was found to have a palpable urinary bladder.
Risk of bias	

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Lau 2004 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "Randomization method was based on the patient's hospital number. Patients whose hospital number was odd were assigned to in–out catheterization while the patients with even hospital numbers were randomized to have the catheter left indwelling until 24h after operation" Comment: randomisation process not truly random
Allocation concealment (selection bias)	High risk	Group allocation can be worked out due to odd or even number of patient's hospital number
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Not possible to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Catheterized urine was sent for routine microscopy and culture." Comment: unlikely microbiologist knew which patients were in the study
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported. All patients that were randomized had their outcomes reported.
Selective reporting (reporting bias)	Low risk	Outcomes are reported both in the methods section and results section in full. No protocol was available.
Other bias	Low risk	Appears to be free from other sources of bias

Li 2014

Study characteristics	
Methods	**Study design:** quasi-RCT, single-centre study **Dates study conducted:** not reported
Participants	**Number of participants:** 128 randomised **Setting:** not reported **Country:** Mongolia **Population (men/women/mixed)**: patients in the hospital with benign prostatic hyperplasia **Condition for hospitalisation (e.g. hysterectomy or TURP):** benign prostatic hyperplasia **Age (mean and SD)**: range 56–92. No further details reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 64):** removal of IUC on post-op day 1-2

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Li 2014 *(Continued)*

	Group B (n = 64): removal of IUC on post-op days 5-7 **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: removal of IUC on post-op day 1-2 Group B: removal of IUC on post-op days 5-7
Outcomes	Length of hospital stay Residual urine Infection Complication (urethral strictures)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	None reported
Ethical approval	None reported
Notes	Paper translated

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Patients were allocated to intervention and control group using a random number chart, based on the order they completed surgery
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Likely not possible given intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported in translation of trial
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist knew participants belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	All data accounted for
Selective reporting (reporting bias)	Low risk	Appears to be free from reporting bias
Other bias	Low risk	Nothing to suggest any other source of bias from translation

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Liang 2009

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** July 2007-January 2008
Participants	**Number of participants:** 162 eligible; 150 randomised; 150 reported **Setting:** Taiwan **Population:** women **Age (mean ± SD):** A 43.7 ± 3.9; B 45.7 ± 3.5; C 45.7 ± 5.8 **Inclusion criteria:** consenting women undergoing laparoscopic-assisted vaginal hysterectomy. Included uterine myoma, adenomyosis, tubo-ovarian abscess, intra-epithelial neoplasia of the cervix, grade 3 and intractable hemorrhagic **Condition for hospitalisation:** hysterectomy **Exclusion criteria:** patients that had pelvic organ prolapse or urodynamic stress incontinence or found with bacteriuria form pre-operative urinalysis or clinically adverse urinary symptoms such as dysuria, frequency of micturition, urgency stress incontinence or obstructive voiding symptoms **Use of antibiotic prophylaxis:** IV prophylactic antibiotics consisting of cefazolin 500 mg after induction of general anaesthesia
Interventions	**Group A (n = 50):** no IUC **Group B (n = 50):** IUC removed after 1 day **Group C (n = 50):** IUC removed after 2 days **Size and type of catheter used:** indwelling Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: no IUC use post-op B: IUC removed 1 day post-op (removal at 7 am-8 am) C: IUCremoved 2 days post-op (removal at 7 am-8 am)
Outcomes	UTI Urinary retention Duration of catheter time
Definition of CAUTI or bacteriuria	UTI was defined as a positive urine culture with colonies of bacteria > 10^5 organisms/µL. However, treatment was instituted for positive urine cultures only if the patient had adverse urinary symptoms or post-op pyrexia (> 38 °C).
Sponsorship/funding	This work was supported by Medical Research Project Grant CMRPG 360291 and BMRP 412 from Chang Gung Memorial Hospital
Ethical approval	The ethics committee of the hospital approved the study protocol (No. 95-1179B).

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Liang 2009 *(Continued)*

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomly allocated …" Comment: unclear as to how randomisation was actually performed
Allocation concealment (selection bias)	Low risk	Quote: "Randomization was achieved by selection of sealed envelopes, which were opened just before surgery. When patients' number in each group reached 50, we ended the patient collection." Comment: adequate method of concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Likely not possible to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist knew participants belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	All outcomes reported in full in methods and results sections
Other bias	Low risk	Appears to be free from other sources of bias

Lista 2020

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** September 2016-May 2017
Participants	**Population:** men **Setting:** Milan **Country**: Italy **Inclusion criteria**: inclusion criteria were age ≤ 75 years, signed informed consent, and absence of contraindications to robotic surgery. Furthermore, only patients with a negative leakage test, performed intraoperatively with intravesical administration of 250 cc of diluted methylene blue, were included. **Condition for hospitalisation:** robot-assisted radical prostatectomy for localised prostate cancer

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Lista 2020 *(Continued)*

	Exclusion criteria: previous prostatic or urethral surgery, previous pelvic radiation therapy, presence of urethral disease (e.g. urethral strictures and diverticulum), and pre-existing urinary stress, urge, or mixed incontinence **Number of participants:** 206 eligible; 176 randomised; 146 reported **Age (median and range):** A 63 (48-75); B 64 (45–75) **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 72)**: IUC removal post-op day 3 **Group B (n = 74)**: IUC removal post-op day 5 **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: removal 3 days post-op Group B: removal 5 days post-op
Outcomes	AUR Length of hospital stay UTI at 30 days
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	None
Ethical approval	After Ethical Committee approval (internal protocol no. 1624)
Notes	"In addition, the economic impact of this strategy has been evaluated. A significant reduction in costs was observed in group 1, with €296 saved per patient and with a total amount of approximately €80 000 saved yearly.Considering also the potential number of hospital beds gained, it has been estimated that almost €320 000 per year could be saved as an additional benefit".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: “were randomly allocated with a 1:1 ratio to the two study arms” Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Lista 2020 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. It is likely that urine samples were sent to a laboratory where the microbiologist would be blinded to participants involved in the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Figure 1 illustrates 7 participants lost to follow-up with no clear explanation
Selective reporting (reporting bias)	Low risk	All outcomes stated in methods section and protocol reported
Other bias	Low risk	Appears to be free from other sources of bias

Liu 2015

Study characteristics	
Methods	**Study design:** quasi-RCT **Dates study conducted:** February 2012-June 2012
Participants	**Number of participants:** 89 eligible; 79 randomised; 79 reported **Setting:** Beijing **Country:** China **Population:** mixed **Age (mean ± SD):** A 51 ± 13.2; B 52 ± 16.4 **Inclusion criteria:** undergone neurosurgery; IUC in situ upon return from the operating theatre; planned IUC duration of 1-14 days; aged 18-85 years; willingness to participate in the study; pre-operatively able to urinate without problem and express the intention to urinate **Condition for hospitalisation:** patients undergoing neurosurgery **Exclusion criteria:** IUC in situ pre-operatively; history of UTI; prostatic hyperplasia; urologic problems or sensory disorders; unable to communicate; signs of cognitive impairment defined as: disorientation to place, time or person, disorganised thinking or agitation **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 39):** no clamping of participants' IUC i.e. control group **Group B (n = 40):** clamping of participants' IUC i.e. observation group **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: no clamping of participants' IUC i.e. control group B: clamping of participants' IUC i.e. observation group
Outcomes	Time to first void Urinary retention requiring re-catheterisation

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Liu 2015 *(Continued)*

	Abnormal micturition function Volume of first void Dysuria Incomplete voiding
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"The study was approved by a University Ethics Review Board and Director of Nursing. The research protocol conformed with the provisions of the Declaration of Helsinki (1995)."
Notes	"the IDC [indwelling catheter] was clamped immediately upon return from the operating theatre and unclamped at certain intervals. The intervals were adjusted by the bedside nurse depending on the patient's input and output volumes, in order to avoid over distension of the bladder. If the patient was receiving intravenous fluids, the IDC was unclamped at 2–3 h intervals for 10 min at a time. If the patient was not receiving intravenous fluids, the IDC was unclamped at 3–4 h intervals. During catheter clamping periods, patients were told to notify the nurse when they felt the need to urinate and that the nurse would then unclamp the catheter. The duration of each unclamping period was 10 min to allow for complete bladder emptying. For removal, nurses clamped the catheter again and removed it clamped when the patient felt the need to urinate."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "The neurosurgical ward has four structural divisions: A, B, C and D. Participants admitted to divisions A and B were in the observation group, and those admitted to C and D, the control group" Comment: used quasi-randomisation
Allocation concealment (selection bias)	High risk	Quote: "The neurosurgical ward has four structural divisions: A, B, C and D. Participants admitted to divisions A and B were in the observation group, and those admitted to C and D, the control group" Comment: no allocation concealment as used quasi-randomisation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "The study was not blinded. This was not actually possible and might have increased the risk of observer bias."
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "The study was not blinded." Comment: blinding not performed
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist would know which patient belonged to the study when samples were sent to the laboratory
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported

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Liu 2015 *(Continued)*

Selective reporting (reporting bias)	Low risk	All outcomes are reported in full.
Other bias	Low risk	No other indications to other sources of bias

Lyth 1997

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 118 randomised; 107 reported **Country:** UK **Population:** unclear **Age (mean and SD):** not reported **Inclusion criteria:** TURP or bladder neck incision **Condition for hospitalisation:** TURP or bladder neck incision **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 33):** removal of IUC at 6 am **Group B (n = 39):** removal of IUC at midnight A third group of 35 participants were not included in our analysis because they received an intervention (infusion trial of micturition) that was outside the scope of this review. **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed at 6 am B: IUC removed at midnight C: infusion trial of micturition (infusion performed by nursing staff, infusing saline from a 500 mL bag of saline via a standard IV giving set attached to the catheter at a fast drip rate until the patient felt the bladder was full)
Outcomes	Mean volume of first void (mL) Removal of catheter to discharge decision (h; mean, SD) Incidence of urinary retention and recatheterisation Patient satisfaction
Definition of CAUTI or bacteriuria	Not reported

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Lyth 1997 *(Continued)*

Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	96 participants had TURP and 22 participants had bladder neck incision 11 participants were excluded from the analysis as data on 5 participants were incomplete and 2 participants had to be recatheterised

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… randomized trial …" Comment: unclear as to what the randomisation process involved
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that participants could have been blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	High risk	5/118 excluded due to missing data, 6/118 excluded because they "failed the trial and had to be re-catheterised". Unclear which intervention group these belonged to
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full in methods and results sections
Other bias	Low risk	Appears to be free from other sources of bias

Mao 1994

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** February 1992-November 1992
Participants	**Population**: obstetric ward patients who underwent abdominal surgery (total hysterectomy or salpingo-oophorectomy). No previous urinary incontinence or infection. No urinary leakage or damage during surgery **Country**: China **Condition for hospitalisation:** abdominal surgery (total hysterectomy or salpingo-oophorectomy)

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Mao 1994 *(Continued)*

	Exclusion criteria: ovarian or cervical conditions were exclusions Surgical wounds too severe **Number of participants:** 227 randomised; 227 reported **Age (mean and SD):** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 114)**: IUC removal same day **Group B (n = 113)**: IUC removal next day **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A (intervention): catheter duration 7 am to 8 pm same day (114) Group B (control): catheter duration 7 am to 6 am next day (113)
Outcomes	Number of participants who passed urine spontaneously after removal (defined as passing spontaneously = able to pass without dribbling or sensation of incomplete urination, post-void volume < 100 mL, passing more than a small amount. Any of the above present considered failure to pass spontaneously) Amount of urine passed for first voiding Time to first spontaneous passage of urine Total number of times passing urine within 12 h of removal
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation process not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported

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Mao 1994 *(Continued)*

All outcomes		
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Can assume urine samples would have been sent to a lab where the microbiologist would have been blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	No evidence to suggest any missing data
Selective reporting (reporting bias)	Low risk	No evidence to suggest selective reporting
Other bias	Low risk	No other sources of bias noted

Matsushima 2015

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** March 2012-September 2014
Participants	**Number of participants:** 125 eligible; 119 randomised; 113 reported **Country:** Japan **Population:** men **Age (mean ± SD):** overall mean 65.9 ± 5.5 **Inclusion criteria:** localised prostate cancer without lymph node and distant metastasis and age < 75 years **Condition for hospitalisation:** prostate cancer **Exclusion criteria:** previous radiotherapy; previous prostatic; bladder neck; urethral, or pelvic surgery; presence of an IUC **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 60):** IUC removed on post-op day 2 **Group B (n = 59):** IUC removed on post-op day 4 **Size and type of catheter used:** 20-Fr Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A 2 days; B 4 days
Outcomes	AUR/recatheterisation Urinary incontinence (data related to treatment of cancer and not catheterisation); Continence (defined as a pad-free status) Serious complications Intraoperative urine leakage

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Matsushima 2015 *(Continued)*

Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Ethical approval for the design of this study was granted by the Keio University Hospital Ethical Committee. Written informed consent was obtained from all patients prior to participation in this study
Notes	This study was registered with the University Hospital Medical Information Network Clinical Trials Registry in Japan (UMIN000014944) on 12 March 2012

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was carried out after consent using a computer generated random table by an independent researcher who was not directly involved with the study." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Blinding was not possible in this trial because the timing of catheter removal was different." Comment: blinding was not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. No microbiological outcomes measured
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	3/60 and 3/59 excluded from analysis because of "extravasation". Comment: unclear how this will affect the outcome measures
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in methods are reported in results
Other bias	Low risk	Appears free from other sources of bias

McDonald 1999

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** November 1995-October 1996
Participants	**Number of participants:** eligible, unclear; 48 randomised; 48 reported

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McDonald 1999 *(Continued)*

	Country: Australia **Population:** men **Inclusion criteria:** patients undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria:** not reported **Age (mean and range):** A 66.7 (51-81); B 68.7 (57-89); overall: 67.8 (51-89) **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 20):** removal of IUC at midnight **Group B (n = 28):** removal of IUC at 6 am **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed at midnight B: IUC removed at 6 am
Outcomes	Mean volume of first void Mean time to first void Discharged same day as IUC removal Discharged next day
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"The study was approved by the research committee; verbal consent was judged adequate for participation in this investigation."
Notes	3 participants were withdrawn from analysis as 1 passed urine in the toilet without informing the staff, the second experienced an extended length of stay due to superficial vein thrombosis and the third failed his trial of void for 10 h after catheter removal. There was no significant difference between the 2 groups with respect to tissue pathology.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "A random-digit chart was used to allocate patients" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported

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McDonald 1999 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely participants were able to be blinded.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	3/48 excluded from analysis. Unclear which group these 3 belonged to.
Selective reporting (reporting bias)	Low risk	All outcomes seem to be reported in full in both the methods and results section. Protocol not available.
Other bias	Low risk	Appears to be free from other sources of bias

Naguimbing-Cuaresma 2007

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** April 2004-April 2005
Participants	**Population:** women **Setting:** Manila **Country**: Phillipines **Inclusion criteria:** women admitted for an elective repeat CS and those who underwent emergency CS for the following indications: malpresentation, multiple gestation, cord accidents, placenta praevia totalis, non-reassuring fetal status, and previous CS in labour **Condition for hospitalisation**: CS **Exclusion criteria:** pregnant patients with concomitant hypertensive diseases, cardiovascular diseases, preeclampsia, eclampsia, gestational diabetes mellitus, bronchial asthma, thyroid disorders, connective tissue diseases and malignancy **Number of participants:** 240 eligible; 240 randomised; 240 reported **Age (mean and SD):** not reported **Use of antibiotic prophylaxis**: not reported
Interventions	**Group A (n = 120)**: IUC removal 4 h post-op **Group B (n = 120)**: IUC removal 24 h post-op **Size and type of catheter used**: not reported **Study definition of short-term catheterisation (days):** 24 h

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Naguimbing-Cuaresma 2007 *(Continued)*

	Intended duration of catheterisation for each group: Group A: 4 h post-op Group B: 24 h post-op
Outcomes	Time to first void Urinary discomfort Time to first ambulate Length of hospital stay Number of participants requiring recatheterisation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Subjects were randomly assigned using a table of random numbers into two groups" Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "The surgeons were blinded prior to the operation as to where the patient would be included and would only be informed immediately after the cesarean section to give the post-operative order for urinary catheter removal" Comment: unlikely this was possible given intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "Interview was done on day 1 post operation by a medical personnel blinded from the study and information as to the time of first void, level of discomfort, time of first ambulation were obtained from each subject" Comment: outcome assessor blinded
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No dropouts or withdrawals
Selective reporting (reporting bias)	High risk	No baseline data reported. No data reported for discomfort measured by VAS

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Naguimbing-Cuaresma 2007 *(Continued)*

Other bias	Low risk	Appears to be free from other sources of bias

Nathan 2001

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 107 randomised; 107 reported **Setting:** Belfast **Country:** UK **Population:** women **Age (mean ± SD):** A 46.5 ± 5.6; B 45.7 ± 5.4 **Inclusion criteria:** women undergoing benign gynaecological surgery (morning lists) **Condition for hospitalisation:** benign gynaecological conditions **Exclusion criteria:** women with permanent indwelling catheters pre-operatively and those requiring prolonged catheterisation post-surgery e.g. operations for stress incontinence and gynaecological malignancies **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 52):** 6 am IUC removal on the second morning following surgery **Group B (n = 55):** 12 am catheter removal on the first day of surgery **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: until 6 am on the second morning after surgery B: until midnight on first day after surgery
Outcomes	Volume of first void (mL) Positive catheter specimen urine culture (%) Time to first void (min) Recatheterisation (%) Length of hospitalisation (day of discharge) Requiring night sedation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported

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Nathan 2001 *(Continued)*

Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: ".. were prospectively randomised…" Comment: randomisation method unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unlikely that blinding was not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist knew participants belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported, all patients in the study were included in the analysis
Selective reporting (reporting bias)	Low risk	Outcomes are reported in full with no missing data
Other bias	Low risk	Appears to be free from any other sources of bias

Nguyen 2012

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** March 2009-July 2011
Participants	**Number of participants:** eligible, not reported; 24 randomised; 24 reported **Setting:** Berne **Country:** Switzerland **Population:** unclear, potentially mixed **Age:** not reported **Inclusion criteria:** patients scheduled for internal urethrotomy **Condition for hospitalisation:** urethral strictures

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Nguyen 2012 *(Continued)*

	Exclusion criteria: not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 9):** post-op IUC for 2 days **Group B (n = 15):** post-op IUC for 10 days **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 2 days post-op B: 10 days post-op
Outcomes	Recurrent stricture Median stricture length (mm) Post-void residual volume: pre-op; 3 months post-op; 6 months post-op; 12 months post-op (no mean reported) IPSS IPSS – S (median (range)): pre-op; 3 months post-op; 6 months post-op; 12 months post-op IPSS – L (median (range)): pre-op ; 3 months post-op; 6 months post-op; 12 months post-op
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	None
Ethical approval	Not reported
Notes	Data obtained from conference abstract and so limited information

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Patients were randomised to postoperative …" Comment: randomisation was done but method not stated
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Not possible to blind the participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Nguyen 2012 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts mentioned in the study. Assume all participants went on to complete the study
Selective reporting (reporting bias)	Unclear risk	As this is an abstract with limited information, selective reporting seems unclear
Other bias	Low risk	Appears to be free from other sources of bias

Nielson 1985

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** 40 eligible; 40 randomised; 40 reported **Country:** Denmark **Population:** unclear **Age (mean and range):** A 64 (21-81); B 64 (16-78) **Inclusion criteria:** not reported **Condition for hospitalisation:** urethral stricture **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 20):** 3 days post-op IUC **Group B (n = 20):** 28 days post-op IUC **Size and type of catheter used:** 16 Foley silicone catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 3 days; B: 28 days
Outcomes	Incidence of epididymitis Urinary retention after removal of IUC Urethral pain and discharge Successful urethrotomy at 3 months Successful urethrotomy at 6 months
Definition of CAUTI or bacteriuria	Not reported

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Nielson 1985 *(Continued)*

Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Criteria for assessing results were as follows. Successful: patient satisfied, maximum urinary flow ≥ 10 mL/second Unsuccessful: patient not satisfied and or maximal flow < 10 mL /second

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… were randomly allocated …" Comment: method of randomisation not clear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely this was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	Outcomes are reported in full in both the methods and results sections. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

Noble 1990

Study characteristics

Methods	**Study design:** quasi-RCT **Dates study conducted:** not reported
Participants	**Number of participants:** 108 eligible; 108 randomised; 86 reported **Setting:** London **Country:** UK **Population:** mixed

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Noble 1990 *(Continued)*

	Age (mean and SD): not reported **Inclusion criteria:** patients requiring urethral catheterisation that were admitted to the urology unit **Condition for hospitalisation:** urological procedures and surgery **Exclusion criteria:** patients who had UTI prior to recruitment **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 46):** removal of IUC at 6 am **Group B (n = 40):** removal of IUC at midnight **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported
Outcomes	Volume of first void Time to first void Discharge same day as IUC removal IUC not removed on time
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	22 participants excluded from study due to pre-existing UTIs More men than women in each group

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "… entered alternately into 1 of 2 groups …" Comment: quasi-randomisation method
Allocation concealment (selection bias)	High risk	Quote: "… entered alternately …." Comment: unlikely any concealment occurred. Participant group could easily be found
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Not likely possible to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Noble 1990 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals, all data reported in full
Selective reporting (reporting bias)	Low risk	All outcomes seem to be reported in full in both methods and results
Other bias	Low risk	Appears to be free from other sources of bias

Nyman 2010

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** April 2006-March 2007
Participants	**Number of participants:** 348 eligible; 113 randomised; 113 reported **Country:** Sweden **Population:** mixed **Age (mean and SD):** A 79 ± 11.0; B 80 ± 11.2 **Inclusion criteria:** patients with a hip fracture in need of surgery **Condition for hospitalisation:** hip fracture; < 50 years **Exclusion criteria:** < 50 years, had a IUC at the time of admission, showed signs of cognitive impairment or had additional severe physical problems at admission. **Use of antibiotic prophylaxis:** not reported. However, skin disinfectant was used
Interventions	**Group A (n = 55):** use of clamping in IUC **Group B (n = 58):** free drainage of IUC **Size and type of catheter used:** 14 FR Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC clamped and removed at 6 am on post-op day 2 B: free-draining IUC removed at 6 am on post-op day 2
Outcomes	Time required to return to normal bladder function (median (quartiles)) Need for recatheterisation (%) Length of hospital stay, days (mean ± SD)

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Nyman 2010 *(Continued)*

Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	This research was supported by grants from the Department of Orthopaedics Orebro University Hospital and Centre for Assessment of Medical Technology, Orebro County Council
Ethical approval	Those who agreed to participate signed informed consent forms before data collection. Ethical approval was obtained from the regional ethical review board of Uppsala, Sweden.
Notes	In the Cochrane Review (Griffiths 2007), two trials reported that clamping reduced the time patients needed to return to normal bladder function. However, this trial could not verify those findings.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The researcher carried out randomisation using sealed envelopes placed in a random order in two boxes, one for men and one for women" Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "…through a concealed allocation to the clamped catheter group" Comment: adequate method of allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Blinding of group assignment for nurses and patients was not possible in this study." Comment: blinding was not possible in this study
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The primary outcome in this study, return to normal bladder function, was measured with a bladder scan, which is an objective measure (Bent et al. 1997). The measurements were performed in a similar way by the nurses. However, the measurements were made by different persons, and a disadvantage in this study is that the reliability of the measurements was not confirmed." Comment: unlikely that outcome measure was affected by blinding
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Five patients did not receive the treatment they were initially randomised to, four patients removed their indwelling catheter themselves by mistake and three patients were transferred to other wards … Adherence to the randomization was 95%" Comment: reasons for withdrawals and exclusions are valid.
Selective reporting (reporting bias)	Low risk	All outcomes in methods were accounted for in the results section. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

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Oberst 1981

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, unclear; 120 randomised; 110 reported **Country:** USA **Population:** mixed **Age (mean (SD)):** A 64.5 (10.26); B: 59 (11.92) **Inclusion criteria:** patients with IUC following either abdominoperineal resection (APR) or lower anterior resection (LAR) for cancer of the bowel and who had no evidence of existing urinary infection or kidney disease, no medical, problems precluding normal fluid intake, clear sensorium, spoke English and no surgical contradiction to bladder recompression **Condition for hospitalisation:** bowel cancer surgery – APR or LAR **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 52):** IUCs clamped **Group B (n = 58):** IUCs not clamped (gravity drainage) **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days)**: not reported **Intended duration of catheterisation for each group:** Group A: clamping. From 4th day post-op catheter was clamped for increasingly longer periods beginning with 1-h interval until max 4-h interval on day 6. Clamping periods alternated with 5 min drainage. Catheter left to straight drainage during the night and on the final day the clamping continued for a full 24 h. Group B: straight drainage. Catheter remained in place until physician advised its removal, usually 10th day post-op
Outcomes	Incidence of recatheterisation in patients following APR Incidence of recatheterisation in patients following LAR Time to first void
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Clamping commenced on the 4th post-op day. The IUC was clamped for increasingly longer periods beginning with a 1-h interval until the maximum 4-h interval was reached on day 6. Clamping periods were alternated with drainage periods of 5 min. On the first 5 study days, the IUC was left to straight gravity drainage during the night. On the final day the clamping continued for a full 24 h

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Oberst 1981 *(Continued)*

	Reasons for withdrawals and dropouts: 3 participants had post-op complications, 3 had their IUC removed erroneously, 1 was commenced on the trial in error and 3 were unable to follow the schedule

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Eligible patients were stratified by sex and surgical procedure and randomly assigned to one of two study conditions." Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely participants were blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist knew participants belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "In addition to the 110 patients in the final sample, 10 other patients were later dropped from the study …" Comment: withdrawal and exclusions from the study are accounted for and reasons provided. Unclear if it will have impact on measured outcomes
Selective reporting (reporting bias)	Low risk	All outcomes seem to be accounted for in both results and methods sections
Other bias	Low risk	Appears to be free from other sources of bias

Onile 2008

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, unclear; 200 randomised; 175 reported **Country:** Nigeria **Population:** women **Inclusion criteria:** consenting women having elective CS **Condition for hospitalisation**: elective CS

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Onile 2008 *(Continued)*

	Exclusion criteria: women with severe pre-eclampsia or eclampsia post-op or any other conditions that needed to monitor urinary output. Women with significant growth of bacteria on pre-operative urine culture **Age (mean (SD)):** A 31.67 (6.042); B 32.72 (5.96) **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 89):** IUC removed after 24 h **Group B (n = 86):** IUC removed immediately post-op **Size and type of catheter used:** Foley 16F **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed after 24 h B: immediate post-op removal of IUC
Outcomes	Number needing to be recatheterised/urinary retention Dysuria Urinary incontinence Ambulation time h Hospital stay h 72 h post-op + urine culture
Definition of CAUTI or bacteriuria	"… significant bacteriuria— defined as more than 100 000 bacteria of the same colony per milliliter of urine - in a sample of midstream urine collected 72 hours postoperatively for MCS" " …fever (defined as temperature of 38 °C or more on 2 occasions within 10 days of the procedure, excluding the first 24 hours"
Sponsorship/funding	Not reported
Ethical approval	Ethical approval was obtained from the ethical clearance committee of the Obafemi Awolowo University Teaching Complex, Ile-Ife
Notes	No significant difference in post-op ambulation time between groups A and B. Group A showed lower incidence of positive urine culture compared to group B. Recommend immediate removal of catheter after elective CS

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: " … were randomized into 2 groups (groups A and B), by block randomization using a random numbers table." Comment: unclear as to how randomisation process was performed
Allocation concealment (selection bias)	Unclear risk	Not reported

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Onile 2008 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not possible to blind participants, other measures of blinding are not reported
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Women with a significant growth of bacteria on preoperative urine microscopy, culture, and sensitivity (MCS) were excluded from other parts of the study …" Comment: suggests that samples were sent to a laboratory and so unlikely that microbiologist would know which patient belonged to the trial and which did not
Incomplete outcome data (attrition bias) All outcomes	Low risk	Withdrawal rates from both groups are similar. Adequate reasons given for withdrawals
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full in both methods and results sections. Protocol not available
Other bias	Low risk	Nothing to indicate any other sources of bias

Ouladsahebmadarek 2012

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** 2009-2010
Participants	**Number of participants:** eligible, not reported; 200 randomised; 200 reported **Country:** Iran **Population:** women **Age (e.g. mean and SD):** A 37.48 ± 8.85; B 39.48 ± 9.54 **Inclusion criteria:** elective abdominal hysterectomy or laparotomy for benign pathology (e.g. fibroma, abnormal uterine bleeding, chronic pelvic pain, ovarian cysts) under general anaesthesia; written informed consent **Condition for hospitalisation:** abdominal hysterectomy or laparotomy **Exclusion criteria:** patients who had intraoperative bleeding > 1 L; operation length > 2 h, severe endometriosis; dense pelvic adhesions; bladder suspension; underlying medical problems were excluded from the study **Use of antibiotic prophylaxis**: cefazoline 1 g IV 30 min before surgery started and continued every 6 h until 2 doses
Interventions	**Group A (n = 100):** Foley catheter removed immediately after surgery **Group B (n = 100):** Foley catheter removed 24 h after surgery

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Ouladsahebmadarek 2012 *(Continued)*

	Size and type of catheter used: 14 F Foley catheter with 15 cc balloon **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A 0 h; B 24 h
Outcomes	Operation to discharge duration (days) Time to ambulation (h) Subjective measure of pain Fever (> 38.5 °C) Use of Nelaton catheter (for AUR) Re-use of indwelling Foley catheter Urethral burn Urine analysis Symptomatic UTI Dysuria at the beginning of urination
Definition of CAUTI or bacteriuria	Mentions symptomatic UTIs but no definition given
Sponsorship/funding	Vice Chancellor for Research, Tabriz University of Medical Sciences
Ethical approval	The Ethics Committee of Tabriz University of Medical Sciences approved the study protocol
Notes	We contacted the trial authors for missing data but no we received no reply.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The randomization procedure was password protected, web based, using permuted blocks and stratified by study centre and invasive procedure." Comment: adequate method of randomisation. Randomisation was probably done
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding is possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not specified
Blinding of microbiological outcome (detection bias)	Low risk	Microbiologists were assumed to be blinded

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Ouladsahebmadarek 2012 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	All 200 participants completed the trial
Selective reporting (reporting bias)	Low risk	All outcomes are accounted for. Protocol was unavailable for assessment
Other bias	Low risk	Appears to be free form other sources of bias

Pervaiz 2019

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2018-June 2018
Participants	**Population:** men **Setting:** Lahore **Country**: Pakistan **Inclusion criteria**: men between 50-80 years of age presenting with benign prostate enlargement (history of difficulty in micturition for at least 1 month) undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria**: abnormal coagulation profile (prothrombin time (PT) > 15 sec; activated partial thromboplastin time (APTT) > 35 s), patients with systemic problems like BP > 140/90 mmHg, blood sugar range > 200 mg/dL, abnormal echocardiogram and ejection fraction < 55% on echocardiography, very large prostate (> 100 g) **Number of participants:** 100 eligible; 100 randomised; 100 reported **Age (mean and SD):** A 67.00 ± 9.11; B 65.56 ± 9.25 **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 50)**: IUC removal day 1 post-op **Group B (n = 50)**: IUC removal day 4 post-op **Size and type of catheter used:** 3-way Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: removal on post-op day 1 Group B: removal on post-op day 4
Outcomes	Number of participants requiring recatheterisation UTI
Definition of CAUTI or bacteriuria	Urine sample was obtained to assess UTI (bacterial colony count >10^5 cfu/mL on urine culture after removal of catheter assessed on day 7)

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Pervaiz 2019 *(Continued)*

Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Then patients were randomly assigned in two sets by utilizing lottery technique." Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume lab technician was blinded to participants belonging to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No exclusions or withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes stated in methods reported in results. Protocol not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

Popiel 2017

Study characteristics

Methods	**Study design:** RCT **Dates study conducted**: not reported
Participants	**Number of participants:** 75 randomised **Setting:** not reported **Country:** not reported **Population:** women **Age (mean and SD):** not reported

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Popiel 2017 *(Continued)*

	Inclusion criteria: women who were scheduled for robotic sacrocolpopexy **Condition for hospitalisation:** vaginal prolapse **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 39):** Foley catheter removal within 6 h of operation completion (no Foley) **Group B (n= 36):** Foley catheter removal on day 1 post-op (Foley) **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: within 6 h Group B: on post-op day 1
Outcomes	Number of participants with urinary retention UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Declarations of interest: "Disclosures: P. Popiel: nothing to disclose; V. Vallabh-Patel: nothing to disclose; C. Salamon: Consultant: Intuitive Surgical, Inc."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "single blinded randomized study" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Can assume specimens were sent to a lab where microbiologist would be unaware of trial participants

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Popiel 2017 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No details given regarding withdrawals/exclusions etc
Selective reporting (reporting bias)	High risk	All outcomes not reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Rajan 2017

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** September 2008-March 2010
Participants	**Number of participants:** 200 participants randomised into 2 groups **Setting**: tertiary teaching institute South India **Country:** India **Population:** women undergoing vaginal surgery **Age (mean and SD):** Group A: 50 ± 18; Group B: 48 ± 2.4 **Inclusion criteria**: all women undergoing vaginal surgery namely Ward Mayo operation; Manchester repair; vaginal hysterectomy and amputation of cervix **Condition for hospitalisation:** vaginal surgery **Exclusion criteria**: all women having pre-operative positive urine cultures; elevated renal parameters (blood urea > 40 mg/dL, serum creatinine > 1 mg/dL); comorbid illness -diabetes; intra operative visceral injury; Kelly's stitch and consent not given by patient **Use of antibiotic prophylaxis:** measured but not reported specifically
Interventions	**Group A (n = 100)**: removal of IUC and vaginal pack in 3 h **Group B (n = 100)**: removal of IUC and vaginal pack in 24 h **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removal 3 h after surgery Group B: IUC removal 24 h after surgery
Outcomes	Number of participants requiring recatheterisation Incidence of UTI Incidence of urinary retention
Definition of CAUTI or bacteriuria	"urinary infections defined as when microscopic examination of the urine revealed pus cells or when urine culture showed growth of pathogenic organisms"

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Rajan 2017 *(Continued)*

Sponsorship/funding	"No external sources of funding"
Ethical approval	"The study was approved by institutional research board (IRB) of Jawaharlal Institute of Post-graduate Medical Education & Research (JIPMER), Puducherry, India (EC Ref # 5_ 2008)"
Notes	Declarations of interest: "The authors declare that they have no competing interest"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "They were randomised into two groups based on a computer-generated randomization table." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not possible given intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely microbiologist would have been blinded as to which samples were in the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No evidence of any incomplete data
Selective reporting (reporting bias)	Low risk	Outcomes reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Ruminjo 2015

Study characteristics

Methods	**Study Design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** not reported **Setting:** 8 Sub-Saharan Africa countries **Population:** women **Age (mean and SD):** not reported

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Ruminjo 2015 *(Continued)*

	Inclusion criteria: women undergoing fistula repair surgery **Condition for hospitalisation:** fistula repair **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = unknown)**: IUC for 7 days post-fistula repair **Group B (n = unknown)**: IUC for 14 days post-fistula repair **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** not reported Group A: 7 days Group B: 14 days
Outcomes	Urinary retention, catheter blockage and febrile episodes
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	"Randomized clinical trial conducted collaboratively by EngenderHealth's Fistula Care Project and World Health Organization with key in-country fistula researchers"
Ethical approval	Not reported
Notes	Abstract only. No usable data

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information about numbers randomised or number of participants included in the analysis

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Ruminjo 2015 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Abstract only. Outcomes not reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Sahin 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2006- January 2008
Participants	**Number of participants:** eligible, not reported; 66 randomised; reported, not reported **Setting:** Istanbul **Country:** Turkey **Population:** men **Age (mean):** range: 48-77 (average 62); A 62.5; B 61.5; C 62 **Inclusion criteria:** surgical candidates diagnosed with benign prostatic hyperplasia **Condition for hospitalisation:** TURP **Exclusion criteria:** cases with > 50 cc of residual urine, central and peripheric nervous system illnesses or diabetes were excluded from the study **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 22):** IUC removal on the 1st post-op day **Group B (n = 22):** IUC removal on the 2nd post-op day **Group C (n = 22):** IUC removal on the 3rd post-op day **Size and type of catheter used:** 22F 3-way Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removal on the 1st post-op day B: IUC removal on the 2nd post-op day C: IUC removal on the 3rd post-op day Note: catheter removal criteria were defined as having clear or pinkish urine colour and the absence of haemorrhage. 2 cases from Group A and one case from Group B did not meet these criteria; hence their catheters were not removed on the designated day.
Outcomes	Recatheterisation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported

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Sahin 2011 *(Continued)*

Ethical approval	Not reported
Notes	We determined criteria for recatheterisation to be development of vesical globe, complaints of excessive irritation and the obstruction of urinary flow due to clotted or non-clotted bleeding

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Cases were randomised into three groups" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or exclusions from the study
Selective reporting (reporting bias)	High risk	The methods section mentions that urine analysis was performed however no data on infection or bacteriuria were presented in the results
Other bias	Low risk	Appears to be free from other sources of bias

Sandberg 2019

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** 31 May 2016-22 July 2017
Participants	**Population:** women **Setting:** Leiden **Country**: Netherlands **Inclusion criteria:** women > 18 years, scheduled for laparoscopic hysterectomy for benign indication or low-grade malignancy (with or without salpingo-oophorectomy) **Exclusion criteria**: women with concomitant procedures such as prolapse surgery, extensive endometriosis surgery or advanced oncological dissection including nodal dissection, were excluded, as

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Sandberg 2019 *(Continued)*

	well as those with stress and urge incontinence, or other systemic diseases potentially influencing their ability to void (e.g. multiple sclerosis) **Condition for hospitalisation**: laparoscopic hysterectomy **Number of participants:** 162 eligible; 162 randomised; 155 reported **Age (mean and SD):** A 49.3 ± 10.5; B 51.5 ± 11.9 **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 74)**: immediate IUC removal post-op **Group B (n = 81)**: IUC removal 18-24 h post-op **Size and type of catheter used:** "Foley Catheter", otherwise not specified **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removed directly in the operating room post-op Group B: IUC removal 18-24 h post-op
Outcomes	Number needing to be recatheterised UTI Time to first ambulation Length of hospital stay Asymptomatic bacteriuria Number of patients not discharged on day of IUC removal Other complications of catheterisation (or recatheterisation) - requested earlier catheter removal because of "complaints" Patient comfort or discomfort (0-10 VAS for overall pain and discomfort 6 h after surgery) Patient comfort or discomfort (0-10 VAS for overall pain and discomfort 24 h after surgery) Patient satisfaction (0-10 VAS for satisfaction with treatment 6 weeks after surgery) Patient satisfaction (0-10 VAS for satisfaction with hospitalisation 6 weeks after surgery)
Definition of CAUTI or bacteriuria	"standard urine test for nitrite and leucocytes in combination with clinical symptoms"
Sponsorship/funding	"There was no patient or public involvement in this study and no core set outcomes were used"
Ethical approval	The protocol was approved by the Ethics Committee of Leiden University Medical Centre (LUMC) in Leiden, the Netherlands (P15.382/NL55504.058.15) and the boards of all participating hospitals
Notes	Declarations of interest: "EM Sandberg reports receiving a research grant from Bronovo Hospital Fund (The Hague, the Netherlands). The funding source had no involvement during the conduction of the research and/or preparation of the article. The other authors report no conflict of interest. Completed disclosure of interest forms are available to view online as supporting information."

