BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

The clinical, humanistic, and economic outcomes, including experiencing of patient safety events, associated with admitting patients to single rooms compared with shared accommodation for acute hospital admissions. A narrative synthesis systematic literature review.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068932
Article Type:	Original research
Date Submitted by the Author:	20-Oct-2022

Complete List of Authors:	Bertuzzi, Andrea; Crystallise Ltd Martin, Alison; Crystallise Ltd Clarke, Nicola; Crystallise Ltd Springate, Cassandra; Crystallise Ltd Ashton, Rachel; Ashton Editorial Consulting; NHS England and NHS Improvement Midlands The Health Economics Unit, Smith, Wayne; NHS England and NHS Improvement Midlands The Health Economics Unit Orlowski, Andi; Health Economics Unit; Imperial College London, Department of Primary Care and Public Health McPherson, Duncan; NHS England, New Hospital Programme

Keywords:	Economics < TROPICAL MEDICINE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

For peer review only

The clinical, humanistic, and economic outcomes, including experiencing of patient safety events, associated with admitting patients to single rooms compared with shared accommodation for acute hospital admissions. A narrative synthesis systematic literature review.

Authors

Andrea Bertuzzi,[2] Alison Martin (0000-0003-4660-278X),[2] Nicola Clarke,[2] Cassandra Springate (0000-0003-1846-6901),[2] Rachel Ashton (0000-0003-1755-7975),[3] Wayne Smith (0000-0002-4297-1978),[3] Andi Orlowski (0000-0002-1463-9206),[3] Duncan McPherson (0000-0002-2560-8552)[1]

[1]New Hospital Programme, NHS England and Improvement, Skipton House, 80 London Road, London SE1 6LH, UK

[2]Crystallise Ltd, 17 High Street, Stanford le Hope, Essex SS17 0HD, UK

[3]The Health Economics Unit, NHS Midlands and Lancashire Commissioning Support Unit, Heron House, 120 Grove Road, Stoke on Trent ST4 4LX, UK

Correspondence to: Dr Duncan McPherson, NHS England and Improvement, Skipton House, 80 London Road, London, SE1 6LH. duncan.mcpherson1@nhs.net.

Word count, excluding title page, abstract, references, figures and tables 7221

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Summary

What is already known on this topic

- The effects of single rooms versus shared accommodation on hospital inpatients' outcomes are not well understood
- Many studies are qualitative or narrative because randomised controlled trials are not practical and most comparative studies have only become possible after relocation to new facilities
- This systematic review investigated the potential range of impacts that inpatient single rooms and shared accommodation have on the health-care processes, outcomes, and costs

What this study adds

- The evidence, though extensive, revealed no clear advantage for one type of inpatient hospital accommodation for many of the areas assessed.
- There was weak evidence indicating advantages for single bedrooms in some areas, such as lower risk of hospital acquired infection in adult intensive care and a range of outcomes in neonatal intensive care.
- Most patients preferred single rooms for privacy and some preferred shared accommodation for avoiding loneliness.

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Abstract

Objectives: Assess the impact of single rooms versus multioccupancy accommodation on inpatient health-care outcomes and processes.

Design: Systematic review.

Setting: Hospitals and secondary care units.

Participants: Inpatients receiving routine, emergency, high-dependency, or intensive care with a named type of hospital accommodation.

Main outcome measures: Qualitative synthesis of findings.

Results: Of 4,861 citations initially identified, 215 were deemed suitable for full-text review, of which 145 were judged to be relevant to this review. Five main method types were reported: 60 before-and-after comparisons, 75 contemporaneous comparisons, 18 qualitative studies of accommodation preferences, 10 evidence syntheses. All studies had methodological issues that potentially biased the results by not adjusting for confounding factors that are likely to have contributed to the outcomes. Ninety-two papers compared clinical outcomes for patients in single rooms versus shared accommodation, but no clearly consistent conclusions could be drawn about overall benefits of single rooms versus shared accommodation (multioccupancy rooms, bays, or wards). Single rooms were most likely to be associated with a small overall clinical benefit for the most severely ill patients, especially neonates in intensive care. Patients who preferred single rooms tended to do so for privacy, and for reduced disturbances. By contrast, men, older adults, children, and adolescents were more likely to prefer shared accommodation to avoid loneliness. While shared accommodation seemed to be the most cost-effective approach for construction, greater costs associated with building single rooms were small and likely to be recouped over time by other efficiencies.

Conclusions: The lack of difference between inpatient accommodation types in a large number of studies suggests that there would be little effect on clinical outcomes, particularly in routine care. Patients in intensive care areas are most likely to benefit from single rooms. Most patients preferred single rooms for privacy and some preferred shared accommodation for avoiding loneliness.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the largest systematic review of this topic to date, including 145 published studies.
- Because of the limitations of the underlying publications it was not possible to undertake a stronger method such as formal meta-analysis.

Keywords

hospital design; hospital construction; hospital management; hospital administration; health care facility environment; single room; single accommodation; single bedroom; multiple bedroom; single bedroom; multiple bedroom; multiple accommodation; multiple beds

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

INTRODUCTION

The UK government announced that 40 new hospitals will be delivered in England by 2030.(1) The majority will be acute secondary care hospitals. One decision is whether beds should be in a single or multioccupancy room. Once each hospital is built it is difficult to change the proportion of single rooms to shared accommodation. It is important to get this right at the start. Many views have been expressed on the correct proportion of single rooms in a hospital in England. NHS England's National Medical Director, Stephen Powis, believes in "…single rooms being the default…".(2) In response David Oliver wrote that, "… our goal [should] perhaps be a greater proportion of single rooms, rather than these exclusively".(3) The topic has been debated in the British Medical Journal.(4) There is a need for a systematic analysis of the evidence on what is most likely to yield the best outcome for patients..

For some situations isolation of the patient in a single room is part of the clinical intervention. For example, a patient with severe immune compromise may be isolated to protect them from acquiring infection. Similarly, patients with highly transmissible infections may be isolated to prevent spread of infection. A single room is also used where privacy is extremely important, for example delivery units on maternity wards or for dying patients and their families. For most patients, accommodation in either a single or multioccupancy room is possible and may have a range of balanced risks and benefits. Patients may have a range of reasons for their preference including what would count as a good experience of hospital admission. However, there is no settled, obvious evidence base to illustrate what type of accommodation is best for overall patient outcomes or patient experience.

This study set out to find published evidence to investigate whether inpatient stays in single rooms or in shared accommodation (i.e., multioccupancy rooms, bays, or wards), have been associated with any impact on the processes undertaken by the hospital and on patients' outcomes. A wide range of clinical, social, and economic outcomes were included from the primary perspective of patients across a range of acute hospital types. Staff perspectives, while not formally assessed, were included if reported as part of a study on patient and caregiver views. The objective was to compare staying in a single room versus shared accommodation for care in which the type of accommodation was not part of the intervention itself. This systematic review protocol has been registered with PROSPERO, registration number CRD42022311689. Ethics approval was not required for this study.

METHODS

Identification of papers

We performed a systematic literature review of content in Medline (via PubMed) and Embase for comparative clinical trials, observational studies, and systematic literature reviews published in any language up to 17 February 2022. Additional searches were performed via Google Scholar and the National Institute for Health and Care Excellence. We used combinations of "hospital", design", "management", "health care facility", "single", "multi", "room", "bay", "bed", and "accommodation", optimised for the search platform (see supplementary information – Appendix: Search Strategy). Eligible papers addressed care of adult and/or paediatric inpatients staying in hospital for routine, emergency, or intensive care and who were assigned to a particular accommodation type (single room or shared accommodation). We excluded papers that assessed long-stay patients, day patients, and those attending accident and emergency departments who were not later admitted to an acute hospital; patients who were relocated to a single room during admission (e.g., for isolation after contracting and infectious disease or for terminal care); no direct comparison condition for staying in a single room; non-clinical outcomes; and impact of care on

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

health-care professionals and/or support staff. We also excluded narrative reviews, perspective papers, letters, editorials, and conference abstracts with no relevant data.