Risk of bias

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Sandberg 2019 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “The randomisation procedure was performed by the operating gynaecologist through an online and secured program called PROMISE. The randomisation sequence was computer-generated with variable blocks of two and four, stratified by centre” Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: “In the operating room, at the end of the surgery, patients were randomised (1:1 ratio) to either ICR or DCR.The allocation code was disclosed directly on the website after entering patient identification number and confirming inclusion criteria." Comment: adequate allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Neither the women nor the medical staff were blinded for the allocated treatment." Comment: no blinding of participants or personnel
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely specimens sent to a lab where it would not be known whether specimen belonged to a trial or not
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: “Three women withdrew consent within 24 h after surgery and four women were randomised despite the fact that the gynaecologist decided immediately at the end of the surgery that prolonged catheterisation was necessary regardless of the randomisation result. These cases were considered dropouts and were not included in any further analyses” Comment: not all participants who were randomised are included in final analysis but numbers of participants withdrawing are low and balanced across groups.
Selective reporting (reporting bias)	Low risk	All outcomes reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Schiotz 1995

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** November 1992-April 1994
Participants	**Number of participants:** eligible, not reported; 165 randomised; 165 reported **Country:** Norway **Population:** women

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Schiotz 1995 *(Continued)*

	Age (mean and range): overall 65.9 (29.9-85.2) **Inclusion criteria:** not reported **Condition for hospitalisation:** elective vaginal plastic repair surgery (anterior colporrhaphy, anterior plus posterior colporrhaphy or a full Manchester repair) **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 82):** 1 day IUC post-op **Group B (n = 83):** 3 days' post-op IUC **Size and type of catheter used:** 12 or 14F Foley catheter, Teflon-coated **Study definition of short-term catheterisation (days):** not reported
Outcomes	UTI Urinary retention Number of patients needing to be recatheterised
Definition of CAUTI or bacteriuria	Cultures were defined as positive when a midstream urine specimen yielded > 100,000 cfu/mL of any organism or a catheter specimen yielded > 10,000 cfu/mL. UTI was defined as a positive culture associated with dysuria, pain, fever or sepsis. Asymptomatic bacteriuria was defined as positive culture in the absence of symptoms. When there was a doubt, participants were defined as having UTI.
Sponsorship/funding	This study was supported by a grant from, Anders Jahre's Foundation, Oslo, Norway.
Ethical approval	Not reported
Notes	A size 12 or 14 Fr transurethral Teflon-coated Foley catheter was used for both groups. Post-catheter removal all participants were encouraged to void spontaneously, those that could not were recatherised. A least 3 urine cultures were taken.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "… randomized by means of a nurse drawing a closed opaque envelope" Comment: no other information reported
Allocation concealment (selection bias)	Low risk	Quote: "…closed opaque envelope" Comment: closed envelopes were used to conceal allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that participants could be blinded
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported

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Schiotz 1995 *(Continued)*
All outcomes

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Suggests that urine samples were sent to a laboratory for microscopy and culture. Unlikely that microbiologist knew which patients belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are reported in full in results
Other bias	Low risk	Appears to be free from other sources of bias

Schiotz 1996

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** November 199-April 1994
Participants	**Number of participants:** eligible, not reported; 109 randomised; 91 reported **Country:** Norway **Population:** women **Age (mean and range):** overall 50.3 (26.9-72.6) **Inclusion criteria**: women admitted for elective retropubic surgery for urinary stress continence **Condition for hospitalisation:** elective retropubic surgery for urinary stress incontinence **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 45):** IUC removal after 1 day **Group B (n = 46):** IUC removal after 3 days **Size and type of catheter used**: 12 or 14 Fr Foley catheter, Teflon-coated **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 1 day post-op IUC B: 3 day post-op IUC
Outcomes	UTI Delayed spontaneous voiding after catheter removal Recatheterisation Length of hospital stay

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Schiotz 1996 *(Continued)*

	Asymptomtic bacteriuria (cannot be incorporated as reported as total number without the numbers in each group)
Definition of CAUTI or bacteriuria	Cultures were defined as positive when an midstream urine specimen yielded > 100,000 cfu/mL of any organism, or a catheter specimen yielded > 10,000 cfu/mL. UTI was defined as a positive culture associated with dysuria, pain, fever or sepsis. Asymptomatic bacteriuria was defined as a positive culture in the absence of symptoms. If there was doubt, participants were defined as having UTI rather than asymptomatic bacteriuria.
Sponsorship/funding	This study was supported by a grant from Anders Jahre's Foundation, Oslo, Norway.
Ethical approval	Not reported
Notes	18 participants were excluded following randomisation; 15 participants were excluded as they were administered antibiotic prophylaxis and 3 had confounding post-op antibiotic treatment Cultures were defined as positive when a midstream urine specimen yielded > 100,000 cfu/mL of any organism or a catheter specimen yielded > 10,000 cfu/mL UTI was defined as a positive culture associated with dysuria, pain, fever or sepsis Asymptomatic bacteriuria was defined as positive culture in the absence of symptoms

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Patients were pre-operatively randomized to …" Comment: randomisation method unclear
Allocation concealment (selection bias)	Low risk	Quote: "… by means of a nurse drawing a closed envelope." Comment: envelopes were concealed
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding of participants occurred
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Urine cultures were taken from microscopy and culture. Suggests that microbiologist processed them at a laboratory and so unlikely to know which patients were part of the study.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "15 patients were excluded owing to …" Comment: reasons for withdrawals given. Participants who completed the study are reported in full
Selective reporting (reporting bias)	Low risk	All outcomes reported in full. However, protocol not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

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Sekhavat 2008

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** December 2002-November 2004
Participants	**Number of participants:** eligible, not reported; 90 randomised; 90 reported **Country:** Iran **Population:** women **Age (mean and SD):** A 38.9 ± 2.9; B 39 ± 3.8 **Inclusion criteria:** women who underwent anterior repair **Condition for hospitalisation:** anterior colporrhaphy (pelvic organ prolapse) **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** in addition, the first dose of 1 mg cephalexin was given immediately before the beginning of operation and the second, given 6 h after the initial dose.
Interventions	**Group A (n = 45):** IUC removed straight after surgery **Group B (n = 45):** IUC removed 24 h after surgery **Size and type of catheter used:** 16F Foley catheter with 10 mL balloon, latex **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed immediately post-op B: IUC removed at least 24 h post-op
Outcomes	UTI Urinary retention Voided spontaneously Number needing to be recatheterised (reported as in and out catheterisation) Ambulation time post-op (h) Hospital stay (h) Urinary discomfort
Definition of CAUTI or bacteriuria	The prevalence of symptomatic UTI was confirmed, detected in the urine culture by a positive urine culture or through urinary signs such as burning urination, frequency, urgency, suprapubic pain and fever.
Sponsorship/funding	Not reported
Ethical approval	The adopted protocol was approved by the hospital research and ethics committee
Notes	

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Sekhavat 2008 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The patients were randomly (the randomisation schedules were prepared using a computer-generated random number table)…" Comment: computer-generated randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that this was possible. No blinding reported
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume microbiologist was blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "All women enrolled in the study were included in the analysis" Comment: no withdrawals reported
Selective reporting (reporting bias)	Low risk	All outcomes outlined in methods are reported in full in results section. However, protocol was not available for analysis
Other bias	Low risk	Appears to be free from other sources of bias

Shahnaz 2016

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** 2013-2015
Participants	**Number of participants:** 70 randomised; 70 reported **Setting:** Martyrs Hospital in the Persian Gulf **Country:** Iran **Population:** women **Age (mean and SD):** A 39.4 ± 3.2; B 38.8 ± 2.8 **Inclusion criteria**: the inclusion criteria included prolapse of vaginal anterior with grades 2 and 3, age between 25-49 years old, and body mass index of 19-24 kg/m^2 **Condition for hospitalisation:** pelvic organ prolapse

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Shahnaz 2016 *(Continued)*

	Exclusion criteria: vaginal anterior prolapse grade 1 and 4, diabetes, connective tissue diseases, different kinds of true urinary incontinence, having a history of hysterectomy **Use of antibiotic prophylaxis:** "After the surgery, the antibiotic was not regularly given except for patients who had abnormal urinary symptoms and unusual urinary analysis in urinary sample 48 h after the surgery"
Interventions	**Group A (n = 35)**: IUC removal 24 h after surgery **Group B (n = 35)**: IUC removal 72 h after surgery **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 24 h after surgery Group B: 72 h after surgery
Outcomes	Number of participants with urinary retention Number of participants requiring recatheterisation Positive urine culture Length of hospitalisation
Definition of CAUTI or bacteriuria	Urine analysis and culture examination was done prior to surgery in all participants. The presence of positive urinary culture or > 100,000 cfu/mL of urine or > 10 pieces of leukocyte in each microscopy field was considered as a urinary infection.
Sponsorship/funding	Not reported
Ethical approval	"approved by the Institutional Ethical Review Board"
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Patients were randomized into two groups using computer-generated randomized schedules" Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible with this intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Shahnaz 2016 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume urine samples were sent to a laboratory where the microbiologist would not know which patients were in the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	All data accounted for with no withdrawals/dropouts
Selective reporting (reporting bias)	Low risk	Outcomes seem to be reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Shrestha 2013

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2012-January 2013
Participants	**Number of participants:** eligible, not reported; 100 randomised; 100 reported **Setting:** Kathmandu, Nepal **Population:** women **Age (mean and SD):** 53.35 ± 10.94 **Inclusion criteria:** vaginal hysterectomy; anterior colporrhaphy; Manchester operations **Condition for hospitalisation:** women who underwent vaginal hysterectomy, anterior colporrhaphy and Manchester operations (79 patients underwent vaginal hysterectomy with pelvic floor repair, 19 anterior colporrhaphy and 2 Manchester operation) **Exclusion criteria:** history of previous urine retention; pre-operative urinary infection; bladder injury; other associated complication during operation **Use of antibiotic prophylaxis:** antibiotics are given for 7 days
Interventions	**Group A (n = 50):** IUC removal 24 h post-op **Group B (n = 50):** IUC removal 72 h post-op **Size of catheter used:** Foley **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC was removed after 24 h B: IUC was removed after 72 h
Outcomes	Recatheterisation Mean catheterisation time (days) Mean hospital stay (days) (mean)

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Shrestha 2013 *(Continued)*

	UTI: pus cells in urine > 5 per high-power field; bacteria culture positive
Definition of CAUTI or bacteriuria	Asymptomatic bacteriuria = pus cells > 5 per high-power field in routine examination of urine and bacterial culture positive
Sponsorship/funding	Not reported
Ethical approval	Protocol was approved by Ethical Committee of hospital and informed consent was obtained from each woman.
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "They were randomized into group A, which include the patients, whom Foley catheterization was kept for 24 hours and group B, which include the patients, whom Foley catheterization was kept for 72 hours" Comment: method of randomisation not stated clearly
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Unlikely that the microbiologist knew which urine sample belonged to which patient
Incomplete outcome data (attrition bias) All outcomes	Low risk	All outcome data is complete with no dropouts
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in methods are accounted for in results section. However, protocol was not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

Souto 2004

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** January 2000-July 2002
Participants	**Number of participants:** eligible, not reported; 73 randomised; 73 reported

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Souto 2004 *(Continued)*

	Country: Brazil
	Population: men
	Age (mean ± SD (range)): overall: 62 (50-73); A 64 ± 7.3 (50-77); B 61 ± 7.3 (49-73)
	Inclusion criteria: no cystography evaluation performed
	Condition for hospitalisation: retropubic radical prostatectomy
	Exclusion criteria: not reported
	Use of antibiotic prophylaxis: not reported
Interventions	**Group A (n = 37):** IUC removed 7 days after surgery
	Group B (n = 36): IUC removed 14 days after surgery
	Size and type of catheter used (e.g. Foley 16F): 2-way 20Fr Foley catheter
	Study definition of short-term catheterisation (days): not reported
	Intended duration of catheterisation for each group:
	A: IUC removal 7 days post-op
	B: IUC removal 14 days post-op
Outcomes	Urinary retention and haematuria
	Vesical neck stenosis
	Urinary incontinence
	Operating time
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"… approved by the Institutional ethics committee"
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were randomized into 2 groups …" Comment: method of randomisation is unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible. No other types of blinding reported
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported

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Souto 2004 *(Continued)*

All outcomes		
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants completed the trial. No dropouts/withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes in methods and results reported in full. However, protocol was not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

Sun 2004

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, unclear; 86 randomised; 85 reported **Country:** Taiwan **Population:** women **Age (mean (SD)):** A 46.7 (6.7); B 48.3 (8.3) **Inclusion criteria:** patients with proven genuine stress incontinence who underwent Burch's colposuspension **Condition for hospitalisation:** Burch colposuspension **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** all participants received prophylactic antibiotics for 2 days (1 g cefazolin IV, 3 times a day). No other antibiotic was administered thereafter unless a fever was noted and its origin was identified. A febrile episode was defined as a body temperature of 38 °C orally
Interventions	**Group A (n = 43):** IUC removed post-op the next morning **Group B (n = 43):** IUC were left in place until the 5th post-op day **Size and type of catheter used:** Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed post-op the next morning after surgery B: IUC left in place until the 5th post-op day. The catheter was clamped on the 3rd post-op day so that participants could participate in a bladder training programme. The bladder training programme involved clamping the catheter for 1 h 45 min and unclamping the catheter for 15 min
Outcomes	Post-op UTIs

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Sun 2004 *(Continued)*

	Immediate voiding difficulty Delayed voiding difficulty Incomplete emptying of the bladder De novo frequency and urgency syndrome Length of hospitalisation
Definition of CAUTI or bacteriuria	A UTI was defined as bacteriuria (> 10^5 cfu/mL urine) or white blood cell count > 5 /high-power field in urine analysis
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	The participant was instructed to comply with a fluid intake of 200 mL-250 mL every 2 h. All participants received prophylactic antibiotics for 2 days Post-op voiding difficulty was classified as the participant experiencing hesitancy in voiding, a weak stream, or a discontinuous flow and/or residual urine of > 100 mL.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "…were then randomly placed into two groups …" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that this was possible due to the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported. No types of blinding reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "The post void residual urine volume was checked and an urine analysis and culture were performed to detect any urinary tract infection" Comment: suggests that all urine samples were sent to a laboratory; unlikely the microbiologist knew which patients were in the trial and which were not
Incomplete outcome data (attrition bias) All outcomes	Low risk	86 participants randomised, 85 reported: "One patient in Group A was lost at follow-up due to immigration".
Selective reporting (reporting bias)	Low risk	All outcomes reported in full in methods and results sections
Other bias	Low risk	Appears to be free from other sources of bias

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Tahmin 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** July 2007-June 2008
Participants	**Number of participants:** eligible, not reported; 80 randomised; 80 reported **Country:** Bangladesh **Population:** women **Age (mean and SD):** A 51.75 ± 10.8; B 53.95 ± 12.8 **Inclusion criteria:** after proper evaluation genital prolapse cases awaiting vaginal hysterectomy and or pelvic floor repair, were enrolled for the study **Condition for hospitalisation:** vaginal hysterectomy with pelvic floor repair **Exclusion criteria:** UTI, diabetes mellitus **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 40):** IUC removal on the 2nd post-op day **Group B (n = 40):** IUC removal on the 5th post-op day Note: recatheterisation was done for 3 more days if residual volume > 200 mL after removal of catheter **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC was removed on 2nd post-op day B: IUC was removed on 5th post-op day
Outcomes	Mean duration of catheterisation (h) Recatheterisation Asymptomatic bacteruria Mean hospital stay (days)
Definition of CAUTI or bacteriuria	"UTI was defined as the presence of $>10^5$ colony forming units/mL in the culture"
Sponsorship/funding	Not reported
Ethical approval	Informed consent was obtained from each woman, and protocol was approved by ethical committee
Notes	

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Quote: "To facilitate that process equal numbers of pre-labelled pieces of papers (40 for short period and 40 for conventional period of catheterisation) were placed and mixed thoroughly in a box."

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Tahmin 2011 *(Continued)*

		Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding of participants was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Urine samples were taken before removal of catheter for routine microscopic examination and culture sensitivity test." Comment: unlikely the microbiologist knew which individual belonged to which group
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals from the study
Selective reporting (reporting bias)	Low risk	All outcomes reported in the methods section is accounted for in the results section. However, protocol was not available for assessment
Other bias	Low risk	Appears to be free from other sources of bias

Talreja 2016

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2014-July 2015
Participants	**Population**: men **Setting:** Karachi **Country**: Pakistan **Inclusion criteria:** all patients admitted for TURP during the period were recruited in the study **Condition for hospitalisation:** TURP **Exclusion criteria:** history of trauma to spinal cord and cerebrovascular accidents; patients having comorbid conditions like diabetes mellitus or any other urogenital problems such as urethral strictures **Number of participants:** eligible, not reported; 86 randomised; 86 reported **Age (mean and SD):** Group A 64.21 ± 5.36; Group B 63.05 ± 4.69 **Use of antibiotic prophylaxis**: participants were given 1 dose of 3rd-generation cephalosporin in preoperative period
Interventions	**Intervention for each group with times:**

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Talreja 2016 *(Continued)*

	Group A (n = 43): IUC was not clamped prior to its removal **Group B (n = 43):** IUC was clamped prior to its removal **Size and type of catheter used**: not reported **Study definition of short-term catheterisation (days)**: not reported **Intended duration of catheterisation for each group:** Group A: IUC was not clamped prior to its removal Group B: clamping of the IUC was performed prior to its removal
Outcomes	AUR Recatheterisation UTI (resulting in recatheterisation) Bleeding (resulting in recatheterisation Length of hospitalisation Catheter removal successful
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	"Written and informed consent was taken, and confidentiality of the patients was taken into account"
Notes	"Clamping refers to interrupting bladder flow by obstructing the drainage pipe of Foley catheter and releasing it intermittently as patient feels urge to void. Foley catheter was removed once patient got mobilized, passed stool, and had no active bleeding or infection. Foley catheter was removed in the early morning in all cases."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Eighty-six study participants who underwent TURP were randomly allocated into two groups." Comment: mentions randomisation but methods are not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported; unlikely that this was possible due to the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Talreja 2016 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Unlikely that microbiologist would know which patient belonged to a clinical trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals reported
Selective reporting (reporting bias)	Low risk	Outcomes reported in the methods are also accounted for in the results section
Other bias	Low risk	No other indications of other sources of bias

Taube 1989

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** 9-month period (not specified)
Participants	**Number of participants:** 83 eligible; 60 randomised; 60 reported **Country:** UK **Population:** male **Age (mean and range):** successful: 72 (57-85); failed: 76.9 (53-86) **Inclusion criteria:** male patients with AUR **Condition for hospitalisation:** AUR **Exclusion criteria:** patients with significant renal impairment or clot retention **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 18):** IUC removed immediately after emptying **Group B (n = 20):** IUC removed after 24 h **Group C (n = 22):** IUC removed after 48 h **Size and type of catheter used (e.g. Foley 16F):** 16F Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed immediately after emptying B: IUC removed after 24 h C: IUC removed after 48 h
Outcomes	Successful remicturition after IUC removal
Definition of CAUTI or bacteriuria	Not reported

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Taube 1989 *(Continued)*

Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were randomized into three groups …" Comment: unclear as to how randomisation was performed
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding was possible. No other types of blinding reported
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "A sample of urine was taken immediately for microscopy and culture …" Comment: unlikely microbiologist knew which sample belonged to the study when it was processed in the laboratory
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts
Selective reporting (reporting bias)	Unclear risk	Report published before CONSORT guidelines. Not sure if this is selective reporting or poor reporting. Protocol not available
Other bias	Low risk	Appears to be free from other sources of bias

Toscano 2001

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** July 1997-November 1998
Participants	**Number of participants:** eligible, not reported; 104 randomised; 104 reported **Country:** Brazil **Population:** men **Age (mean and SD):** A 68.6 ± 7.4; B 69.5 ± 6.4

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Toscano 2001 *(Continued)*

	Inclusion criteria: patients undergoing surgery for benign prostatic hyperplasia; no coagulation disorders; no use of anticoagulants (mainly acetylsalicylic acid) in the month before the operation **Condition for hospitalisation:** TURP **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** antibiotic therapy with first-generation cephalosporin was given at induction of anaesthesia and for up to 7 days after the operation.
Interventions	**Group A (n = 54):** removal of the IUC within 24 h **Group B (n = 50):** removal of the IUC within 48 h **Size and type of catheter used:** 22F Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A removal of IUC within 24 h post-op B removal of IUC within 48 h post-op
Outcomes	Haematuria Urinary retention
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	22 F Owens catheter used (similar to Foley but has a third route for irrigation) Surgery undertaken by residents under supervision. Patients had bladder irrigation for 24 h. Definition of urinary retention not stated

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "A seleção dos pacientes que teriam a sonda retirada com 24 ou 48 horas foi feita por sorteio ao término do procedimento." Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that it was possible due to the intervention. No other blinding mentioned
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported

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Toscano 2001 *(Continued)*

Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts
Selective reporting (reporting bias)	Low risk	All outcomes seem to be reported in methods and results in full. Published protocol not available but this was not common practice at the time of the study
Other bias	Low risk	Nothing to indicate any other source of bias

Valero Puerta 1998

Study characteristics	
Methods	**Study design:** quasi-RCT **Dates study conducted**: not reported
Participants	**Population**: men with benign prostatic hyperplasia undergoing TURP **Country**: Spain **Inclusion criteria:** via clinic **Condition for hospitalisation (e.g. hysterectomy or TURP):** TURP **Exclusion criteria:** not reported **Number of participants:** 117 randomised; 117 reported **Age (e.g. mean and SD; median, IQR):** Group A mean 70 (53-83); Group B mean 69 (50-87) **Use of antibiotic prophylaxis:** Yes. 1 g of ceftriaxone every 24 h for 2 days
Interventions	**Group A (n = 55)**: IUC removal at 48 h **Group B (n = 62)**: IUC removal according to usual care **Intervention for each group (e.g. catheter removal, bladder infusion) with times (e.g. midnight catheter removal):** Group A: IUC removal at 48 h Group B: IUC removal according to usual care (lack of haematuria) **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A removal of catheter at 48 h B removal according to usual care
Outcomes	Duration of post-op hospital stay

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Valero Puerta 1998 *(Continued)*

	Duration of total hospital stay Volume of dried tissue Number of men requiring transfusion Number of men with urinary retention Number of men readmitted to hospital
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Participants were assigned to the 2 groups according to the day of the week of their TURP operation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Can assume that samples were sent to a laboratory where the microbiologist is unlikely to know which patient belongs to the study
Incomplete outcome data (attrition bias) All outcomes	Low risk	No evidence that there was incomplete data
Selective reporting (reporting bias)	Low risk	All outcomes measured in results were the same as was mentioned in the methods section
Other bias	Low risk	Appears to be free form other sources of bias

Vallabh-Patel 2020

Study characteristics

Methods	**Study design:** RCT

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Vallabh-Patel 2020 *(Continued)*

	Dates study conducted: December 2015-May 2017
Participants	**Population:** women **Setting:** New Jersey **Country**: USA **Inclusion criteria:** women undergoing robotic sacrocolpopexy for pelvic organ prolapse **Exclusion criteria:** a history of prior vaginal mesh, history of pre-operative urinary retention or postvoid residual of > 200 mL, pregnancy or desire for future pregnancy, and intraoperative complications necessitating a post-op IUC such as intraoperative cystotomy, bowel injury, or estimated blood loss > 500 mL **Condition for hospitalisation**: pelvic organ prolapse **Number of participants:** 94 eligible; 88 randomised; 88 reported **Age (mean and SD):** A 59.52 ± 8.5; B 59.57 ± 11.2 **Use of antibiotic prophylaxis:** “All participants received appropriate perioperative antibiotics per American College of Obstetricians and Gynecologists guidelines.”
Interventions	**Group A (n = 44)**: IUC removal 6 h post-op **Group B (n = 44)**: IUC removal post-op day 1 **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: IUC removal 6 h post-op Group B: IUC removal day 1 post-op
Outcomes	Incidence of UTI Number of participants requiring recatheterisation Complications
Definition of CAUTI or bacteriuria	“For the purpose of this study, patients were considered positive for a UTI if they had (1) positive urine cultures per CDC guidelines or (2) if a patient was treated empirically over the phone for symptoms of UTI, even in the absence of a urine culture”
Sponsorship/funding	“Funding was provided through a grant from Morristown Medical Center Research Foundation”
Ethical approval	"Approval for this study was obtained by the Atlantic Health System institutional review board (# 908398-5)."
Notes	Declarations of interest: “The authors declare that they have no conflict of interest”

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed in the immediate postoperative period utilizing REDCap (Research Electronic Data Capture) (Nashville, Tenn) using a random-number generator for an overall allocation ratio of 1:1."

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Vallabh-Patel 2020 *(Continued)*

		Comment: adequate randomisation method
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Likely specimens sent to a lab blinded as to which specimens belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing data, no withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes reported in full
Other bias	Low risk	Appears to be free from other sources of bias

Webster 2006

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** February 2001-March 2003
Participants	**Number of participants:** 631 eligible; 210 randomised; 206 reported **Setting:** Brisbane **Country:** Australia **Population:** mixed **Inclusion criteria:** > 18 years of age; able to give written informed consent **Condition for hospitalisation:** general surgery and medical patients who require IUCs as part of their health care **Exclusion criteria:** patients with a suprapubic catheter or a long-term IUC who were pregnant or newly diagnosed with gynaecologic cancer **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 98):** removal of IUC at 6 am **Group B (n = 97):** removal of IUC at 10 pm **Size and type of catheter used (e.g. Foley 16F):** not reported

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Webster 2006 *(Continued)*

	Study definition of short-term catheterisation (days): not reported **Intended duration of catheterisation for each group:** A: IUC removal at 6 am B: IUC removal at 10 pm
Outcomes	Time between catheter removal and discharge (h) Duration of catheterisation (h) Time to first void (h) Mean volume of first void Recatheterisation/failed trial of void Post discharge urinary problems: retention; difficulty passing urine; pain when passing urine; loin pain; febrile; incontinent
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	The Queensland Nursing Council and the Queensland University of Technology funded the study.
Ethical approval	The hospital's human research ethics committee approved the study, and the authors obtained informed consent from all participants
Notes	Sample size calculation stated The ward or location in which the catheter was inserted and fluid intake in the previous 24 h were also recorded.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed using a computer-generated table of random numbers supplied by the hospital's perinatal research centre." Comment: adequate randomisation method
Allocation concealment (selection bias)	Low risk	Quote: "Individuals were allocated to either to 22:00-hour catheter removal (intervention group), or to 06:00-hour catheter removal (control group) by telephone call to a scientist who was independent of the recruitment process and blinded to baseline interview." Comment: adequate concealment method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "Neither the clinicians nor the patients were blinded to the intervention." Comment: blinding of participants and staff is not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "Ward staff, who were aware of group assignment but who were not part of the research team, recorded outcome data. Data were processed and coded by a researcher who was unconnected with treatment but who was not blind to randomization."

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Webster 2006 *(Continued)*

		Comment: attempts were made to blind outcome assessment but still prone to detection bias
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcome reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	All data reported in full. No exclusions or withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes reported in full in methods and results sections
Other bias	Low risk	Appears to be free from other sources of bias

Weemhoff 2011

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2006-September 2008
Participants	**Number of participants:** 390 eligible; 246 randomised; 246 reported **Setting: 3** different hospitals **Country:** Netherlands **Population:** women **Age (mean and SD):** A 59.9 ± 10.2; B 60.7 ± 11.1 **Inclusion criteria:** patients undergoing anterior colporrhaphy **Condition for hospitalisation:** anterior colporrhaphy **Exclusion criteria:** excluded were women who were performing self-catheterisation because of voiding dysfunctions pre-operatively, women < 18 years of age, and those who were not able to understand informed consent because of low IQ or a language barrier. **Use of antibiotic prophylaxis:** all patients received prophylactic antibiotics at the beginning of the operation. Post-op prophylactic antibiotics were not given routinely.
Interventions	**Group A (n = 124):** 2-day IUC **Group B (n = 122):** 5-day IUC **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC for 2 days (removed in the morning) B: IUC for 5 days (removed in the morning)
Outcomes	Participants needing temporary catheter replacement/recatheterisation (%)

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Weemhoff 2011 *(Continued)*

	Participants with a UTI at the time of first catheter removal (%) Hospital stay (median (range)) Percentage of participants with uneventful post-op period UTIs: post-voiding residual > 200 mL; post-voiding residual < 200 mL
Definition of CAUTI or bacteriuria	"Signs of urine tract infection were defined as having more than 25 white blood cells per high-power field, nitrate production, or more than 20 bacteria per high-power field. When urinary tract infection after the removal of the catheter was confirmed by a positive culture, patients were treated with antibiotics irrespective of complaints. A culture was scored positive when the sample contained more than 10^5 colony forming units per milliliter. For the outcome measure urinary tract infection, only the infections proven by a positive culture at the time of the first removal of the catheter were included. No other urinary cultures were taken on behalf of the study protocol."
Sponsorship/funding	"None"
Ethical approval	After informed consent, participants were included at the outpatient clinic at the time the operation was planned. The protocol was approved by the medical ethical committees of the three participating hospitals.
Notes	"Based on retrospectively collected data in one of the participating hospitals, the average percentage of patients needing repeated catheterization after removal of the catheter on the fifth day after an anterior colporrhaphy was 10%."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "A randomization list was made by an independent statistician. Randomization was performed in blocks and was stratified for the different hospitals. According to the randomization list, opaque, numbered, and sealed envelopes were prepared by an independent person. At the start of the operation, urine was collected for sedimentation. After the operation was finished, the indwelling catheter was inserted; the envelope with study number was opened, and at that moment, the patient was randomized to temporary indwelling catheterization for either 2 or 5 days" Comment: adequate randomisation methods
Allocation concealment (selection bias)	Low risk	Quote: "According to the randomization list, opaque, numbered, and sealed envelopes were prepared by an independent person." Comment: adequate concealment method
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible due to intervention.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "After removal of the catheter, urine samples were taken for sedimentation and culture." Comment: unlikely the microbiologist knew which patient belonged to which group as study implies routine cultures were taken

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Weemhoff 2011 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "One patient, randomized to the 2-day protocol, died of a heart attack on the first postoperative day with the catheter in situ. She died before she could participate in the study. Two patients allocated to the 5-day protocol had their catheter removed on the third day because of miscommunication. The three patients were analysed in the allocated group." Comment: patients analysed on an ITT basis
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in the methods were reported in the results section fully
Other bias	Low risk	Appears to be free from other sources of bias

Williamson 1982

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** 14-month period (not specified)
Participants	**Number of participants:** eligible, unclear; 8 randomised; 8 reported **Country:** USA **Population:** female **Age (range):** 22-40 years **Inclusion criteria:** IUC durations of at least 36 h **Condition for hospitalisation:** all female patients undergoing surgery **Exclusion criteria:** history of UTI or urinary incontinence in the preceding 12 months, patients whose urinalysis identified bacteriuria, and patients with spinal cord injuries and muscular degenerative disorders. Baseline residual urinary volume of > 25 mL were not considered. Patients who had taken medication known to cause bladder dystonia or urinary retention were not allowed to continue in the study **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 4):** bladder reconditioning **Group B (n = 4):** no reconditioning **Size and type of catheter used:** Foley catheter **Study definition of short-term catheterisation (days):** **Intended duration of catheterisation for each group:** A: bladder reconditioning. Reconditioning included clamping to prevent drainage of urine for 3-h cycles. At the end of 3 h the drainage tubing was unclamped for 5 min to allow complete emptying. Tubing was reclamped for 3 h followed by 5 min drainage period and a final 3 h followed by 5 min drainage. Reconditiong required a total of 9 h and 10 min. Reconditioning was conducted by the investigator. After catheter removal each participant in both groups maintained a minimum fluid intake of 100 mL/h B: control group (no reconditioning)
Outcomes	Mean time to first void

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Williamson 1982 *(Continued)*

	Post-IUC residual urine volume
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The four subjects randomly assigned…" Comment: randomisation method unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that it was possible to blind participants and staff. Nursing staff needed to know which patient needed reconditioning and so would be aware which patient was in which group.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts. However, only 8 participants
Selective reporting (reporting bias)	Unclear risk	Very limited information. Published in 1982. Not sure if this is selective reporting or poor reporting
Other bias	High risk	Underpowered study with only 8 participants

Wilson 2000

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** 75 eligible; 75 randomised; 75 reported **Setting:** Scotland **Country:** UK

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Wilson 2000 *(Continued)*

	Population: men **Age (mean and SD):** not reported **Inclusion criteria:** patients undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria:** inability of the patient to give consent **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 37):** bladder infusion with normal saline at 6 am by gravity from a 500 mL bag, until the participant felt that their bladder was full **Group B (n = 38):** IUC removed at 6 am and participant advised to drink fluids **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: infusion of normal saline at 6 am by gravity from a 500 mL bag until participant felt bladder was full. IUC then removed B: IUC removed at 6 am with no infusion protocol
Outcomes	Ready for discharge same day as trial of voiding Discharged same day as trial of voiding
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Ethical committee approval was obtained for the trial
Notes	A trial of voiding was carried out on the second day after TURP in all participants

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were randomized by opening marked, easily identifiable envelopes for each stratum with the allocation schedules enclosed." Comment: unclear as to whether randomisation method was adequate
Allocation concealment (selection bias)	Unclear risk	Quote: "… easily identifiable envelopes for each stratum with the allocation schedules enclosed …" Comment: unclear as to whether these envelopes were sealed or opaque
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "…was not blinded." Comment: blinding was not used. Likely blinding would not be possible with regards to the intervention
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported

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Wilson 2000 *(Continued)*

All outcomes		
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts reported
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are reported in results
Other bias	Low risk	Appears to be free from other sources of bias

Wu 2015

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** January 2011-December 2013
Participants	**Population:** mixed **Setting**: not reported **Inclusion criteria:** hospital patients who had biliary surgery for gallstones (in the gallbladder or in the biliary tree) **Condition for hospitalisation**: cholecystectomy **Exclusion criteria**: renal insufficiency pre-surgery, UTI, post-surgery severe complication, clinically unstable **Number of participants:** eligible, not reported; 100 randomised; 100 reported "Group A and B patients gender, age and surgery types and liver function stages were similar at baseline, with no statistically significant differences at P>0.05" **Age (e.g. mean and SD; median, IQR):** Group A: 24-77 years (min-max), average 45.6 years, SD 7.2 years Group B: 23-79 years, average 46.1, SD 7 years **Use of antibiotic prophylaxis**: not reported
Interventions	**Intervention for each group:** **Group A**: catheter clamped when participant woke up after the surgery. On Day 1 morning after surgery, when the participant felt the urge to pass urine, the IUC balloon was deflated and the catheter allowed to be self-dislodged during urination. [Translator Note, the catheter remains clamped] (n = 50) **Group B**: on the morning of Day1 post-surgery, after the participant passes urine (through the catheter), saline used to wash the bladder and the catheter clamped. 10 min after clamping, the balloon was deflated and the catheter allowed to be self-dislodged during urination (n = 50) **Size and type of catheter used**: not reported

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Wu 2015 *(Continued)*

	Study definition of short-term catheterisation (days): not reported **Intended duration of catheterisation for each group:** Group A: catheter clamped when participant woke up after the surgery. On Day 1 morning after surgery, when the participant felt the urge to pass urine, the IUC balloon was deflated and the catheter allowed to be self-dislodged during urination. Group B: on the morning Day 1 post surgery, after the participant passes urine (through the catheter), saline used to wash the bladder and the catheter clamped. 10 min after clamping, the balloon was deflated and the catheter allowed to be self-dislodged during urination.
Outcomes	Percentage of participants able to pass urine spontaneously on their own (success defined as: when they feel the urge, and 30 min after deflation of the balloon, the participant is able to spontaneously pass urine and dislodge/push out the catheter in one urination. Failure is defined as: not dislodged/pushed out in one urination, time taken > 30 min, needing to keep the catheter for passing urine)
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Trial report translated by contact for Cochrane Incontinence Biliary surgery patients for: Group A: gallstones in the biliary tract (28 participants) and gallstones (22 participants). Liver function Child-Pugh stage A (30), Stage B (20) Group B – gallstones in the biliary tract (29 participant) and gallstones (21 participant). Liver function Child-Pugh stage A (32), Stage B (18)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Statement of “patients were assigned using a random number chart”
Allocation concealment (selection bias)	Low risk	Allocation using a random number chart
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias)	Low risk	No data unaccounted for

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Wu 2015 *(Continued)*

All outcomes

Selective reporting (reporting bias)	Low risk	No evidence to report selective reporting
Other bias	Low risk	No other sources of bias identified

Wyman 1987

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 103 randomised; 103 reported **Setting:** Derby **Country:** UK **Population:** men **Age (mean and range):** 70.8 (50-89) **Inclusion criteria:** men undergoing TURP **Condition for hospitalisation:** TURP **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 51):** removal of IUC between 6 am and 7 am **Group B (n = 52):** removal of IUC between 10 pm and 11 pm **Size and type of catheter used:** 20-22 Fr 3-way Foley catheter **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removal between 6 am and 7 am B: IUC removal between 10 pm and 11 pm
Outcomes	Urinary retention Time interval between IUC removal and recatheterisation
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	All participants were catheterised using a 3-way Simplastic urethral catheter size 20 or 22 French gauge

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Wyman 1987 *(Continued)*

	Higher incidence of post-op retention in patients with pre-operative retention

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Patients were randomized into two groups …" Comment: method of randomisation unclear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely this was possible due to the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	No microbiological outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals or dropouts
Selective reporting (reporting bias)	Unclear risk	Difficult to judge as report is very short. All outcomes seem to be reported in methods and results section
Other bias	Low risk	Appears to be free from other sources of bias

Yaghmaei 2017

Study characteristics

Methods	**Study design:** RCT **Dates study conducted:** 2017
Participants	**Number of participants:** 110 randomised; 110 reported **Setting:** Zahedan, Sistan and Balouchestan **Country:** Iran **Population:** women **Age (mean and SD):** Group A 28.19 ± 5.80; Group B 28.01 ± 5.83 **Inclusion criteria**: caesarean volunteers in Imam Ali Hospital **Exclusion criteria:** haemorrhage > 1000 cc during surgery, pyuria before surgery, urinary bladder injury during or before surgery, special medication conditions such as: diabetes, drug addictions, pregnancy

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Yaghmaei 2017 *(Continued)*

	high blood pressure, urinary system problems signs and record, bladder synechiae, existence of > 5 leucocyte in patients' blood test before surgery **Condition for hospitalisation**: CS **Use of antibiotic prophylaxis**: cefazolin 1 g
Interventions	**Group A (n =110)**: IUC removal 6 h post-op **Group B (n = 110)**: IUC removal 12-24 h post-op **Size and type of catheter used (e.g. Foley 16F):** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 6 h post-op Group B: 12-24 h post-op
Outcomes	Urinary urgency Urinary difficulty Urinary frequency Urinary irritation Pyuria after surgery Time to first ambulation Time to first void Length of hospitalisation Fever Patient satisfaction
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Farsi paper. Translation provided by independent translator

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias)	High risk	Not reported. Unlikely given the nature of intervention

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Yaghmaei 2017 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assumed microbiologist were blinded to the intervention
Incomplete outcome data (attrition bias) All outcomes	High risk	Quote from translator: "Ready Samples for pyuria in 1st group (catheters were taken out 6 hours after surgery) was 91 and for 2nd group (was taken out 12,24 hours after) was 82. So totally it was 173 and there is no explanation regarding the missing data unfortunately." Comment: unclear as to why some data were not available
Selective reporting (reporting bias)	Low risk	Appears to be free from reporting bias. Protocol not available for assessment, however
Other bias	Low risk	Appears to be free from other sources of bias

Yee 2015

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** not reported
Participants	**Number of participants:** eligible, not reported; 112 randomised; 112 reported **Setting:** Penang General Hospital **Country:** Malaysia **Population:** women **Age:** not reported **Inclusion criteria:** women who underwent CS under spinal anaesthesia **Condition for hospitalisation:** elective CS under spinal anaesthesia **Exclusion criteria:** not reported **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = not reported by abstract):** IUC removal at 8 h post-op **Group B (n = not reported by abstract):** IUC removal at 24 h post-op **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: 8 h post-op

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Yee 2015 *(Continued)*

	B: 24 h post-op
Outcomes	Severe pain or discomfort CAUTI AUR
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Conference abstract with limited information

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assumed microbiologists were blinded to the intervention
Incomplete outcome data (attrition bias) All outcomes	High risk	High risk of bias due to incomplete data being reported. Only P values are reported
Selective reporting (reporting bias)	High risk	Conference abstract. Reported with limited information with only P values
Other bias	Low risk	No other bias likely present

Zaouter 2009

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted: 1** February-31 October 2008

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Zaouter 2009 *(Continued)*

Participants	**Number of participants:** 321 eligible; 215 randomised; 215 reported **Setting:** Montreal **Country:** Canada **Population:** mixed **Age (mean and SD):** A 57 ± 15; B 63 ± 11 **Inclusion criteria:** patients scheduled for elective major abdominal and thoracic surgery **Condition for hospitalisation:** major elective abdominal and thoracic surgery **Exclusion criteria:** history of post-op urinary retention and with medical conditions and surgical conditions recognised to be at risk for post-op urinary retention. All patients completed a questionnaire on lower urinary tract flow obstruction, if positive they underwent uroflowmetry and if considered at risk of urinary retention and were excluded. **Use of antibiotic prophylaxis:** 20 min before skin incision, 2 g cefazolin with or without 500 mg metronidazole was administered IV. If the surgery lasted for > 5 h, a second dose of cefazolin (1 g) would be administered. Once the urine and blood samples were sent for culture and sensitivity, an empirical treatment with broad-spectrum antibiotics based on local susceptibility patterns was started. Afterward, when the urine sample was positive, targeted antibiotic therapy was prescribed according to the urine culture results.
Interventions	**Group A (n = 110):** IUC removed same morning as the surgery **Group B (n = 105):** IUC removed when epidural anaesthesia removed **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: IUC removed the same morning as the surgery B: IUC up until the epidural removed (3-5 days)
Outcomes	Contracted UTI Recatheterisation Length of hospital stay Duration of bladder catheterisation VAS pain score
Definition of CAUTI or bacteriuria	“Patients were diagnosed having in-hospital UTI according to international guidelines based on the following characteristics: pyrexia to a temperature of 38-C, urinary tract symptoms (dysuria, increased frequency of urination, urinary urgency, suprapubic pain, burning on micturition, or onset or aggravation of urinary incontinence), and positive urine culture (10^7 bacterial colonies of microorganism-forming units per litre within 2 weeks after the removal of bladder catheter).”
Sponsorship/funding	This work was supported by internal funds, Department of Anesthesia, McGill University Health Centre.
Ethical approval	The trial was approved by the ethics board of the McGill University Health Centre and written informed consent was obtained from all participants.
Notes	

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Zaouter 2009 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "... allocated, using a computer-generated block randomization schedule." Comment: adequate randomisation method
Allocation concealment (selection bias)	High risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely blinding was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "Once the urine and blood samples were sent for culture and sensitivity" Comment: implies that samples were sent to a laboratory and so unlikely the microbiologist would know which patient belonged to the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	There are no dropouts from the study
Selective reporting (reporting bias)	Low risk	Outcomes reported in methods are represented in the results section. However, the protocol is not available for viewing.
Other bias	Low risk	No other bias likely present

Zhou 2012

Study characteristics	
Methods	**Study design:** quasi-RCT **Dates study conducted:** January-December 2011
Participants	**Population:** women undergoing CS for: cephalopelvic disproportionate; social reasons; stuck fetus; abnormal placenta; twins; overly large baby; scarred uterus; other reasons unstated **Setting:** Guangdong Hospital **Inclusion criteria**: obstetric patients undergoing CS **Exclusion criteria:** heart, liver, kidney, brain or other severe conditions, no obstetric complications or conditions Surgical or anaesthesia complications **Condition for hospitalisation**: CS

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Zhou 2012 *(Continued)*

	Number of participants: eligible, not reported; 138 randomised; 138 reported **Age (mean and SD):** **Group A**: mean 25.11, SD 4.88, rRange 20-33 **Group B**: mean 26.33, SD 5.08, range 19-35 **Use of antibiotic prophylaxis**: not reported
Interventions	**Size and type of catheter used (e.g. Foley 16F)**: not reported **Study definition of short-term catheterisation (days)**: not reported **Intended duration of catheterisation for each group:** Group A: removal of IUC at 6 h post surgery (intervention) (n = 46) Group B: removal of IUC at 8 h post surgery (intervention) (n = 46) Group C: removal at 24 h (control) (n = 46)
Outcomes	Urinary retention Post-op 24 h bleeding Post-op comfort after removal (measuring using VAS and urinary symptoms. “Mild” – pain score 1-3, “Moderate” 4-7, “Severe” 8-10)
Definition of CAUTI or bacteriuria	Defined as post-catheter removal midstream clean catch culture of ≥ 10^4 cfu/mL for Gram-positive organisms or ≥ 10^5 cfu/mL for Gram-negative organisms
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	Translator note: there is no description given of how the intervention group is separated into 6- or 8-hour removal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Patients were allocated based on timing of presentation (odd or even days) into either intervention (6 h or 8 h removal) or control (24 h)
Allocation concealment (selection bias)	High risk	Patients were allocated based on timing of presentation (odd or even days) into either intervention (6 h or 8 h removal) or control (24 h)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely possible given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported, likely that specimens sent to a lab

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Zhou 2012 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	All completed, none lost
Selective reporting (reporting bias)	Low risk	Appears free from selective bias
Other bias	Low risk	Nothing to indicate any other source of bias

Zmora 2010

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** 2005-2008
Participants	**Number of participants:** eligible, not reported; 118 randomised; 118 reported **Country:** Israel and Egypt **Population:** mixed **Age (mean and range):** A 57.4 (18-85); B 54.6 (25-81); C 54.2 (22-78) **Inclusion criteria:** age ≥ 18 years; pelvic colorectal surgery with dissection of the rectum below the level of the sacral promontory; elective surgery; ASA score 1-3; the ability to understand the objectives of the study and give an informed consent **Condition for hospitalisation:** patients undergoing colon and rectal surgery with pelvic dissection via an abdominal approach **Exclusion criteria:** pre-operative antibiotic treatment other than routine perioperative prophylaxis; past or current urinary tract malignancy; IUC inserted 48 h before surgery or longer; chronic IUC drainage; known renal failure with blood creatinine levels of 2.0 mg or higher, including end-stage renal disease requiring dialysis; previous pelvic surgery via the abdominal approach, including rectal, gynaecologic, and lower urinary tract procedures; severe benign prostatic hyperplasia with an AUA symptom index of ≥ 20; chronic urinary diseases including chronic infections and urinary anomalies; daily intake of medications affecting urinary output or urinary bladder contraction; neurogenic bladder; chronic intermittent IUC; past or current enterovesicle fistula; pregnancy; known pelvic abscess; malnutrition with albumin levels of < 2.7 g; immunosuppression (after organ transplantation, HIV-positive with a CD4 count of < 200, chemotherapy in the past 2 weeks) **Use of antibiotic prophylaxis:** all participants received prophylactic perioperative antibiotics for 24 h according to the participating department's protocols, and antibiotic treatment was uniform across the groups.
Interventions	**Group A (n = 41):** IUC removed post-op day 1 **Group B (n = 38):** IUC removed post-op day 3 **Group C (n = 39):** IUC removed post-op day 5 **Size and type of catheter used (e.g. Foley 16F):** Foley catheter, size not specified **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** A: the Foley catheter was removed on post-op day 1

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Zmora 2010 *(Continued)*

	B: the Foley catheter was removed on post-op day 3 C: the Foley catheter was removed on post-op day 5
Outcomes	Urinary retention/recatheterisation UTI Asymptomatic bacteriuria Anastomotic leak (%) Overall surgical site infection Pulmonary complications Overall complications rate
Definition of CAUTI or bacteriuria	UTI diagnosed based on symptoms and positive urine culture, symptomatic bacteriuria based on cultures routinely taken on catheter removal
Sponsorship/funding	Not reported
Ethical approval	Not reported
Notes	AUR was defined as the inability to pass urine despite significant urge and attempt for at least 30 min, or if the patient did not spontaneously pass urine within 8 h after removal of the Foley catheter.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was done by use of computer-generated institutional randomisation tables with blocks of 15; that is, in each 15 patients from the same institution, 5 patients were randomly assigned to each of the groups." Comment: adequate method of randomisation
Allocation concealment (selection bias)	Low risk	Quote: "Each patient's allocation was revealed after completion of surgery." Comment: adequate method of concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely that blinding of patients was possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Quote: "… based on cultures routinely taken on catheter removal." Comment: suggests that cultures were taken alongside routine cultures for other patients and not specifically for the trial. Thus unlikely that the microbiologist knew which patient belonged to the trial and which did not.
Incomplete outcome data (attrition bias) All outcomes	Low risk	"Sixteen protocol violations were recorded, including 6 patients in whom routine urinary cultures were not undertaken on removal of the catheter, 5 male patients without a reported history of BPH in whom AUA-BPH symptom scores were not recorded, and 5 patients in whom intraoperative nerve identification

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Zmora 2010 *(Continued)*

		was not recorded. All violations were considered minor, and did not require exclusion of these patients from the study." No dropouts or withdrawals. All participants who were randomised were analysed according to their allocated intervention group.
Selective reporting (reporting bias)	Low risk	All outcomes reported in methods are accounted for. Protocol was not available to assess
Other bias	Low risk	Nothing to indicate any other source of bias

Zomorrodi 2018

Study characteristics	
Methods	**Study design:** RCT **Dates study conducted:** April 2016-September 2016
Participants	**Population:** mixed **Setting:** Tabriz **Country**: Iran **Inclusion criteria**: all patients suffered from end-stage renal failure and had negative urinary culture and had been operated by the same team of surgery using 3 medications (tacrolimus, prednisolone and mycophenolate mofetil) **Exclusion criteria**: any patient with history of lower urinary tract disease and abnormality of lower urinary tract and also any patient who disagreed with the study was excluded **Condition for hospitalisation**: renal transplantation for end stage renal failure **Number of participants:** eligible; 88 randomised; 88 reported **Age (mean and SD):** A 43.52 ± 13.6; B 43.20 ± 14.39 **Use of antibiotic prophylaxis:** not reported
Interventions	**Group A (n = 44)**: IUC removal 3 days post-op **Group B (n = 44)**: IUC removal 7 days post-op **Size and type of catheter used:** not reported **Study definition of short-term catheterisation (days):** not reported **Intended duration of catheterisation for each group:** Group A: 3 days post-op Group B: 7 days post-op
Outcomes	UTI
Definition of CAUTI or bacteriuria	Not reported
Sponsorship/funding	This study was supported by Tabriz University of Medical Sciences, Tabriz, Iran.