Retrieved abstracts were screened by two researchers (AB and NC) using the inclusion criteria in the appendix. Disagreements were resolved by discussion with the project leader. Shortlisted papers were retrieved as full texts. The reference lists of all papers included in this analysis were reviewed to identify any additional publications of primary research that met the inclusion criteria. Full papers were screened for relevance by two researchers (AB and AM) independently.

The quality of each paper was assessed by the same researcher using the Downs and Black checklist for observational studies(5) and the Joanna Briggs Institute checklists (https://jbi.global/critical-appraisal-tools) for qualitative studies and for systematic reviews. These checklists enable assessment of reporting quality, generalisability of findings, biases in measurements of intervention and outcome, confounding in the selection of participants, and power (whether negative findings could be the result of chance). Each quality assessment checklist score was converted to a percentage of the maximum possible score and were categorised for the purposes of this report into high (75–100%), moderate (50–74%), or low quality (<50%; see supplementary table 1).

Data extraction and synthesis

Data were extracted into an Excel spreadsheet and checked, with final adjudication by the project leader (AM), and were synthesised narratively, according to the methods of Campbell et al.(6) The fields for extraction were study methodology, baseline characteristics of participants (when provided), clinical outcomes, non-clinical outcomes, resource use, and costs. The clinical outcomes of interest were in-hospital mortality, overall mortality (≥30 days), morbidity (e.g., falls, deterioration, new pressure ulcers, and complications), patient safety incidents, and hospital-acquired infections. Non-clinical outcomes of interest were patient and family member experiences, length of stay, cost of stay, experience of accommodation change and number of changes (for the same type of care) during admission, and impact on the caregivers and family members of dependent patients. Outcomes were assessed based on the measures used in the original articles. Extracted data were sorted by outcome and then by population and setting. Relevant data for each outcome were summarised narratively by comparing heterogeneity across studies in terms of whether differences were statistically significant and in favour of single room or shared accommodation.

Statistical analysis

As substantial heterogeneity across studies (e.g., how data were reported, study methods, etc) was expected, formal meta-analysis was not deemed feasible. Thus, no formal measures of heterogeneity or overall effect size were performed, and all data reported are descriptive. To aid comparison and assess consistency of the conclusions, data are presented in summary tables.

Certainty of findings was assessed based on whether the direction of benefit was consistently statistically significant for single rooms or shared accommodation (across all studies or those with the lowest risk of bias) or was inconsistent or not statistically significant.

There are special areas of hospitals where responses to the intervention might differ, such as intensive-care or paediatric units and areas for women in labour. Therefore, we aimed to present data separately by different subgroups.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Patient and Public Involvement

Patients and the public were not involved in designing this study. The study aim was to establish what is already published in peer reviewed literature on the topic, including the views of patients, their parents or caregivers, and the public.

Ethics Approval

This study did not require ethics approval as it was a study of preexisting published literature, not human participants.

RESULTS

Study characteristics

The initial searches returned 4,861 potentially relevant abstracts. After screening and removal of duplicates, 145 publications were included in this review (Figure 1). There were six main types of studies: 60 before-and-after comparisons (shared accommodation followed by relocation to single-rooms); 75 comparisons of patients allocated to single rooms compared with others simultaneously in shared accommodation; 18 qualitative studies recording the views of patients, caregivers, or healthcare professionals on accommodation preferences; 10 evidence syntheses, including systematic literature reviews, guidelines and other reports; and three economic evaluations of accommodation type (Figure 2). Some studies incorporated more than one design.

All studies had methodological issues that potentially biased the results by not adjusting for confounding factors that are likely to have contributed to the outcomes. In the 60 before-and-after trials, many factors other than accommodation changed due to moving into new facilities, such as unfamiliarity with new layouts and logistics. In the 75 contemporaneous comparisons, reasons for bed space allocations were not generally reported (e.g., availability, severity of illness), making their effects on the differences in outcomes unclear. Nine studies did not report baseline characteristics, and of those that did, only three reported no significant difference between age, sex, and comorbidity or health status of patients at baseline.

The quality of studies varied widely. Thirty-four studies were assigned high quality scores (75–100%) with a range of 78–100% (see supplementary table 1). Twenty-three studies were classified as being of low quality (<50%) with a range of 10–48%.

Mortality

Eighteen studies reported mortality (see Figure 3 and supplementary Table 2).(7–24) Ten were before-and-after studies and the others were contemporary studies. Only one article scored less than 50% for quality and two had high quality scores. Six studies involved neonates/infants, one assessed children, and the remainder were concerned with adult/elderly care. The numbers of deaths were low, meaning that the studies might not have had enough patient-years of follow-up to detect small but statistically significant differences in mortality. Likewise, whether reported increases in mortality reflected true increases in risk or were due to confounding factors (e.g., unreported reasons for patients being allocated single rooms) is unclear.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Routine care

Four studies involved patients receiving routine care,(7,8,16,22), all in adults, none of which found a significant difference in mortality between those in single rooms versus shared accommodation, including up to 1 year after discharge.

Intensive care

Six studies assessed mortality among adults in ICUs.(12,13,17,18,20,24) One study by Bracco and colleagues(17) favoured single rooms. That study included 2,522 adults in ICUs in Canada and reported mortality of 2.9% among those in single rooms or cubicles compared with 8.3% among those in shared accommodation ($p<0.001$). A study of 666 adults in ICUs in Korea with COVID-19 favoured shared accommodation, reporting 2.4% mortality versus 4.6% among those treated in single rooms but no statistical analysis of the difference was reported.(20) The other studies showed no differences between accommodation types.

Seven studies assessed mortality specifically among neonates in ICU.(9–11,15,19,21,23) Three favoured single rooms. Lehtonen et al.(23) assessed 4,662 neonates in 331 neonatal ICUs (NICUs) across 10 countries (Canada, Australia, New Zealand, Finland, Israel, Japan, Spain, Sweden, Switzerland, Italy) and found that those cared for in units with single rooms had lower odds of death or any major morbidity than those in units with no such facilities (adjusted odds ratio 0.76; 95% CI 0.64–0.89). Two papers reported reduced mortality in single rooms among a small population of neonates in intensive care, but statistical significance was not reported.(9,10) By contrast, two studies favoured shared accommodation. Puumala and colleagues(15) reported a lower percentage of deaths among 9,995 neonates. Harris et al.(19,25) assessed NICUs in 11 hospitals in the USA and found fewer deaths among neonates nursed in units with shared accommodation compared with units with single rooms. However, statistical significance was not reported in either.

Lazar et al(14) was the only study to assess children in a paediatric ICU and found no difference between accommodations types.

Patient care and disease management

Twelve publications reported on outcomes related to patient care and disease management (see Figure 3 and supplementary Table 3).(26,8,27–36) All were in adults or non-specified age groups. Three were before-and-after studies, four were contemporaneous studies, and five were evidence syntheses. Four studies had quality scores below 50% but four had scores greater than 75%. All papers assessed routine care.

Most findings favoured single rooms. Significance was shown for improvements in cleanliness,(30) pain management(30), and interactions between patients and medical staff,(31) and other findings were descriptive. A study in Australia of 1,569 orthopaedic patients had fewer emergency calls due to deterioration in condition after a move to single rooms compared with patients in shared accommodation.(8) As room allocation was based partly on severity of illness, nurses tended to position themselves nearer higher-risk patients to aid visualisation. Lawson and Phiri(27) found better patient satisfaction with care and lower analgesic use in orthopaedic patients in single rooms.