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Zomorrodi 2018 *(Continued)*

Ethical approval	The research followed the tenets of the Declaration of Helsinki. Consent for operation and study had been taken. The ethical committee of Tabriz University of Medical Sciences approved the research. All patients' information remained confidential.
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were all divided into two groups randomly" Comment: unclear method of randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not reported. Unlikely given nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Blinding of microbiological outcome (detection bias)	Low risk	Not reported. Assume lab technician blinded to participants of the trial
Incomplete outcome data (attrition bias) All outcomes	Low risk	Appears to be free from attrition bias
Selective reporting (reporting bias)	Low risk	Appears to be free from reporting bias. Outcomes reported in protocol also reported in trial
Other bias	Low risk	Appears to be free from other sources of bias

APR: abdominoperineal resection; **ASA:** American Society of Anesthesiologists; **AUA:** American Urological Association; **AUB:** abnormal uterine bleeding; **AUR:** acute urinary retention; **BP:** blood pressure; **CAUTI:** catheter-associated urinary tract infection; **CDC:** Centers for Disease Control and Prevention; **cfu:** colony forming unit; **CS:** caesarian section; **DVT:** deep vein thrombosis; **EAU:** European Association of Urology; **FIGO:** International Federation of Gynecology and Obstetrics; **ICU:** intensive care unit; **IM:** intramuscular(ly); **IPSS:** International Prostate Symptom Score; **IQR:** interquartile range; **ITT:** intention-to-treat; **IUC:** indwelling urethral catheter; **IV:** intravenous; **LAR:** low anterior resection; **PCEA:** patient-controlled epidural anaesthesia; **Post-op:** post-operative(ly); **PSA:** prostate-specific antigen; **PTFE:** polytetrafluoroethylene; **QoL:** quality of life; **RCT:** randomised controlled trial; **RUV:** residual urine volume; **SD:** standard deviation; **TUIP:** transurethral incision of the prostate; **TURP:** transurethral resection of the prostate; **UTI:** urinary tract infection; **VAS:** visual analogue scale

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
2004-005138-38	Trial looked at the prophylactic usage of cefuroxime
ACTRN12617001191381	Intervention not relevant

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Study	Reason for exclusion
Agrawal 1993	Not an RCT or quasi-RCT
Airaksinen 1979	Intervention was not relevant
Aunruean 2007	Intervention was not relevant
Bach 1990	Intervention was not relevant
Benjamin 2018	Intervention not relevant
Bergqvist 1979	The study compares catheter materials for long-term usage
Boyd 2019	Intervention not relevant
Christensen 1983	Intervention was not relevant. Trial looks at intermittent drainage in long-term IUC
Cleland 1971	Comparative study of interventions to prevent infection
CTRI/2019/02/017836	Participants of trial are children aged 1-10 years
Dhariwal 2019	Intervention not relevant
Downey 1997	Not an RCT or quasi-RCT
Efimenko 2004	Intervention not relevant
Farag 2018	Intervention not relevant
Farrell 1989	Intervention not relevant. Involved suprapubic catheterisation
Fattah 2013	Not an RCT or quasi-RCT
Fernandez-Gonzalez 2019	Trial uses intermittent self-catheterisation
Ghoreishi 2003	Intervention not relevant. Trial compared catheterisation to no catheterisation in women undergoing cesarean deliveries
Gillespie 1962	Intervention not relevant. Trial looked at catheter disinfection and also involved intermittent catheterisation
Gross 1990	Intermittent catheterisation used
Halaska 1991	Intervention not relevant. Trial involved suprapubic catheters
Hollingsworth 2013	Not an RCT
Hu 1999	Intervention not relevant
ISRCTN44339585	Intervention was not relevant
ISRCTN48516968	Intervention not relevant
Jankowska 1995	Intervention not relevant. Trial compares no catheterisation to 24-h catheterisation
Ledermair 1970	Intervention not relevant

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Study	Reason for exclusion
Loeb 2008	Intervention not relevant. Trial uses stop orders for the removal of IUCs under specified criteria and does not compare durations of catheterisation. There were no fixed time points for when catheters were removed.
Mamo 1991	Retrospective study - not an RCT or quasi-RCT
Mayer 1973	Intervention not relevant
Medina 2005	Intervention not relevant. Trial compares physiological and retrograde filling of the bladder to determine if one method would substantially shorten the evaluation of bladder emptying.
Menshawy 2020	Not an RCT
Michelson 2005	Intervention not relevant. Catheter protocols are not related to catheter removal
Miller 1960	Intervention not relevant. Describes outcomes between closed and open drainage systems
Mills 2018	Intervention not relevant
Moon 2012	Study involves long-term catheterisation
Mustafa 1968	Study compares catheterisation and no catheterisation
Nadu 2001	Not an RCT or quasi-RCT
Nardos 2011	Catheterisation is part of intervention (vesicovaginal fistula repair)
Nardos 2012	Catheterisation is part of intervention (vesicovaginal fistula repair)
NCT00182832	Intervention not relevant. Study compares two methods of measuring post-void residual volume
NCT00392210	Intervention not relevant. Study compares voiding techniques post-surgery
NCT00446732	Intervention not relevant. Study compares efficacy of Uroshield treatment with standard therapy
NCT00959920	Study compared intermittent and indwelling catheterisation
NCT01067768	Intervention not relevant. Study compared efficacy of daily nurse reviews of the IUC
NCT01108757	Interention not relevant. Study compared efficacy of antibiotic prophylaxis
NCT01343784	Intervention not relevant. Study compares various sling procedures
NCT01525498	Study withdrawn prior to recruitment stages
NCT01646190	Intervention not relevant. Study compares fast track programme to regular practice
NCT01797146	Intervention not relevant. Study compares catheter reminder programmes
NCT01926756	Study compares catheterisation to no catheterisation
NCT02054065	Intervention not relevant. Study looks at catheter reminder systems
NCT02126813	Intervention not relevant. Study looking at fast track programmes in surgery

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Study	Reason for exclusion
NCT02357251	Intervention not relevant. Study compares current perioperative care of the investigators' gynaecologic oncology patients with a standardised perioperative "enhanced recovery" pathway
NCT02996968	Intervention not relevant. Uses intermittent catheterisation
NCT03646136	Intervention not relevant
NCT03684941	Trial registration. Uses intermittent catheterisation
NL2677	Study compares indwelling and intermittent catheterisation
Norton 1987	Study uses suprapubic catheterisation
Okrainec 2017	Not an RCT. Prospective cohort study
Panknin 2007	This is a commentary on a non-randomised study
Patel 2018	Intervention only partially meets criteria for review. Trial compares shorter durations of catheterisation and also includes the use of alpha blockers
Pellegrini 1995	Intervention not relevant. Compares intermittent catheterisation
Peniakov 2004	Intervention not relevant. Study involved intermittent catheterisation
Perera 2002	Not an RCT or quasi-RCT
Priefer 1982	Long-term catheterisation
Rabkin 1998	Not an RCT or quasi-RCT
Ratahi 2005	Study compares catheterisation to no catheterisation
Rehm 1962	Not an RCT or quasi-RCT
Ross 1966	This trial compares infection rates when IUCs were inserted with and without the application of topical antibiotics
Salem Mohamed 2018	Intervention not relevant
Sandberg 2018	Not an RCT
Souto 2000	Group allocation determined on clinical criteria i.e. not an RCT or quasi-RCT
Symonds 1967	Intervention not relevant
Tomaszewski 2015	Not an RCT or quasi-RCT
Uberoi 2013	Not a RCT or quasi-RCT
UMIN000014474	Intervention not relevant. Compares catheterisation to no catheterisation
UMIN000015289	Intervention not relevant
Watt 1998	Not an RCT or quasi-RCT

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Study	Reason for exclusion
Weitzel 2008	Not an RCT or quasi-RCT
Wilson 2013	Not an RCT or quasi-RCT
Zhang 1999	Intervention not relevant
Zhao 1994	Compares suprapubic versus urethral catheterisation

IUC: indwelling urethral catheter; **RCT:** randomised controlled trial

Characteristics of studies awaiting classification *[ordered by study ID]*

NCT02602132

Methods	**Study design:** RCT
Participants	**Inclusion criteria:** adult patients of both sexes, aged 18-85 years who require IUC short-term (1-14 days) in the units of internal medicine at University Hospital Alcorcón Foundation. Patients who express a desire to participate in the study by signing the informed consent. **Exclusion criteria:** patients with permanent long-term (≥ 15 days) urinary catheter; patients with recurrent episodes of UTI, which has submitted episodes of urinary retention in the last month, or who have urologic pathology; patients with cognitive impairments that hinder communication with the medical staff; disoriented patients in person, time and place; anatomical and physiological genito-urinary system alterations; patients taking a drug that affects the bladder and kidney function the week prior to catheterisation; pregnant patients; patients with a known history of benign prostatic hyperplasia
Interventions	Group A: to clamp before the removal of short-term IUC Group B: IUC is clamped before removal and unclamped when the patient expresses desire to urinate
Outcomes	Complications of IUC
Notes	This trial is currently listed as suspended. We contacted the trial author to provide further information and confirmed that this trial had been suspended due to poor recruitment.

IUC: indwelling urethral catheter; **RCT:** randomised controlled trial; **UTI:** urinary tract infection

Characteristics of ongoing studies *[ordered by study ID]*

ACTRN12611000414910

Study name	Bladder care following laparoscopy for benign non-hysterectomy gynaecological conditions – a randomised controlled trial (ACTRN12611000414910)
Methods	**Study design:** RCT
Participants	Patients undergoing laparoscopic surgery for benign non-hysterectomy gynaecological conditions **Inclusion criteria:** elective laparoscopy for a benign gynaecological condition; patients to be aged ≥ 18 years at time of surgery; patients who understand the conditions of the study and are willing to participate for the length of the prescribed term of follow-up; patients who are capable of, and have given written informed consent to their participation in the study; patients presenting with

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ACTRN12611000414910 *(Continued)*

	benign gynaecological conditions that require surgical intervention as agreed to by the patient and her attending medical team **Exclusion criteria**: concurrent involvement in other research studies; past history of incontinence surgery; surgery for urinary incontinence or prolapse; suspected or confirmed gynaecological malignancy; patients scheduled for hysterectomy as part of their surgical procedure; patients with long-term bladder catheterisation (intermittent or permanent); suspected or confirmed pregnancy at the time of surgery; intermittent flow pattern on uroflowmetry (indicative of pre-existing voiding dysfunction); pre-operative PVR ≥ 150 mL
Interventions	**Group A**: immediate removal of the IUC post-laparoscopic surgery for benign non-hysterectomy gynaecological conditions **Group B**: removal of the IUC at 6 am on the 1st post-op day following laparoscopic surgery for benign non-hysterectomy gynaecological conditions
Outcomes	Incidence of post-op UTI Incidence and pattern of post-op voiding dysfunction PVR urine volume in patients before surgery Duration of hospital stay Re-admission to hospital (incidence and indication) Unscheduled presentation to general practitioner Emergency department or outpatient service (clinic/rooms) Economic analyses of the 2 modalities for care
Starting date	1 March 2012
Contact information	Associate Professor Jason Abbott Royal Hospital for Women Barker Street Randwick NSW 2031 Country: Australia Phone: +61 2 93826111 Email: j.abbott@unsw.edu.au
Notes	**Recruitment status**: not yet recruiting

ChiCTR1800016149

Study name	Randomized control study of early extubation of indwelled urinary catheter after rectal cancer radical operation
Methods	**Study design**: randomised controlled trial **Setting:** Sixth Affiliated Hospital of Sun Yat-sen University, China

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ChiCTR1800016149 *(Continued)*

Participants	I**nclusion criteria**: aged 18-75 years old; pre-operative fibrosis colonoscopy and pathological biopsy confirmed colorectal cancer as the primary cancer; no difficulty in urination and no UTI before operation; provision of written informed consent **Exclusion criteria**: patients with colorectal cancer palliative surgery, Miles operation and emergency surgery; patients with obvious urinary diseases including urinary tract stone, tumour, prostatic hyperplasia; patients having a history of urinary enuresis within 72 h; patients with history of pelvic surgery or with severe systemic diseases such as heart, lung, kidney, etc.; patients required lateral lymph node dissection; patients with recurrent rectal cancer or multiple rectal cancer and with other tumour; patient unconscious and unable to express the intention of urination correctly; patients with dementia, stroke or mental illness. Antibiotic treatment was applied 1 week before surgery.
Interventions	**Group A**: removal of IUC within 24 h directly after surgery **Group B**: removal of IUC after training bladder function on the 3rd day regularly after surgery
Outcomes	AUR UTI Urethral bleeding Residual volume Urinary incontinence Discomfort of lower urinary tract
Starting date	14 May 2018
Contact information	Tenghui Ma, austin_2004@163.com
Notes	

CTRI/2018/11/016299

Study name	A randomized controlled trial comparing early versus late catheter removal after radical hysterectomy
Methods	**Study design**: RCT
Participants	Effect of early catheter removal in those undergoing radical hysterectomy in early-stage cervical cancer compared to the late removal group Inclusion criteria: women aged 18-80, all early stages (IA2, IB1, IIA1) cervical cancer undergoing radical hysterectomy **Exclusion criteria**: non-cervical cancer, previous pelvic irradiation, prior urinary dysfunction, bladder injury during surgery, other indications for prolonging bladder catheterisation
Interventions	**Group A**: will be assigned for catheter removal on post-op day 4+/-1 day **Group B**: will be assigned for catheter removal on post-op day 10+/- day
Outcomes	CAUTI

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CTRI/2018/11/016299 *(Continued)*

Starting date	11 November 2018
Contact information	Amy Jose, amy.jose@cmcvellore.ac.in
Notes	

IRCT20180208038670N1

Study name	The effect of urinary catheter removal time on the incidence of urinary infection and satisfaction level in patients undergoing lower extremity fracture surgery
Methods	**Study design**: RCT
Participants	**Inclusion criteria:** age 18-60 years; placement in the lower extremity surgery list **Exclusion criteria:** UTI; common chronic diseases (diabetes, heart failure, renal failure, chronic obstructive pulmonary disease); multiple trauma; other infections Target sample size: 96
Interventions	**Group A**: people with IUC to 24 h after catheterisation **Group B**: people with IUC to 48 h after catheterisation **Group C**: people with IUC 72 h after catheterisation
Outcomes	Incidence of UTI
Starting date	31 July 2018
Contact information	Tahereh Haghparast, shirinehaghparast1389@yahoo.com
Notes	

NCT03539107

Study name	Voiding assessment based on minimum spontaneous void of 150 mL compared to retrograde fill method after female pelvic floor reconstructive surgery
Methods	**Study design**: RCT This study will compare voiding assessment based on a minimum spontaneous voided volume of 150 cc with the standard retrograde fill approach in women after pelvic floor procedures.
Participants	Women undergoing pelvic floor procedures Inclusion criteria: all women ≥ 18 years who undergo surgery for urinary incontinence and/or pelvic organ prolapse (POP) **Exclusion criteria**: patients who require prolonged Foley catheter or suprapubic catheter
Interventions	**Group A**: retrograde bladder fill - participants will have their bladder retrograde filled with 300 mL of fluid prior to a voiding trial

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NCT03539107 *(Continued)*

	Group B: spontaneous void - participants will not have retrograde fill of bladder, rather will be required to void 150 mL spontaneously prior to discharge
Outcomes	The percentage of participants who did not meet the required voiding assessment criteria and needed catheterisation
Starting date	1 September 2019
Contact information	Harmanli Oz, MD
Notes	

NCT03668535

Study name	Filling of the urinary bladder during difficult cesaerean section
Methods	**Allocation**: randomised **Intervention model**: parallel Assignment **Intervention model description**: 2 groups of women with difficult CS at risk of urinary bladder injury. Group A will receive the intervention. Group B will not receive the intervention. **Masking**: double (participant, investigator) **Masking description**: closed envelope will be used for randomisation. The patient and the investigator will be blinded. Primary purpose: prevention
Participants	**Patients and Methods** Inclusion criteria: pregnant women at gestation from 20- 41 weeks who have any of the following risk factors: previous CS ≥ 3 times; previous history of bladder injury during CS; operative report of extensive adhesions in the last CS; CS for placenta accreta spectrum No exclusion criteria reported **Methods**: this is a RCT done at the department of Obstetrics & Gynaecology unit, South Valley University from 1 August 2017-30 August 2018. The research is approved by the Committee of Ethics for Biomedical Researches, South Valley University at June 2017. All cases have informed consent before inclusion in the research. Closed envelope is used to randomise patients to either group. Group A: are cases of CS who have the intervention. Group B: are cases of CS who do not have the intervention.
Interventions	**Group A**: bladder filling: participants have a triple-way IUC insertion before establishment of anaesthesia. Evaluation of the drained urine is done (including: amount, character, and culture and sensitivity). Instillation of 200 mL sterile saline is done by 50 mL syringe through the irrigation way. The irrigation way is closed temporarily by artery forceps. After laparotomy the bladder may be deflated by 50 mL or further inflated by 50 mL if needed to allow comfortable dissection. **Group B**: bladder deflation: participants have Foley's catheter inserted as usual. The catheter is connected freely to urinary bag
Outcomes	Intra-operative rate of urinary bladder injury
Starting date	1 August 2017
Contact information	Mohammad AM Ahmed, MD

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NCT03668535 *(Continued)*

Notes	

NCT03835351

Study name	Urinary retention after laparoscopic inguinal hernia repair: comparing the use of the intraoperative urinary catheter
Methods	**Study design**: RCT This will be a RCT that will compare the rate of post-op urinary retention after laparoscopic inguinal hernia repair between patients who receive an intra-operative IUC and those who do not. The primary aim of the study is to determine if the use of intra-operative IUC reduces the incidence of post-op urinary retention after laparoscopic inguinal hernia repair. Specific patient inclusion criteria include all patients aged ≥ 18 years presenting for an elective unilateral or bilateral inguinal hernia repair, who are able to tolerate general anaesthesia and are considered eligible to have a hernia repair through a laparoscopic approach.
Participants	Laparoscopic inguinal hernia repair between patients who receive an intra-operative urinary catheter and those who do not Inclusion criteria: ≥ 18 years; able to give informed consent; unilateral or bilateral inguinal hernia; scheduled for elective inguinal hernia repair; eligible to tolerate general anaesthesia; eligible to undergo minimally invasive inguinal hernia repair Exclusion criteria: diagnosed with benign prostate hyperplasia (BPH); < 18 years old; unable to give informed consent Emergent inguinal hernia repairs (acute incarceration or strangulation); unable to tolerate general anaesthesia; not eligible for minimally invasive inguinal hernia repair
Interventions	**Group A**: intraoperative IIUC - after induction of general anaesthesia, a standard catheterization kit available at the institution where the surgery is being performed will be used to place the urinary catheter using standard sterile technique. Intervention: device: IUC **Group B**: no intraoperative IUC. No intraoperative IUC will be used during the case
Outcomes	"The rate of post-op urinary retention requiring insertion of a urinary catheter Intraoperative bladder injuries (time frame: measured from start to end of procedure.) This will be determined by comparing the rates of intraoperative bladder injuries between the 2 study groups Complications of intra-operative urinary catheter (time frame: from the day of surgery until post-op day 30). This will be accomplished by analysing the rates of urinary tract injury, infections and bladder injuries due to intraoperative catheter placement. IUC complications for patients who develop retention (time frame: from the day of surgery until post-op day 30). This will be accomplished by analysing the rates of urinary tract injury, or infections and bladder injuries due to catheter placement after patients develop post operative urinary retention."
Starting date	7 March 2019
Contact information	Michael Rosen, MD, rosenm@ccf.org
Notes	Currently recruiting

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Xu 2019

Study name	A single-centre, prospective, randomized clinical trial to investigate the optimal removal time of the urinary catheter after laparoscopic anterior resection of the rectum: study protocol for a randomized controlled trial
Methods	**Study design**: RCT This study is a superiority trial and is designed as a prospective, single-centre, randomized, parallel-group, trial. It will be enrolled and divided into 2 groups: the early removal group (the intervention group) and the normal removal group (the control group). The flow diagram for this trial is shown in Fig. 1. The sample size was estimated as follows. According to the latest studies, the incidence of urinary retention after rectal surgery is 25% when the catheter is removed within 2 days after surgery and 10% when the catheter is removed after 7 days. To detect these outcomes with $\alpha = 0.05$ and $\beta = 0.2$, we would need 100 patients per group (total 200). We decided to enrol 110 patients in each group (total 220), to allow for a possible 10% dropout rate.
Participants	The study participants will be rectal cancer patients requiring laparoscopic anterior resection of the rectum. Inclusion criteria: age 18–75 years; diagnosed with rectal cancer and posted for total or tumour-specific mesorectal excision with colorectal or coloanal anastomosis; ASA classification of 1–3 Exclusion criteria: pre-operatively diagnosed UTIs or urinary system diseases (including end-stage renal disease, neurological bladder dysfunction, and malignancy); previous history of urinary retention or of having received drugs likely to affect bladder function; male patients with disease of the prostate (such as benign prostatic hyperplasia); patients receiving emergency surgery
Interventions	A total of 220 participants meeting the inclusion criteria will be randomly assigned to an experimental group or a control group. **Group A**: the experimental group will have their IUCs removed on post-op day 2. **Group** B: control group will have their IUCs removed on post-op day 7. In both groups, catheter removal will be performed when the bladder is full.
Outcomes	**Primary outcome**: post-operative urinary retention requiring recatheterisation following IUC removal **Secondary outcome**: UTI occurring following IUC removal
Starting date	July 2017
Contact information	Correspondence: Xiaoy@pumch.cn; Xiaoy@pumcn.cn
Notes	"This trial protocol is approved by the Ethics Committee of Peking Union Medical College Hospital (reviewed in 2017 as ZS-1269) and has been registered at ClinicalTrials.gov under the identifier NCT03065855, registered on February 23, 2017. All eligible participants and their legal surrogates will be fully informed of the potential risks and benefits of the interventions in each group."

ASA: American Society of Anesthesiologists; **AUR:** acute urinary retention; **CAUTI:** catheter-associated urinary tract infection; **CS:** caesarean section; **IUC:** indwelling urethral catheter; **PVR:** post-void residual; **RCT:** randomised controlled trial; **UTI:** urinary tract infection

DATA AND ANALYSES

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Comparison 1. Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Number needing to be re-catheterised	10	1920	Risk Ratio (M-H, Fixed, 95% CI)	0.70 [0.52, 0.94]
1.1.1 Urological surgery and procedures	6	1400	Risk Ratio (M-H, Fixed, 95% CI)	0.87 [0.60, 1.27]
1.1.2 Gynaecological surgery	2	202	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.15, 0.69]
1.1.3 General medical and surgical patients	2	318	Risk Ratio (M-H, Fixed, 95% CI)	0.73 [0.36, 1.46]
1.2 Number needing to be re-catheterised: subgroup analysis based on sex	6	1200	Risk Ratio (M-H, Fixed, 95% CI)	0.44 [0.25, 0.76]
1.2.1 Men only	4	998	Risk Ratio (M-H, Fixed, 95% CI)	0.63 [0.28, 1.44]
1.2.2 Women only	2	202	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.15, 0.69]
1.3 Symptomatic catheter-associated urinary tract infection (number of participants)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.3.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.4 Asymptomatic bacteriuria (number of participants)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.4.1 Gynaecological surgery	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.5 Incidence of urinary retention	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.5.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.6 Difficulty in passing urine	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.6.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.7 Loin pain	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.7.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.8 Fever	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.8.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.9 Incontinence	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.9.1 General medical and surgical patients	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.10 Dysuria (number of participants)	1	170	Risk Ratio (M-H, Fixed, 95% CI)	2.20 [0.70, 6.86]
1.10.1 General medical and surgical patients	1	170	Risk Ratio (M-H, Fixed, 95% CI)	2.20 [0.70, 6.86]
1.11 Volume of the first void (mL)	11	1198	Mean Difference (IV, Fixed, 95% CI)	21.98 [3.04, 40.92]
1.11.1 Urological surgery and procedures	8	923	Mean Difference (IV, Fixed, 95% CI)	11.63 [-10.65, 33.91]
1.11.2 Gynaecological surgery	1	107	Mean Difference (IV, Fixed, 95% CI)	34.00 [-11.30, 79.30]
1.11.3 General medical and surgical patients	2	168	Mean Difference (IV, Fixed, 95% CI)	74.54 [15.35, 133.73]
1.12 Volume of first void (median and range)	1		Other data	No numeric data
1.12.1 Following gynaecological surgery	1		Other data	No numeric data
1.13 Time to first void (hours)	10	1140	Mean Difference (IV, Fixed, 95% CI)	0.71 [0.41, 1.01]
1.13.1 Urological surgery and procedures	6	703	Mean Difference (IV, Fixed, 95% CI)	0.72 [0.39, 1.06]
1.13.2 Gynaecological surgery	1	107	Mean Difference (IV, Fixed, 95% CI)	0.10 [-1.46, 1.66]
1.13.3 General medical and surgical patients	3	330	Mean Difference (IV, Fixed, 95% CI)	0.79 [0.02, 1.57]
1.14 Time to first void (median)	1		Other data	No numeric data
1.14.1 Following gynaecological surgery	1		Other data	No numeric data
1.15 Post-void residual volume	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.15.1 General medical and surgical patients	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.16 Length of hospitalisation in days	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.16.1 Gynaecological surgery	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.17 Length of hospitalisation in days	2		Other data	No numeric data
1.17.1 Urological surgery and procedures (mean, total)	1		Other data	No numeric data
1.17.2 Gynaecological surgery involving the bladder /urethra (median, range)	1		Other data	No numeric data
1.17.3 Gynaecological surgery not involving the bladder/urethra (median, range)	1		Other data	No numeric data
1.18 Time between removal of catheter to discharge	2	272	Mean Difference (IV, Fixed, 95% CI)	0.08 [-5.96, 6.12]
1.18.1 Urological surgery and procedures	1	72	Mean Difference (IV, Fixed, 95% CI)	0.00 [-6.06, 6.06]
1.18.2 General medical and surgical patients	1	200	Mean Difference (IV, Fixed, 95% CI)	15.50 [-67.34, 98.34]

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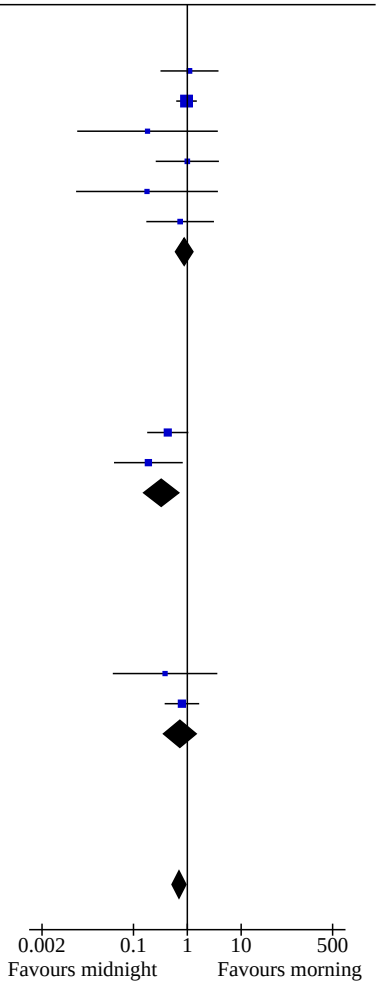
Analysis 1.1. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 1: Number needing to be recatheterised

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.1.1 Urological surgery and procedures						
Chillington 1992 (1)	4	35	5	48	4.8%	1.10 [0.32 , 3.79]
Crowe 1993 (2)	28	115	32	127	34.4%	0.97 [0.62 , 1.50]
Ganta 2005 (3)	0	44	2	40	3.0%	0.18 [0.01 , 3.68]
Kelleher 2002 (4)	4	80	4	80	4.5%	1.00 [0.26 , 3.86]
Lyth 1997 (5)	0	385	2	343	3.0%	0.18 [0.01 , 3.70]
Wyman 1987 (6)	3	52	4	51	4.6%	0.74 [0.17 , 3.12]
Subtotal (95% CI)		**711**		**689**	**54.3%**	**0.87 [0.60 , 1.27]**
Total events:	39		49			
Heterogeneity: Chi² = 2.52, df = 5 (P = 0.77); I² = 0%						
Test for overall effect: Z = 0.70 (P = 0.48)						
1.1.2 Gynaecological surgery						
Ind 1993 (7)	6	49	13	46	15.2%	0.43 [0.18 , 1.04]
Nathan 2001 (8)	2	55	10	52	11.6%	0.19 [0.04 , 0.82]
Subtotal (95% CI)		**104**		**98**	**26.8%**	**0.33 [0.15 , 0.69]**
Total events:	8		23			
Heterogeneity: Chi² = 0.93, df = 1 (P = 0.34); I² = 0%						
Test for overall effect: Z = 2.92 (P = 0.004)						
1.1.3 General medical and surgical patients						
Hall 1998 (9)	1	57	3	66	3.1%	0.39 [0.04 , 3.61]
Webster 2006 (10)	11	97	14	98	15.8%	0.79 [0.38 , 1.66]
Subtotal (95% CI)		**154**		**164**	**18.9%**	**0.73 [0.36 , 1.46]**
Total events:	12		17			
Heterogeneity: Chi² = 0.36, df = 1 (P = 0.55); I² = 0%						
Test for overall effect: Z = 0.90 (P = 0.37)						
Total (95% CI)		**969**		**951**	**100.0%**	**0.70 [0.52 , 0.94]**
Total events:	59		89			
Heterogeneity: Chi² = 8.96, df = 9 (P = 0.44); I² = 0%						
Test for overall effect: Z = 2.35 (P = 0.02)						
Test for subgroup differences: Chi² = 5.29, df = 2 (P = 0.07), I² = 62.2%						



Footnotes

(1) All particpants had TURP; 6 AM versus midnight
(2) Urological surgery and procedure; 6AM versus midnight
(3) All participants had TURP; 6 AM versus midnight
(4) Urology or renal unit; 6 AM versus midnight
(5) All particpants had TURP or bladder neck incision; 6 AM versus midnight
(6) All particpants had TURP; 6-7AM versus 10-11PM
(7) 6 AM versus midnight
(8) 6 AM verus midnight
(9) 7-9AM versus 9-11PM
(10) 6 AM versus 10PM

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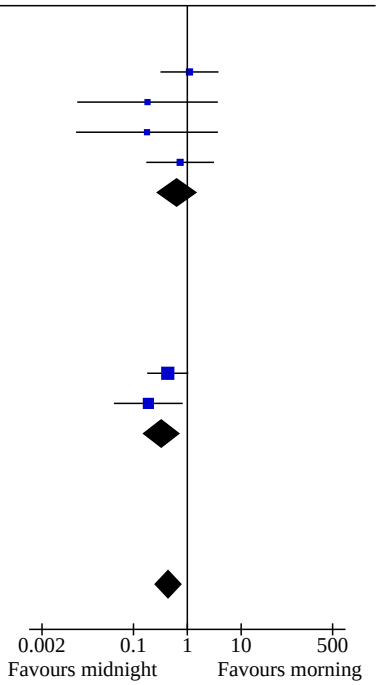
Analysis 1.2. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 2: Number needing to be recatheterised: subgroup analysis based on sex

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.2.1 Men only						
Chillington 1992 (1)	4	35	5	48	11.3%	1.10 [0.32 , 3.79]
Ganta 2005 (2)	0	44	2	40	7.0%	0.18 [0.01 , 3.68]
Lyth 1997 (3)	0	385	2	343	7.1%	0.18 [0.01 , 3.70]
Wyman 1987 (4)	3	52	4	51	10.9%	0.74 [0.17 , 3.12]
Subtotal (95% CI)		**516**		**482**	**36.3%**	**0.63 [0.28 , 1.44]**
Total events:	7		13			
Heterogeneity: Chi² = 2.13, df = 3 (P = 0.55); I² = 0%						
Test for overall effect: Z = 1.09 (P = 0.27)						
1.2.2 Women only						
Ind 1993 (5)	6	49	13	46	36.0%	0.43 [0.18 , 1.04]
Nathan 2001 (6)	2	55	10	52	27.6%	0.19 [0.04 , 0.82]
Subtotal (95% CI)		**104**		**98**	**63.7%**	**0.33 [0.15 , 0.69]**
Total events:	8		23			
Heterogeneity: Chi² = 0.93, df = 1 (P = 0.34); I² = 0%						
Test for overall effect: Z = 2.92 (P = 0.004)						
Total (95% CI)		**620**		**580**	**100.0%**	**0.44 [0.25 , 0.76]**
Total events:	15		36			
Heterogeneity: Chi² = 4.52, df = 5 (P = 0.48); I² = 0%						
Test for overall effect: Z = 2.96 (P = 0.003)						
Test for subgroup differences: Chi² = 1.35, df = 1 (P = 0.25), I² = 25.7%						

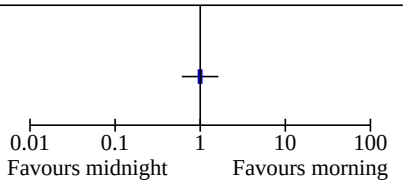


Footnotes

(1) All particpants had TURP; 6 AM versus midnight
(2) All participants had TURP; 6 AM versus midnight
(3) All particpants had TURP or bladder neck incision; 6 AM versus midnight
(4) All particpants had TURP; 6-7AM versus 10-11PM
(5) 6 AM versus midnight
(6) 6 AM verus midnight

Analysis 1.3. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 3: Symptomatic catheter-associated urinary tract infection (number of participants)

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.3.1 General medical and surgical patients					
Gross 2007 (1)	14	23	11	18	1.00 [0.61 , 1.63]



Footnotes

(1) Participants with stroke; 10PM versus 7AM

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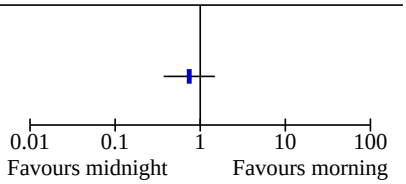
Analysis 1.4. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 4: Asymptomatic bacteriuria (number of participants)

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.4.1 Gynaecological surgery					
Nathan 2001 (1)	11	55	14	52	0.74 [0.37 , 1.49]

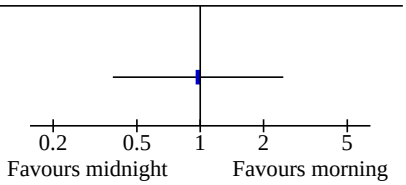


Footnotes

(1) No definition of positive urine culture reported by trial

Analysis 1.5. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 5: Incidence of urinary retention

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.5.1 General medical and surgical patients					
Webster 2006 (1)	8	86	8	84	0.98 [0.38 , 2.48]

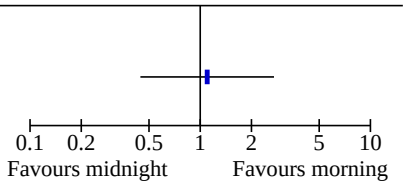


Footnotes

(1) Post-discharge urinary retention 6 AM versus 10PM

Analysis 1.6. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 6: Difficulty in passing urine

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.6.1 General medical and surgical patients					
Webster 2006 (1)	9	86	8	84	1.10 [0.45 , 2.71]



Footnotes

(1) 6 AM versus 10PM

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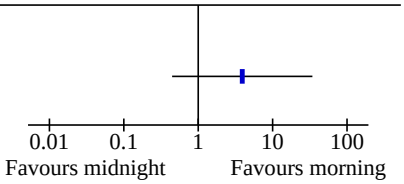
Analysis 1.7. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 7: Loin pain

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.7.1 General medical and surgical patients					
Webster 2006 (1)	4	86	1	84	3.91 [0.45 , 34.24]

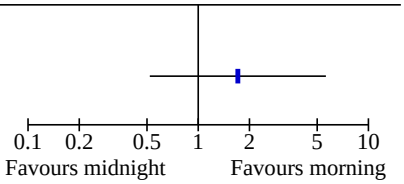


Footnotes

(1) 6 AM versus 10PM

Analysis 1.8. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 8: Fever

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.8.1 General medical and surgical patients					
Webster 2006 (1)	7	86	4	84	1.71 [0.52 , 5.62]

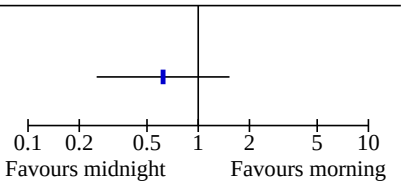


Footnotes

(1) 6 AM versus 10PM

Analysis 1.9. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 9: Incontinence

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Risk Ratio M-H, Fixed, 95% CI
1.9.1 General medical and surgical patients					
Webster 2006 (1)	7	86	11	84	0.62 [0.25 , 1.53]



Footnotes

(1) 6 AM versus 10PM

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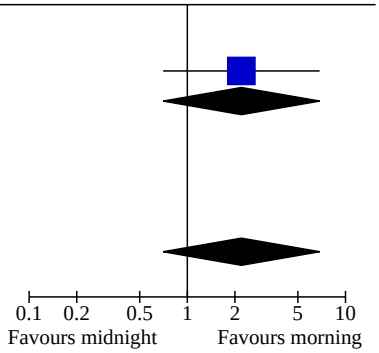
Analysis 1.10. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 10: Dysuria (number of participants)

Study or Subgroup	Midnight Events	Midnight Total	Morning Events	Morning Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.10.1 General medical and surgical patients						
Webster 2006 (1)	9	86	4	84	100.0%	2.20 [0.70 , 6.86]
Subtotal (95% CI)		**86**		**84**	**100.0%**	**2.20 [0.70 , 6.86]**
Total events:	9		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.36 (P = 0.18)						
Total (95% CI)		**86**		**84**	**100.0%**	**2.20 [0.70 , 6.86]**
Total events:	9		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.36 (P = 0.18)						
Test for subgroup differences: Not applicable						



Footnotes

(1) 6 AM versus 10PM

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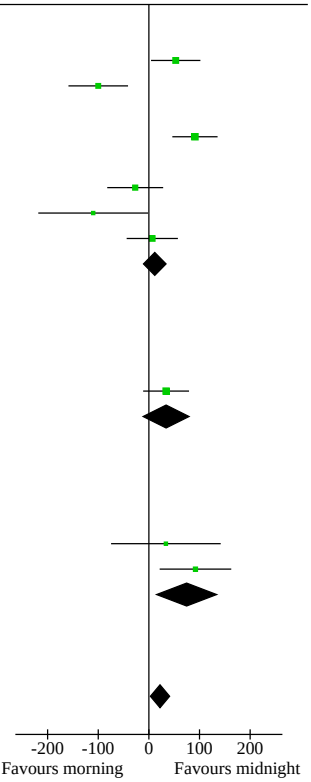
Analysis 1.11. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 11: Volume of the first void (mL)

Study or Subgroup	Midnight Mean	Midnight SD	Midnight Total	Morning Mean	Morning SD	Morning Total	Weight	Mean Difference IV, Fixed, 95% CI
1.11.1 Urological surgery and procedures								
Chillington 1992 (1)	198	111	35	145	113	48	15.1%	53.00 [4.27 , 101.73]
Crowe 1993 (2)	145	233.18	127	245	233.18	115	10.4%	-100.00 [-158.83 , -41.17]
Ganta 2005 (3)	131	0	44	152	0	40		Not estimable
Kelleher 2002 (4)	268	144.16	80	177	144.16	80	18.0%	91.00 [46.33 , 135.67]
Lyth 1997 (5)	385	0	39	343	0	33		Not estimable
McDonald 1999 (6)	126	96.25	20	153	96.25	28	11.8%	-27.00 [-82.23 , 28.23]
Noble 1990 (7)	197	255.86	40	307	255.86	46	3.1%	-110.00 [-218.42 , -1.58]
Webster 2006 (8)	221.4	142.9	68	214.7	171.1	80	14.0%	6.70 [-43.89 , 57.29]
Subtotal (95% CI)			**453**			**470**	**72.3%**	**11.63 [-10.65 , 33.91]**
Heterogeneity: Chi² = 35.48, df = 5 (P < 0.00001); I² = 86%								
Test for overall effect: Z = 1.02 (P = 0.31)								
1.11.2 Gynaecological surgery								
Nathan 2001 (9)	219	126	55	185	113	52	17.5%	34.00 [-11.30 , 79.30]
Subtotal (95% CI)			**55**			**52**	**17.5%**	**34.00 [-11.30 , 79.30]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.47 (P = 0.14)								
1.11.3 General medical and surgical patients								
Gross 2007 (10)	188.5	151.4	26	154.9	203	19	3.1%	33.60 [-74.65 , 141.85]
Hall 1998 (11)	313	199.48	57	221	199.48	66	7.2%	92.00 [21.30 , 162.70]
Subtotal (95% CI)			**83**			**85**	**10.2%**	**74.54 [15.35 , 133.73]**
Heterogeneity: Chi² = 0.78, df = 1 (P = 0.38); I² = 0%								
Test for overall effect: Z = 2.47 (P = 0.01)								
Total (95% CI)			**591**			**607**	**100.0%**	**21.98 [3.04 , 40.92]**
Heterogeneity: Chi² = 40.39, df = 8 (P < 0.00001); I² = 80%								
Test for overall effect: Z = 2.27 (P = 0.02)								
Test for subgroup differences: Chi² = 4.13, df = 2 (P = 0.13), I² = 51.6%								



Footnotes

(1) All particpants had TURP; 6 AM versus midnight
(2) Standard Deviation (SD) calculated by using the reported p value of <0.001
(3) All participants had TURP; 6 AM versus midnight
(4) Standard Deviation (SD) calculated by using the reported p value of 0.0001
(5) All particpants had TURP or bladder neck incision; 6 AM versus midnight
(6) Standard Deviation (SD) calculated by using the reported p value of 0.343
(7) Standard Deviation (SD) calculated by using the reported p value of 0.05
(8) 6 AM versus 10PM
(9) 6AM versus midnight
(10) Participants with stroke; 10PM versus 7AM
(11) 7-9AM versus 9-11PM.Standard Deviation (SD) calculated by using the reported p value of 0.012 using Excel file (Reference)

Analysis 1.12. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 12: Volume of first void (median and range)

Volume of first void (median and range)

Study	Midnight removal	Morning removal	Significance
Following gynaecological surgery			
Ind 1993	275 ml (10 to 600 ml) 49 participants	100 ml (5 to 450 ml) 46 participants	P < 0.0001 (95% CI 124.9 to 225.5)

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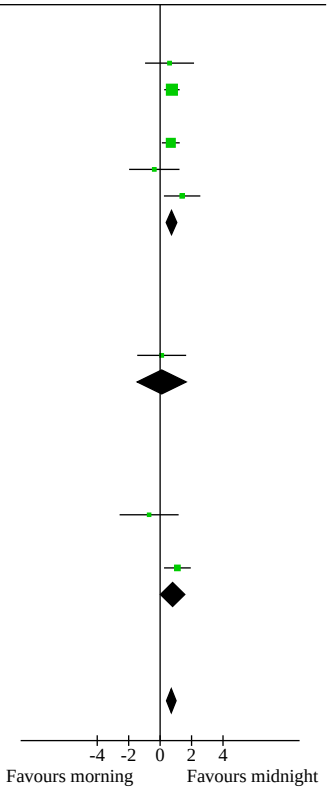
Analysis 1.13. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 13: Time to first void (hours)

Study or Subgroup	Midnight Mean	Midnight SD	Midnight Total	Morning Mean	Morning SD	Morning Total	Weight	Mean Difference IV, Fixed, 95% CI
1.13.1 Urological surgery and procedures								
Chillington 1992 (1)	4.5	3.4	35	3.9	3.8	48	3.8%	0.60 [-0.96 , 2.16]
Crowe 1993 (2)	3.5	1.94	115	2.75	1.94	127	38.2%	0.75 [0.26 , 1.24]
Ganta 2005 (3)	2.23	0	44	2.03	0	40		Not estimable
Kelleher 2002 (4)	3.65	1.83	80	2.97	1.83	80	28.5%	0.68 [0.11 , 1.25]
McDonald 1999 (5)	2.18	2.79	20	2.55	2.79	28	3.6%	-0.37 [-1.97 , 1.23]
Noble 1990 (4)	4.6	2.73	40	3.2	2.73	46	6.8%	1.40 [0.24 , 2.56]
Subtotal (95% CI)			**334**			**369**	**80.9%**	**0.72 [0.39 , 1.06]**
Heterogeneity: Chi² = 3.16, df = 4 (P = 0.53); I² = 0%								
Test for overall effect: Z = 4.22 (P < 0.0001)								
1.13.2 Gynaecological surgery								
Nathan 2001 (6)	5.8	4.4	55	5.7	3.8	52	3.8%	0.10 [-1.46 , 1.66]
Subtotal (95% CI)			**55**			**52**	**3.8%**	**0.10 [-1.46 , 1.66]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.13 (P = 0.90)								
1.13.3 General medical and surgical patients								
Gross 2007 (7)	5.54	2.88	26	6.24	3.37	19	2.6%	-0.70 [-2.58 , 1.18]
Hall 1998 (8)	5.45	0	57	4.52	0	66		Not estimable
Webster 2006 (9)	4.9	2.9	79	3.8	2.6	83	12.7%	1.10 [0.25 , 1.95]
Subtotal (95% CI)			**162**			**168**	**15.3%**	**0.79 [0.02 , 1.57]**
Heterogeneity: Chi² = 2.93, df = 1 (P = 0.09); I² = 66%								
Test for overall effect: Z = 2.01 (P = 0.04)								
Total (95% CI)			**551**			**589**	**100.0%**	**0.71 [0.41 , 1.01]**
Heterogeneity: Chi² = 6.74, df = 7 (P = 0.46); I² = 0%								
Test for overall effect: Z = 4.60 (P < 0.00001)								
Test for subgroup differences: Chi² = 0.64, df = 2 (P = 0.73), I² = 0%								



Footnotes

(1) All particpants had TURP; 6 AM versus midnight
(2) Standard Deviation (SD) calculated by using the reported p value of <0.003
(3) All participants had TURP; 6 AM versus midnight
(4) Standard Deviation (SD) calculated by using the reported p value of 0.02
(5) Standard Deviation (SD) calculated by using the reported p value of 0.721
(6) 6AM versus midnight
(7) Participants with stroke; 10PM versus 7AM
(8) 7-9AM versus 9-11PM
(9) 6 AM versus 10PM

Analysis 1.14. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 14: Time to first void (median)

Time to first void (median)

Study	Midnight removal	Morning removal	Significance
Following gynaecological surgery			
Ind 1993	Median time 3 hours 20 minutes 49 participants	Median time 5 hours 46 participants	P = 0.012 (95% CI 0.33 to 2.58)

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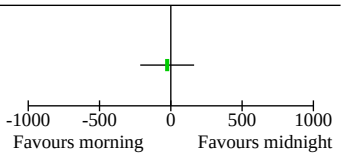
Analysis 1.15. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 15: Post-void residual volume

Study or Subgroup	Midnight Mean	Midnight SD	Midnight Total	Morning Mean	Morning SD	Morning Total	Mean Difference IV, Fixed, 95% CI	Mean Difference IV, Fixed, 95% CI
1.15.1 General medical and surgical patients								
Gross 2007 (1)	157.3	256	26	182.8	358.6	19	-25.50 [-214.40 , 163.40]	

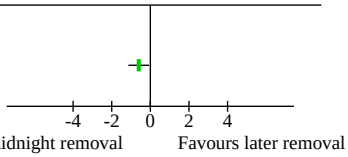


Footnotes

(1) Participants with stroke; 10PM versus 7AM

Analysis 1.16. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 16: Length of hospitalisation in days

Study or Subgroup	Midnight Mean	Midnight SD	Midnight Total	Morning Mean	Morning SD	Morning Total	Mean Difference IV, Fixed, 95% CI	Mean Difference IV, Fixed, 95% CI
1.16.1 Gynaecological surgery								
Nathan 2001 (1)	5.1	1.3	55	5.7	1.5	52	-0.60 [-1.13 , -0.07]	



Footnotes

(1) 6AM versus midnight

Analysis 1.17. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 17: Length of hospitalisation in days

Length of hospitalisation in days

Study	Midnight removal	Morning removal	significance
Urological surgery and procedures (mean, total)			
Chillington 1992	4.7 (35)	5.4 (48)	
Gynaecological surgery involving the bladder /urethra (median, range)			
Ind 1993	9 days (4 to 17 days)	12 days (5 to 20 days)	p=0.043
Gynaecological surgery not involving the bladder/urethra (median, range)			
Ind 1993	6 days (1 to 14 days)	7 days (2 to 18 days)	

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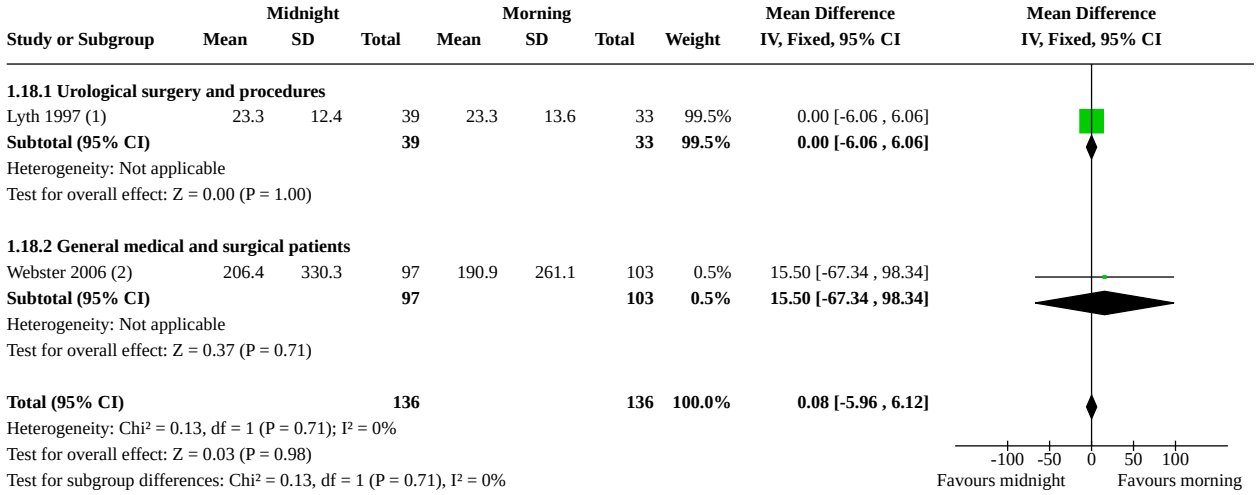
Analysis 1.18. Comparison 1: Removal of indwelling urethral catheter at one specified time of day (10 pm to midnight) versus another specified time of day (6 am to 7 am), Outcome 18: Time between removal of catheter to discharge



Footnotes

(1) All particpants had TURP or bladder neck incision; 6 AM versus midnight

(2) 6 AM versus 10PM

Comparison 2. Shorter versus longer duration of catheter

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Number needing to be re-catheterised	44	5870	Risk Ratio (M-H, Random, 95% CI)	1.81 [1.35, 2.41]
2.1.1 Early removal versus later	19	2528	Risk Ratio (M-H, Random, 95% CI)	2.59 [1.47, 4.57]
2.1.2 1-day policy versus later	16	1874	Risk Ratio (M-H, Random, 95% CI)	1.45 [0.93, 2.25]
2.1.3 2-day to 7-day policy versus later	10	1468	Risk Ratio (M-H, Random, 95% CI)	1.67 [0.93, 2.99]
2.2 Number needing to be re-catheterised: subgroup analysis based on type of surgery	37	4736	Risk Ratio (M-H, Random, 95% CI)	1.85 [1.36, 2.51]
2.2.1 Urological surgery	9	1104	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.50, 1.67]
2.2.2 Gynaecological surgery	24	2935	Risk Ratio (M-H, Random, 95% CI)	2.25 [1.58, 3.22]
2.2.3 Obstetric surgery	4	697	Risk Ratio (M-H, Random, 95% CI)	3.36 [0.93, 12.15]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.3 Number needing to be re-catheterised: subgroup analysis based on sex	37	4736	Risk Ratio (M-H, Random, 95% CI)	1.85 [1.36, 2.51]
2.3.1 Men only	9	1104	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.50, 1.67]
2.3.2 Women only	28	3632	Risk Ratio (M-H, Random, 95% CI)	2.29 [1.64, 3.18]
2.4 Number needing to be re-catheterised: subgroup analysis based on antibiotic prophylaxis	27	3839	Risk Ratio (M-H, Random, 95% CI)	1.72 [1.11, 2.65]
2.4.1 Antibiotic prophylaxis given	22	3040	Risk Ratio (M-H, Random, 95% CI)	1.73 [1.04, 2.89]
2.4.2 No antibiotic prophylaxis	5	799	Risk Ratio (M-H, Random, 95% CI)	1.65 [0.70, 3.86]
2.5 Symptomatic catheter-associated urinary tract infection (number of participants)	41	5759	Risk Ratio (M-H, Fixed, 95% CI)	0.52 [0.45, 0.61]
2.5.1 Early versus later	17	2220	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.43, 0.71]
2.5.2 1 day versus later	15	1879	Risk Ratio (M-H, Fixed, 95% CI)	0.48 [0.37, 0.62]
2.5.3 2 to 7 days versus later	9	1660	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.39, 0.78]
2.6 Symptomatic catheter-associated urinary tract infection: post-hoc subgroup analysis by antibiotic prophylaxis	24	3516	Risk Ratio (M-H, Fixed, 95% CI)	0.47 [0.38, 0.59]
2.6.1 Antibiotic prophylaxis	20	2871	Risk Ratio (M-H, Fixed, 95% CI)	0.49 [0.39, 0.62]
2.6.2 No antibiotic prophylaxis given	4	645	Risk Ratio (M-H, Fixed, 95% CI)	0.28 [0.11, 0.72]
2.7 Asymptomatic bacteruria (number of participants)	18	2611	Risk Ratio (M-H, Fixed, 95% CI)	0.47 [0.38, 0.58]
2.7.1 Early versus later	10	1461	Risk Ratio (M-H, Fixed, 95% CI)	0.59 [0.45, 0.77]
2.7.2 1 day versus later	6	683	Risk Ratio (M-H, Fixed, 95% CI)	0.37 [0.26, 0.54]
2.7.3 2 to 7 days versus later	3	467	Risk Ratio (M-H, Fixed, 95% CI)	0.32 [0.18, 0.59]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.8 Incidence of urinary retention	19		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.8.1 Early versus later	7	1108	Risk Ratio (M-H, Random, 95% CI)	1.07 [0.57, 2.00]
2.8.2 1 day versus later	7	680	Risk Ratio (M-H, Random, 95% CI)	1.36 [1.03, 1.81]
2.8.3 2 to 7 days versus later	6	881	Risk Ratio (M-H, Random, 95% CI)	1.37 [0.88, 2.12]
2.9 Delayed voiding after catheter removal	2	176	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.53, 1.97]
2.9.1 1 day versus later	2	176	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.53, 1.97]
2.10 Chronic urinary retention	2	339	Risk Ratio (M-H, Fixed, 95% CI)	0.84 [0.29, 2.44]
2.10.1 1-day policy versus later	2	230	Risk Ratio (M-H, Fixed, 95% CI)	0.81 [0.26, 2.59]
2.10.2 2 to 7 days versus later	1	109	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.07, 15.87]
2.11 Other complications of catheterisation: fever	2	470	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [0.40, 3.40]
2.11.1 Early versus later	2	470	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [0.40, 3.40]
2.12 Other complications of catheterisation: epididymitis	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.12.1 2 to 7 days versus later	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.13 Pain or discomfort (dichotomous)	5	510	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.21, 1.27]
2.13.1 Immediate post-op removal versus removal 24 hours post-op	3	230	Risk Ratio (M-H, Random, 95% CI)	0.31 [0.04, 2.64]
2.13.2 Removal 4 hours post-op versus removal 24 hours post-op	1	240	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.78, 1.29]
2.13.3 Removal 3 days post-op versus removal 28 days post-op	1	40	Risk Ratio (M-H, Random, 95% CI)	0.20 [0.01, 3.92]
2.14 Pain or discomfort: 0-10 VAS (higher score = greater pain)	5	695	Mean Difference (IV, Fixed, 95% CI)	-0.34 [-0.47, -0.20]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.14.1 Removal 4 hours post-op versus removal at 6am 1 day post-op	1	57	Mean Difference (IV, Fixed, 95% CI)	-0.60 [-1.65, 0.45]
2.14.2 Immediate post-op removal versus removal 24 hours post-op	3	433	Mean Difference (IV, Fixed, 95% CI)	-0.37 [-0.52, -0.23]
2.14.3 Immediate removal post-op versus removal 3-5 days post-op	1	205	Mean Difference (IV, Fixed, 95% CI)	0.10 [-0.37, 0.56]
2.15 Patient satisfaction	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.16 Urinary incontinence	7	1195	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.35, 0.86]
2.16.1 Early versus later	2	396	Risk Ratio (M-H, Fixed, 95% CI)	0.13 [0.03, 0.55]
2.16.2 2 to 7 days versus later	5	799	Risk Ratio (M-H, Fixed, 95% CI)	0.82 [0.52, 1.32]
2.17 Dysuria	7	1398	Risk Ratio (M-H, Random, 95% CI)	0.42 [0.20, 0.88]
2.17.1 Early versus later	7	1398	Risk Ratio (M-H, Random, 95% CI)	0.42 [0.20, 0.88]
2.18 Volume of first void (mL)	3	364	Mean Difference (IV, Fixed, 95% CI)	27.02 [1.00, 53.04]
2.18.1 Early removal versus later	1	227	Mean Difference (IV, Fixed, 95% CI)	12.00 [-21.97, 45.97]
2.18.2 2-day to 7-day policy versus later	2	137	Mean Difference (IV, Fixed, 95% CI)	48.36 [7.88, 88.84]
2.19 Time to first void (hours)	2	277	Mean Difference (IV, Random, 95% CI)	-8.59 [-16.16, -1.01]
2.19.1 Early removal versus later	2	277	Mean Difference (IV, Random, 95% CI)	-8.59 [-16.16, -1.01]
2.20 Post-void residual volume (mL)	2	137	Mean Difference (IV, Fixed, 95% CI)	6.37 [-9.14, 21.88]
2.20.1 2-day to 7-day policy versus later	2	137	Mean Difference (IV, Fixed, 95% CI)	6.37 [-9.14, 21.88]
2.21 Post-void residual volume (median and range) (mL)	1		Other data	No numeric data
2.22 Length of hospitalisation in days	27		Mean Difference (IV, Random, 95% CI)	Subtotals only

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.22.1 Early removal versus later	13	2012	Mean Difference (IV, Random, 95% CI)	-0.54 [-0.82, -0.27]
2.22.2 1-day policy versus later	10	1249	Mean Difference (IV, Random, 95% CI)	-1.66 [-2.25, -1.07]
2.22.3 2-day to 7-day policy versus later	5	474	Mean Difference (IV, Random, 95% CI)	-5.00 [-5.89, -4.11]
2.23 Length of hospitalisation in days: subgrouping based on type of surgery	27	3735	Mean Difference (IV, Random, 95% CI)	-1.13 [-1.42, -0.83]
2.23.1 Urological procedures	7	1005	Mean Difference (IV, Random, 95% CI)	-3.40 [-4.75, -2.05]
2.23.2 Gynaecological procedures	13	1453	Mean Difference (IV, Random, 95% CI)	-0.92 [-1.33, -0.51]
2.23.3 Obstetric procedures	6	1217	Mean Difference (IV, Random, 95% CI)	-0.50 [-0.87, -0.13]
2.23.4 General surgical procedures	1	60	Mean Difference (IV, Random, 95% CI)	-1.10 [-2.77, 0.57]
2.24 Length of hospitalisation in days (median and range)	6		Other data	No numeric data
2.25 Frequency of micturition	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
2.25.1 Early versus later	2	521	Risk Ratio (M-H, Fixed, 95% CI)	0.18 [0.06, 0.53]
2.26 Time to first ambulation (hours)	9	1688	Mean Difference (IV, Fixed, 95% CI)	-5.06 [-5.24, -4.88]
2.26.1 Early versus later	9	1688	Mean Difference (IV, Fixed, 95% CI)	-5.06 [-5.24, -4.88]

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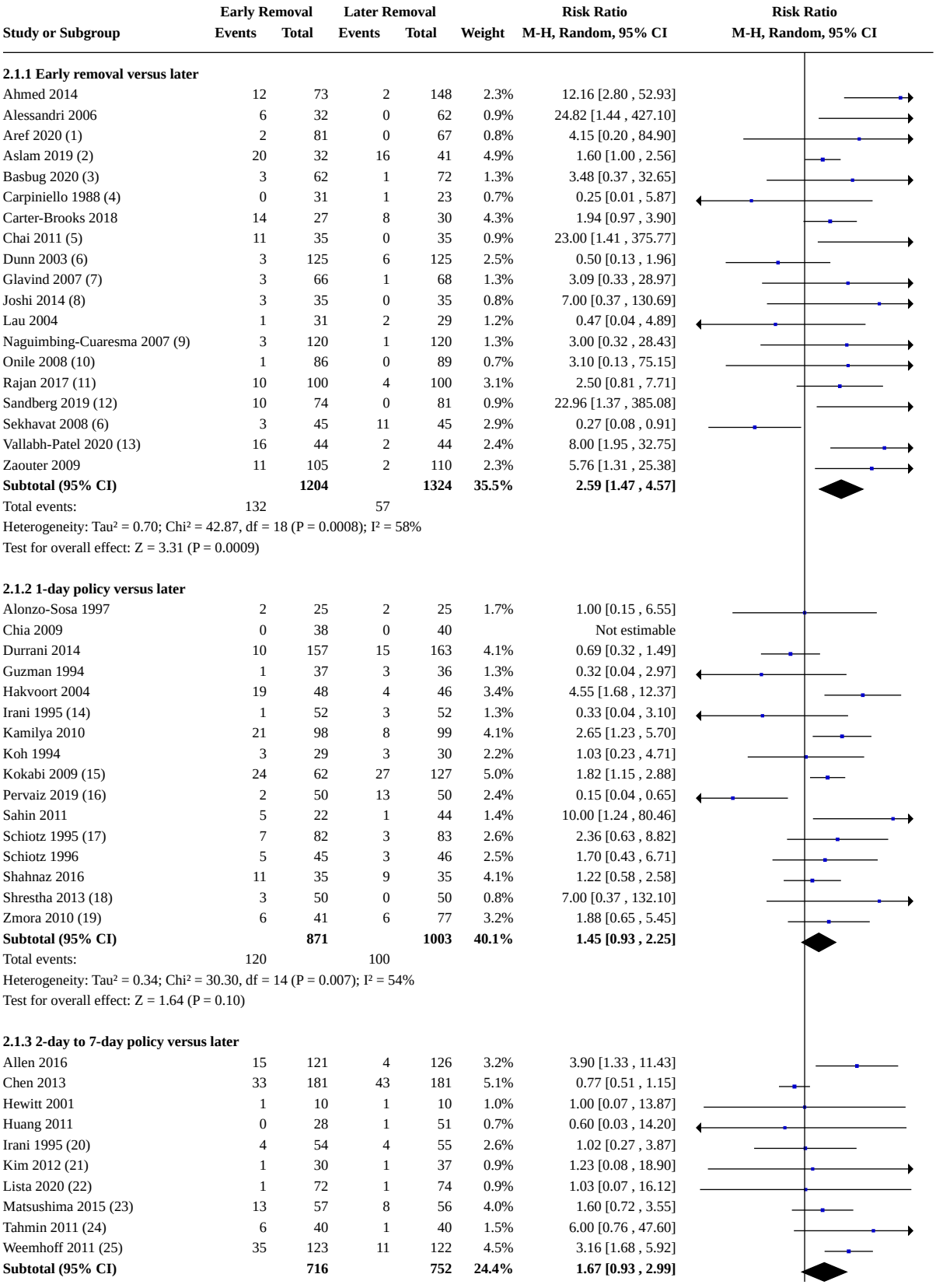
Analysis 2.1. Comparison 2: Shorter versus longer duration of catheter, Outcome 1: Number needing to be recatheterised



Study or Subgroup	Early Removal Events	Early Removal Total	Later Removal Events	Later Removal Total	Weight	Risk Ratio M-H, Random, 95% CI
2.1.1 Early removal versus later						
Ahmed 2014	12	73	2	148	2.3%	12.16 [2.80 , 52.93]
Alessandri 2006	6	32	0	62	0.9%	24.82 [1.44 , 427.10]
Aref 2020 (1)	2	81	0	67	0.8%	4.15 [0.20 , 84.90]
Aslam 2019 (2)	20	32	16	41	4.9%	1.60 [1.00 , 2.56]
Basbug 2020 (3)	3	62	1	72	1.3%	3.48 [0.37 , 32.65]
Carpiniello 1988 (4)	0	31	1	23	0.7%	0.25 [0.01 , 5.87]
Carter-Brooks 2018	14	27	8	30	4.3%	1.94 [0.97 , 3.90]
Chai 2011 (5)	11	35	0	35	0.9%	23.00 [1.41 , 375.77]
Dunn 2003 (6)	3	125	6	125	2.5%	0.50 [0.13 , 1.96]
Glavind 2007 (7)	3	66	1	68	1.3%	3.09 [0.33 , 28.97]
Joshi 2014 (8)	3	35	0	35	0.8%	7.00 [0.37 , 130.69]
Lau 2004	1	31	2	29	1.2%	0.47 [0.04 , 4.89]
Naguimbing-Cuaresma 2007 (9)	3	120	1	120	1.3%	3.00 [0.32 , 28.43]
Onile 2008 (10)	1	86	0	89	0.7%	3.10 [0.13 , 75.15]
Rajan 2017 (11)	10	100	4	100	3.1%	2.50 [0.81 , 7.71]
Sandberg 2019 (12)	10	74	0	81	0.9%	22.96 [1.37 , 385.08]
Sekhavat 2008 (6)	3	45	11	45	2.9%	0.27 [0.08 , 0.91]
Vallabh-Patel 2020 (13)	16	44	2	44	2.4%	8.00 [1.95 , 32.75]
Zaouter 2009	11	105	2	110	2.3%	5.76 [1.31 , 25.38]
Subtotal (95% CI)		**1204**		**1324**	**35.5%**	**2.59 [1.47 , 4.57]**
Total events:	132		57			
Heterogeneity: Tau² = 0.70; Chi² = 42.87, df = 18 (P = 0.0008); I² = 58%						
Test for overall effect: Z = 3.31 (P = 0.0009)						
2.1.2 1-day policy versus later						
Alonzo-Sosa 1997	2	25	2	25	1.7%	1.00 [0.15 , 6.55]
Chia 2009	0	38	0	40		Not estimable
Durrani 2014	10	157	15	163	4.1%	0.69 [0.32 , 1.49]
Guzman 1994	1	37	3	36	1.3%	0.32 [0.04 , 2.97]
Hakvoort 2004	19	48	4	46	3.4%	4.55 [1.68 , 12.37]
Irani 1995 (14)	1	52	3	52	1.3%	0.33 [0.04 , 3.10]
Kamilya 2010	21	98	8	99	4.1%	2.65 [1.23 , 5.70]
Koh 1994	3	29	3	30	2.2%	1.03 [0.23 , 4.71]
Kokabi 2009 (15)	24	62	27	127	5.0%	1.82 [1.15 , 2.88]
Pervaiz 2019 (16)	2	50	13	50	2.4%	0.15 [0.04 , 0.65]
Sahin 2011	5	22	1	44	1.4%	10.00 [1.24 , 80.46]
Schiotz 1995 (17)	7	82	3	83	2.6%	2.36 [0.63 , 8.82]
Schiotz 1996	5	45	3	46	2.5%	1.70 [0.43 , 6.71]
Shahnaz 2016	11	35	9	35	4.1%	1.22 [0.58 , 2.58]
Shrestha 2013 (18)	3	50	0	50	0.8%	7.00 [0.37 , 132.10]
Zmora 2010 (19)	6	41	6	77	3.2%	1.88 [0.65 , 5.45]
Subtotal (95% CI)		**871**		**1003**	**40.1%**	**1.45 [0.93 , 2.25]**
Total events:	120		100			
Heterogeneity: Tau² = 0.34; Chi² = 30.30, df = 14 (P = 0.007); I² = 54%						
Test for overall effect: Z = 1.64 (P = 0.10)						
2.1.3 2-day to 7-day policy versus later						
Allen 2016	15	121	4	126	3.2%	3.90 [1.33 , 11.43]
Chen 2013	33	181	43	181	5.1%	0.77 [0.51 , 1.15]
Hewitt 2001	1	10	1	10	1.0%	1.00 [0.07 , 13.87]
Huang 2011	0	28	1	51	0.7%	0.60 [0.03 , 14.20]
Irani 1995 (20)	4	54	4	55	2.6%	1.02 [0.27 , 3.87]
Kim 2012 (21)	1	30	1	37	0.9%	1.23 [0.08 , 18.90]
Lista 2020 (22)	1	72	1	74	0.9%	1.03 [0.07 , 16.12]
Matsushima 2015 (23)	13	57	8	56	4.0%	1.60 [0.72 , 3.55]
Tahmin 2011 (24)	6	40	1	40	1.5%	6.00 [0.76 , 47.60]
Weemhoff 2011 (25)	35	123	11	122	4.5%	3.16 [1.68 , 5.92]
Subtotal (95% CI)		**716**		**752**	**24.4%**	**1.67 [0.93 , 2.99]**

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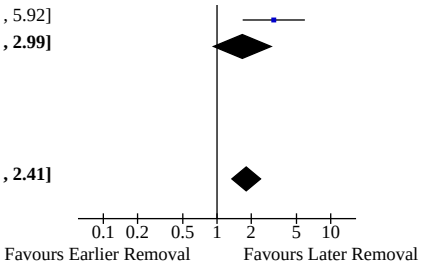
Analysis 2.1. (Continued)

Weemhoff 2011 (25)	35	123	11	122	4.5%	3.16 [1.68 , 5.92]
Subtotal (95% CI)		**716**		**752**	**24.4%**	**1.67 [0.93 , 2.99]**
Total events:	109		75			
Heterogeneity: Tau² = 0.38; Chi² = 21.32, df = 9 (P = 0.01); I² = 58%						
Test for overall effect: Z = 1.72 (P = 0.08)						
Total (95% CI)		**2791**		**3079**	**100.0%**	**1.81 [1.35 , 2.41]**
Total events:	361		232			
Heterogeneity: Tau² = 0.39; Chi² = 96.66, df = 43 (P < 0.00001); I² = 56%						
Test for overall effect: Z = 3.99 (P < 0.0001)						
Test for subgroup differences: Chi² = 2.60, df = 2 (P = 0.27), I² = 22.9%						



Footnotes

(1) Catheter removal 6h post-op vs 24h removal post-op
(2) Immediate removal vs Day 1 post-op removal
(3) Catheter removal 2 hours vs 12 hours post-procedure
(4) Catheter removal in recovery room vs catheter removal after 1 day post-op
(5) Re-catheterisation within 12 hours
(6) Immediate vs 1 day post-op removal
(7) Catheter removal 3 hours post-op vs removal the next morning post-op
(8) Immediate vs 24h removal; defined as inability to pass urine at the end of 12h, or failure to void after two attempts
(9) Catheter removal 4 hours vs 24 hours post-op
(10) Immediate removal vs 1 day post-op
(11) Removal of bladder catheter and vaginal pack in 3 hours vs Removal of bladder catheter and vaginal pack in 24 hours
(12) Catheter removal immediately vs removal 18-24 hours post-op
(13) Catheter removal 6 hours vs day 1 post-op
(14) Participants who received TUIP
(15) 1 day vs 2 and 4 day removal (3 arm trial)
(16) Catheter removal day 1 post-op vs day 4 post-op
(17) Catheter removal 1 day post-op vs 3 day post-op
(18) 1 day vs 3 day removal
(19) Participants undergoing colon or rectal surgery; 1 day vs 3 or 5 day removal
(20) Participants with TURP. Catheter in the control group was removed at the surgeons discretion (Median duration 4 days)
(21) catheter removal on day 3,4 vs day 7,8
(22) Catheter removal Day 3 vs Day 5 post-op
(23) 2 vs 4 day cathter removal
(24) vaginal hysterectomy with pelvic floor repair; 2 day vs 5 day removal
(25) Participants undergoing anterior colporrhaphy; 2 vs 5 day removal

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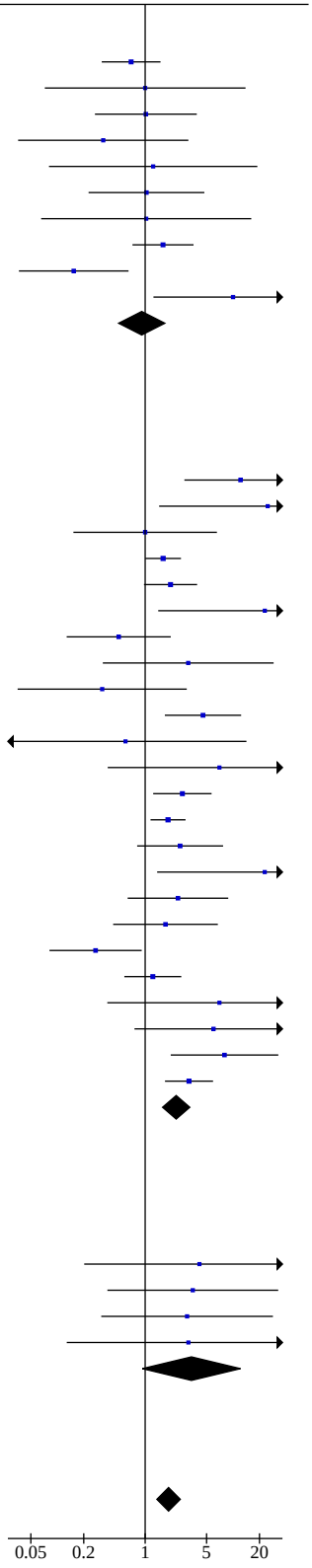
Analysis 2.2. Comparison 2: Shorter versus longer duration of catheter, Outcome 2: Number needing to be recatheterised: subgroup analysis based on type of surgery

Study or Subgroup	Early Removal Events	Early Removal Total	Later Removal Events	Later Removal Total	Weight	Risk Ratio M-H, Random, 95% CI
2.2.1 Urological surgery						
Durrani 2014	10	157	15	163	4.9%	0.69 [0.32 , 1.49]
Hewitt 2001	1	10	1	10	1.1%	1.00 [0.07 , 13.87]
Irani 1995 (1)	4	54	4	55	3.0%	1.02 [0.27 , 3.87]
Irani 1995 (2)	1	52	3	52	1.5%	0.33 [0.04 , 3.10]
Kim 2012 (3)	1	30	1	37	1.1%	1.23 [0.08 , 18.90]
Koh 1994	3	29	3	30	2.6%	1.03 [0.23 , 4.71]
Lista 2020 (4)	1	72	1	74	1.1%	1.03 [0.07 , 16.12]
Matsushima 2015 (5)	13	57	8	56	4.8%	1.60 [0.72 , 3.55]
Pervaiz 2019 (6)	2	50	13	50	2.8%	0.15 [0.04 , 0.65]
Sahin 2011	5	22	1	44	1.7%	10.00 [1.24 , 80.46]
Subtotal (95% CI)		**533**		**571**	**24.5%**	**0.91 [0.50 , 1.67]**
Total events:	41		50			
Heterogeneity: Tau² = 0.31; Chi² = 14.31, df = 9 (P = 0.11); I² = 37%						
Test for overall effect: Z = 0.29 (P = 0.77)						
2.2.2 Gynaecological surgery						
Ahmed 2014	12	73	2	148	2.7%	12.16 [2.80 , 52.93]
Alessandri 2006	6	32	0	62	1.0%	24.82 [1.44 , 427.10]
Alonzo-Sosa 1997	2	25	2	25	1.9%	1.00 [0.15 , 6.55]
Aslam 2019 (7)	20	32	16	41	6.1%	1.60 [1.00 , 2.56]
Carter-Brooks 2018	14	27	8	30	5.2%	1.94 [0.97 , 3.90]
Chai 2011 (8)	11	35	0	35	1.0%	23.00 [1.41 , 375.77]
Dunn 2003 (9)	3	125	6	125	3.0%	0.50 [0.13 , 1.96]
Glavind 2007 (10)	3	66	1	68	1.5%	3.09 [0.33 , 28.97]
Guzman 1994	1	37	3	36	1.5%	0.32 [0.04 , 2.97]
Hakvoort 2004	19	48	4	46	4.1%	4.55 [1.68 , 12.37]
Huang 2011	0	28	1	51	0.8%	0.60 [0.03 , 14.20]
Joshi 2014 (11)	3	35	0	35	1.0%	7.00 [0.37 , 130.69]
Kamilya 2010	21	98	8	99	4.9%	2.65 [1.23 , 5.70]
Kokabi 2009 (12)	24	62	27	127	6.1%	1.82 [1.15 , 2.88]
Rajan 2017 (13)	10	100	4	100	3.6%	2.50 [0.81 , 7.71]
Sandberg 2019 (14)	10	74	0	81	1.0%	22.96 [1.37 , 385.08]
Schiotz 1995 (15)	7	82	3	83	3.1%	2.36 [0.63 , 8.82]
Schiotz 1996	5	45	3	46	2.9%	1.70 [0.43 , 6.71]
Sekhavat 2008 (9)	3	45	11	45	3.4%	0.27 [0.08 , 0.91]
Shahnaz 2016	11	35	9	35	5.0%	1.22 [0.58 , 2.58]
Shrestha 2013 (16)	3	50	0	50	0.9%	7.00 [0.37 , 132.10]
Tahmin 2011 (17)	6	40	1	40	1.7%	6.00 [0.76 , 47.60]
Vallabh-Patel 2020 (18)	16	44	2	44	2.8%	8.00 [1.95 , 32.75]
Weemhoff 2011 (19)	35	123	11	122	5.5%	3.16 [1.68 , 5.92]
Subtotal (95% CI)		**1361**		**1574**	**70.8%**	**2.25 [1.58 , 3.22]**
Total events:	245		122			
Heterogeneity: Tau² = 0.32; Chi² = 49.16, df = 23 (P = 0.001); I² = 53%						
Test for overall effect: Z = 4.47 (P < 0.00001)						
2.2.3 Obstetric surgery						
Aref 2020 (20)	2	81	0	67	0.9%	4.15 [0.20 , 84.90]
Basbug 2020 (21)	3	62	1	72	1.5%	3.48 [0.37 , 32.65]
Naguimbing-Cuaresma 2007 (22)	3	120	1	120	1.5%	3.00 [0.32 , 28.43]
Onile 2008 (23)	1	86	0	89	0.8%	3.10 [0.13 , 75.15]
Subtotal (95% CI)		**349**		**348**	**4.7%**	**3.36 [0.93 , 12.15]**
Total events:	9		2			
Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 3 (P = 1.00); I² = 0%						
Test for overall effect: Z = 1.85 (P = 0.06)						
Total (95% CI)		**2243**		**2493**	**100.0%**	**1.85 [1.36 , 2.51]**
Total events:	295		174			
Heterogeneity: Tau² = 0.34; Chi² = 74.08, df = 37 (P = 0.0003); I² = 50%						



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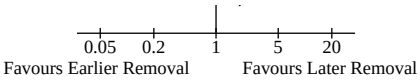
Analysis 2.2. (Continued)

Total events:	295	174
Heterogeneity: Tau² = 0.34; Chi² = 74.08, df = 37 (P = 0.0003); I² = 50%		
Test for overall effect: Z = 3.92 (P < 0.0001)		
Test for subgroup differences: Chi² = 7.24, df = 2 (P = 0.03), I² = 72.4%		



Footnotes

(1) Participants with TURP. Catheter in the control group was removed at the surgeons discretion (Median duration 4 days)
(2) Participants who received TUIP
(3) catheter removal on day 3,4 vs day 7,8
(4) Catheter removal Day 3 vs Day 5 post-op
(5) 2 vs 4 day cathter removal
(6) Catheter removal day 1 post-op vs day 4 post-op
(7) Immediate removal vs Day 1 post-op removal
(8) Re-catheterisation within 12 hours
(9) Immediate vs 1 day post-op removal
(10) Catheter removal 3 hours post-op vs removal the next morning post-op
(11) Immediate vs 24h removal; defined as inability to pass urine at the end of 12h, or failure to void after two attempts
(12) 1 day vs 2 and 4 day removal (3 arm trial)
(13) Removal of bladder catheter and vaginal pack in 3 hours vs Removal of bladder catheter and vaginal pack in 24 hours
(14) Catheter removal immediately vs removal 18-24 hours post-op
(15) Catheter removal 1 day post-op vs 3 day post-op
(16) 1 day vs 3 day removal
(17) vaginal hysterectomy with pelvic floor repair; 2 day vs 5 day removal
(18) Catheter removal 6 hours vs day 1 post-op
(19) Participants undergoing anterior colporrhaphy; 2 vs 5 day removal
(20) Catheter removal 6h post-op vs 24h removal post-op
(21) Catheter removal 2 hours vs 12 hours post-procedure
(22) Catheter removal 4 hours vs 24 hours post-op
(23) Immediate removal vs 1 day post-op

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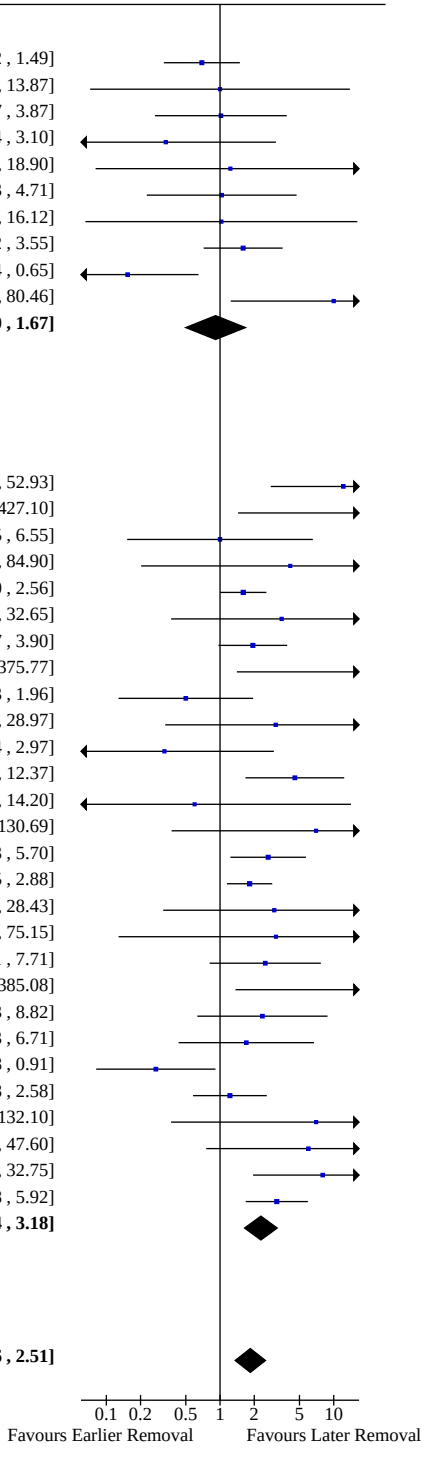
Analysis 2.3. Comparison 2: Shorter versus longer duration of catheter, Outcome 3: Number needing to be recatheterised: subgroup analysis based on sex