Three systematic reviews found that patients in single rooms may have faster recovery due to better sleep and a more pleasant environment,(33) but there was no consistent effect on use of

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

medication.(35) An OECD WHO report concluded that single-room occupancy was associated with reduced pain scores, but due to a lack of detail had a very low quality score (14%).(37)

Findings in favour of shared accommodation were feelings of safety(28) and less use of restraints.(34) In a comparison of only single rooms after a move to a new hospital with only shared accommodation in the previous hospital, falls and medication errors in the medical assessment unit increased notably immediately but by 9 months had fallen to levels lower than previously.(26) However, in the single-room ward for older adults, falls and pressure ulcers significantly increased after the move and remained higher than before moving. No similar trends were seen after the move in a control hospital with 50% single rooms and 50% shared accommodation, and this was the preferred choice of nurses before and after the move (38% and 40%, respectively).

Maternity and neonatal care

Twenty-three studies were found that assessed maternity and neonatal care (see Figure 3 and supplementary Table 4).(10,11,15,38–57) Most (n=14) were before-and after studies and the remainder were contemporaneous studies. Three studies were low quality and only one had a high-quality score. Many of these studies included statistically assessed findings, with most favouring single rooms or showing no difference between accommodation types.

Maternity care

Nine studies considered maternity care and perceptions of mothers and family members.(39,40,42,44,45,47,48,50,51)

Harris and colleagues(41) assessed 976 low-risk patients, 583 of whom received all care in single rooms and 393 in separate labour, delivery, and recovery areas. While overall use of intrapartum interventions was similar, maternal outcomes were better in single rooms. After discharge, Erdeve et al(48) reported that mothers of babies in NICUs who received care in shared accommodation had significantly more acute care visits ($p=0.046$), telephone consultations ($p=0.01$), and rehospitalizations ($p<0.05$) than those cared for in single rooms, and the reasons were more likely to be for issues related to prematurity like feeding difficulties compared with anatomical disorders. This perception is supported by the findings of Janssen et al,(42) which showed that mother in single rooms rated information and instructions at discharge as being clearer than those in shared accommodation.

Multiple studies indicated that satisfaction with care teams was greater in single rooms, including duration and quality of interactions and needs met.(39,40,42–45,47) In one study participants felt that parental presence was greater in single rooms than in shared accommodation.(50) In a US study, women reported less pain in single rooms than in shared accommodation.(43)

Neonatal care

Fourteen papers reported on outcomes in neonatal care.(10,15,38,41–43,46,49,52–57) Many of the results for neonates in ICUs showed no differences in outcomes between accommodation types. Significant improvements were seen in breastfeeding outcomes(10,15,55,58) and weight gain(46,58) in favour of single rooms. However, Tandberg et al(49) reported that longer-term weight gain (4 months) was better after neonatal care in shared accommodation. In two studies, reduced apnoea

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

events were associated with single rooms,(10,59) and in another study less need for mechanical ventilation was reported in single rooms.(55) Significantly reduced neonatal pain scores were also reported.(43)

Complications of disease

Twenty-three articles assessed disease complications (see Figure 3 and supplementary Table 5).(7,8,16–18,22–24,26,34,37,41,43,48,54,56,60–64) Nine were before-and-after studies, 10 were contemporaneous studies, one used a mix of study designs, and three were evidence syntheses. Two articles had quality scores below 50% and two had scores greater than 75%. Findings generally favoured single rooms or showed no differences between accommodation types.