Study or Subgroup	Early Removal Events	Early Removal Total	Later Removal Events	Later Removal Total	Weight	Risk Ratio M-H, Random, 95% CI
2.3.1 Men only						
Durrani 2014	10	157	15	163	4.9%	0.69 [0.32 , 1.49]
Hewitt 2001	1	10	1	10	1.1%	1.00 [0.07 , 13.87]
Irani 1995 (1)	4	54	4	55	3.0%	1.02 [0.27 , 3.87]
Irani 1995 (2)	1	52	3	52	1.5%	0.33 [0.04 , 3.10]
Kim 2012 (3)	1	30	1	37	1.1%	1.23 [0.08 , 18.90]
Koh 1994	3	29	3	30	2.6%	1.03 [0.23 , 4.71]
Lista 2020 (4)	1	72	1	74	1.1%	1.03 [0.07 , 16.12]
Matsushima 2015 (5)	13	57	8	56	4.8%	1.60 [0.72 , 3.55]
Pervaiz 2019 (6)	2	50	13	50	2.8%	0.15 [0.04 , 0.65]
Sahin 2011	5	22	1	44	1.7%	10.00 [1.24 , 80.46]
Subtotal (95% CI)		**533**		**571**	**24.5%**	**0.91 [0.50 , 1.67]**
Total events:	41		50			
Heterogeneity: Tau² = 0.31; Chi² = 14.31, df = 9 (P = 0.11); I² = 37%						
Test for overall effect: Z = 0.29 (P = 0.77)						
2.3.2 Women only						
Ahmed 2014	12	73	2	148	2.7%	12.16 [2.80 , 52.93]
Alessandri 2006	6	32	0	62	1.0%	24.82 [1.44 , 427.10]
Alonzo-Sosa 1997	2	25	2	25	1.9%	1.00 [0.15 , 6.55]
Aref 2020 (7)	2	81	0	67	0.9%	4.15 [0.20 , 84.90]
Aslam 2019 (8)	20	32	16	41	6.1%	1.60 [1.00 , 2.56]
Basbug 2020 (9)	3	62	1	72	1.5%	3.48 [0.37 , 32.65]
Carter-Brooks 2018	14	27	8	30	5.2%	1.94 [0.97 , 3.90]
Chai 2011 (10)	11	35	0	35	1.0%	23.00 [1.41 , 375.77]
Dunn 2003 (11)	3	125	6	125	3.0%	0.50 [0.13 , 1.96]
Glavind 2007 (12)	3	66	1	68	1.5%	3.09 [0.33 , 28.97]
Guzman 1994	1	37	3	36	1.5%	0.32 [0.04 , 2.97]
Hakvoort 2004	19	48	4	46	4.1%	4.55 [1.68 , 12.37]
Huang 2011	0	28	1	51	0.8%	0.60 [0.03 , 14.20]
Joshi 2014 (13)	3	35	0	35	1.0%	7.00 [0.37 , 130.69]
Kamilya 2010	21	98	8	99	4.9%	2.65 [1.23 , 5.70]
Kokabi 2009 (14)	24	62	27	127	6.1%	1.82 [1.15 , 2.88]
Naguimbing-Cuaresma 2007 (15)	3	120	1	120	1.5%	3.00 [0.32 , 28.43]
Onile 2008 (16)	1	86	0	89	0.8%	3.10 [0.13 , 75.15]
Rajan 2017 (17)	10	100	4	100	3.6%	2.50 [0.81 , 7.71]
Sandberg 2019 (18)	10	74	0	81	1.0%	22.96 [1.37 , 385.08]
Schiotz 1995 (19)	7	82	3	83	3.1%	2.36 [0.63 , 8.82]
Schiotz 1996	5	45	3	46	2.9%	1.70 [0.43 , 6.71]
Sekhavat 2008 (11)	3	45	11	45	3.4%	0.27 [0.08 , 0.91]
Shahnaz 2016	11	35	9	35	5.0%	1.22 [0.58 , 2.58]
Shrestha 2013 (20)	3	50	0	50	0.9%	7.00 [0.37 , 132.10]
Tahmin 2011 (21)	6	40	1	40	1.7%	6.00 [0.76 , 47.60]
Vallabh-Patel 2020 (22)	16	44	2	44	2.8%	8.00 [1.95 , 32.75]
Weemhoff 2011 (23)	35	123	11	122	5.5%	3.16 [1.68 , 5.92]
Subtotal (95% CI)		**1710**		**1922**	**75.5%**	**2.29 [1.64 , 3.18]**
Total events:	254		124			
Heterogeneity: Tau² = 0.27; Chi² = 49.77, df = 27 (P = 0.005); I² = 46%						
Test for overall effect: Z = 4.91 (P < 0.00001)						
Total (95% CI)		**2243**		**2493**	**100.0%**	**1.85 [1.36 , 2.51]**
Total events:	295		174			
Heterogeneity: Tau² = 0.34; Chi² = 74.08, df = 37 (P = 0.0003); I² = 50%						
Test for overall effect: Z = 3.92 (P < 0.0001)						
Test for subgroup differences: Chi² = 6.81, df = 1 (P = 0.009), I² = 85.3%						



Footnotes

(1) Participants with TURP. Catheter in the control group was removed at the surgeons discretion (Median duration 4 days)

(2) Participants who received TUIP

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Analysis 2.3. (Continued)

(1) Participants with TURP. Catheter in the control group was removed at the surgeons discretion (Median duration 4 days)
(2) Participants who received TUIP
(3) catheter removal on day 3,4 vs day 7,8
(4) Catheter removal Day 3 vs Day 5 post-op
(5) 2 vs 4 day cathter removal
(6) Catheter removal day 1 post-op vs day 4 post-op
(7) Catheter removal 6h post-op vs 24h removal post-op
(8) Immediate removal vs Day 1 post-op removal
(9) Catheter removal 2 hours vs 12 hours post-procedure
(10) Re-catheterisation within 12 hours
(11) Immediate vs 1 day post-op removal
(12) Catheter removal 3 hours post-op vs removal the next morning post-op
(13) Immediate vs 24h removal; defined as inability to pass urine at the end of 12h, or failure to void after two attempts
(14) 1 day vs 2 and 4 day removal (3 arm trial)
(15) Catheter removal 4 hours vs 24 hours post-op
(16) Immediate removal vs 1 day post-op
(17) Removal of bladder catheter and vaginal pack in 3 hours vs Removal of bladder catheter and vaginal pack in 24 hours
(18) Catheter removal immediately vs removal 18-24 hours post-op
(19) Catheter removal 1 day post-op vs 3 day post-op
(20) 1 day vs 3 day removal
(21) vaginal hysterectomy with pelvic floor repair; 2 day vs 5 day removal
(22) Catheter removal 6 hours vs day 1 post-op
(23) Participants undergoing anterior colporrhaphy; 2 vs 5 day removal

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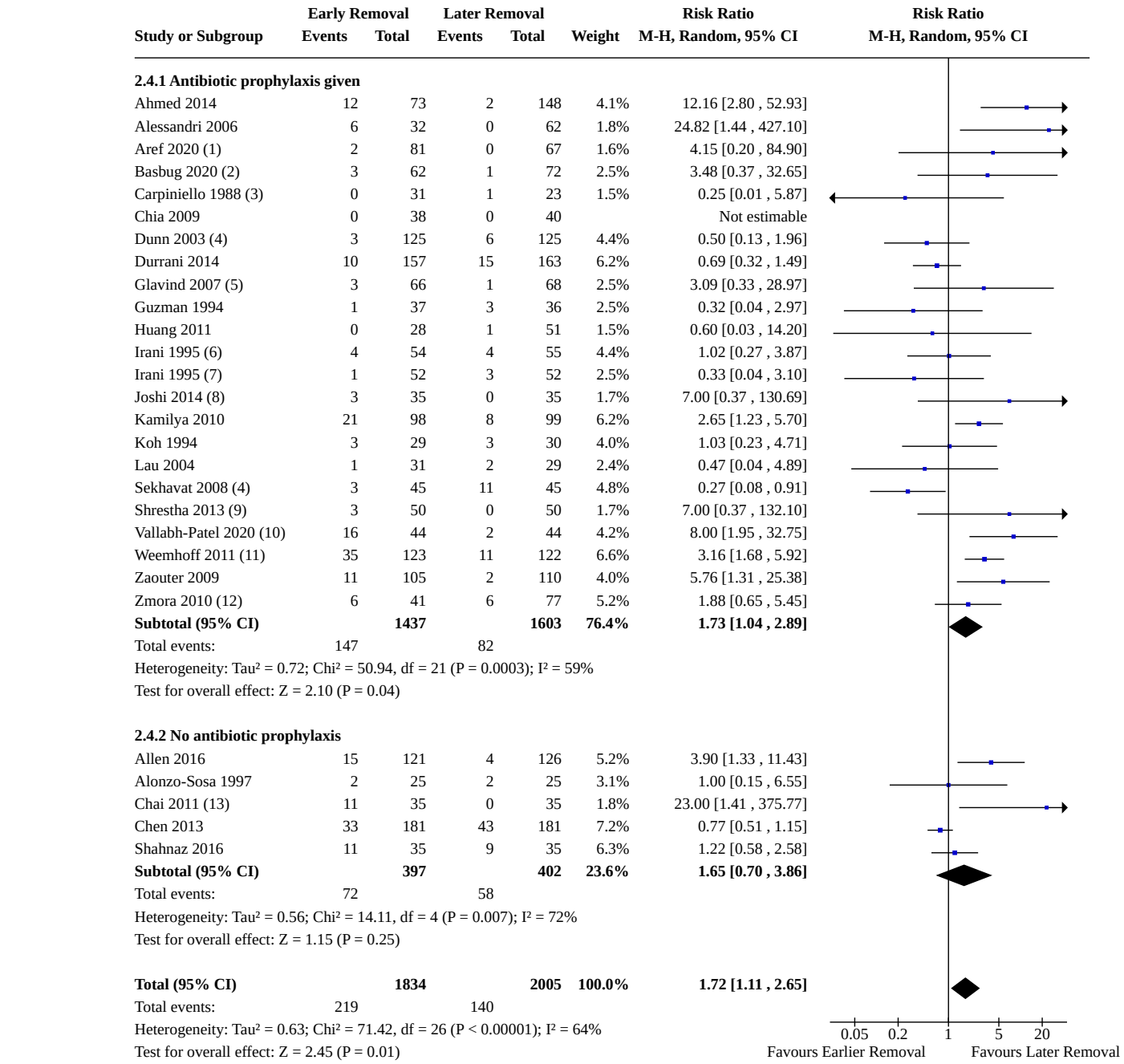
Analysis 2.4. Comparison 2: Shorter versus longer duration of catheter, Outcome 4: Number needing to be recatheterised: subgroup analysis based on antibiotic prophylaxis



Study or Subgroup	Early Removal Events	Early Removal Total	Later Removal Events	Later Removal Total	Weight	Risk Ratio M-H, Random, 95% CI
2.4.1 Antibiotic prophylaxis given						
Ahmed 2014	12	73	2	148	4.1%	12.16 [2.80 , 52.93]
Alessandri 2006	6	32	0	62	1.8%	24.82 [1.44 , 427.10]
Aref 2020 (1)	2	81	0	67	1.6%	4.15 [0.20 , 84.90]
Basbug 2020 (2)	3	62	1	72	2.5%	3.48 [0.37 , 32.65]
Carpiniello 1988 (3)	0	31	1	23	1.5%	0.25 [0.01 , 5.87]
Chia 2009	0	38	0	40		Not estimable
Dunn 2003 (4)	3	125	6	125	4.4%	0.50 [0.13 , 1.96]
Durrani 2014	10	157	15	163	6.2%	0.69 [0.32 , 1.49]
Glavind 2007 (5)	3	66	1	68	2.5%	3.09 [0.33 , 28.97]
Guzman 1994	1	37	3	36	2.5%	0.32 [0.04 , 2.97]
Huang 2011	0	28	1	51	1.5%	0.60 [0.03 , 14.20]
Irani 1995 (6)	4	54	4	55	4.4%	1.02 [0.27 , 3.87]
Irani 1995 (7)	1	52	3	52	2.5%	0.33 [0.04 , 3.10]
Joshi 2014 (8)	3	35	0	35	1.7%	7.00 [0.37 , 130.69]
Kamilya 2010	21	98	8	99	6.2%	2.65 [1.23 , 5.70]
Koh 1994	3	29	3	30	4.0%	1.03 [0.23 , 4.71]
Lau 2004	1	31	2	29	2.4%	0.47 [0.04 , 4.89]
Sekhavat 2008 (4)	3	45	11	45	4.8%	0.27 [0.08 , 0.91]
Shrestha 2013 (9)	3	50	0	50	1.7%	7.00 [0.37 , 132.10]
Vallabh-Patel 2020 (10)	16	44	2	44	4.2%	8.00 [1.95 , 32.75]
Weemhoff 2011 (11)	35	123	11	122	6.6%	3.16 [1.68 , 5.92]
Zaouter 2009	11	105	2	110	4.0%	5.76 [1.31 , 25.38]
Zmora 2010 (12)	6	41	6	77	5.2%	1.88 [0.65 , 5.45]
Subtotal (95% CI)		**1437**		**1603**	**76.4%**	**1.73 [1.04 , 2.89]**
Total events:	147		82			
Heterogeneity: Tau² = 0.72; Chi² = 50.94, df = 21 (P = 0.0003); I² = 59%						
Test for overall effect: Z = 2.10 (P = 0.04)						
2.4.2 No antibiotic prophylaxis						
Allen 2016	15	121	4	126	5.2%	3.90 [1.33 , 11.43]
Alonzo-Sosa 1997	2	25	2	25	3.1%	1.00 [0.15 , 6.55]
Chai 2011 (13)	11	35	0	35	1.8%	23.00 [1.41 , 375.77]
Chen 2013	33	181	43	181	7.2%	0.77 [0.51 , 1.15]
Shahnaz 2016	11	35	9	35	6.3%	1.22 [0.58 , 2.58]
Subtotal (95% CI)		**397**		**402**	**23.6%**	**1.65 [0.70 , 3.86]**
Total events:	72		58			
Heterogeneity: Tau² = 0.56; Chi² = 14.11, df = 4 (P = 0.007); I² = 72%						
Test for overall effect: Z = 1.15 (P = 0.25)						
Total (95% CI)		**1834**		**2005**	**100.0%**	**1.72 [1.11 , 2.65]**
Total events:	219		140			
Heterogeneity: Tau² = 0.63; Chi² = 71.42, df = 26 (P < 0.00001); I² = 64%						
Test for overall effect: Z = 2.45 (P = 0.01)						
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.92), I² = 0%						

Footnotes

(1) Catheter removal 6h post-op vs 24h removal post-op
(2) Catheter removal 2 hours vs 12 hours post-procedure
(3) Catheter removal in recovery room vs catheter removal after 1 day post-op
(4) Immediate vs 1 day post-op removal
(5) Catheter removal 3 hours post-op vs removal the next morning post-op
(6) Participants with TURP. Catheter in the control group was removed at the surgeons discretion (Median duration 4 days)
(7) Participants who received TUIP
(8) Immediate vs 24h removal; defined as inability to pass urine at the end of 12h, or failure to void after two attempts
(9) 1 day vs 2 day removal

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Analysis 2.4. (Continued)

(7) Participants who received TOH
(8) Immediate vs 24h removal; defined as inability to pass urine at the end of 12h, or failure to void after two attempts
(9) 1 day vs 3 day removal
(10) Catheter removal 6 hours vs day 1 post-op
(11) Participants undergoing anterior colporrhaphy; 2 vs 5 day removal
(12) Participants undergoing colon or rectal surgery; 1 day vs 3 or 5 day removal
(13) Re-catheterisation within 12 hours

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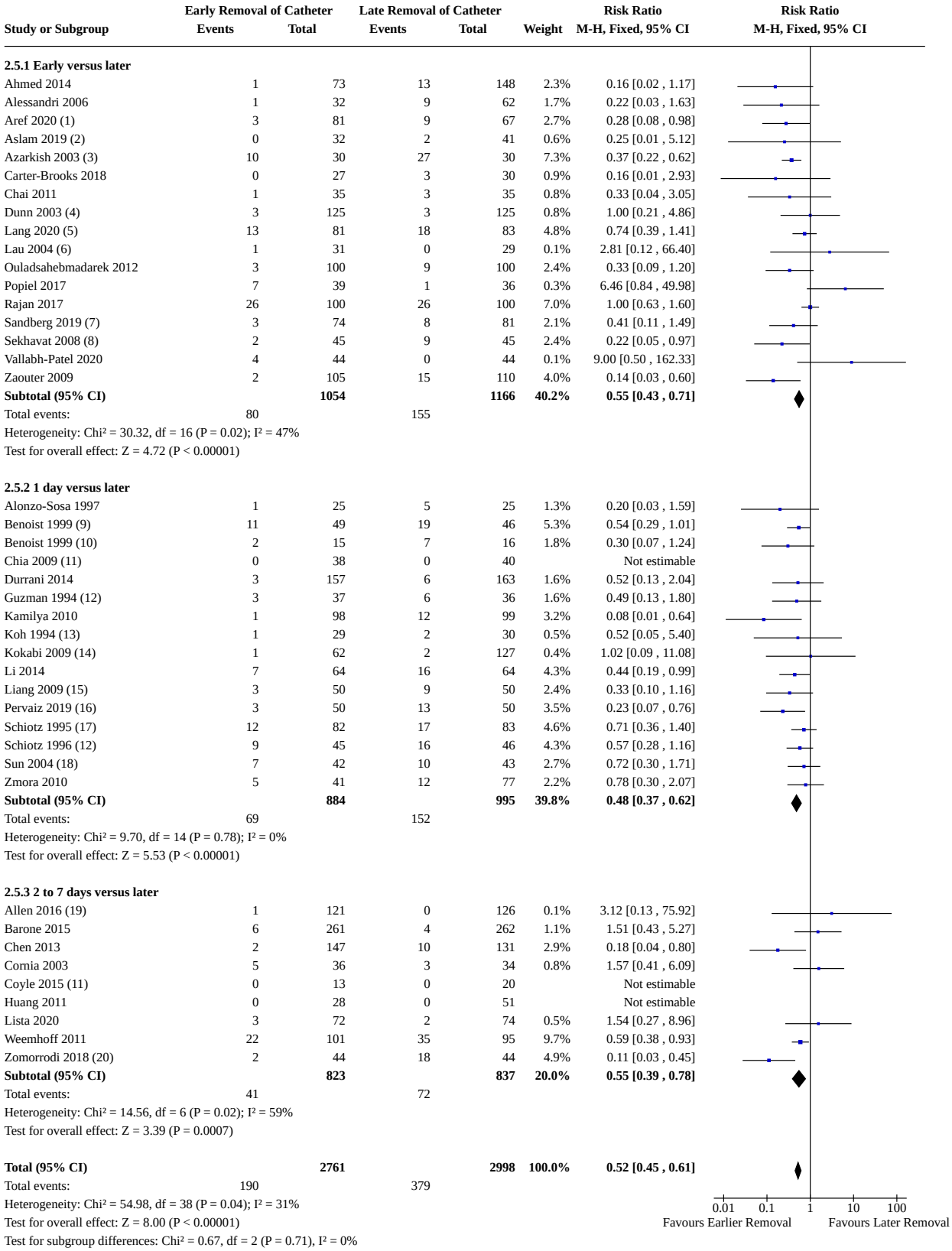
Analysis 2.5. Comparison 2: Shorter versus longer duration of catheter, Outcome 5: Symptomatic catheter-associated urinary tract infection (number of participants)



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Analysis 2.5. (Continued)

Test for overall effect: Z = 8.00 (P < 0.00001) Favours Earlier Removal Favours Later Removal
Test for subgroup differences: Chi² = 0.67, df = 2 (P = 0.71), I² = 0%

Footnotes
(1) Catheter removal 6h post-op vs 24h removal post-op
(2) Immediate removal vs Day 1 post-op removal
(3) Catheter removal 2-3 hours vs morning after surgery
(4) After hysterectomy
(5) Catheter removal 4 hours post-op vs Day 1 post-op
(6) Participants with urinary retention
(7) Catheter removal immediately vs removal 18-24 hours post-op
(8) Immediate removal vs 1 day post-op
(9) After total mesorectum excision
(10) After rectal excision
(11) Definition of CAUTI not specified
(12) After gynaecological surgery
(13) 1 day vs 2 days policy after TURP
(14) 1 day vs 2 and 4 day removal of catheter (three arm trial)
(15) Catheter removal day 1 post-op vs removal day 2 post-op
(16) Catheter removal day 1 vs day 4 post-op
(17) Catheter removal 1 day post-op vs 3 day post-op
(18) After colposuspension
(19) Catheter removed within 48 hours post-op vs Removal 6 hours after epidural removed
(20) Catheter removal 3 days post-op vs 7 days post-op

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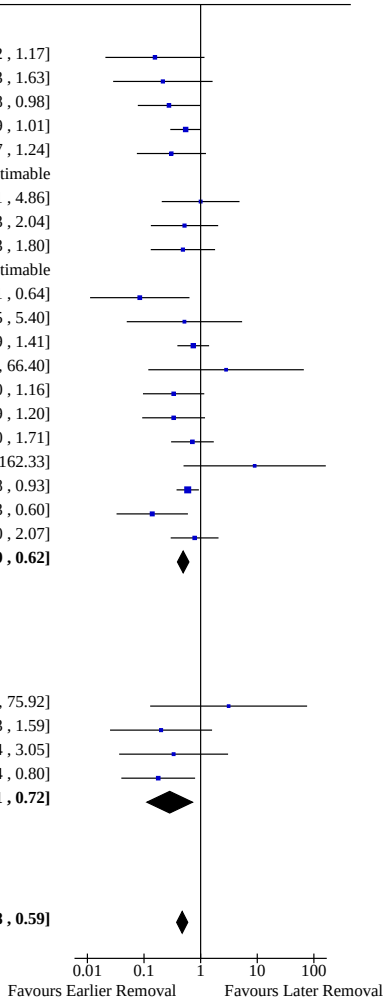
Analysis 2.6. Comparison 2: Shorter versus longer duration of catheter, Outcome 6: Symptomatic catheter-associated urinary tract infection: post-hoc subgroup analysis by antibiotic prophylaxis

Study or Subgroup	Early Removal of Catheter Events	Total	Late Removal of Catheter Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
2.6.1 Antibiotic prophylaxis						
Ahmed 2014	1	73	13	148	4.2%	0.16 [0.02 , 1.17]
Alessandri 2006	1	32	9	62	3.0%	0.22 [0.03 , 1.63]
Aref 2020 (1)	3	81	9	67	4.8%	0.28 [0.08 , 0.98]
Benoist 1999 (2)	11	49	19	46	9.6%	0.54 [0.29 , 1.01]
Benoist 1999 (3)	2	15	7	16	3.3%	0.30 [0.07 , 1.24]
Chia 2009 (4)	0	38	0	40		Not estimable
Dunn 2003 (5)	3	125	3	125	1.5%	1.00 [0.21 , 4.86]
Durrani 2014	3	157	6	163	2.9%	0.52 [0.13 , 2.04]
Guzman 1994 (6)	3	37	6	36	3.0%	0.49 [0.13 , 1.80]
Huang 2011	0	28	0	51		Not estimable
Kamilya 2010	1	98	12	99	5.8%	0.08 [0.01 , 0.64]
Koh 1994 (7)	1	29	2	30	1.0%	0.52 [0.05 , 5.40]
Lang 2020 (8)	13	81	18	83	8.7%	0.74 [0.39 , 1.41]
Lau 2004 (9)	1	31	0	29	0.3%	2.81 [0.12 , 66.40]
Liang 2009 (10)	3	50	9	50	4.4%	0.33 [0.10 , 1.16]
Ouladsahebmadarek 2012	3	100	9	100	4.4%	0.33 [0.09 , 1.20]
Sun 2004 (11)	7	42	10	43	4.8%	0.72 [0.30 , 1.71]
Vallabh-Patel 2020	4	44	0	44	0.2%	9.00 [0.50 , 162.33]
Weemhoff 2011	22	101	35	95	17.6%	0.59 [0.38 , 0.93]
Zaouter 2009	2	105	15	110	7.2%	0.14 [0.03 , 0.60]
Zmora 2010	5	41	12	77	4.1%	0.78 [0.30 , 2.07]
Subtotal (95% CI)		**1357**		**1514**	**90.7%**	**0.49 [0.39 , 0.62]**
Total events:	89		194			
Heterogeneity: Chi² = 19.40, df = 18 (P = 0.37); I² = 7%						
Test for overall effect: Z = 5.99 (P < 0.00001)						
2.6.2 No antibiotic prophylaxis given						
Allen 2016 (12)	1	121	0	126	0.2%	3.12 [0.13 , 75.92]
Alonzo-Sosa 1997	1	25	5	25	2.4%	0.20 [0.03 , 1.59]
Chai 2011	1	35	3	35	1.5%	0.33 [0.04 , 3.05]
Chen 2013	2	147	10	131	5.2%	0.18 [0.04 , 0.80]
Subtotal (95% CI)		**328**		**317**	**9.3%**	**0.28 [0.11 , 0.72]**
Total events:	5		18			
Heterogeneity: Chi² = 2.67, df = 3 (P = 0.45); I² = 0%						
Test for overall effect: Z = 2.66 (P = 0.008)						
Total (95% CI)		**1685**		**1831**	**100.0%**	**0.47 [0.38 , 0.59]**
Total events:	94		212			
Heterogeneity: Chi² = 23.66, df = 22 (P = 0.37); I² = 7%						
Test for overall effect: Z = 6.53 (P < 0.00001)						
Test for subgroup differences: Chi² = 1.27, df = 1 (P = 0.26), I² = 21.0%						



Footnotes

(1) Catheter removal 6h post-op vs 24h removal post-op
(2) After total mesorectum excision
(3) After rectal excision
(4) Definition of CAUTI not specified
(5) After hysterectomy
(6) After gynaecological surgery
(7) 1 day vs 2 days policy after TURP
(8) Catheter removal 4 hours post-op vs Day 1 post-op
(9) Participants with urinary retention
(10) Catheter removal day 1 post-op vs removal day 2 post-op
(11) After colposuspension
(12) Catheter removed within 48 hours post-op vs Removal 6 hours after epidural removed

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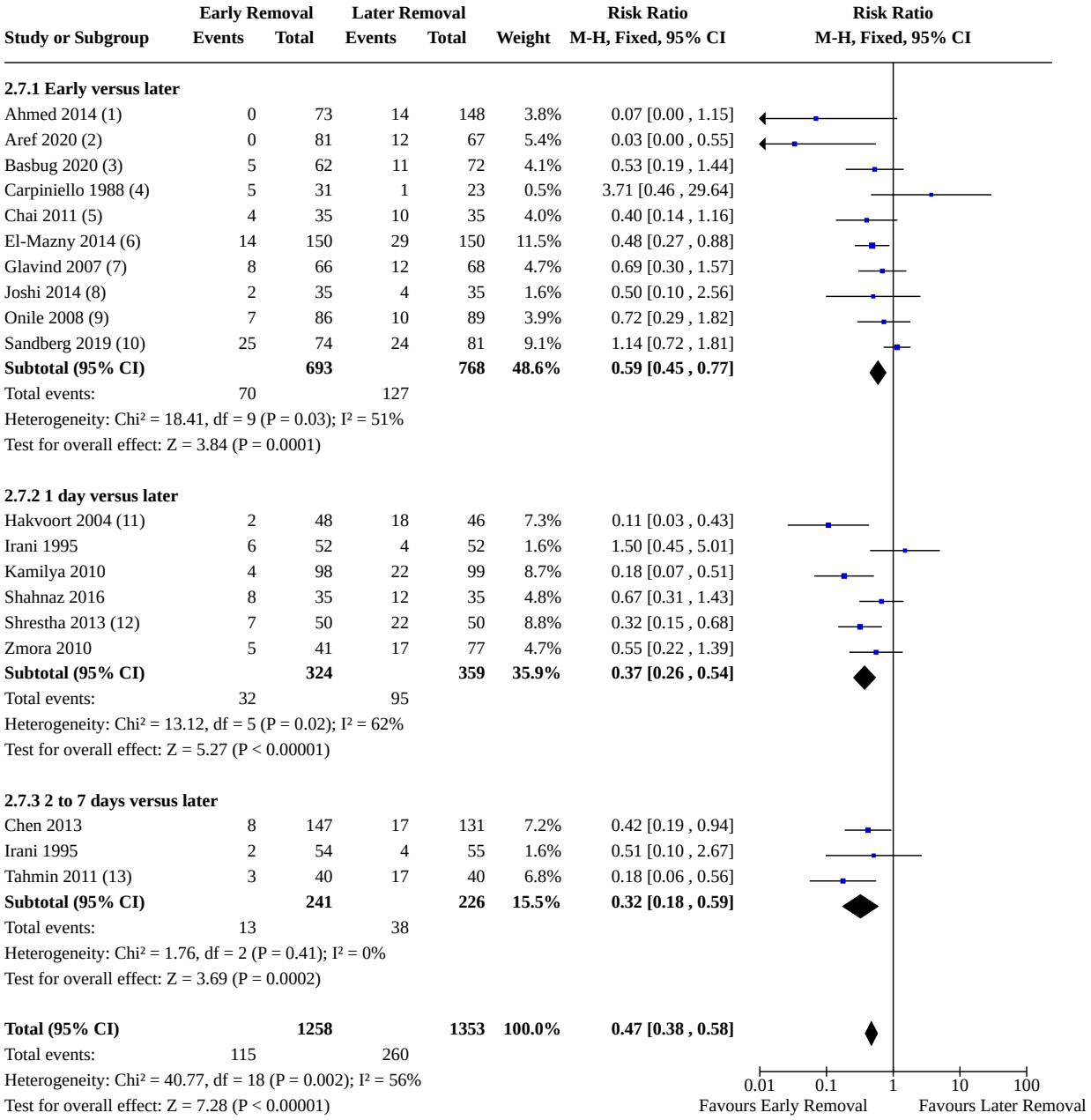
Analysis 2.7. Comparison 2: Shorter versus longer duration of catheter, Outcome 7: Asymptomatic bacteruria (number of participants)



Footnotes

(1) 1 week postoperative
(2) Catheter removal 6h post-op vs 24h removal post-op
(3) Catheter removal 2 hours vs 12 hours post-procedure
(4) Catheter removal in recovery room vs catheter removal after 1 day post-op
(5) Postoperative urine culture
(6) Immediate IUC removal vs removal at 12 hours, participants received elective caesarean
(7) Catheter removal 3 hours post-op vs removal the next morning post-op
(8) Two weeks postoperative
(9) Immediate removal vs 1 day post-op
(10) Catheter removal immediately vs removal 18-24 hours post-op

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Analysis 2.7. (Continued)

(9) Immediate removal vs 1 day post-op
(10) Catheter removal immediately vs removal 18-24 hours post-op
(11) After anterior colporrhaphy
(12) Participants underwent vaginal hysterectomy; 24 hour vs 3 day removal of catheter
(13) Vaginal hysterectomy with pelvic floor repair; 2 day vs 5 day removal

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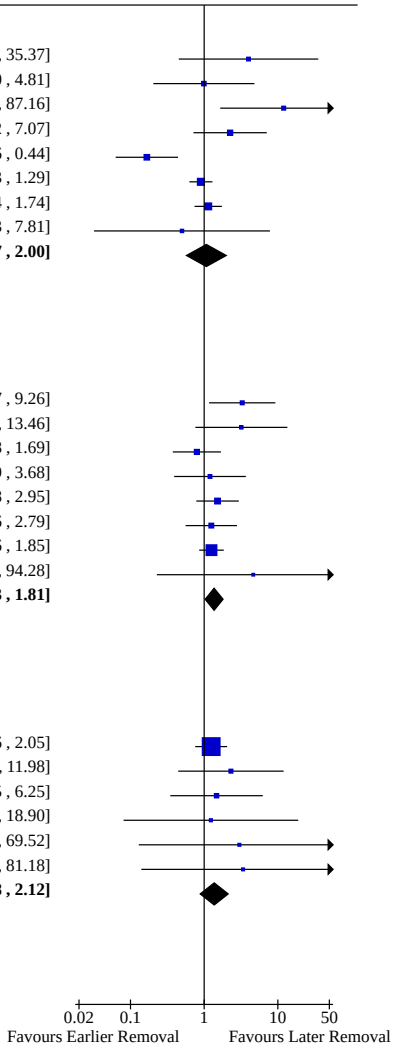
Analysis 2.8. Comparison 2: Shorter versus longer duration of catheter, Outcome 8: Incidence of urinary retention

Study or Subgroup	Early Removal of Catheter Events	Total	Late Removal of Catheter Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
2.8.1 Early versus later						
El-Mazny 2014 (1)	4	150	1	150	6.1%	4.00 [0.45 , 35.37]
Mao 1994 (2)	3	114	3	113	9.5%	0.99 [0.20 , 4.81]
Popiel 2017 (3)	13	39	1	36	7.0%	12.00 [1.65 , 87.16]
Rajan 2017	9	100	4	100	13.4%	2.25 [0.72 , 7.07]
Sekhavat 2008 (4)	4	45	24	45	15.3%	0.17 [0.06 , 0.44]
Taube 1989 (5)	13	18	16	20	22.6%	0.90 [0.63 , 1.29]
Taube 1989 (6)	13	18	14	22	21.9%	1.13 [0.74 , 1.74]
Zhou 2012 (7)	1	92	1	46	4.2%	0.50 [0.03 , 7.81]
Subtotal (95% CI)		**576**		**532**	**100.0%**	**1.07 [0.57 , 2.00]**
Total events:	60		64			
Heterogeneity: Tau² = 0.41; Chi² = 23.34, df = 7 (P = 0.001); I² = 70%						
Test for overall effect: Z = 0.22 (P = 0.83)						
2.8.2 1 day versus later						
Benoist 1999 (8)	14	49	4	46	7.0%	3.29 [1.17 , 9.26]
Benoist 1999 (9)	6	15	2	16	3.7%	3.20 [0.76 , 13.46]
Guzman 1994	9	37	11	36	12.9%	0.80 [0.38 , 1.69]
Liang 2009 (10)	6	50	5	50	6.1%	1.20 [0.39 , 3.68]
Schiotz 1995	18	82	12	83	16.3%	1.52 [0.78 , 2.95]
Shahnaz 2016	10	35	8	35	11.4%	1.25 [0.56 , 2.79]
Taube 1989 (11)	16	20	14	22	41.6%	1.26 [0.86 , 1.85]
Toscano 2001 (12)	2	54	0	50	0.9%	4.64 [0.23 , 94.28]
Subtotal (95% CI)		**342**		**338**	**100.0%**	**1.36 [1.03 , 1.81]**
Total events:	81		56			
Heterogeneity: Tau² = 0.01; Chi² = 7.44, df = 7 (P = 0.38); I² = 6%						
Test for overall effect: Z = 2.17 (P = 0.03)						
2.8.3 2 to 7 days versus later						
Barone 2015	31	261	25	262	77.3%	1.24 [0.76 , 2.05]
Coyle 2015	3	13	2	20	7.1%	2.31 [0.44 , 11.98]
Han 1997	4	48	3	53	9.2%	1.47 [0.35 , 6.25]
Kim 2012 (13)	1	30	1	37	2.6%	1.23 [0.08 , 18.90]
Nielson 1985 (14)	1	20	0	20	1.9%	3.00 [0.13 , 69.52]
Valero Puerta 1998	1	55	0	62	1.9%	3.38 [0.14 , 81.18]
Subtotal (95% CI)		**427**		**454**	**100.0%**	**1.37 [0.88 , 2.12]**
Total events:	41		31			
Heterogeneity: Tau² = 0.00; Chi² = 1.09, df = 5 (P = 0.95); I² = 0%						
Test for overall effect: Z = 1.40 (P = 0.16)						
Test for subgroup differences: Chi² = 0.51, df = 2 (P = 0.77), I² = 0%						



Footnotes

(1) Immediate IUC removal vs removal at 12 hours, participants received elective caesarean
(2) Catheter duration 7am to 8pm (same day) vs Catheter duration 7am to 6am (next day)
(3) Foley catheter removal within 6h of operation vs Foley catheter removal on day 1 post-operatively
(4) Immediate vs 1 day post-op catheter removal
(5) Immediate versus delay of 1 day before catheter removal after acute urinary retention
(6) Immediate versus delay of 2 days before catheter removal after acute urinary retention
(7) Removal of urinary indwelling catheter at 6 to 8 hours post surgery (intervention groups combined) vs Removal of urinary indwelling catheter at 24 hours (three arm trial, results not
(8) 1 day policy versus 5 day policy after total mesorectum excision
(9) 1 day policy versus 5 day policy after rectal excision
(10) Catheter removal day 1 post-op vs removal day 2 post-op
(11) 1 day delay versus 2 day delay before catheter removal after acute urinary retention
(12) 1 day delay versus 2 day delay before catheter removal after surgery for prostatic hyperplasia
(13) 3,4 vs 7,8 day catheter removal; early removal had 1 clot urinary retention, later removal had 1 AUR
(14) 3 day policy versus 28 day policy after urethrotomy

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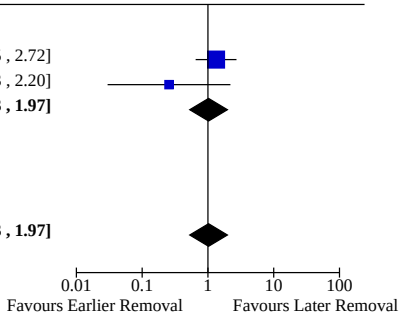
Analysis 2.9. Comparison 2: Shorter versus longer duration of catheter, Outcome 9: Delayed voiding after catheter removal

Study or Subgroup	Early Removal of Catheter Events	Total	Late Removal of Catheter Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
2.9.1 1 day versus later						
Schiotz 1996 (1)	13	45	10	46	71.4%	1.33 [0.65 , 2.72]
Sun 2004 (2)	1	42	4	43	28.6%	0.26 [0.03 , 2.20]
Subtotal (95% CI)		**87**		**89**	**100.0%**	**1.02 [0.53 , 1.97]**
Total events:	14		14			
Heterogeneity: Chi² = 2.11, df = 1 (P = 0.15); I² = 53%						
Test for overall effect: Z = 0.07 (P = 0.95)						
Total (95% CI)		**87**		**89**	**100.0%**	**1.02 [0.53 , 1.97]**
Total events:	14		14			
Heterogeneity: Chi² = 2.11, df = 1 (P = 0.15); I² = 53%						
Test for overall effect: Z = 0.07 (P = 0.95)						
Test for subgroup differences: Not applicable						

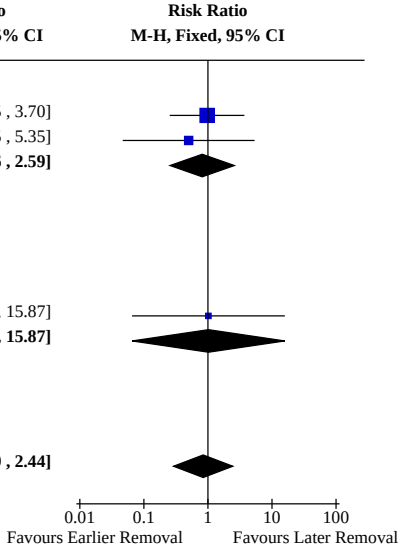


Footnotes

(1) 1 day versus 3 day policy after gynaecological surgery
(2) 1 day versus 5 day policy after colposuspension

Analysis 2.10. Comparison 2: Shorter versus longer duration of catheter, Outcome 10: Chronic urinary retention

Study or Subgroup	Early Removal of Catheter Events	Total	Late Removal of Catheter Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
2.10.1 1-day policy versus later						
Benoist 1999	4	64	4	62	57.6%	0.97 [0.25 , 3.70]
Irani 1995 (1)	1	52	2	52	28.4%	0.50 [0.05 , 5.35]
Subtotal (95% CI)		**116**		**114**	**86.0%**	**0.81 [0.26 , 2.59]**
Total events:	5		6			
Heterogeneity: Chi² = 0.23, df = 1 (P = 0.63); I² = 0%						
Test for overall effect: Z = 0.35 (P = 0.73)						
2.10.2 2 to 7 days versus later						
Irani 1995 (2)	1	54	1	55	14.0%	1.02 [0.07 , 15.87]
Subtotal (95% CI)		**54**		**55**	**14.0%**	**1.02 [0.07 , 15.87]**
Total events:	1		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.01 (P = 0.99)						
Total (95% CI)		**170**		**169**	**100.0%**	**0.84 [0.29 , 2.44]**
Total events:	6		7			
Heterogeneity: Chi² = 0.25, df = 2 (P = 0.88); I² = 0%						
Test for overall effect: Z = 0.31 (P = 0.75)						
Test for subgroup differences: Chi² = 0.02, df = 1 (P = 0.88), I² = 0%						



Footnotes

(1) Participants recieved TUIP. Catheter removed within 24 hours vs Surgeons discretion
(2) Participants with TURP. Catheter removal at 48 hours vs Surgeons discretion (Median duration 4 days)

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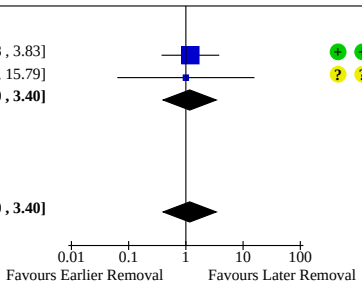
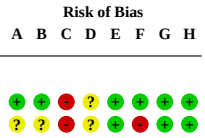
Analysis 2.11. Comparison 2: Shorter versus longer duration of catheter, Outcome 11: Other complications of catheterisation: fever

Study or Subgroup	Early removal of catheter Events	Total	Late removal of catheter Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
2.11.1 Early versus later						
Dunn 2003	6	125	5	125	83.3%	1.20 [0.38 , 3.83]
Yaghmaei 2017	1	110	1	110	16.7%	1.00 [0.06 , 15.79]
Subtotal (95% CI)		**235**		**235**	**100.0%**	**1.17 [0.40 , 3.40]**
Total events:	7		6			
Heterogeneity: Chi² = 0.01, df = 1 (P = 0.90); I² = 0%						
Test for overall effect: Z = 0.28 (P = 0.78)						
Total (95% CI)		**235**		**235**	**100.0%**	**1.17 [0.40 , 3.40]**
Total events:	7		6			
Heterogeneity: Chi² = 0.01, df = 1 (P = 0.90); I² = 0%						
Test for overall effect: Z = 0.28 (P = 0.78)						
Test for subgroup differences: Not applicable						

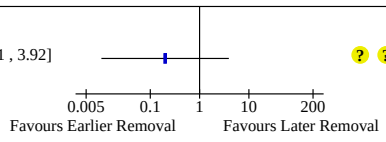


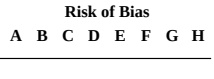


Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

Analysis 2.12. Comparison 2: Shorter versus longer duration of catheter, Outcome 12: Other complications of catheterisation: epididymitis

Study or Subgroup	Early removal of catheter Events	Total	Late removal of catheter Events	Total	Risk Ratio M-H, Fixed, 95% CI
2.12.1 2 to 7 days versus later					
Nielson 1985 (1)	0	20	2	20	0.20 [0.01 , 3.92]





Footnotes
(1) 3 day policy versus 28 day policy after urethrotomy procedure. Participants interviewed at 6 months.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

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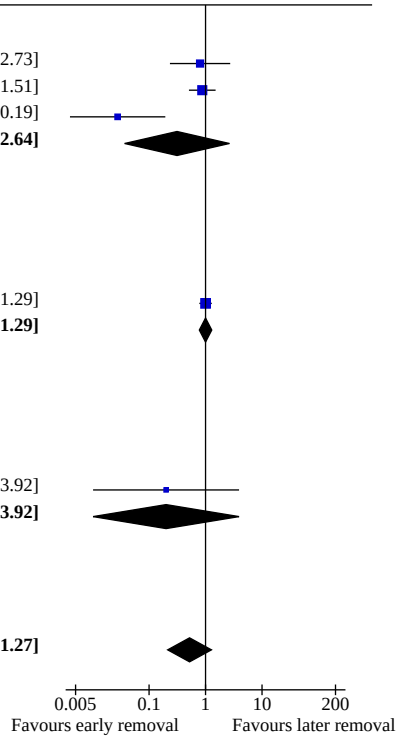
Analysis 2.13. Comparison 2: Shorter versus longer duration of catheter, Outcome 13: Pain or discomfort (dichotomous)

Study or Subgroup	Early removal Events	Total	Later removal Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
2.13.1 Immediate post-op removal versus removal 24 hours post-op						
Chai 2011	4	35	5	35	20.0%	0.80 [0.23 , 2.73]
Joshi 2014	14	35	16	35	28.8%	0.88 [0.51 , 1.51]
Sekhavat 2008	1	45	36	45	12.7%	0.03 [0.00 , 0.19]
Subtotal (95% CI)		**115**		**115**	**61.5%**	**0.31 [0.04 , 2.64]**
Total events:	19		57			
Heterogeneity: Tau² = 3.11; Chi² = 20.36, df = 2 (P < 0.0001); I² = 90%						
Test for overall effect: Z = 1.07 (P = 0.29)						
2.13.2 Removal 4 hours post-op versus removal 24 hours post-op						
Naguimbing-Cuaresma 2007	60	120	60	120	31.4%	1.00 [0.78 , 1.29]
Subtotal (95% CI)		**120**		**120**	**31.4%**	**1.00 [0.78 , 1.29]**
Total events:	60		60			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
2.13.3 Removal 3 days post-op versus removal 28 days post-op						
Nielson 1985 (1)	0	20	2	20	7.0%	0.20 [0.01 , 3.92]
Subtotal (95% CI)		**20**		**20**	**7.0%**	**0.20 [0.01 , 3.92]**
Total events:	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.06 (P = 0.29)						
Total (95% CI)		**255**		**255**	**100.0%**	**0.52 [0.21 , 1.27]**
Total events:	79		119			
Heterogeneity: Tau² = 0.64; Chi² = 21.92, df = 4 (P = 0.0002); I² = 82%						
Test for overall effect: Z = 1.43 (P = 0.15)						
Test for subgroup differences: Chi² = 2.22, df = 2 (P = 0.33), I² = 9.9%						



Footnotes

(1) Urethral pain

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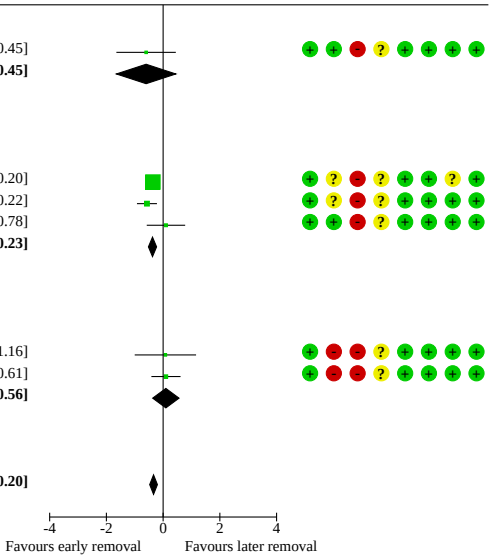
Analysis 2.14. Comparison 2: Shorter versus longer duration of catheter, Outcome 14: Pain or discomfort: 0-10 VAS (higher score = greater pain)

Study or Subgroup	Early removal Mean	SD	Total	Later removal Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI	Risk of Bias A B C D E F G H
2.14.1 Removal 4 hours post-op versus removal at 6am 1 day post-op									
Carter-Brooks 2018 (1)	3.8	2.01	27	4.4	2.02	30	1.7%	-0.60 [-1.65 , 0.45]	+ + - ? + + + +
Subtotal (95% CI)			**27**			**30**	**1.7%**	**-0.60 [-1.65 , 0.45]**	
Heterogeneity: Not applicable									
Test for overall effect: Z = 1.12 (P = 0.26)									
2.14.2 Immediate post-op removal versus removal 24 hours post-op									
Chia 2009	0.21	0.5	38	0.57	0.1	40	70.7%	-0.36 [-0.52 , -0.20]	+ ? - ? + + ? +
Ouladsahebmadarek 2012	6.46	1.25	100	7.03	1.29	100	15.0%	-0.57 [-0.92 , -0.22]	+ ? - ? + + + +
Sandberg 2019	2.9	2	74	2.8	2.3	81	4.0%	0.10 [-0.58 , 0.78]	+ + - ? + + + +
Subtotal (95% CI)			**212**			**221**	**89.7%**	**-0.37 [-0.52 , -0.23]**	
Heterogeneity: Chi² = 3.10, df = 2 (P = 0.21); I² = 36%									
Test for overall effect: Z = 5.10 (P < 0.00001)									
2.14.3 Immediate removal post-op versus removal 3-5 days post-op									
Zaouter 2009 (2)	1.76	2.01	45	1.68	2.02	19	1.6%	0.08 [-1.00 , 1.16]	+ - - ? + + + +
Zaouter 2009 (3)	1.13	1.44	56	1.03	1.64	85	7.0%	0.10 [-0.41 , 0.61]	+ - - ? + + + +
Subtotal (95% CI)			**101**			**104**	**8.6%**	**0.10 [-0.37 , 0.56]**	
Heterogeneity: Chi² = 0.00, df = 1 (P = 0.97); I² = 0%									
Test for overall effect: Z = 0.41 (P = 0.68)									
Total (95% CI)			**340**			**355**	**100.0%**	**-0.34 [-0.47 , -0.20]**	
Heterogeneity: Chi² = 6.95, df = 5 (P = 0.22); I² = 28%									
Test for overall effect: Z = 4.86 (P < 0.00001)									
Test for subgroup differences: Chi² = 3.85, df = 2 (P = 0.15), I² = 48.1%									

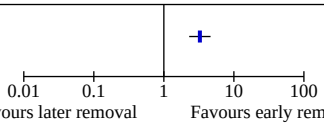


Footnotes
(1) Estimated SD from Zaouter 2009
(2) post-void residual > 200 ml
(3) post-void residual < 200 ml

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

Analysis 2.15. Comparison 2: Shorter versus longer duration of catheter, Outcome 15: Patient satisfaction

Study or Subgroup	Early removal Events	Total	Later removal Events	Total	Risk Ratio M-H, Fixed, 95% CI	Risk of Bias A B C D E F G H
Yaghmaei 2017 (1)	85	110	26	110	3.27 [2.30 , 4.64]	? ? - ? + - + +



Footnotes
(1) Measured as satisfied or very satisfied

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

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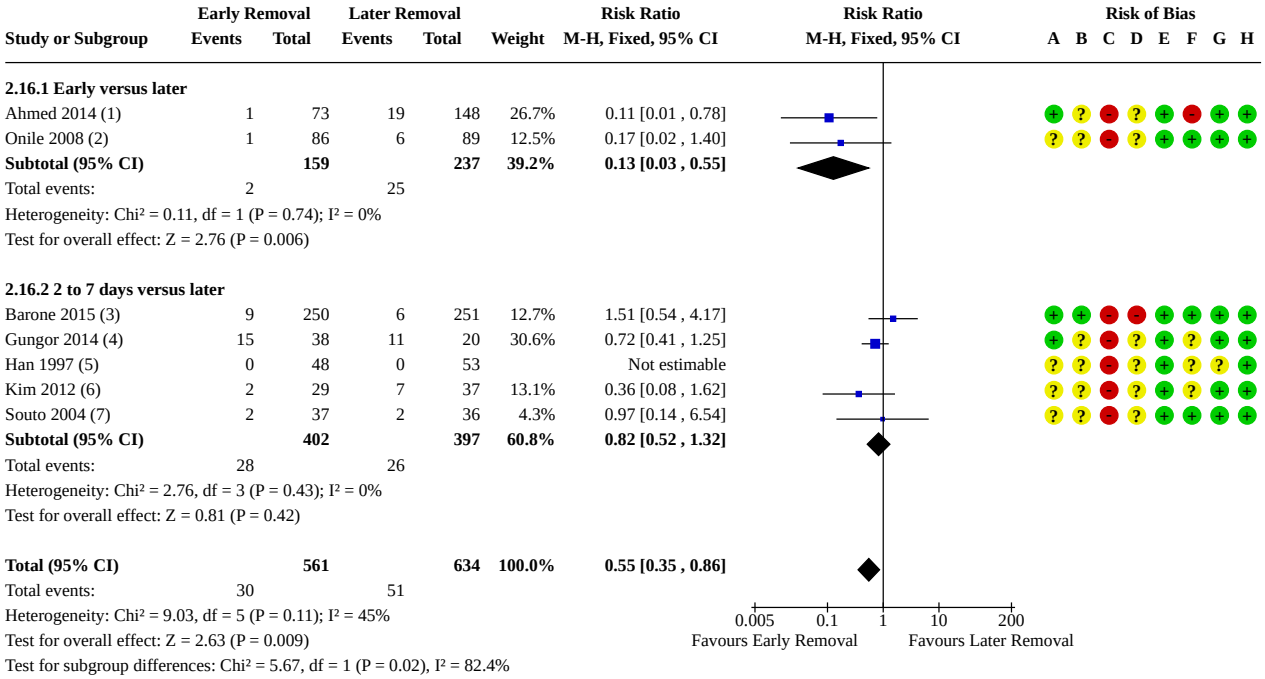
Analysis 2.16. Comparison 2: Shorter versus longer duration of catheter, Outcome 16: Urinary incontinence



Footnotes

(1) Urgency Incontinence
(2) Reported as frequency/urgency; Immediate removal vs 1 day post-op
(3) Catheter removal at day 7 post-op vs removal at 14 days post-op
(4) Stress or mixed incontinence
(5) Incontinence (>3 months)
(6) Incontinence at 3 months (type not specified)
(7) Urinary incontinence; catehter removal 7 day post-op vs 14 day post-op following retropubic radical prostatectomy

Risk of bias legend

(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

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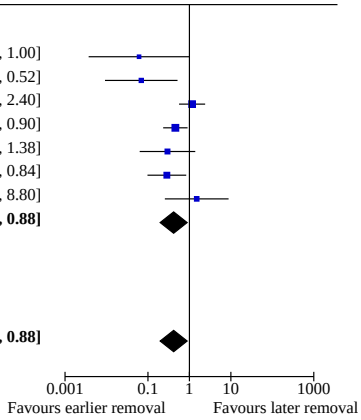
Analysis 2.17. Comparison 2: Shorter versus longer duration of catheter, Outcome 17: Dysuria

Study or Subgroup	Early Removal of Catheter Events	Total	Late Removal of Catheter Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
2.17.1 Early versus later						
Ahmed 2014 (1)	0	73	16	148	5.7%	0.06 [0.00 , 1.00]
Aref 2020 (2)	1	81	12	67	9.2%	0.07 [0.01 , 0.52]
Basbug 2020 (3)	12	62	12	72	21.8%	1.16 [0.56 , 2.40]
El-Mazny 2014	11	150	24	150	22.4%	0.46 [0.23 , 0.90]
Onile 2008 (4)	2	86	7	89	12.7%	0.30 [0.06 , 1.38]
Ouladsahebmadarek 2012 (5)	4	100	14	100	17.5%	0.29 [0.10 , 0.84]
Yaghmaei 2017	3	110	2	110	10.8%	1.50 [0.26 , 8.80]
Subtotal (95% CI)		**662**		**736**	**100.0%**	**0.42 [0.20 , 0.88]**
Total events:	33		87			
Heterogeneity: Tau² = 0.53; Chi² = 15.22, df = 6 (P = 0.02); I² = 61%						
Test for overall effect: Z = 2.29 (P = 0.02)						
Total (95% CI)		**662**		**736**	**100.0%**	**0.42 [0.20 , 0.88]**
Total events:	33		87			
Heterogeneity: Tau² = 0.53; Chi² = 15.22, df = 6 (P = 0.02); I² = 61%						
Test for overall effect: Z = 2.29 (P = 0.02)						
Test for subgroup differences: Not applicable						

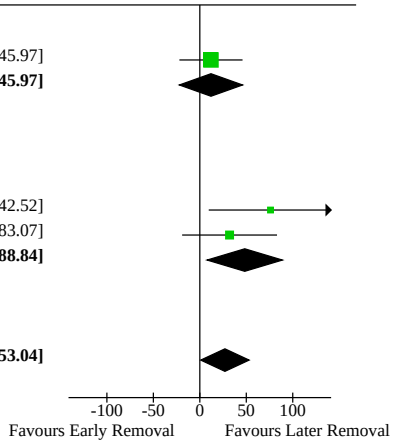


Footnotes

(1) Dysuria at 1 week postoperatively
(2) Catheter removal 6h post-op vs 24h removal post-op
(3) Catheter removal 2 hours vs 12 hours post-procedure
(4) Dysuria; Immediate removal vs 1 day post-op
(5) Dysuria at the beginning of urination

Analysis 2.18. Comparison 2: Shorter versus longer duration of catheter, Outcome 18: Volume of first void (mL)

Study or Subgroup	Early Removal Mean	SD	Total	Later Removal Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
2.18.1 Early removal versus later								
Mao 1994	247	127	114	235	134	113	58.7%	12.00 [-21.97 , 45.97]
Subtotal (95% CI)			**114**			**113**	**58.7%**	**12.00 [-21.97 , 45.97]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.69 (P = 0.49)								
2.18.2 2-day to 7-day policy versus later								
Gungor 2014	319.06	135.3	38	243	115.6	20	15.3%	76.06 [9.60 , 142.52]
Huang 2011 (1)	223.39	110.39	28	191.37	111.34	51	26.0%	32.02 [-19.03 , 83.07]
Subtotal (95% CI)			**66**			**71**	**41.3%**	**48.36 [7.88 , 88.84]**
Heterogeneity: Chi² = 1.06, df = 1 (P = 0.30); I² = 6%								
Test for overall effect: Z = 2.34 (P = 0.02)								
Total (95% CI)			**180**			**184**	**100.0%**	**27.02 [1.00 , 53.04]**
Heterogeneity: Chi² = 2.88, df = 2 (P = 0.24); I² = 31%								
Test for overall effect: Z = 2.04 (P = 0.04)								
Test for subgroup differences: Chi² = 1.82, df = 1 (P = 0.18), I² = 45.0%								



Footnotes

(1) First time voiding in the morning

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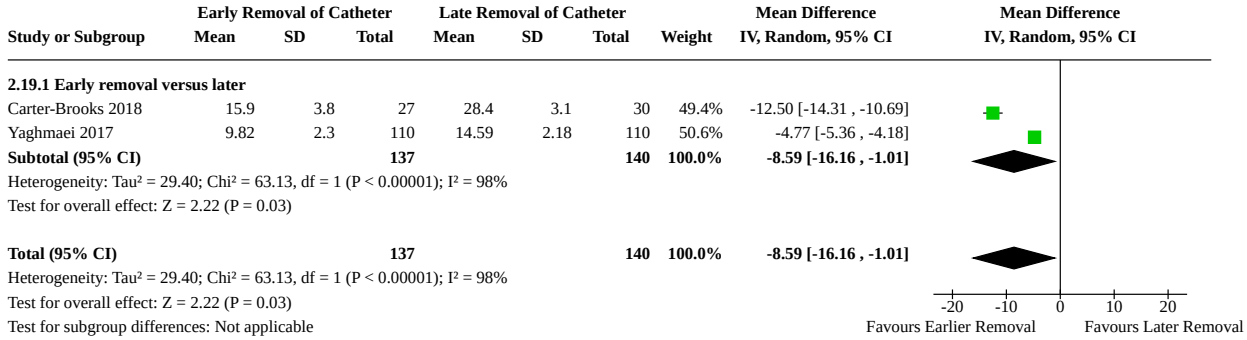
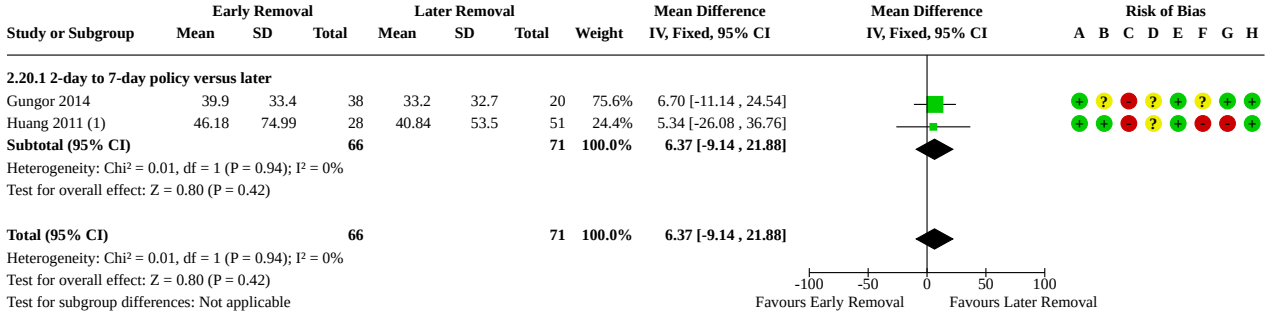
Analysis 2.19. Comparison 2: Shorter versus longer duration of catheter, Outcome 19: Time to first void (hours)



Study or Subgroup	Early Removal of Catheter Mean	SD	Total	Late Removal of Catheter Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
2.19.1 Early removal versus later								
Carter-Brooks 2018	15.9	3.8	27	28.4	3.1	30	49.4%	-12.50 [-14.31 , -10.69]
Yaghmaei 2017	9.82	2.3	110	14.59	2.18	110	50.6%	-4.77 [-5.36 , -4.18]
Subtotal (95% CI)			**137**			**140**	**100.0%**	**-8.59 [-16.16 , -1.01]**
Heterogeneity: Tau² = 29.40; Chi² = 63.13, df = 1 (P < 0.00001); I² = 98%								
Test for overall effect: Z = 2.22 (P = 0.03)								
Total (95% CI)			**137**			**140**	**100.0%**	**-8.59 [-16.16 , -1.01]**
Heterogeneity: Tau² = 29.40; Chi² = 63.13, df = 1 (P < 0.00001); I² = 98%								
Test for overall effect: Z = 2.22 (P = 0.03)								
Test for subgroup differences: Not applicable								

Analysis 2.20. Comparison 2: Shorter versus longer duration of catheter, Outcome 20: Post-void residual volume (mL)



Study or Subgroup	Early Removal Mean	SD	Total	Later Removal Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
2.20.1 2-day to 7-day policy versus later								
Gungor 2014	39.9	33.4	38	33.2	32.7	20	75.6%	6.70 [-11.14 , 24.54]
Huang 2011 (1)	46.18	74.99	28	40.84	53.5	51	24.4%	5.34 [-26.08 , 36.76]
Subtotal (95% CI)			**66**			**71**	**100.0%**	**6.37 [-9.14 , 21.88]**
Heterogeneity: Chi² = 0.01, df = 1 (P = 0.94); I² = 0%								
Test for overall effect: Z = 0.80 (P = 0.42)								
Total (95% CI)			**66**			**71**	**100.0%**	**6.37 [-9.14 , 21.88]**
Heterogeneity: Chi² = 0.01, df = 1 (P = 0.94); I² = 0%								
Test for overall effect: Z = 0.80 (P = 0.42)								
Test for subgroup differences: Not applicable								

Footnotes

(1) Post-void residual in the morning

Risk of bias legend

(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

Analysis 2.21. Comparison 2: Shorter versus longer duration of catheter, Outcome 21: Post-void residual volume (median and range) (mL)

Post-void residual volume (median and range) (mL)

Study	Outcome	IUC for 2 days	IUC for 10 days
Nguyen 2012	Median (range) post-void residual volume (mls)	Pre-op: 100 (20 - 400) 3 months post-op: 35 (30 - 200)	Pre-op: 50 (0 - 180) 3 months post-op: 20 (0 - 180) 6 months post-op: 20 (0 - 65) 12 months post-op: 30 (0 - 100)

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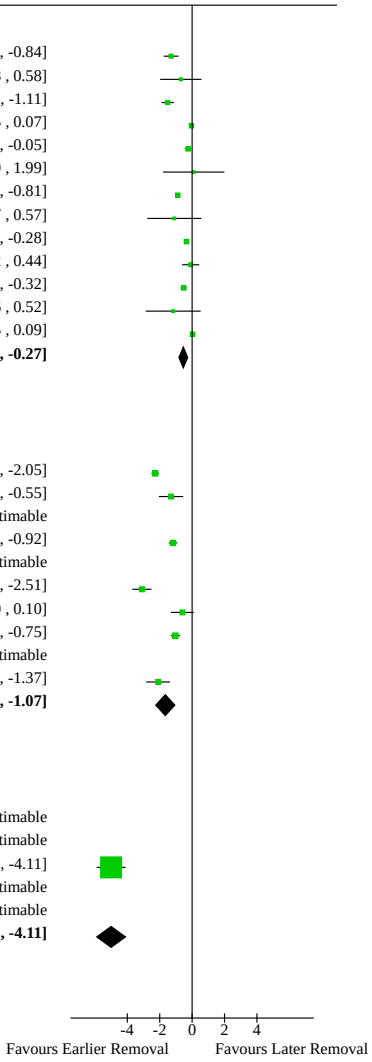
Analysis 2.22. Comparison 2: Shorter versus longer duration of catheter, Outcome 22: Length of hospitalisation in days

Study or Subgroup	Early Removal of Catheter Mean	SD	Total	Late Removal of Catheter Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
2.22.1 Early removal versus later								
Ahmed 2014	3.2	1.6	73	4.5	1.7	148	8.5%	-1.30 [-1.76 , -0.84]
Alessandri 2006	1.5	2.3	32	2.2	4	62	3.2%	-0.70 [-1.98 , 0.58]
Aref 2020 (1)	2.4	1.3	81	3.9	1.1	67	9.1%	-1.50 [-1.89 , -1.11]
Aslam 2019 (2)	1.02	0.183	32	1.06	0.31	41	11.0%	-0.04 [-0.15 , 0.07]
Basbug 2020 (3)	1.74	0.63	62	1.99	0.54	72	10.5%	-0.25 [-0.45 , -0.05]
Carter-Brooks 2018	1.2	5	27	1.1	0.3	30	1.7%	0.10 [-1.79 , 1.99]
El-Mazny 2014 (4)	0.79	0.096	150	1.68	0.47	150	11.1%	-0.89 [-0.97 , -0.81]
Lau 2004 (5)	2.2	2.1	31	3.3	4.1	29	2.1%	-1.10 [-2.77 , 0.57]
Naguimbing-Cuaresma 2007 (6)	2.29	0.21	120	2.64	0.32	120	11.1%	-0.35 [-0.42 , -0.28]
Onile 2008 (7)	6.82	1.76	86	6.91	1.82	89	7.8%	-0.09 [-0.62 , 0.44]
Ouladsahebmadarek 2012 (8)	2.17	0.68	100	2.69	0.75	100	10.6%	-0.52 [-0.72 , -0.32]
Sekhavat 2008	1.03	3.1	45	2.2	4.9	45	2.1%	-1.17 [-2.86 , 0.52]
Yaghmaei 2017	1.16	0.23	110	1.14	0.3	110	11.1%	0.02 [-0.05 , 0.09]
Subtotal (95% CI)			**949**			**1063**	**100.0%**	**-0.54 [-0.82 , -0.27]**
Heterogeneity: Tau² = 0.17; Chi² = 380.90, df = 12 (P < 0.00001); I² = 97%								
Test for overall effect: Z = 3.93 (P < 0.0001)								
2.22.2 1-day policy versus later								
Durrani 2014	1.29	1.03	157	3.57	1.028	163	15.8%	-2.28 [-2.51 , -2.05]
Hakvoort 2004 (9)	5.7	1.85	48	7	1.85	46	12.8%	-1.30 [-2.05 , -0.55]
Irani 1995 (10)	3.4	0	52	5.8	0	52		Not estimable
Kamilya 2010	6.54	0.91	98	7.72	0.95	99	15.7%	-1.18 [-1.44 , -0.92]
Koh 1994	2.3	0	29	3.3	0	30		Not estimable
Li 2014	3.7	1.5	64	6.8	1.9	64	13.9%	-3.10 [-3.69 , -2.51]
Schiotz 1996 (11)	5	1.71	45	5.6	1.71	46	13.2%	-0.60 [-1.30 , 0.10]
Shahnaz 2016	2.91	0.61	35	3.94	0.59	35	15.6%	-1.03 [-1.31 , -0.75]
Shrestha 2013 (12)	3.42	0	50	4.48	0	50		Not estimable
Sun 2004 (13)	5.3	2	43	7.4	1.4	43	13.0%	-2.10 [-2.83 , -1.37]
Subtotal (95% CI)			**621**			**628**	**100.0%**	**-1.66 [-2.25 , -1.07]**
Heterogeneity: Tau² = 0.56; Chi² = 95.07, df = 6 (P < 0.00001); I² = 94%								
Test for overall effect: Z = 5.51 (P < 0.00001)								
2.22.3 2-day to 7-day policy versus later								
Han 1997	4.1	0	48	7.4	0	53		Not estimable
Irani 1995 (14)	4.9	0	54	7	0	55		Not estimable
Kim 2012	6.6	0.5	30	11.6	2.7	37	100.0%	-5.00 [-5.89 , -4.11]
Tahmin 2011	5	0	40	7.95	0	40		Not estimable
Valero Puerta 1998	3.25	0	55	4.85	0	62		Not estimable
Subtotal (95% CI)			**227**			**247**	**100.0%**	**-5.00 [-5.89 , -4.11]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 11.03 (P < 0.00001)								
Test for subgroup differences: Chi² = 93.38, df = 2 (P < 0.00001), I² = 97.9%								



Footnotes

(1) Catheter removal 6h post-op vs 24h removal post-op
(2) Immediate removal vs Day 1 post-op removal
(3) Catheter removal 2 hours vs 12 hours post-procedure
(4) Participants undergoing elective caesarean section. Immediate vs removal of IUC at 12 hours
(5) Immediate removal policy versus 1 day policy for urinary retention
(6) Catheter removal 4 hours vs 24 hours post-op
(7) Immediate removal vs 1 day post-op
(8) Immediate vs 24 hour catheter removal; abdominal hysterectomy or laparotomy
(9) 1 day versus 5 day policy after anterior colporrhaphy. Standard Deviation (SD) calculated by using the reported p value of 0.001 using Excel file (Reference)
(10) Participants who received TUIP
(11) Participants received retropubic surgery (colposuspension in women). Standard Deviation (SD) calculated by using the reported p value of 0.099 using Excel file (Reference)
(12) 1 day vs 3 day removal
(13) 1 day versus 5 day policy after colposuspension
(14) Participants with TURP

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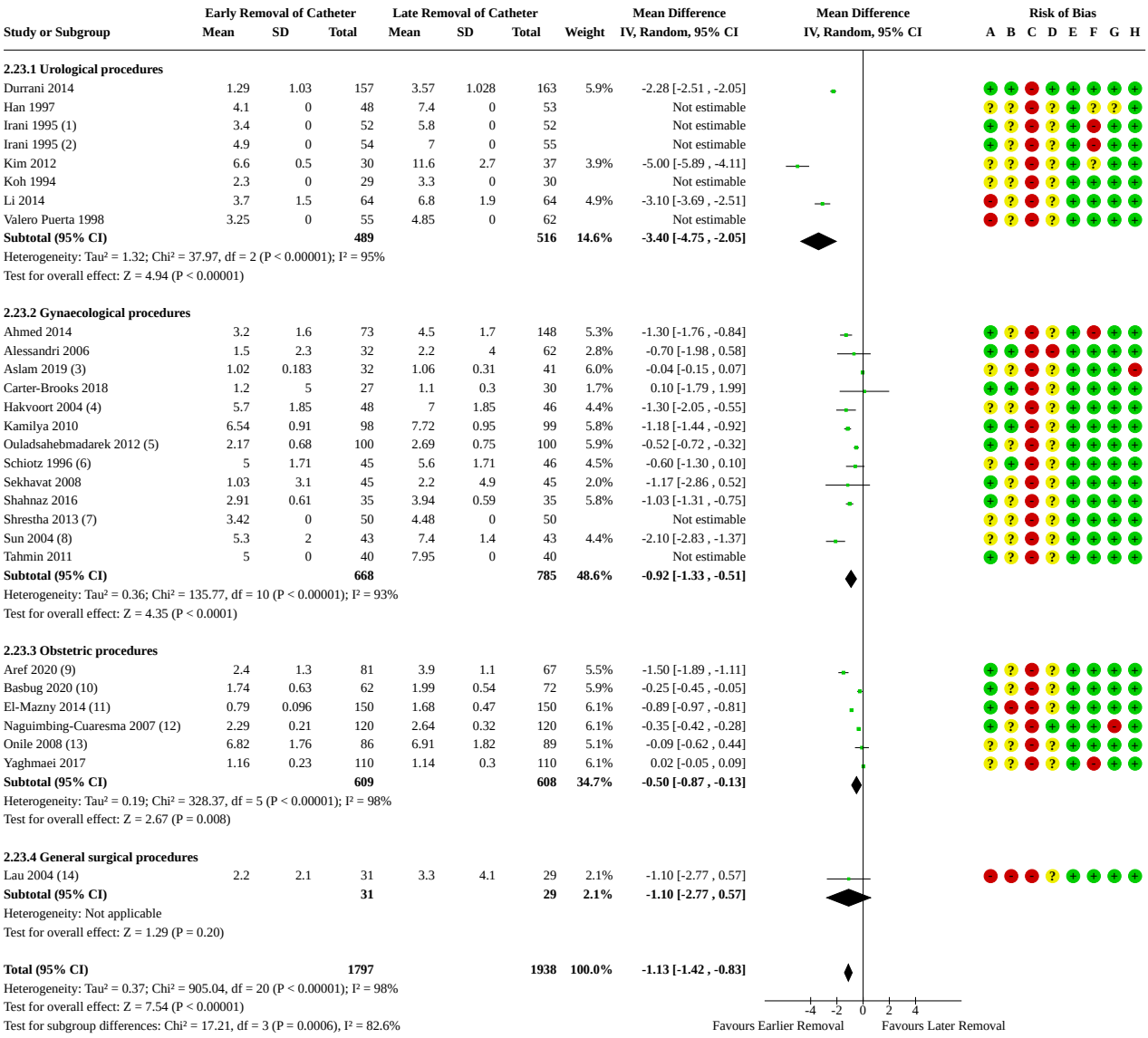
Analysis 2.23. Comparison 2: Shorter versus longer duration of catheter, Outcome 23: Length of hospitalisation in days: subgrouping based on type of surgery



Footnotes

(1) Participants who received TUIP
(2) Participants with TURP
(3) Immediate removal vs Day 1 post-op removal
(4) 1 day versus 5 day policy after anterior colporrhaphy. Standard Deviation (SD) calculated by using the reported p value of 0.001 using Excel file (Reference)
(5) Immediate vs 24 hour catheter removal; abdominal hysterectomy or laparotomy
(6) Participants received retropubic surgery (colposuspension in women). Standard Deviation (SD) calculated by using the reported p value of 0.099 using Excel file (Reference)
(7) 1 day vs 3 day removal
(8) 1 day versus 5 day policy after colposuspension
(9) Catheter removal 6h post-op vs 24h removal post-op
(10) Catheter removal 2 hours vs 12 hours post-procedure
(11) Participants undergoing elective caesarean section. Immediate vs removal of IUC at 12 hours
(12) Catheter removal 4 hours vs 24 hours post-op
(13) Immediate removal vs 1 day post-op
(14) Immediate removal policy versus 1 day policy for urinary retention

Risk of bias legend

(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)

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Analysis 2.23. (Continued)

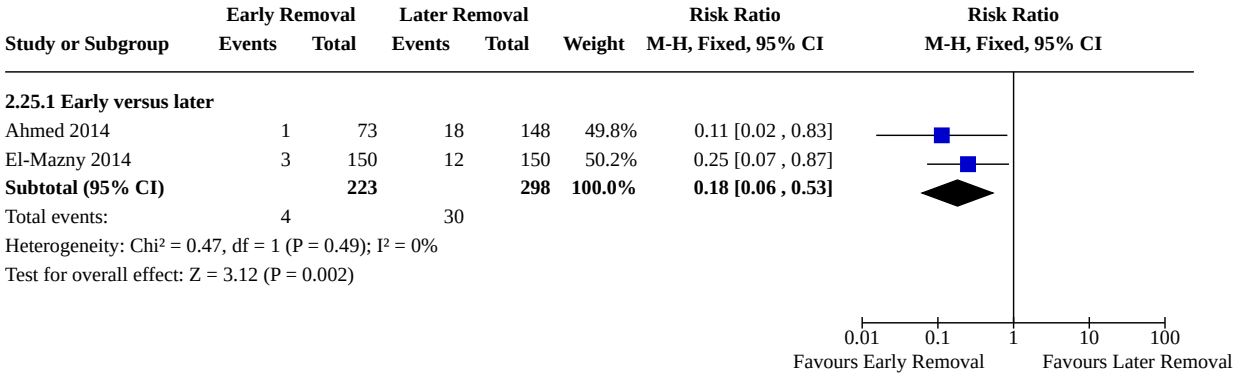
(E) Blinding of microbiological outcome (detection bias)
(F) Incomplete outcome data (attrition bias)
(G) Selective reporting (reporting bias)
(H) Other bias

Analysis 2.24. Comparison 2: Shorter versus longer duration of catheter, Outcome 24: Length of hospitalisation in days (median and range)

Length of hospitalisation in days (median and range)

Study	Early Removal; median and range	Later Removal; median and range
Allen 2016	5 (4-42)	5 (3-24)
Alonzo-Sosa 1997	2 (range not reported)	3 (range not reported)
Lista 2020	4 (3-7)	6 (4-8)
Sandberg 2019	1.5 (0-4)	1 (1-4)
Weemhoff 2011	3 (2-42)	5 (1-59)
Zaouter 2009	7 (5-11)	9 (6-14)

Analysis 2.25. Comparison 2: Shorter versus longer duration of catheter, Outcome 25: Frequency of micturition



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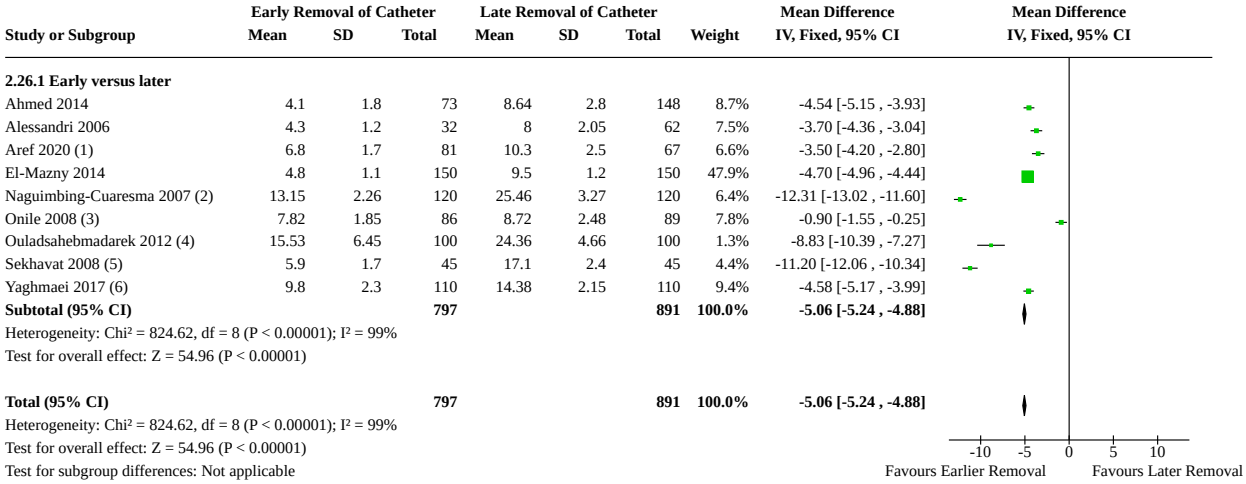
Analysis 2.26. Comparison 2: Shorter versus longer duration of catheter, Outcome 26: Time to first ambulation (hours)



Study or Subgroup	Early Removal of Catheter Mean	SD	Total	Late Removal of Catheter Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
2.26.1 Early versus later								
Ahmed 2014	4.1	1.8	73	8.64	2.8	148	8.7%	-4.54 [-5.15 , -3.93]
Alessandri 2006	4.3	1.2	32	8	2.05	62	7.5%	-3.70 [-4.36 , -3.04]
Aref 2020 (1)	6.8	1.7	81	10.3	2.5	67	6.6%	-3.50 [-4.20 , -2.80]
El-Mazny 2014	4.8	1.1	150	9.5	1.2	150	47.9%	-4.70 [-4.96 , -4.44]
Naguimbing-Cuaresma 2007 (2)	13.15	2.26	120	25.46	3.27	120	6.4%	-12.31 [-13.02 , -11.60]
Onile 2008 (3)	7.82	1.85	86	8.72	2.48	89	7.8%	-0.90 [-1.55 , -0.25]
Ouladsahebmadarek 2012 (4)	15.53	6.45	100	24.36	4.66	100	1.3%	-8.83 [-10.39 , -7.27]
Sekhavat 2008 (5)	5.9	1.7	45	17.1	2.4	45	4.4%	-11.20 [-12.06 , -10.34]
Yaghmaei 2017 (6)	9.8	2.3	110	14.38	2.15	110	9.4%	-4.58 [-5.17 , -3.99]
Subtotal (95% CI)			**797**			**891**	**100.0%**	**-5.06 [-5.24 , -4.88]**
Heterogeneity: Chi² = 824.62, df = 8 (P < 0.00001); I² = 99%								
Test for overall effect: Z = 54.96 (P < 0.00001)								
Total (95% CI)			**797**			**891**	**100.0%**	**-5.06 [-5.24 , -4.88]**
Heterogeneity: Chi² = 824.62, df = 8 (P < 0.00001); I² = 99%								
Test for overall effect: Z = 54.96 (P < 0.00001)								
Test for subgroup differences: Not applicable								

Footnotes

(1) Catheter removal 6h post-op vs 24h removal post-op
(2) Catheter removal 4 hours vs 24 hours post-op
(3) Immediate removal vs 1 day post-op
(4) Immediate vs 24 hour catheter removal
(5) Immediate vs 1 day post-op catheter removal
(6) 6 hour removal vs 12-24 hours removal

Comparison 3. Clamping versus free drainage

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Number needing to be re-catheterised	5	569	Risk Ratio (M-H, Fixed, 95% CI)	0.82 [0.55, 1.21]
3.1.1 Clamping versus removal at 48 hours	2	311	Risk Ratio (M-H, Fixed, 95% CI)	0.94 [0.51, 1.71]
3.1.2 Clamping versus removal at 72 hours or longer	3	258	Risk Ratio (M-H, Fixed, 95% CI)	0.73 [0.44, 1.21]
3.2 Number needing to be re-catheterised: subgroup analysis based on type of surgery and sex	5	569	Risk Ratio (M-H, Fixed, 95% CI)	0.82 [0.55, 1.21]
3.2.1 Gynaecological surgery (women)	2	267	Risk Ratio (M-H, Fixed, 95% CI)	0.92 [0.48, 1.77]
3.2.2 Non-gynaecological surgery (men and women)	3	302	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.47, 1.23]
3.3 Symptomatic catheter-associated urinary tract infection (number of participants)	2	267	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.60, 1.63]
3.3.1 Clamping versus removal at 48 hours	1	198	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.65, 1.95]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.3.2 Clamping versus removal at 72 hours or longer	1	69	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.15, 2.01]
3.4 Incidence of urinary retention (number of participants)	2	169	Risk Ratio (M-H, Fixed, 95% CI)	1.18 [0.69, 2.02]
3.4.1 Clamping versus removal at 24 hours	1	100	Risk Ratio (M-H, Fixed, 95% CI)	0.86 [0.31, 2.37]
3.4.2 Clamping versus removal at 72 hours or longer	1	69	Risk Ratio (M-H, Fixed, 95% CI)	1.39 [0.74, 2.61]
3.5 Dysuria (number of participants)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.5.1 Clamping versus removal at 72 hours or longer	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.6 Volume of first void (mL)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.6.1 Clamping versus removal at 72 hours or longer	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.7 Time to first void (minutes)	2		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.7.1 Clamping versus removal at 24 hours	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.7.2 Clamping versus removal at 72 hours or longer	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.8 Length of hospitalisation (median days)	1		Other data	No numeric data
3.9 Length of hospitalisation (days)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.9.1 Clamping versus removal at 48 hours	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.10 Time required to return to normal bladder function (hours)	1		Other data	No numeric data

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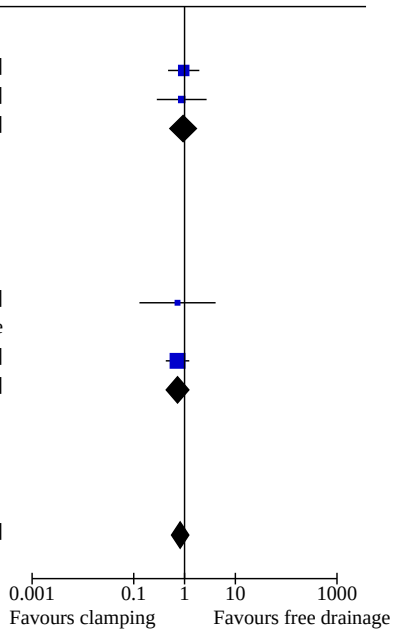
Analysis 3.1. Comparison 3: Clamping versus free drainage, Outcome 1: Number needing to be recatheterised