Routine care

Eight papers assessed complications specifically in routine care and all assessed care of adults.(7,10,16,22,41,63–65) Only one study reported results with significance assessed, which showed reduced incidence of delirium among older adults with dementia nursed in single rooms (hazard ratio 0.66, 95% CI 0.48–0.93, $p<0.02$).(65) The Scottish guidelines on delirium recommend reducing light and noise and having familiar items around patients with or at risk of developing delirium,(64) which might be supported by this finding.

In a small relocation study (n=64)(26) pressure injuries seemed to be increased around tenfold in single rooms and falls in 50% or 100% shared accommodation, but a substantial change in case mix made this finding difficult to interpret. By contrast, in a larger non-controlled UK relocation study (n=1,569), no significant difference was noted between different types of accommodation.

The findings for other complications, such as hip fracture rates following falls, thromboembolic events, infections, and other medical complications were not significantly different among orthopaedic patients in single rooms compared with those in shared accommodation in an Australian study.(42) Patients in single rooms were more likely to be female and much more likely to have private health insurance, which may have biased the outcomes.

Intensive care

Twelve papers specified assessments in ICU settings, of which three assessed adults(17,18,24) and nine concerned neonatal care.(23,43,48,54,56,60,60–62) In one study of 1,253 adults in Brazil,(18) delirium was significantly less likely among those in ICU single rooms than in shared accommodation, but no significant difference was seen between groups of elderly patients in different types of ICU accommodation in the Netherlands.(24) Organ failure was reported to be significantly lower in patients managed in single rooms in one study.(17) However, few data are available in adults and most studies reported no differences between accommodation types.

An international study of 4,662 preterm neonates found a significantly lower risk of death or any major morbidity, including sepsis and retinopathy of prematurity, among those nursed in NICUs with single family rooms (odds ratio 0.76, 95% CI 0.64-0.89).(23) In contrast, another study showed lower rates of necrotising enterocolitis and intraventricular haemorrhage in shared accommodation.(46) However, in other studies, rates of these and other serious complications were similar in all ward

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

types.(46,56,59,60) Lester et al(60) found that neonatal stress levels were reduced among babies in NICU single maternity care rooms compared with those in shared accommodation.

Prevention of infection

Fifty-one studies discussed prevention of infection (see Figure 3 and supplementary Table 6).(8,10,11,13–15,17–19,21,26,34–36,46,49,53,56,61,66–98) Twenty were before-and-after studies, 28 were contemporaneous studies, one used a mix of study designs, and three were evidence syntheses. Seven had low quality scores and nine had high quality scores. More than half (n=33) studies reported statistically analysed data.

Routine care

Routine care was assessed in adults in 10 studies(8,69,75,77,79,80,84,87,89,93) and eight involved mixed age populations and care levels that stated or were assumed to include adults and routine care.(26,35,36,67,71,72,88,95) Hospital-acquired infection rates were shown to be reduced in single rooms in six studies.(26,36,67,69,71,87,88) However, in Maben et al,(26) this finding depended on the ward mix: *Clostridium difficile* infections were reduced in single rooms where the split with shared accommodation was half and half, whereas all shared accommodation performed better than all single rooms. In Darley et al(67) this finding was only for *C difficile*, whereas hospital-acquired MRSA rates did not differ by accommodation type. Bocquet et al(78) and Munier-Marion et al(87) found reduced nosocomial influenza infections in single rooms and one study showed a reduced risk of norovirus infection.(82) By contrast, McDonald and colleagues(71) noted reduced infection rates for *Enterococcus* spp, *C difficile*, and MRSA. In a systematic review, Voigt et al(35) concluded that the quality of evidence did not support the use of single rooms over shared accommodation. Indeed, only two studies showed increased infections in shared accommodation.(26,83) Nevertheless, in one study patients(77) preferred single rooms for infection prevention. In a study of more than 1 million patients of all ages across 2018 hospitals in the USA, O'Neill and colleagues(95) found that single rooms were significantly associated with reductions in central-line-associated bloodstream infections.