Study or Subgroup	Clamping Events	Clamping Total	Free Drainage Events	Free Drainage Total	Weight	Risk Ratio M-H, Fixed, 95% CI
3.1.1 Clamping versus removal at 48 hours						
Gong 2017 (1)	10	70	19	128	30.6%	0.96 [0.47 , 1.95]
Nyman 2010 (2)	5	55	6	58	13.3%	0.88 [0.28 , 2.72]
Subtotal (95% CI)		**125**		**186**	**43.9%**	**0.94 [0.51 , 1.71]**
Total events:	15		25			
Heterogeneity: Chi² = 0.02, df = 1 (P = 0.89); I² = 0%						
Test for overall effect: Z = 0.21 (P = 0.83)						
3.1.2 Clamping versus removal at 72 hours or longer						
Guzman 1994 (3)	2	33	3	36	6.5%	0.73 [0.13 , 4.08]
Liu 2015 (4)	0	40	0	39		Not estimable
Oberst 1981 (5)	15	52	23	58	49.5%	0.73 [0.43 , 1.24]
Subtotal (95% CI)		**125**		**133**	**56.1%**	**0.73 [0.44 , 1.21]**
Total events:	17		26			
Heterogeneity: Chi² = 0.00, df = 1 (P = 1.00); I² = 0%						
Test for overall effect: Z = 1.22 (P = 0.22)						
Total (95% CI)		**250**		**319**	**100.0%**	**0.82 [0.55 , 1.21]**
Total events:	32		51			
Heterogeneity: Chi² = 0.42, df = 3 (P = 0.94); I² = 0%						
Test for overall effect: Z = 1.00 (P = 0.32)						
Test for subgroup differences: Chi² = 0.40, df = 1 (P = 0.53), I² = 0%						



Footnotes

(1) Catheter intermittently clamped and removed after 48 hours vs Catheterisation for 48 hours
(2) Catheter clamped and removed at 6am on POD 2 vs free drainage removal at 6am on POD 2
(3) Clamping and removal of IUC at 72 hours vs Removal of IUC at 72 hours
(4) Clamping of Indwelling urethral catheter vs Free-drainage of indwelling urethral catheter
(5) Clamping of IUC in patients undergoing abdominoperinoeal resection (APR) and lower anterior resection (LAR) vs Straight drainage in patients underg

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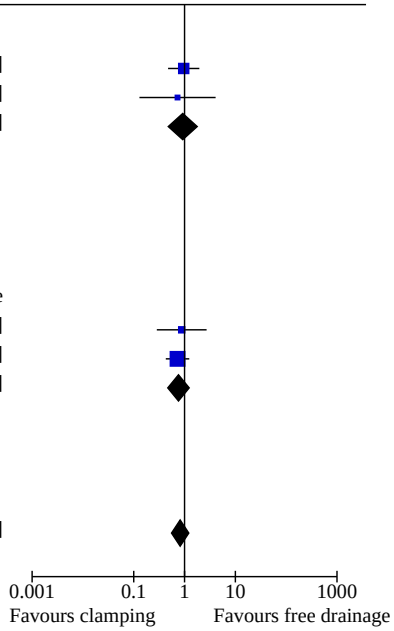
Analysis 3.2. Comparison 3: Clamping versus free drainage, Outcome 2: Number needing to be recatheterised: subgroup analysis based on type of surgery and sex

Study or Subgroup	Clamping Events	Clamping Total	Free Drainage Events	Free Drainage Total	Weight	Risk Ratio M-H, Fixed, 95% CI
3.2.1 Gynaecological surgery (women)						
Gong 2017 (1)	10	70	19	128	30.6%	0.96 [0.47 , 1.95]
Guzman 1994 (2)	2	33	3	36	6.5%	0.73 [0.13 , 4.08]
Subtotal (95% CI)		**103**		**164**	**37.1%**	**0.92 [0.48 , 1.77]**
Total events:	12		22			
Heterogeneity: Chi² = 0.09, df = 1 (P = 0.77); I² = 0%						
Test for overall effect: Z = 0.25 (P = 0.81)						
3.2.2 Non-gynaecological surgery (men and women)						
Liu 2015 (3)	0	40	0	39		Not estimable
Nyman 2010 (4)	5	55	6	58	13.3%	0.88 [0.28 , 2.72]
Oberst 1981 (5)	15	52	23	58	49.5%	0.73 [0.43 , 1.24]
Subtotal (95% CI)		**147**		**155**	**62.9%**	**0.76 [0.47 , 1.23]**
Total events:	20		29			
Heterogeneity: Chi² = 0.09, df = 1 (P = 0.76); I² = 0%						
Test for overall effect: Z = 1.11 (P = 0.27)						
Total (95% CI)		**250**		**319**	**100.0%**	**0.82 [0.55 , 1.21]**
Total events:	32		51			
Heterogeneity: Chi² = 0.42, df = 3 (P = 0.94); I² = 0%						
Test for overall effect: Z = 1.00 (P = 0.32)						
Test for subgroup differences: Chi² = 0.22, df = 1 (P = 0.64), I² = 0%						



Footnotes

(1) Catheter intermittently clamped and removed after 48 hours vs Catheterisation for 48 hours
(2) Clamping and removal of IUC at 72 hours vs Removal of IUC at 72 hours
(3) Clamping of Indwelling urethral catheter vs Free-drainage of indwelling urethral catheter
(4) Catheter clamped and removed at 6am on POD 2 vs free drainage removal at 6am on POD 2
(5) Clamping of IUC in patients undergoing abdominoperinoeal resection (APR) and lower anterior resection (LAR) vs Straight drainage in patients underg

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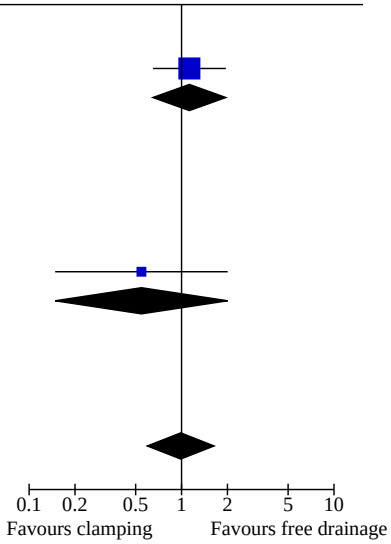
Analysis 3.3. Comparison 3: Clamping versus free drainage, Outcome 3: Symptomatic catheter-associated urinary tract infection (number of participants)

Study or Subgroup	Clamping Events	Clamping Total	Free Drainage Events	Free Drainage Total	Weight	Risk Ratio M-H, Fixed, 95% CI
3.3.1 Clamping versus removal at 48 hours						
Gong 2017 (1)	16	70	26	128	76.2%	1.13 [0.65 , 1.95]
Subtotal (95% CI)		**70**		**128**	**76.2%**	**1.13 [0.65 , 1.95]**
Total events:	16		26			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.42 (P = 0.67)						
3.3.2 Clamping versus removal at 72 hours or longer						
Guzman 1994 (2)	3	33	6	36	23.8%	0.55 [0.15 , 2.01]
Subtotal (95% CI)		**33**		**36**	**23.8%**	**0.55 [0.15 , 2.01]**
Total events:	3		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.91 (P = 0.36)						
Total (95% CI)		**103**		**164**	**100.0%**	**0.99 [0.60 , 1.63]**
Total events:	19		32			
Heterogeneity: Chi² = 1.01, df = 1 (P = 0.31); I² = 1%						
Test for overall effect: Z = 0.05 (P = 0.96)						
Test for subgroup differences: Chi² = 1.01, df = 1 (P = 0.32), I² = 0.7%						



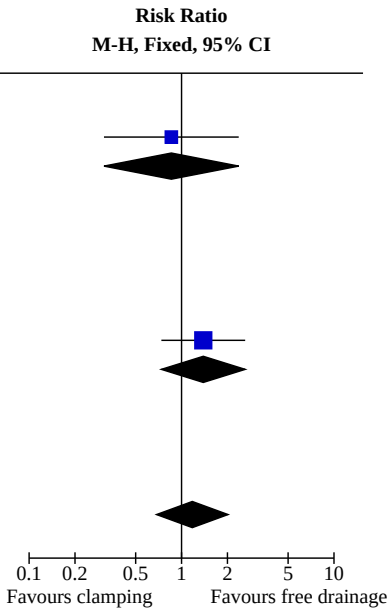
Footnotes

(1) Catheter intermittently clamped and removed after 48 hours vs Catheterisation for 48 hours, antibiotic prophylaxis not reported

(2) Clamping of IUC with removal at 72 hours vs Removal of IUC at 72 hours (no clamping), participants received Quemicentina as antibiotic prophylaxis

Analysis 3.4. Comparison 3: Clamping versus free drainage, Outcome 4: Incidence of urinary retention (number of participants)

Study or Subgroup	Clamping Events	Clamping Total	Free Drainage Events	Free Drainage Total	Weight	Risk Ratio M-H, Fixed, 95% CI
3.4.1 Clamping versus removal at 24 hours						
Wu 2015	6	50	7	50	40.0%	0.86 [0.31 , 2.37]
Subtotal (95% CI)		**50**		**50**	**40.0%**	**0.86 [0.31 , 2.37]**
Total events:	6		7			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.30 (P = 0.77)						
3.4.2 Clamping versus removal at 72 hours or longer						
Guzman 1994 (1)	14	33	11	36	60.0%	1.39 [0.74 , 2.61]
Subtotal (95% CI)		**33**		**36**	**60.0%**	**1.39 [0.74 , 2.61]**
Total events:	14		11			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**83**		**86**	**100.0%**	**1.18 [0.69 , 2.02]**
Total events:	20		18			
Heterogeneity: Chi² = 0.64, df = 1 (P = 0.43); I² = 0%						
Test for overall effect: Z = 0.59 (P = 0.56)						
Test for subgroup differences: Chi² = 0.62, df = 1 (P = 0.43), I² = 0%						



Footnotes

(1) Clamping of IUC with removal at 72 hours vs Removal of IUC at 72 hours (no clamping)

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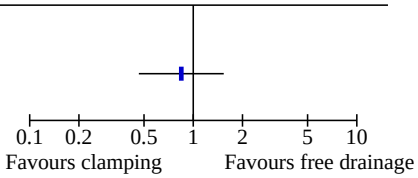
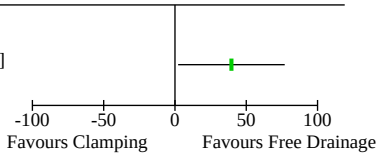
Analysis 3.5. Comparison 3: Clamping versus free drainage, Outcome 5: Dysuria (number of participants)

Study or Subgroup	Clamping Events	Clamping Total	Free Drainage Events	Free Drainage Total	Risk Ratio M-H, Fixed, 95% CI
3.5.1 Clamping versus removal at 72 hours or longer					
Liu 2015	13	40	15	39	0.84 [0.46 , 1.54]



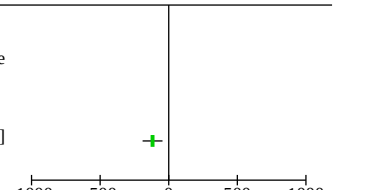
Analysis 3.6. Comparison 3: Clamping versus free drainage, Outcome 6: Volume of first void (mL)

Study or Subgroup	Clamping Mean	Clamping SD	Clamping Total	Free Drainage Mean	Free Drainage SD	Free Drainage Total	Mean Difference IV, Fixed, 95% CI
3.6.1 Clamping versus removal at 72 hours or longer							
Liu 2015	264.5	65	40	224.9	100.3	39	39.60 [2.23 , 76.97]



Analysis 3.7. Comparison 3: Clamping versus free drainage, Outcome 7: Time to first void (minutes)

Study or Subgroup	Clamping Mean	Clamping SD	Clamping Total	Free Drainage Mean	Free Drainage SD	Free Drainage Total	Mean Difference IV, Fixed, 95% CI
3.7.1 Clamping versus removal at 24 hours							
Williamson 1982 (1)	115.2	0	4	165	0	4	Not estimable
3.7.2 Clamping versus removal at 72 hours or longer							
Oberst 1981 (1)	207	184	44	325	168	47	-118.00 [-190.54 , -45.46]



Footnotes

(1) Clamping of Indwelling urethral catheter vs free drainage of urethral catheter

Analysis 3.8. Comparison 3: Clamping versus free drainage, Outcome 8: Length of hospitalisation (median days)

Length of hospitalisation (median days)

Study	Catheter Removal at 72 hours without bladder re-training (median)	Catheter Removal at 72 hours with bladder re-training i.e. clamping (median)
Guzman 1994	6.9	6.9

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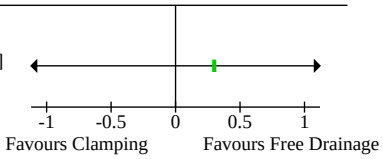
Analysis 3.9. Comparison 3: Clamping versus free drainage, Outcome 9: Length of hospitalisation (days)

Study or Subgroup	Clamping Mean	Clamping SD	Clamping Total	Free Drainage Mean	Free Drainage SD	Free Drainage Total	Mean Difference IV, Fixed, 95% CI
3.9.1 Clamping versus removal at 48 hours							
Nyman 2010	10.9	6.2	55	10.6	6.5	58	0.30 [-2.04 , 2.64]



Analysis 3.10. Comparison 3: Clamping versus free drainage, Outcome 10: Time required to return to normal bladder function (hours)

Time required to return to normal bladder function (hours)

Study	Clamping	Free Drainage
Nyman 2010	6 (4-8); median (quartiles)	4 (3-7.25); median (quartiles)

Comparison 4. Prophylactic use of alpha blocker versus no drug or intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.1 Number of participants needing to be recatheterised	2	184	Risk Ratio (M-H, Fixed, 95% CI)	1.18 [0.58, 2.42]
4.2 Symptomatic catheter-associated urinary tract infection (number of participants)	1	94	Risk Ratio (M-H, Fixed, 95% CI)	0.20 [0.01, 4.06]
4.3 Incidence of urinary retention (number of participants)	2	308	Risk Ratio (M-H, Fixed, 95% CI)	0.38 [0.20, 0.73]
4.4 Post-void residual volume	2	301	Mean Difference (IV, Fixed, 95% CI)	-2.00 [-11.42, 7.42]
4.5 Length of hospitalisation in days	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4.6 Length of hospitalisation in days (median, range, N)	1		Other data	No numeric data

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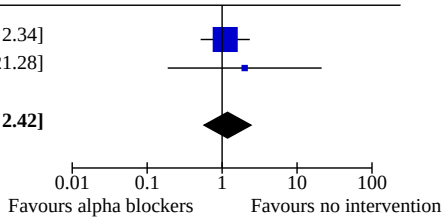
Analysis 4.1. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 1: Number of participants needing to be recatheterised

Study or Subgroup	Alpha Blocker Events	Alpha Blocker Total	No Intervention Events	No Intervention Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jang 2012 (1)	11	47	10	47	90.9%	1.10 [0.52 , 2.34]
Jun 2011	2	45	1	45	9.1%	2.00 [0.19 , 21.28]
Total (95% CI)		**92**		**92**	**100.0%**	**1.18 [0.58 , 2.42]**
Total events:	13		11			

Heterogeneity: Chi² = 0.22, df = 1 (P = 0.64); I² = 0%
Test for overall effect: Z = 0.46 (P = 0.65)
Test for subgroup differences: Not applicable

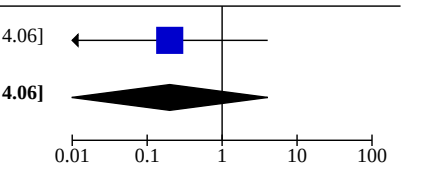


Footnotes
(1) Number requiring re-catheterisation on POD 3

Analysis 4.2. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 2: Symptomatic catheter-associated urinary tract infection (number of participants)

Study or Subgroup	Alpha Blocker Events	Alpha Blocker Total	No Intervention Events	No Intervention Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jang 2012	0	47	2	47	100.0%	0.20 [0.01 , 4.06]
Total (95% CI)		**47**		**47**	**100.0%**	**0.20 [0.01 , 4.06]**
Total events:	0		2			

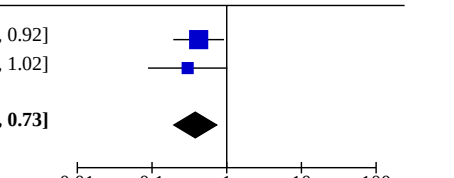
Heterogeneity: Not applicable
Test for overall effect: Z = 1.05 (P = 0.29)
Test for subgroup differences: Not applicable



Analysis 4.3. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 3: Incidence of urinary retention (number of participants)

Study or Subgroup	Alpha Blocker Events	Alpha Blocker Total	No Intervention Events	No Intervention Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jeong 2014 (1)	8	109	19	109	65.5%	0.42 [0.19 , 0.92]
Jun 2011	3	45	10	45	34.5%	0.30 [0.09 , 1.02]
Total (95% CI)		**154**		**154**	**100.0%**	**0.38 [0.20 , 0.73]**
Total events:	11		29			

Heterogeneity: Chi² = 0.21, df = 1 (P = 0.65); I² = 0%
Test for overall effect: Z = 2.89 (P = 0.004)
Test for subgroup differences: Not applicable



Footnotes
(1) Participants reported with AUR on POD 5 (defined as painful palpable or percussible bladder with the patient unable to pass any urine)

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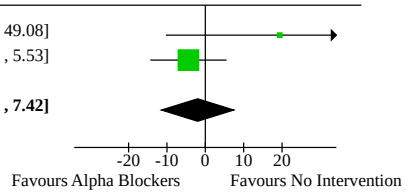
Analysis 4.4. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 4: Post-void residual volume

Study or Subgroup	Alpha Blocker Mean	SD	Total	No Intervention Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Jang 2012 (1)	53	84.8	47	33.6	59.9	47	10.1%	19.40 [-10.28 , 49.08]
Jeong 2014 (2)	22.7	29.1	105	27.1	42.4	102	89.9%	-4.40 [-14.33 , 5.53]
Total (95% CI)			**152**			**149**	**100.0%**	**-2.00 [-11.42 , 7.42]**

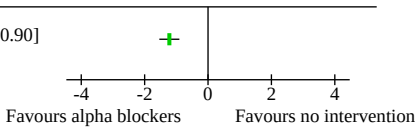
Heterogeneity: Chi² = 2.22, df = 1 (P = 0.14); I² = 55%
Test for overall effect: Z = 0.42 (P = 0.68)
Test for subgroup differences: Not applicable



Footnotes
(1) Post-Void residual on POD 7
(2) Post-void residual 2 weeks after surgery

Analysis 4.5. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 5: Length of hospitalisation in days

Study or Subgroup	Alpha Blocker Mean	SD	Total	No Intervention Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
Jun 2011	3.51	0.78	45	4.73	0.75	45	-1.22 [-1.54 , -0.90]



Analysis 4.6. Comparison 4: Prophylactic use of alpha blocker versus no drug or intervention, Outcome 6: Length of hospitalisation in days (median, range, N)

Length of hospitalisation in days (median, range, N)

Study	Alpha Blocker	No Intervention
Jang 2012	9, (7.0-12.0), 47	9, (8.0-11.0), 47

ADDITIONAL TABLES

Table 1. Types of participants

Trial ID	Reason for hospitalisation	Type of surgery/reason for being admitted	Gender
Ahmed 2014	Elective gynaecological surgery	Total abdominal hysterectomy with or without bilateral salpingo-oophorectomy	Female
Alessandri 2006	Elective gynaecological surgery	Vaginal hysterectomy	Female
Allen 2016	Patients undergoing cardiothoracic surgery	General thoracic surgical procedure, in whom an epidural catheter was placed for analgesia	Mixed
Alonzo-Sosa 1997	Elective gynaecological surgery	Anterior colporrhapy, anterior and posterior colporrhaphy with or without vaginal hysterectomy	Female
Aref 2020	Elective CS	Participants admitted for elective CS	Female

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Table 1. Types of participants *(Continued)*

Aslam 2019	Elective gynaecological surgery	Participants undergoing minimally invasive pelvic organ prolapse surgery	Female
Azarkish 2003	Elective CS	Participants admitted for elective CS	Female
Azarkish 2005	Emergency CS	Participants admitted for emergency CS	Female
Barone 2015	Elective gynaecological surgery	Participants admitted for vaginal fistula repair	Female
Basbug 2020	Elective CS	Participants admitted for elective CS	Female
Benoist 1999	Elective GI surgery	Extensive rectal resection (total or subtotal proctectomy)	Mixed
Bristoll 1989	Not reported	Not reported	Unknown
Carpiniello 1988	Elective orthopaedic surgery	Total joint replacement (hip or knee)	Female
Carter-Brooks 2018	Elective gynaecological surgery	Participants undergoing pelvic organ prolapse surgery	Female
Chai 2011	Elective gynaecological surgery	Total abdominal hysterectomy with or bilateral salpingo-oophorectomy for various benign gynaecological diseases	Female
Chen 2013	Admitted to ICU	Patients requiring mechanical ventilation for respiratory failure	Mixed
Chia 2009	Elective cardiothoracic surgery	Thoracotomy	Mixed
Chillington 1992	Elective urological surgery	TURP	Male
Cornia 2003	Admitted to medicine and cardiology services	Patients admitted to the medicine and cardiology services	Mixed
Coyle 2015	Elective GI surgery	Elective transabdominal colectomy, proctectomy or coloproctectomy	Mixed
Crowe 1993	Admitted to urology ward	Patients admitted to the urology ward with IUCs or who were catheterised during their inpatient stay	Mixed
Dunn 1999	Elective obstetric and gynaecological surgery	Patients undergoing elective obstetric or gynaecological surgery	Female
Dunn 2000b	Elective gynaecological surgery or CS	Patients undergoing hysterectomy or CS who do not require bladder suspension or strict fluid management	Female
Dunn 2003	Elective gynaecological surgery	Women undergoing hysterectomy for various benign diseases (e.g. fibroid tumours, abnormal uterine bleeding, chronic pain, and persistent cervical dysplasia or micro invasive cancer	Female
Durrani 2014	Elective urological surgery	Patients with bladder outflow obstruction due to benign prostatic enlargement undergoing TURP	Male

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Table 1. Types of participants *(Continued)*

El-Mazny 2014	Primary or elective CS	Patients admitted to the prenatal wards for primary or repeat elective CS	Female
Ganta 2005	Elective urological surgery	TURP	Male
Glavind 2007	Elective gynaecological surgery	Patients undergoing any type of vaginal prolapse surgery	Female
Gong 2017	Elective gynaecological surgery	Patients undergoing radical hysterectomy for cervical cancer FIGO stage IB-IIB	Female
Gross 2007	Admitted to stroke ward	Patients with a stroke admitted to the ward	Mixed
Gungor 2014	Elective gynaecological surgery	Patients with pelvic organ prolapse and/or urinary incontinence undergoing anterior colporrhaphy	Female
Guzman 1994	Elective gynaecological surgery	Patients undergoing vaginal surgery	Female
Hakvoort 2004	Elective gynaecological surgery	Patients undergoing anterior colporrhaphy for vaginal prolapse surgery	Female
Hall 1998	Elective general surgery	Patients admitted to the general surgery wards	Mixed
Han 1997	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Hewitt 2001	Elective urological surgery	Patients requiring radical perineal prostatectomy	Male
Huang 2011	Elective gynaecological surgery	Patients with cystocele of at least stage II, who were symptomatic and desired operative treatment with anterior vaginal repair with or without other concomitant pelvic surgeries	Female
Ind 1993	Elective hysterectomy, posterior exenteration, colposuspension, anterior colporrhaphy, total/radical vulvectomy, radical oophorectomy, ovarian cystectomy, adhesiolysis myomectomy	Patients which were admitted for any of the following operations: hysterectomy, posterior exenteration, colposuspension, anterior colporrhaphy, total/radical vulvectomy, radical oophorectomy, ovarian cystectomy, adhesiolysis myomectomy	Female
Irani 1995	Elective transurethral prostatic surgery	Patients admitted for transurethral prostatic surgery due to benign hyperplasia	Male
Iversen Hansen 1984	Urethral strictures	Patients with urethral strictures	Not reported
Jang 2012	Surgery for rectal cancer	Patients undergoing elective rectal surgery for cancer	Mixed
Jeong 2014	Robot-assisted laparoscopic radical prostatectomy	Patients with localised or advanced prostate cancer	Men
Joshi 2014	Elective hysterectomy with salpingo-oophorectomy	Patients undergoing uneventful hysterectomy with salpingo-oophorectomy	Female
Jun 2011	Elective TURP	Patients admitted for TURP	Male

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Table 1. Types of participants *(Continued)*

Kamilya 2010	Vaginal prolapse surgery	Patients undergoing vaginal prolapse surgery	Female
Kelleher 2002	Urological surgery	Patients admitted to urology or renal unit	Not reported
Kim 2012	Radical prostatectomy	Patients undergoing extraperitoneal laparoscopic radical prostatectomy	Men
Koh 1994	Elective TURP	Patients admitted for TURP	Men
Kokabi 2009	Anterior colporrhaphy for pelvic organ prolapse	Patients undergoing anterior colporrhaphy due to pelvic organ prolapse and stress incontinence	Female
Lang 2020	Elective gynaecological surgery	Patients admitted for elective benign gynaecological surgery	Female
Lau 2004	Elective general surgery	Patients admitted for elective general surgery	Mixed
Li 2014	Elective TURP	Patients admitted for TURP	Men
Liang 2009	Laparoscopic vaginal hysterectomy	Patients admitted for laparoscopic vaginal hysterectomy	Female
Lista 2020	Elective urological surgery	Patients admitted for robot-assisted radical prostatectomy for localised prostate cancer	Male
Liu 2015	Neurosurgery	Patients undergoing neurosurgery	Mixed
Lyth 1997	TURP or bladder neck incision	Patients undergoing TURP or bladder neck incision	Unclear
Mao 1994	Elective gynaecological surgery	Patients undergoing surgery for total hysterectomy or salpingo-oophorectomy	Female
Matsushima 2015	Surgery for prostate cancer removal (unclear what operation was done)	Patients with prostate cancer	Male
McDonald 1999	TURP	Patients undergoing TURP	Male
Naguimbing-Cuaresma 2007	Elective CS	Participants admitted for elective CS	Female
Nathan 2001	Elective gynaecological surgery	Patients undergoing surgery for benign gynaecological conditions	Female
Nguyen 2012	Elective urological surgery for urethral strictures	Patients undergoing surgery for urethral strictures	Unclear
Nielson 1985	Elective urological surgery for urethral strictures	Patients undergoing surgery for urethral strictures	Unclear
Noble 1990	Elective urological surgery and procedures	Patients admitted to the urological unit	Mixed
Nyman 2010	Orthopaedic surgery	Patients admitted with hip fractures in need of surgery	Mixed

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Table 1. Types of participants *(Continued)*

Oberst 1981	Elective general surgery	Patients undergoing surgery for bowel cancer; low anterior bowel resection or abdominoperineal resection	Mixed
Onile 2008	Elective CS	Patients admitted for elective CS	Female
Ouladsahebmadarek 2012	Elective gynaecological surgery	Patienst admitted for elective abdominal hysterectomy or laparotomy for being pathology (fibroma, AUB, chronic pelvic pain, ovarian cysts etc.)	Female
Pervaiz 2019	Elective urological surgery	Patients undergoing TURP	Male
Popiel 2017	Elective gynaecological surgery	Patients undergoing robotic sacrocolpopexy for vaginal prolapse	Female
Rajan 2017	Elective gynaecological surgery	Patients undergoing surgery for Ward Mayo operation; Manchester repair; vaginal hysterectomy and amputation of cervix	Female
Ruminjo 2015	Elective gynaecological surgery	Patients undergoing fistula repair surgery	Female
Sahin 2011	Elective urological surgery	Patients admitted for TURP due to benign prostate hypertrophy	Male
Sandberg 2019	Elective gynaecological surgery	Patients undergoing laparoscopic hysterectomy	Female
Schiotz 1995	Elective gynaecological surgery	Patients admitted for vaginal plastic surgery (anterior colporrhaphy, anterior plus posterior colporrhaphy or a full Manchester repair)	Female
Schiotz 1996	Elective urogynaecological surgery	Patients admitted for elective retro-pubic surgery for stress incontinence	Female
Sekhavat 2008	Elective gynaecological surgery	Patients undergoing anterior colporrhaphy	Female
Shahnaz 2016	Elective gynaecological surgery	Patients undergoing surgery for pelvic organ prolapse	Female
Shrestha 2013	Elective gynaecological surgery	Patients admitted for vaginal hysterectomy, anterior colporrhaphy or Manchester operations	Female
Souto 2004	Elective urological surgery	Patients admitted for retropubic radical prostatectomy	Male
Sun 2004	Elective urogynaecological surgery	Patients admitted for Burch's colposuspension	Female
Tahmin 2011	Elective gynaecological surgery	Patients with genital prolapses admitted for vaginal hysterectomy and or pelvic floor repair	Female
Talreja 2016	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Taube 1989	AUR	Patients admitted to the hospital with AUR	Male

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Table 1. Types of participants *(Continued)*

Toscano 2001	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Valero Puerta 1998	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Vallabh-Patel 2020	Elective gynaecological surgery	Patients undergoing robotic sacrocolpopexy for pelvic organ prolapse	Female
Webster 2006	General surgery and medical patients	Patients who required IUC on general surgery and medical wards	Mixed
Weemhoff 2011	Elective gynaecological surgery	Patients admitted for anterior colporrhaphy	Female
Williamson 1982	Elective surgery (unspecific)	Patients undergoing surgery (not specified by trial)	Female
Wilson 2000	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Wu 2015	Elective gallbladder or biliary tree surgery	Pateints undergoing gallbladder or biliary tree surgery	Mixed
Wyman 1987	Elective urological surgery	Patients with benign prostatic enlargement undergoing TURP	Male
Yaghmaei 2017	Elective CS	Patients who underwent CS	Female
Yee 2015	Elective CS	Patients who underwent CS under spinal anaesthesia	Female
Zaouter 2009	Elective major abdominal and thoracic surgery	Patients admitted for elective major abdominal and thoracic surgery	Mixed
Zhou 2012	Elective CS	Patients who underwent CS	Female
Zmora 2010	Elective colon and rectal surgery with pelvic dissection	Patients admitted for elective colon and rectal surgery	Mixed
Zomorrodi 2018	Elective renal transplant surgery	Patients with end-stage renal failure undergoing renal transplant surgery	Mixed

AUB: abnormal uterine bleeding; **AUR:** acute urinary retention; **CS:** cesarean section; **GI:** gastrointestinal; **FIGO:** International Federation of Gynecology and Obstetrics; **ICU:** intensive care unit; **IUC:** indwelling urethral catheter; **TURP:** transurethral resection of the prostate

Table 2. Interventions and age of participants

Trial**ID**	**InterventionA**	**Intervention B**	**Age (A), years** **Mean (SD)**	**Age (B), years** **Mean (SD)**	**Age (overall), years**
Ahmed 2014	IUC removal immediately post-op	IUC removal 24 h post-op	59.1(8.3)	61.3 (10.5)	Not reported
Alessandri 2006	IUC removal immediately post-op	IUC removal 12 h post-op	51 (4.3)	47 (5)	Not reported

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Table 2. Interventions and age of participants *(Continued)*

Allen 2016	IUC removed within 48 h post-op	IUC removed within 6 h after epidural removal	61.1 (range 31–85)	61.7 (range 21–87)	61.5 (range 21-87)
Alonzo-Sosa 1997	IUC removal 1 day post-op	IUC removal 3 days post-op	53.5 (range 37-63)	47.1 (range 37-67)	Not reported
Aref 2020	IUC removal 6 h post-op	IUC removal 24 h post-op	25.3 (2)	25.6 (3)	Not reported
Aslam 2019	IUC removal immediately post-op	IUC removal 1-day post-op	Not reported	Not reported	Not reported
Azarkish 2003	IUC removal 2-3 h after surgery	IUC removal the morning after surgery	24.96 (4.88)	27.06 (5.56)	Not reported
Azarkish 2005	IUC removal 2-3 h after surgery	IUC removal 24 h after surgery	Not reported	Not reported	Not reported
Barone 2015	IUC removal 7 days after surgery	IUC removal 14 days after surgery	31.9 (11.5)	30.6 (11.7)	Not reported
Basbug 2020	IUC removal 2 h after surgery	IUC removal 12 h after surgery	30.13 (5.83)	29.96 (4.71)	Not reported
Benoist 1999	IUC removal 1 day post-op	IUC removal 5 days post-op	55 (18)	56 (17)	Not reported
Bristoll 1989	threshold clamping	complete drainage	Not reported	Not reported	Not reported
Carpiniello 1988	IUC removal immediately post-op	IUC removal 1-day post-op	73 (6.6)	70 (8.6)	Not reported
Carter-Brooks 2018	IUC removal 4 h after surgery	IUC removal 6 am on post-op day 1	64.9 (11.5)	65.2 (10.3)	Not reported
Chai 2011	IUC removal immediately post-op	IUC removal 1 day post-op	46.4 (3.9)	46.4 (4.0)	Not reported
Chen 2013	IUC removal ≤ 7 days	IUC removal > 7 days	77 (12.7)	78 (10.5)	Not reported
Chia 2009	IUC removal 1 day post-op	IUC removal 3 days post-op	54.7 (11.2)	55.7 (10.3)	Not reported
Chillington 1992	IUC removal at midnight	IUC removal at 6 am the next morning	Not reported	Not reported	Not reported
Cornia 2003	A computer study order was used to remind staff to remove the IUC after 3 days	A computer study order was not used to remind staff to remove the IUC after 3 days	Not reported	Not reported	Not reported
Coyle 2015	IUC removal 2 days post-op	IUC removal within 12 h of withdrawal of epidural anaesthesia	63.5 (SD not reported)	62 (SD not reported)	Not reported
Crowe 1993	IUC removal at 6 am	IUC removal at midnight	Not reported	Not reported	Not reported
Dunn 1999	IUC removal immediately post-op	Delayed IUC removal post-op	Not reported	Not reported	Not reported

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Table 2. Interventions and age of participants *(Continued)*

Dunn 2000b	IUC removal immediately post-op	IUC removal 1 day post-op	Not reported	Not reported	Not reported
Dunn 2003	IUC removal immediately post-op	IUC removal 1 day post-op	Not reported	Not reported	Not reported
Durrani 2014	IUC removal 1 day post-op	IUC removal 4 or 5 days post-op	Not reported	Not reported	71.32 (5.94)
El-Mazny 2014	IUC removal immediately post-op	IUC removal 12 h post-op	24.5 (4.2)	23.8 (3.9)	Not Reported
Ganta 2005	IUC removal at midnight	IUC removal at 6 am	69.9 (SD not reported)	68.2 (SD not reported)	68.9 (SD not reported)
Glavind 2007	IUC removal 3 h post-op	IUC removal the next morning	Not reported	Not reported	61 (range 31-88)
Gong 2017	IUC for 48 h with intermittent clamping	IUC for 48 h without intermittent clamping	46.14 (8.33)	45.70 (9.63)	Not Reported
Gross 2007	IUC removal at 10 pm the day the order for removal was written	IUC removal at 7 am the day after the order for removal was written	Not reported	Not reported	70.3 (11.7)
Gungor 2014	IUC removal 2 days post-op	IUC removal 3 or 4 days post-op	55.7 (8.8)	3 days: 58.5 (10.1) 4 days: 55.8 (9.0)	Not reported
Guzman 1994	IUC removal 1 day post-op	IUC removal 3 days post-op (with and without bladder-clamping)	56 (range 40-75)	No clamping: 58 (range 8-79) Clamping: 57 (range 36-75)	Not reported
Hakvoort 2004	IUC removal on the morning after surgery	IUC removal 5 days post-op	67 (range 36 - 86)	66 (range 33-87)	Not reported
Hall 1998	IUC removal between 7 am and 9 am	IUC removal between 9 pm and 11 pm	Not reported	Not reported	Not reported
Han 1997	IUC removal 2 days post-op	IUC removal ≥ 3 days post-op	64.6 (range 50-86)	68.2 (range 50-90)	Not reported
Hewitt 2001	IUC removal 4-6 days post-op	IUC removal at 14 days post-op	Not reported	Not reported	Not reported
Huang 2011	IUC removal 2 days post-op	IUC removal 3 or 4 days post-op	61.21, (10.17)	3 days: 63.93 (10.43) 4 days: 63.7 (12.5)	62.9 (10.93)
Ind 1993	IUC removal at 6 am	IUC removal at midnight	49.59 (14.2)	49.84 (16.6)	Not reported

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Table 2. Interventions and age of participants *(Continued)*

Irani 1995	IUC removal within 48 h	IUC removal at surgeon's discretion	70.7 (range 42-88)	70 (range 58-85)	Not reported
Iversen Hansen 1984	IUC removal 1 day post-op	IUC removal 14 days post-op	Not reported	Not reported	70 (range 24-85)
Jang 2012	No alpha blockers given	Prophylactic alpha blockers given	54 (range 48-62)	59 (range 54-66)	Not reported
Jeong 2014	Prophylactic alpha blockers given	No alpha blockers given	63.6 (6.6)	63.4 (8)	Not reported
Joshi 2014	IUC removal immediately post-op	IUC removal 1 day post-op	46.8 (6.9)	45.09 (6.44)	Not reported
Jun 2011	Prophylactic alpha blockers given	No alpha blockers given	68.71 (7.6)	71.4 (7.85)	Not reported
Kamilya 2010	IUC removal 1 day post-op	IUC removal 4 days post-op	46.9 (12.02)	47.9 (12.78)	Not reported
Kelleher 2002	IUC removal at 6 am	IUC removal at midnight	Not reported	Not reported	Not reported
Kim 2012	IUC removal on post-op day 3/4	IUC removal on post-op day 7/8	Not reported	Not reported	Not reported
Koh 1994	IUC removal 1 day post-op	IUC removal 2 days post-op	68.8, 7.3 (mean, SD)	73, 7.6 (mean, SD)	Not reported
Kokabi 2009	IUC removal 1 day post-op	IUC removal 2 days post-op OR 4 days post-op (3-arm trial)	Not reported	Not reported	Not reported
Lang 2020	IUC removal 4 h post-op	IUC removal day 1 post-op	Not reported	Not reported	44.4 (8.8)
Lau 2004	"In out" catheterisation	IUC overnight	Not reported	Not reported	63.3 (4.9)
Li 2014	IUC removal on day 1-2 post-op	IUC removal on day 5-7 post-op	Not reported	Not reported	Range 56 - 92
Liang 2009	IUC removal immediately	IUC removal 1 day post-op OR 2 days post-op (3-arm trial)	43.7 (3.9)	B) 45.7 (3.5) C) 45.7 (5.8)	Not reported
Lista 2020	IUC removal on day 3 post-op	IUC removal on day 5 post-op	63 (range 48 - 75)	64 (range 45 – 75)	Not reported
Liu 2015	Clamping of IUC	No clamping of IUC i.e. free drainage	51 (13.2)	52 (16.4 SD)	Not reported
Lyth 1997	IUC removal at 6 am	IUC removal at midnight	Not reported	Not reported	Not reported
Mao 1994	IUC duration 7 am to 8 pm (same day)	IUC duration 7 am to 6 am (next day)	Not reported	Not reported	Not reported
Matsushima 2015	IUC removal 2 days post-op	IUC removal 4 days post-op	Not reported	Not reported	65.9 (5.5)

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Table 2. Interventions and age of participants *(Continued)*

McDonald 1999	IUC removal at midnight	IUC removal at 6 am	66.7 (range 51-81)	68.7 (range 57-89)	67.8 (range 51-89)
Naguimbing-Cuaresma 2007	IUC removal 4 h post-op	IUC removal day 1 post-op	Not reported	Not reported	Not reported
Nathan 2001	IUC removal at 6 am	IUC removal at midnight	46.5 (5.6)	45.7 (5.4)	Not reported
Nguyen 2012	IUC removal 2 days post-op	IUC removal 10 days post-op	Not reported	Not reported	Not reported
Nielson 1985	IUC removal 3 days post-op	IUC removal 28 days post-op	64 (range 21-81)	64 (range 16-78)	Not reported
Noble 1990	IUC removal at 6 am	IUC removal at midnight	Not reported	Not reported	Not reported
Nyman 2010	Clamping of IUC	No clamping of IUC	79 (11)	80 (11.2)	Not reported
Oberst 1981	Clamping of IUC	No clamping of IUC	64.5 (10.26)	59 (11.92)	Not reported
Onile 2008	IUC removal 1 day post-op	IUC removed immediately post-op	31.67 (6.042)	32.72 (5.96)	Not reported
Ouladsahebmadarek 2012	IUC removed immediately post-op	IUC removal 1 day post-op	37.48 (8.85)	39.48 (9.54)	Not reported
Pervaiz 2019	IUC removal on day 1 post-op	IUC removal on day 4 post-op	67.00 (9.11)	65.56 (9.25)	Not reported
Popiel 2017	IUC removal within 6 h of operation completion	IUC removal on day 1 post-op	Not reported	Not reported	Not reported
Rajan 2017	IUC removal within 3 h of operation completion	IUC removal on day 1 post-op	50 (18)	48 (2.4)	Not reported
Ruminjo 2015	IUC removal on day 7 post-op	IUC removal on day 14 post-op	Not reported	Not reported	Not reported
Sahin 2011	IUC removal 1 day post-op	IUC removal 2 days post-op AND 3 days post-op (3-arm trial)	62.5 (SD not reported)	B: 61.5, C: 62 (SD not reported)	62 (range 48-77)
Sandberg 2019	IUC removal immediately post-op	IUC removal 18-24 h post-op	49.3 (10.5)	51.5 (11.9)	Not reported
Schiotz 1995	IUC removal 1 day post-op	IUC removal 3 days post-op	Not reported	Not reported	65.9 (range 29.9-95.2)
Schiotz 1996	IUC removal 1 day post-op	IUC removal 1 day post-op	Not reported	Not reported	50.3 (range 26.9-72.6)
Sekhavat 2008	IUC removed immediately post-op	IUC removal 1 day post-op	38.9 (2.9)	39 (3.8)	Not reported
Shahnaz 2016	IUC removal 24 h post-op	IUC removal 72 h post-op	39.4 (3.2)	38.8 (2.8)	Not reported

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Table 2. Interventions and age of participants *(Continued)*

Shrestha 2013	IUC removal 1 day post-op	IUC removal 3 days post-op	Not reported	Not reported	53.35 (10.94)
Souto 2004	IUC removal 7 days post-op	IUC removal 14 days post-op	64 (7.3)	61 (7.3)	62 (range 50-73)
Sun 2004	IUC removal on the next morning post-op	IUC removal 5 days post-op	46.7 (6.7)	48.3 (8.3)	Not reported
Tahmin 2011	IUC removal 2 days post-op	IUC removal 5 days post-op	51.75 (10.8)	53.95 (12.8)	Not reported
Talreja 2016	Clamping of IUC	No clamping of IUC i.e. free drainage	63.05 (4.69)	64.21 (5.36)	Not reported
Taube 1989	IUC removal immediately after emptying of bladder	IUC removal 1 day post-op AND 2 days post-op (3-arm trial)	Not reported	Not reported	Not reported
Toscano 2001	IUC removal 1 day post-op	IUC removal 2 days post-op	Not reported	Not reported	Not reported
Valero Puerta 1998	IUC removal on day 2 post-op	IUC removal according to usual care	70 (range 53-83)	69 (range 50-87)	Not reported
Vallabh-Patel 2020	IUC removal 6 h post-op	IUC removal 1 day post-op	59.52 (8.5)	59.57 (11.2)	Not reported
Webster 2006	IUC removal at 6 am	IUC removal at 10 pm	55.02 (19.97)	55.05 (18.99)	Not reported
Weemhoff 2011	IUC removal 2 days post-op	IUC removal 5 days post-op	59.9 (10.2)	60.7 (11.1)	Not reported
Williamson 1982	Clamping of IUC	No clamping of IUC i.e. free drainage	Not reported	Not reported	Range 22-40
Wilson 2000	Bladder infusion with normal saline by gravity until bladder was full	IUC removal at 6 am	Not reported	Not reported	Not reported
Wu 2015	Catheter clamped when patient woke up post-op. On Day 1 morning post-op, when the patient felt urge to pass urine, the urinary catheter balloon was deflated and the catheter allowed to be self-dislodged during urination	On the morning of Day1 post-op, after the patient passed urine (through the catheter), saline was used to wash the bladder and the catheter clamped. 10 min after clamping, the balloon was deflated and the catheter allowed to be self-dislodged during urination	45.6 (7.2)	46.1 (7)	Not reported
Wyman 1987	IUC removal between 6 am and 7 am	IUC removal between 10 pm and 11 pm	Not reported	Not reported	70.8 (range 50-89)
Yaghmaei 2017	IUC removal 6 h post-op	IUC removal 12-24 h post-op	28.19 (5.80)	28.01 (5.83)	Not reported
Yee 2015	IUC removal 8 h post-op	IUC removal 1 day post-op	Not reported	Not reported	Not reported
Zaouter 2009	IUC removal on the same morning as the surgery	IUC removal when the epidural anaesthesia was removed	57 (15)	63 (11)	Not reported

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Table 2. Interventions and age of participants *(Continued)*

Zhou 2012	IUC removal 6-8 h post-op	IUC removal 24 h post-op	25.11(4.88)	26.33 (5.08)	Not reported
Zmora 2010	IUC removal 1 day post-op	IUC removal 3 days post-op AND 5 days post-op (3-arm trial)	57.4 (range 18-85)	B: 54.6 (range 25-81) C: 54.2 (range 22-78)	Not reported
Zomorrodi 2018	IUC removal 3 days post-op	IUC removal 7 days post-op	43.52 (13.6)	43.20 (14.39)	Not reported

IUC: indwelling urethral catheter

Table 3. Use of antibiotic prophylaxis

Trial**ID**	**Comparison**	**Antibiotic prophylaxis used**	**Details**
Ahmed 2014;	2	Yes	Prophylaxis was given to all patients on the morning of surgery in the form of 1 g of ceftriaxone IM
Alessandri 2006	2	Yes	Prophylaxis was given as a single dose before operation
Allen 2016	2	No	N/A
Alonzo-Sosa 1997	2	No	N/A
Aref 2020	2	Yes	Single dose of prophylactic antibiotic in the form of ceftriaxone 1 g IM
Aslam 2019	2	Not reported	Not reported
Azarkish 2003	2	Not reported	Not reported
Azarkish 2005	2	Not reported	Perineum wash by povidone iodine 10% before catheter insertion
Barone 2015	2	No	N/A
Basbug 2020	2	Yes	All participants received 1 g IV cefazolin as prophylaxis
Benoist 1999	2	Yes	All participants received IV antibiotics as a single dose at the induction of anaesthesia
Bristoll 1989	3	Not reported	N/A
Carpiniello 1988	2	Yes	Prophylactic cefazolin sodium or clindamycin was given on post-op day 3
Carter-Brooks 2018	2	Not reported	N/A
Chai 2011	2	No	N/A
Chen 2013	2	No	Routine prophylaxis was not given. Antibiotics were only used in symptomatic participants.

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Table 3. Use of antibiotic prophylaxis *(Continued)*

Chia 2009	2	Yes	Single dose of prophylactic antibiotic was given IV in all participants
Chillington 1992	1	Not reported	Not reported
Cornia 2003	2	Not reported	Not reported
Coyle 2015	2	Not reported	Not reported
Crowe 1993	1	Not reported	Not reported
Dunn 1999	N/A	Not reported	Not reported
Dunn 2000b	N/A	Not reported	Not reported
Dunn 2003	2	Yes	Single dose of antibiotic prophylaxis before operation
Durrani 2014	2	Yes	Cephalosporin 1 g was administered IV at the time of induction of anaesthesia
El-Mazny 2014	2	Yes	Cefazolin 2 g IV single dose 30 min before surgery
Ganta 2005	1	Not reported	Not reported
Glavind 2007	2	Yes	Participants who had vaginal hysterectomy or high uterosacral suspension received 1 pre-op injection of cefuroxime. No antibiotic prophylaxis was used in the remaining participants.
Gong 2017	3	Not reported	Not reported
Gross 2007	1	Not reported	Not reported
Gungor 2014	2	Not reported	Not reported
Guzman 1994	2 and 3	Yes	All participants received Quemicetina as prophylaxis
Hakvoort 2004	2	Not reported	Not reported
Hall 1998	1	Not reported	Not reported
Han 1997	2	Not reported	Not reported
Hewitt 2001	2	Not reported	Not reported
Huang 2011	2	Yes	Ciprofloxacin used during all days of hospitalisation in all 3 groups
Ind 1993	1	Not reported	Not reported
Irani 1995	2	Yes	Antibiotics (quinolones) were given from the day of operation until the participant was discharged home
Iversen Hansen 1984	2	Yes	Antibiotics were not administered routinely but participants with urinary infections pre- or post-op were treated with antibiotics according to urine culture results.

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Table 3. Use of antibiotic prophylaxis *(Continued)*

Jang 2012	4	Yes	All participants were given an IV dose of antibiotic during anaesthesia induction before operation
Jeong 2014	4	Not reported	Not reported
Joshi 2014	2	Yes	All participants received 1 dose of antibiotic prophylaxis at the time of surgery and continued post-op as per department protocol
Jun 2011	4	Not reported	Not reported
Kamilya 2010	2	Yes	All participants received 2 doses of antibiotic injection ceftriaxone 1 g, one just before the operation and another 12 h after the first dose
Kelleher 2002	1	Not reported	Not reported
Kim 2012	2	Not reported	Not reported
Koh 1994	2	Yes	Antibiotics were given at induction to participants with IUCs or proven urinary tract infections
Kokabi 2009	2	Not reported	Not reported
Lang 2020	2	Yes	All participants received pre-op antibiotics with either American College of Obstetricians and Gynecologists approved dosing of cefazolin (78%) or a combination of gentamicin and clindamycin (22%) with no difference between fast-track or conventional Foley management groups
Lau 2004	2	Yes	Single dose of parenteral antibiotic was given upon induction of general anaesthesia in most cholecystectomies, hernia repairs, gastrointestinal and anorectal operations
Li 2014	2	Not reported	Not reported
Liang 2009	2	Yes	IV antibiotics consisting of cefazolin 500 mg after induction of general anaesthesia
Lista 2020	2	Not reported	Not reported
Liu 2015	3	Not reported	Not reported
Lyth 1997	1	Not reported	Not reported
Mao 1994	2	Not reported	Not reported
Matsushima 2015	2	Not reported	Not reported
McDonald 1999	1	Not reported	Not reported
Naguimbing-Cuaresma 2007	2	Not reported	Not reported
Nathan 2001	1	Not reported	Not reported
Nguyen 2012	2	Not reported	Not reported

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Table 3. Use of antibiotic prophylaxis *(Continued)*

Nielson 1985	2	Not reported	Not reported
Noble 1990	1	Not reported	Not reported
Nyman 2010	3	Not reported	Not reported
Oberst 1981	3	Not reported	Not reported
Onile 2008	2	Not reported	Not reported
Ouladsaheb-madarek 2012	2	Yes	Cephazoline 1 g IV half an hour before surgery started and continued every 6 h for another 2 doses
Pervaiz 2019	2	Not reported	Not reported
Popiel 2017	2	Not reported	Not reported
Rajan 2017	2	Not reported	Not reported
Ruminjo 2015	2	Not reported	Not reported
Sahin 2011	2	Not reported	Not reported
Sandberg 2019	2	Not reported	Not reported
Schiotz 1995	2	Not reported	Not reported
Schiotz 1996	2	Not reported	Not reported
Sekhavat 2008	2	Not reported	Not reported
Shahnaz 2016	2	No	"antibiotic was not regularly given except for patients who had abnormal urinary symptoms and unusual urinary analysis in urinary sample 48 h after the surgery"
Shrestha 2013	2	Yes	Antibiotics given for 7 days
Souto 2004	2	Not reported	Not reported
Sun 2004	2	Yes	All participants were given prophylactic antibiotics for 2 days (1 g cefazolin IV 3 times daily)
Tahmin 2011	2	Not reported	Not reported
Talreja 2016	3	Yes	Participants were given 1 dose of third-generation cephalosporin in pre-op period
Taube 1989	2	Not reported	Not reported
Toscano 2001	2	Yes	Antiobiotic prophylaxis with first generation cephalosporin was given at the induction of anaesthesia for up to 7 days after the operation
Valero Puerta 1998	2	Yes	1 g of ceftriaxone every 24 h for 2 days

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Table 3. Use of antibiotic prophylaxis *(Continued)*

Vallabh-Patel 2020	2	Yes	All participants received appropriate perioperative antibiotics per American College of Obstetricians and Gynecologists guidelines
Webster 2006	1	Not reported	Not reported
Weemhoff 2011	2	Yes	All participants received antibiotic prophylaxis at the beginning of the operation.
Williamson 1982	3	Not reported	Not reported
Wilson 2000	1	Not reported	Not reported
Wu 2015	3	Not reported	Not reported
Wyman 1987	1	Not reported	Not reported
Yaghmaei 2017	2	Yes	Cefazolin 1 g
Yee 2015	2	Not reported	Not reported
Zaouter 2009	2	Yes	2 g cefazolin with or without 500 mg of metronidazole was given IV
Zhou 2012	2	Not reported	Not reported
Zmora 2010	2	Yes	Prophylactic antibiotics were given 24 h in the perioperative period according to department protocol
Zomorrodi 2018	2	Not reported	Not reported

IM: intramuscular(ly); **IUC:** indwelling urethral catheter; **IV:** intravenous(ly); **N/A:** not applicable

Table 4. Measurement of symptomatic urinary tract infection

Trial**ID**	**Outcome as defined by trial authors**	**Trial definition**	**Relevant definition outlined by International Guideline Panel**
Ahmed 2014	Symptomatic UTI	Significant bacteriuria with at least one of the following symptoms: dysuria, frequency of micturition, urgency, suprapubic pain ir burning sensation at micturition	CDC
Alessandri 2006	UTI	Significant bacteria which is determined by: urine culture and defined as at least 10^5 cfu/mL	EAU: symptomatic bacteriuria
Allen 2016	UTI	Not reported	N/A
Alonzo-Sosa 1997	UTI	Defined as a positive urine sample associated with: dysuria, polyuria, incomplete emptying, pain, fever or sepsis. A positive urine sample was defined as the presence of > 10^5 cfu/mL if MSU and 10^4 cfu/mL in a catheter sample.	CDC

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Table 4. Measurement of symptomatic urinary tract infection *(Continued)*

Aref 2020	Symptomatic UTI	"The diagnosis of symptomatic urinary tract infection was based on the following criteria: significant bacteriuria with at least one of the following symptoms; dysuria, frequency of micturition, urgency, supra pubic pain, or burning sensation at micturition."	CDC
Aslam 2019	UTI	Not reported	N/A
Azarkish 2003	UTI	Not reported	N/A
Azarkish 2005	Not reported	Not reported	N/A
Barone 2015	UTI	Not reported	N/A
Basbug 2020	Significant bacteruria	Significant microscopic bacteriuria was defined as ≥ 100,000 bacteria/ mL MSU	EAU: asymptomatic bacteriuria
Benoist 1999	UTI	Culture yield of > 10^5 cfu/mL with or without symptoms	With symptoms: CDC Without symptoms: EAU definition for "Asymptomatic bacteriuria"
Bristoll 1989	Not reported	Not reported	N/A
Carpiniello 1988	UTI	Culture yield of 10^5 cfu/mL	EAU: asymptomatic bacteriuria
Carter-Brooks 2018	UTI	Defined as a positive culture or symptoms and antibiotic treatment	N/A
Chai 2011	Symptomatic UTI	Positive urine culture: > 10^5 cfu/mL of an identified single uropathogen/mL of urine Symptomatic UTI: fever (> 38 °C) and dysuria with a positive urine culture	CDC
Chen 2013	CAUTI	CDC criteria used to define symptomatic UTI and asymptomatic bacteriuria	CDC
Chia 2009	CAUTI	Not reported	N/A
Chillington 1992	Not reported	N/A	N/A
Cornia 2003	CAUTI	Growth from a urine specimen aseptically aspirated from the catheter of ≥ 100 cfu of a predominant pathogen OR ≥ 10 leukocytes per high-power field on urinalysis in a patient with a clinical diagnosis of UTI	N/A
Coyle 2015	Bacteriuria	Symptomatic or asymptomatic bacteriuria used. No definition given	N/A
Crowe 1993	Not reported	N/A	N/A
Dunn 1999	Not reported	N/A	N/A

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Table 4. Measurement of symptomatic urinary tract infection *(Continued)*

Dunn 2000b	UTI	Not reported	N/A
Dunn 2003	UTI	Determined by either microscopic abnormality or any patient symptoms	N/A
Durrani 2014	UTI	Not reported	N/A
El-Mazny 2014	Significant bacteriuria	Significant bacteriuria: > 10^5 cfu/mL of urine in a MSU sample collected 24 h post-op	EAU: asymptomatic bacteriuria
Ganta 2005	Not reported	N/A	N/A
Glavind 2007	Positive urine culture	Defined as the presence of ≥ 10^5 cfu/mL	EAU: asymptomatic bacteriuria
Gong 2017	Symptomatic UTI	Defined as bacteriuria with fever, frequent or painful urination or burning on urination	CDC
Gross 2007	UTI	Used CDC criteria	CDC
Gungor 2014	Not reported	N/A	N/A
Guzman 1994	UTI	Urine culture of > 10^5 cfu/mL reported as outcome. Definition is not provided	EAU: asymptomatic bacteriuria
Hakvoort 2004	UTI	Signs of UTI: having > 10 WBC/high-powered field and significant microscopic bacteriuria (1/high-powered field) in the urine sediment UTI: presence of > 10^5 cfu/mL in urine culture	EAU: asymptomatic bacteriuria
Hall 1998	Not reported	N/A	N/A
Han 1997	Not reported	N/A	N/A
Hewitt 2001	Not reported	N/A	N/A
Huang 2011	UTI	Not reported	N/A
Ind 1993	Not reported	N/A	N/A
Irani 1995	UTI	Not reported	N/A
Iversen Hansen 1984	Not reported	N/A	N/A
Jang 2012	Not reported	N/A	N/A
Jeong 2014	Not reported	N/A	N/A
Joshi 2014	Symptomatic UTI	Symptomatic UTI: based on the presence of significant bacteriuria accompanied by at least 1 of the following symptoms: fever, dysuria, increased frequency of micturition, urinary urgency, suprapubic pain and dysuria	CDC
Jun 2011	Not reported	N/A	N/A

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Table 4. Measurement of symptomatic urinary tract infection *(Continued)*

Kamilya 2010	Symptomatic UTI	Symptomatic UTI: positive urine culture of > 10^5 cfu/mL plus 1 of the following symptoms: dysuria, fever (> 38 °C) or rigors	CDC
Kelleher 2002	Not reported	N/A	N/A
Kim 2012	Not reported	N/A	N/A
Koh 1994	UTI	Not reported	N/A
Kokabi 2009	UTI	Not reported	N/A
Lang 2020	UTI	Not reported	N/A
Lau 2004	Positive urine culture	Not reported	N/A
Li 2014	Infection	Not reported	N/A
Liang 2009	UTI	UTI: positive urine culture of > 10^5 cfu/mL. However, treatment was only given for positive urine cultures if participant had adverse urinary symptoms or post-op pyrexia (> 38 °C)	CDC
Lista 2020	UTI	Not reported	N/A
Liu 2015	Not reported	N/A	N/A
Lyth 1997	Not reported	N/A	N/A
Mao 1994	Not reported	N/A	N/A
Matsushima 2015	Not reported	N/A	N/A
McDonald 1999	Not reported	N/A	N/A
Naguimbing-Cuaresma 2007	Not reported	N/A	N/A
Nathan 2001	Positive catheter specimen urine (CSU)	Not reported	N/A
Nguyen 2012	Not reported	N/A	N/A
Nielson 1985	Not reported	N/A	N/A
Noble 1990	Not reported	N/A	N/A
Nyman 2010	Not reported	N/A	N/A
Oberst 1981	Not reported	N/A	N/A
Onile 2008	Significant bacteriuria	Significant bacteriuria: positive urine culture of > 10^5 cfu/mL in a sample of MSU collected 72 h post-op with signs of a fever (a temperature of > 38 °C on 2 occasions within 10 days of the procedure, excluding the first 24 h)	CDC

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Table 4. Measurement of symptomatic urinary tract infection *(Continued)*

Ouladsaheb-madarek 2012	Symptomatic UTI	Not reported	N/A
Pervaiz 2019	UTI	Urine sample was obtained to assess UTI (bacterial colony count > 10^5 cfu/mL on urine culture after removal of catheter assessed on day 7)	EAU: catheter-associated asymptomatic bacteriuria
Popiel 2017	UTI	Not reported	N/A
Rajan 2017	UTI	Urinary infections defined as when microscopic examination of the urine revealed pus cells or when urine culture showed growth of pathogenic organisms	N/A
Ruminjo 2015	Not reported	N/A	N/A
Sahin 2011	Not reported	N/A	N/A
Sandberg 2019	UTI	Standard urine test for nitrite and leucocytes in combination with clinical symptoms	Not clear whether test is dipstick only or whether it involves microscopy/culture
Schiotz 1995	UTI	Positive cultures: culture of > 10^5 cfu/mL in a sample of MSU or CSU culture of > 10^4 cfu/mL UTI: positive urine culture in the absence of symptoms. Patients were defined as having UTI if there was any doubt	EAU: asymptomatic bacteriuria
Schiotz 1996	UTI	Positive cultures: culture of > 10^5 cfu/mL in a sample of MSU or CSU culture of > 10^4 cfu/mL UTI: positive urine culture in the absence of symptoms. Participants were defined as having UTI if there was any doubt	EAU: asymptomatic bacteriuria
Sekhavat 2008	Positive urine culture	Positive urine culture: prevalence of symptomatic UTI was confirmed through a positive urine culture OR through signs of UTI such as: frequency, urgency, dysuria, suprapubic pain or fever	Does not fully meet the criteria for CDC. Must be positive cultures AND clinical features
Shahnaz 2016	Positive urine culture	The presence of positive urinary culture or > 100,000 colony counts in each mL of urine or > 10 pieces of leukocyte in each microscopy field was considered as a urinary infection.	EAU: asymptomatic bacteriuria
Shrestha 2013	Asymptomatic bacteriuria	Asymptomatic bacteriuria: pus cells of > 5 per high-power field in routine examination of urine and bacterial culture positive	EAU: asymptomatic bacteriuria
Souto 2004	Not reported	N/A	N/A
Sun 2004	UTI	UTI: positive urine culture of > 10^5 cfu/mL or WBC > 5/high-power field in urine analysis	EAU: asymptomatic bacteriuria
Tahmin 2011	UTI	UTI: positive urine culture of > 10^5 cfu/mL	EAU: asymptomatic bacteriuria
Talreja 2016	Not reported	N/A	N/A

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Table 4. Measurement of symptomatic urinary tract infection *(Continued)*

Taube 1989	Not reported	N/A	N/A
Toscano 2001	Not reported	N/A	N/A
Valero Puerta 1998	Not reported	N/A	N/A
Vallabh-Patel 2020	UTI	For the purpose of this trial, participants were considered positive for a UTI if they had (1) positive urine cultures per CDC guidelines or (2) treated empirically over the phone for symptoms of UTI, even in the absence of a urine culture	CDC
Webster 2006	Not reported	N/A	N/A
Weemhoff 2011	UTI	UTI: > 25 WBC/high-power field, nitrate production, > 20 bacteria/high-power field, positive urine culture of > 10^5 cfu/mL	EAU: asymptomatic bacteriuria
Williamson 1982	Not reported	N/A	N/A
Wilson 2000	Not reported	N/A	N/A
Wu 2015	Not reported	N/A	N/A
Wyman 1987	Not reported	N/A	N/A
Yaghmaei 2017	Not reported	N/A	N/A
Yee 2015	Not reported	N/A	N/A
Zaouter 2009	UTI	UTI: pyrexia of > 38 °C, clinical features of UTI (dysuria, frequency, urgency, suprapubic pain, urinary incontinence) and a positive urine culture (10^7 bacterial colonies of micro-organism-forming units/L within 2 weeks after the removal of bladder catheter)	CDC EAU: complicated UTI
Zhou 2012	Not reported	Defined as post-catheter removal MSU clean catch culture of ≥ 10^4 cfu/mL for Gram positive organisms or ≥ 10^5 cfu/mL for Gram negative organisms	EUA: asymptomatic bacteriuria
Zmora 2010	UTI Asymptomatic bacteriuria	UTI: positive urine culture and symptoms suggestive of UTI	CDC
Zomorrodi 2018	UTI	Not reported	N/A

CAUTI: catheter-associated urinary tract infection; **CDC:** Centers for Disease Control and Prevention; **cfu:** colony forming unit; **CSU:** catheter specimen urine; **EAU:** European Association of Urology; **MSU:** midstream urine; **N/A:** not applicable; **UTI:** urinary tract infection; **WBC:** white blood count

Table 5. Definitions for urinary tract infection

Guideline Committee	Population	Clinical features	Microbiological findings

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Table 5. Definitions for urinary tract infection *(Continued)*

Centres for Disease Control and Prevention (CDC) (CDC 2016; Gould 2009)	CAUTI - UTI in patients who have IUCs that have been in place for > 2 days (day 1 being when the catheter was placed)	At least **one** of the following: • Urgency • Dysuria • Frequency • Suprapubic tenderness • Fever (> 38 °C) • Costovertebral angle pain or tenderness	**AND** a urine culture of at least ≥ 10^5 cfu/mL with no more than 2 species of organisms
Infectious Diseases Society of America (IDSA) (Hooton 2010)	UTI in patients with urethral (indwelling or intermittent) or suprapubic catheters that are inserted at the time or removed in the previous 48 h	Patient must have clinical features compatible with UTI (not specified)	**AND** a MSUor CSU with a urine culture of ≥ 10^3 cfu/mL of ≥ 1 species of bacterial organism (single-catheter specimen or MSU)
European Association of Urology (EAU) (EAU 2020; Grabe 2015)	Asymptomatic bacteriuria	No clinical features	• A single, catheterised sample bacterial growth may be as low as 10^2 cfu/mL to be considered representing true bacteriuria in both men and women • > 10^5 cfu/mL on 2 consecutive MSU in women or 1 MSU in men
	Uncomplicated UTI (see Table 6 for definition)	• Urgency • Dysuria • Frequency • Suprapubic tenderness • No urinary symptoms in 4 weeks before this episode	• Positive urine culture of ≥ 10^5 cfu/mL and pyuria of > 10 WBC/mm^3
	Complicated UTI (see Table 6 for definition)	• Urgency • Dysuria • Frequency • Suprapubic pain • Fever • Chills • Flank pain No urinary symptoms 4 weeks before	• > 10^5 cfu/mL for women • > 10^4 cfu/mL for men or in women with straight catheters • > 10 WBC/mm^3

CAUTI: catheter-associated urinary tract infection; **CDC:** Centers for Disease Control and Prevention; **cfu:** colony forming unit; **CSU:** catheter specimen urine; **EAU:** European Association of Urology; **MSU:** midstream urine; **UTI:** urinary tract infection; **WBC:** white blood count

Table 6. European Association of Urology classification of urinary tract infection

Uncomplicated UTIs	Acute, sporadic or recurrent lower (uncomplicated cystitis) and/or upper (uncomplicated pyelonephritis) UTI, limited to non-pregnant, premenopausal women with no known relevant anatomical and functional abnormalities within the urinary tract or co-morbidities
Complicated UTIs	All UTIs that are not defined as uncomplicated. Meaning in a narrower sense UTIs in a patient with an increased chance of a complicated course: i.e. all men, pregnant women, patients with relevant

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Table 6. European Association of Urology classification of urinary tract infection *(Continued)*

	anatomical or functional abnormalities of the urinary tract, IUCs, renal diseases, and/or with other concomitant immunocompromising diseases for example, diabetes
Recurrent UTIs	Recurrences of uncomplicated and/or complicated UTIs, with a frequency of at least 3 UTIs/year or 2 UTIs in the last 6 months
Catheter associated UTIs (CAUTI)	Catheter-associated urinary tract infection (CAUTI) refers to UTIs occurring in a person whose urinary tract is currently catheterised or has had a catheter in place within the past 48 h
Urosepsis	Urosepsis is defined as life-threatening organ dysfunction caused by a disregulated host response to infection originating from the urinary tract and/or male genital organs

CAUTI: catheter-associated urinary tract infection; **IUC:** indwelling urethral catheter; **UTI:** urinary tract infection
Table obtained from EAU Guidelines on Urological Infections (EAU 2020).

Table 7. Heterogeneity of reported outcomes

Reported outcomes in this review	Similar outcomes reported by trials
Asymptomatic bacteriuria	• Positive urine culture
Incidence of urinary retention	• Post-discharge urinary retention • Short-term retention • Acute urinary retention • Delayed voiding after catheter removal • Chronic urinary retention
Loin pain	• Post-discharge loin pain
Fever	• Post-discharge fever
Dysuria	• Post-discharge pain on passing urine
Difficulty in passing urine	• Post-discharge difficulty in passing urine • Post-operative voiding dysfunction
Incontinence	• Post-discharge incontinence

APPENDICES

Appendix 1. Plain language medical glossary

- **Abscess:** a collection of pus
- **Alpha-blocker:** medication used to relax muscle or blood vessels
- **Antimicrobials:** a substance that kills or stops the growth of potentially harmful tiny organisms that can only be seen under a microscope
- **Bacteruria:** bacteria in the urine
- **Cystitis:** inflammation of the bladder wall
- **Detrusor:** the outer muscular structure of the bladder wall
- **Dysuria:** difficult or painful passage of urine
- **Flank:** the fleshy part of the body between the ribs and hip bone

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- **Haematuria:** blood in the urine
- **Haemorrhage:** excessive bleeding
- **Incontinence:** involuntary leakage of urine
- **In situ:** in place
- **Loin:** the part of the body on either side of the spine between the ribs and hip bone
- **Lumen:** the walls of a urethral catheter
- **Meatal:** relating to a body passage (in this case the urethra or passage to the bladder)
- **Morbidity:** the rate of sickness
- **Perioperative:** occurring around the time of surgery
- **Prostatitis:** inflammation of the prostate
- **Radical prostatectomy:** complete surgical removal of the prostate
- **Rigors:** shivering from the chills
- **Stricture:** the narrowing of a bodily structure
- **Suprapubic:** above the pelvic area
- **Urodynamic trials:** tests assessing the bladder and urethra's ability to store and pass urine
- **Urological:** relating to the organs responsible for making and passing urine

Appendix 2. Search strategies for the 2021 update of the review

Cochrane Incontinence Specialised Register

We searched the Cochrane Incontinence Specialised Register using the Group's own keyword system. The date of the last search was: 17 March 2020. The search terms used were:

(design.rct* or design.cct*)
AND
(intvent.mech.cath* OR intvent.mech.device* OR intvent.mech.sheaths. OR intvent.prevent.antibiotics* OR intvent.prevent.antinfect.* OR intvent.prevent.cath* OR intvent.prevent.cleaning fluids* OR intvent.prevent.surg* OR intvent.surg.intraoperativemanagement* OR intvent.surg.postsurgman* OR intvent.surg.presurgman*. OR intvent.surg.urethrotomy.)

All searches were of the keywords field of EndNote 2018.

Appendix 3. CINAHL search strategy used for an earlier update of this version of the review

CINAHL (on EBSCO) covering December 1981 to 11 May 2016 (searched on 12 May 2016). For the 2020 update of the search, this search was incorporated into the search for the Cochrane Incontinence Specialised Register and was not searched separately. The search strategy used is given below:

#	Query
S29	(S23 AND S28)
S28	S24 OR S25 OR S26 OR S27
S27	TI urin* N6 catheter* OR AB urin* N6 catheter*
S26	(MH "Catheter Removal") OR (MH "Sheath Removal") OR (MH "Urinary Catheter Care (Saba CCC)") OR (MH "Urinary Catheter Insertion (Saba CCC)") OR (MH "Urinary Catheter Irrigation (Saba CCC)") OR (MH "Urinary Tract Infections, Catheter-Related") OR (MH "Urinary Catheterization+") OR (MH "Catheters, Urinary+")
S25	(MH "Catheter Occlusion")
S24	(MH "Catheter Care, Urinary+")
S23	S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22

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(Continued)

S22	TI (singl* N25 blind* OR singl* N25 mask* OR doubl* N25 blind* or doubl* N25 mask* OR trebl* N25 blind* OR trebl* N25 mask*OR tripl* N25 blind* OR tripl* N25 mask*) or AB (singl* N25 blind* OR singl* N25 mask* OR doubl* N25 blind* or doubl* N25 mask* OR trebl* N25 blind* OR trebl* N25 mask*OR tripl* N25 blind* OR tripl* N25 mask*)
S21	(MH "Comparative Studies")
S20	(MH "Clinical Research+")
S19	(MH "Static Group Comparison")
S18	(MH "Quantitative Studies")
S17	(MH "Crossover Design") or (MH "Solomon Four-Group Design")
S16	(MH "Factorial Design")
S15	(MH "Community Trials")
S14	(MH "Random Sample")
S13	TI balance* N2 block* or AB balance* N2 block*
S12	TI "latin square" or AB "latin square"
S11	TI factorial or AB factorial
S10	TI clin* N25 trial* or AB clin* N25 trial*
S9	(MH "Study Design")
S8	(AB random*) OR (TI random*)
S7	(AB placebo*) OR (TI placebo*)
S6	(MH "Placebos")
S5	(PT Clinical Trial) OR (PT "randomized controlled trial")
S4	(MH "Clinical Trials+")
S3	MH (random assignment) OR (crossover design)
S2	cross-over
S1	crossover

Key: * = truncation; AB = abstract TI = title; PT = publication type; MH = major subject heading; N = near (adjacency) eg N6 means within 6 words, in any order.

Appendix 4. Details of the additional searches conducted for previous versions of this review

Please find below details of the searches for the previous version of this review (Griffiths 2007).

Cochrane Incontinence Specialised Register

The terms used to search the Cochrane Incontinence Specialised Register are given below:

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({design.cct*} OR {design.rct*})
AND
{topic.mech.cath*}

All searches were of the keyword field of Reference Manager 2002. Searched: 7 December 2005.

Electronic bibliographic databases

The following electronic bibliographic databases were searched.

Cochrane Central Register of Controlled Trials (CENTRAL; 2006, Issue 2), (on web, Update Software site, via OVID in July 2006) using the following search strategy:

1. Urin*
2. Ureth*
3. (1 or 2)
4. Cath*
5. (3 and 4)
6. Time
7. Morn*
8. Night
9. Dawn
10. Dusk
11. Evening
12. Afternoon
13. Noon
14. Day
15. 6AM
16. (6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15)
17. (5 and 16)
18. Suprapubic
19. (17 not 18)
20. Removal
21. (19 and 20)

Key: * = truncation symbol.

MEDLINE (via Ovid) (years searched: January 1966 to 12 July 2006) using the following search terms:

1. urinary catheterization/ or catheter, urinary/
2. (catheter$ and (urin$ or urethra$)).mp.
3. 1 or 2
4. (remov$ or withdraw$).mp.
5. Time Factors/
6. (time or timing or morning$ or afternoon$ or evening$ or night$ or day$).mp.
7. 5 or 6
8. 3 and 4 and 7

Key: / = MeSH term with all subheadings; $ = truncation symbol; mp = map, searches a number of fields including MeSH terms and textwords in titles and abstracts

EMBASE (via Ovid) (years searched: January 1980 to 12 July 2006) using the following search terms:

1. urinary catheterization/ or catheter, urinary/
2. (catheter$ and (urin$ or urethra$)).mp.
3. 1 or 2
4. (remov$ or withdraw$).mp.
5. Time Factors/
6. (time or timing or morning$ or afternoon$ or evening$ or night$ or day$).mp.
7. 5 or 6
8. 3 and 4 and 7

Key: / = MeSH term with all subheadings; $ = truncation symbol; mp = map, searches a number of fields including EMTREE terms and textwords in titles and abstracts

CINAHL (via Ovid) (years searched: January 1982 to 12 July 2006) using the following search terms:

1. urinary catheterization/ or catheter, urinary/

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2. (catheter$ and (urin$ or urethra$)).mp.
3. 1 or 2
4. (remov$ or withdraw$).mp.
5. Time Factors/
6. (time or timing or morning$ or afternoon$ or evening$ or night$ or day$).mp.
7. 5 or 6
8. 3 and 4 and 7
Key: / = MeSH term with all subheadings; $ = truncation symbol; mp = map, searches a number of fields including CINAHL subject terms and textwords in titles and abstracts

Nursing Collection Journals @ OVID (years searched: January 1995 to January 2002) using the following search terms:

1. urinary catheterization/ or catheter, urinary/
2. (catheter$ and (urin$ or urethra$)).mp.
3. 1 or 2
4. (remov$ or withdraw$).mp.
5. Time Factors/
6. (time or timing or morning$ or afternoon$ or evening$ or night$ or day$).mp.
7. 5 or 6
8. 3 and 4 and 7
Key: / = MeSH term with all subheadings; $ = truncation symbol; mp = map, searches a number of fields including textwords in titles and abstracts

Conference proceedings

The following conference proceedings were scanned briefly:

- International Continence Society (ICS), Annual Meeting (1995 to 2000 inclusive);
- International Urogynecological Association (IUGA), Annual Meeting (2000 and 2001);
- Hong Kong Urological Association, Annual Meeting (1995 to 2001 inclusive).

Other sources

The reference lists of relevant articles were searched for other possible relevant trials. Manufacturers, researchers and experts in the field were contacted to ask for other possibly relevant trials, published or unpublished.

We did not impose any language or other limits on any of the searches described above.

Appendix 5. Shorter duration versus longer duration of catheter use

Outcomes not mentioned in Types of outcome measures

Frequency of micturition

Two trials reported data on the frequency of micturition (Ahmed 2014; El-Mazny 2014). Participants who had their catheters removed immediately tended to micturate more frequently than those who had their catheters removed later (RR 0.18, 95% CI 0.06 to 0.53; I^2 = 0%; 2 trials; 521 participants; Analysis 2.25).

Time to first ambulation (hours)

Nine trials provided data on time to first ambulation (Ahmed 2014; Alessandri 2006; Aref 2020; El-Mazny 2014; Naguimbing-Cuaresma 2007; Onile 2008; Ouladsahebmadarek 2012; Sekhavat 2008; Yaghmaei 2017). Immediate removal of the indwelling urethral catheters compared to later resulted in a shorter time to first ambulation of participants (MD −5.06, 95% CI −5.24 to −4.88; I^2 = 99%; 9 trials, 1688 participants; Analysis 2.26). There was significant heterogeneity between the trials, which we think is most likely due to the differing types of surgeries the participants received. As a result, we would recommend these data to be interpreted with caution.

Appendix 6. Clamping versus free drainage before catheter removal

Outcomes not mentioned in Types of outcome measures

Time required to return to normal bladder function

One trial reported this outcome (Nyman 2010). The data were presented in medians and interquartile range and therefore we could not perform meta-analysis (Analysis 3.10).

WHAT'S NEW

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Date	Event	Description
21 June 2021	New search has been performed	This update, published in 2021, includes the following changes. 1. The search was updated to March 2020 and a further 73 trials have been included (taking the total of included trials to 99): Ahmed 2014; Alessandri 2006; Allen 2016; Alonzo-Sosa 1997; Aref 2020; Aslam 2019; Azarkish 2003; Azarkish 2005; Barone 2015; Basbug 2020; Bristoll 1989; Carpiniello 1988; Carter-Brooks 2018; Chai 2011; Chen 2013; Chia 2009; Cornia 2003; Coyle 2015; Dunn 1999; Dunn 2000b; Durrani 2014; El-Mazny 2014; Glavind 2007; Gong 2017; Gross 2007; Gungor 2014; Hall 1998; Han 1997; Hewitt 2001; Huang 2011; Jang 2012; Jeong 2014; Joshi 2014; Jun 2011; Kamilya 2010; Kim 2012; Kokabi 2009; Lang 2020; Li 2014; Liang 2009; Lista 2020; Liu 2015; Mao 1994; Matsushima 2015; Naguimbing-Cuaresma 2007; Nathan 2001; Nguyen 2012; Nyman 2010; Onile 2008; Ouladsahebmadarek 2012; Pervaiz 2019; Popiel 2017; Rajan 2017; Ruminjo 2015; Sahin 2011; Sandberg 2019; Schiotz 1995; Sekhavat 2008; Shahnaz 2016; Shrestha 2013; Souto 2004; Tahmin 2011; Talreja 2016; Valero Puerta 1998; Vallabh-Patel 2020; Weemhoff 2011; Wu 2015; Yaghmaei 2017; Yee 2015; Zaouter 2009; Zhou 2012; Zmora 2010; Zomorrodi 2018. 2. We revised the outcomes in line with the GRADE recommendations in order to include outcomes deemed important for clinical and patient decision-making. 3. We performed post-hoc subgroup analysis for or one outcome in one comparison to assess whether the use of prophylactic antibiotics would impact the number of participants developing symptomatic catheter-associated urinary tract infection. We also performed post hoc subgroup analysis for length of hospitalisation in one comparison to explore possible reasons for very high heterogeneity. 4. The review was substantially updated in accordance with current Cochrane methodology, including performing a risk of bias assessment on all 99 included trials and adopting the GRADE approach for assessing the certainty of evidence.
21 June 2021	New citation required but conclusions have not changed	The review has been updated; however, the conclusions did not change.

HISTORY

Protocol first published: Issue 1, 2003
Review first published: Issue 1, 2005

Date	Event	Description
13 October 2008	Amended	Converted to new review format.
21 February 2007	New citation required and conclusions have changed	Substantive amendment. Update Issue 2, 2007. Twenty-six trials (eight new) involving a total of 2933 participants were included in this first update of the review. One trial (Guzman 1994) included three treatment groups. Eleven (three new) compared late night versus early morning removal of catheters (Chilling-

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Date	Event	Description
		ton 1992; Crowe 1994; Ganta 2005; Ind 1993; Kelleher 2002; Lyth 1997; McDonald 1999; Noble 1990; Webster 2006; Wilson 2000; Wyman 1987); thirteen (five new) compared various durations of catheterisation (Benoist 1999; Dunn 2003; Guzman 1994; Hakvoort 2004; Hansen 1984; Irani 1995; Koh 1994; Lau 2004; Nielson 1985; Schiotz 1996; Sun 2004; Taube 1989; Toscano 2001); and three (Guzman 1994; Oberst 1981; Williamson 1982) compared clamping to free drainage.

CONTRIBUTIONS OF AUTHORS

AE: screened the abstracts and full-text reports of all potentially eligible trials; performed data extraction and risk of bias assessment for all included trials; assessed the certainty of evidence and conducted data analysis; wrote the manuscript and responded to peer review comments.
FS: performed some data extraction and risk of bias assessments for all the trials (shared with MIO and EAK); assessed the certainty of evidence and conducted data analysis.
EAK: performed some data extraction and risk of bias assessments for all the trials (shared with FS and MIO).
RG: contributed to drafts of this review and approved the final version.
RF: contributed to drafts of this review and approved the final version.
MIO: screened the abstracts and full-text reports of all potentially eligible trials; performed some data extraction and risk of bias assessments for all the trials (shared with FS and EAK); assessed the certainty of evidence and conducted data analysis; assisted in responding to peer review comments.

DECLARATIONS OF INTEREST

In accordance with Cochrane's Commercial Sponsorship Policy, the following declarations have been made:
AE: none known
FS: none known
EAK: none known
RG: none known
RF: none known
MIO: none known

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

For this update, published in 2021, we made the following changes.

Changes to the search methods

The Cochrane Incontinence Specialised Register now also covers MEDLINE In-Process, MEDLINE Epub Ahead of Print, ClinicalTrials.gov, WHO ICTRP, Be Part of Research and handsearching of journals and conference proceedings as well as MEDLINE and Cochrane Central Register of Controlled Trials (CENTRAL). Embase is now searched centrally for Cochrane and the search of CENTRAL for the Cochrane Incontinence Specialised Register will pick up these Embase records; a separate search of Embase was therefore not conducted. CINAHL was searched to ensure coverage of the nursing and allied health professions' literature. By the time of the last search run for this review,

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the CINAHL search had been incorporated into the search for the Cochrane Incontinence Specialised Register and was not run separately for this review; please see Appendix 2 for further details.

Changes to outcomes

After reviewing the original protocol for this review, we decided to add the following clinically important outcomes to bring the updated review in line with the GRADE recommendations to report outcomes deemed important for clinical decision making.

- Patient pain or discomfort
- Urinary incontinence
- Number of patients reporting dysuria/difficulty passing urine
- Symptomatic catheter-associated urinary tract infection (CAUTI)
- Post-void residual volume
- Asymptomatic bacteriuria
- Other complications of catheterisation (or recatheterisation), for example, haemorrhage, stricture formation, fever
- Number of patients not discharged on day of indwelling urethral catheter removal
- Time between removal of catheter to discharge (days)

The following outcomes were removed from the previous update (in 2007) as they were deemed to be either not clinically relevant or not related to short-term urethral catheterisation: indwelling urethral catheter not removed on time; deep vein thrombosis (DVT); secondary haemorrhage; recurrence of strictures; long-term urinary complications (unspecified); post-operative fever; number of patients not discharged on day of indwelling urethral catheter removal.

Changes to methods

The review authors re-abstracted trial data for all previously and newly included trials, as well as assessing the risk of bias in all included trials. The GRADE approach for assessing the certainty of evidence was adopted for five critical outcomes which are included in the summary of findings tables.

Post-hoc subgroup analysis

We performed post-hoc subgroup analysis for one outcome in comparison 2 to assess whether the use of prophylactic antibiotics would impact the number of participants developing symptomatic CAUTI (Analysis 2.6). This was not stated in our protocols or methods section and was conducted after the results were obtained to assess the effect of prophylactic antibiotics on participants developing symptomatic CAUTI. It could not be performed for the other comparisons due to an insufficient number of trials reporting whether antibiotic prophylaxis was used.

Similarly, we performed post hoc subgroup analysis for length of hospitalisation in comparison 2 to explore possible reasons for very high heterogeneity.

INDEX TERMS

Medical Subject Headings (MeSH)

Bias; Catheter-Related Infections [etiology]; *Catheters, Indwelling [adverse effects]; Device Removal [methods] [*standards]; Length of Stay; Randomized Controlled Trials as Topic; Time Factors; Urethra; Urinary Catheterization [*instrumentation]; Urinary Tract Infections [etiology]; Urination

MeSH check words

Adult; Female; Humans; Male

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