Seven studies assessed routine care in children.(78,81,82,86,90,96,97) Two found a decrease in nosocomial infections in single rooms – one overall(78) and one for diarrhoea in gastrointestinal and neurosurgical units,(81) but the latter found no difference between accommodation types in a cardiological unit. In two large studies in Finland (n=1,927 and n=5,119), Kinnula and colleagues(96,97) saw increases in hospital-acquired infections among children admitted to shared accommodation in an infectious disease ward because there was no grouping by aetiology. All hospital-acquired infections with symptoms during the hospital stay and 49% of those manifesting after discharge led to diarrhoea. The risk of infection was doubled among children sharing accommodation with patients who had respiratory infections (OR 2.3, 95% CI: 1.1–4.8; p=0.03). Risk decreased per year of age. Among 83,334 children assessed in two hospitals, Quach et al(90) found significantly increased rates of respiratory infections when accommodation was more than 50% single rooms (rate per 1,000 patient-days 1.33, 95% CI 1.29–1.37).

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Intensive care

Outcomes in ICUs were reported specifically in 26 studies, 11 in adults and mixed-age populations,(13,17,18,66,68,70,73,85,91,92,98) one in children,(14) and 14 in neonates.(10,11,15,19,21,46,49,53,56,61,72,74,76,94)

Among adult populations, only one study showed outcomes in favour of shared accommodation, with reductions per 10,000 patient-days in cultures positive for *Enterobacter* spp, *Haemophilus*, *Streptococcus viridans*, *Acinetobacter* spp, *Streptococcus pneumoniae*, Group B *Streptococcus* spp, *Neisseria* spp, and MRSA.(73) However, in the same study, single rooms showed lower rates of infections with many common organisms, such as *Staphylococcus* spp, *C difficile*, and *Pseudomonas* spp. Four studies showed significant data on reduced bacterial infection and transmission in single rooms based on isolates and antibiotic use,(17,66,70,91) although in the study by Halaby et al,(70) transmission of *Morganella* spp, *Proteus* spp, *Serratia* spp, and *Pseudomonas* spp did not differ between accommodation types. Two studies indicated reduced risks of bloodstream infections in single rooms.(17,92) As for routine care, patients perceived infection prevention to be better in single rooms than in share spaces.(68)

Among neonates and among children in ICUs, the findings were mixed. In favour of shared accommodation, four studies reported reduced cases of nosocomial sepsis,(10,15) one reduced colonisation with multidrug-resistant organisms,(46) and one nosocomial infections with pneumonia.(19) Four studies indicated no difference between accommodation types for sepsis or septicaemia and/or found that the use of single rooms was associated with fewer sepsis cases.(15,49,56,74) Only one study showed an increase in sepsis in shared accommodation, and that was specifically in neonates born at or after term.(15)

Patient safety

11 studies considered patient safety (see Figure 3 and supplementary Table 7).(8,16,22,26,34–36,65,84,99,100). Three were before-and-after studies, four were contemporaneous studies, one used mixed design, and three were evidence syntheses. Two had low quality scores and three had high quality scores. Most of the studies assessed routine care or mixed care populations, and generally the populations were adults and elderly people.

Overall, the data showed no differences between accommodation types or favoured shared accommodation. Only the OECD study indicated reduced risk of falls in single rooms,(36) but the quality of this study was deemed to be very low due to reporting very few details of the research. Significantly lower rates of falls were seen in multi-bed accommodation in two studies.(16,22) The study of Poncette et al,(100) which analysed alarm data in an ICU, found that the number of alarms per bed per day was higher in single rooms than in shared accommodation.

Readmissions and reinterventions

Only two studies reported on readmissions and reinterventions (see Figure 3 and supplementary Table 8). They were both contemporaneous studies and one had a quality score of 74% and one of 78%. One showed that single rooms were associated with lower rates of rehospitalisation.(48) The other favoured shared accommodation, with fewer patients returning to theatre within 6 weeks of treatment.(63)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Privacy

Forty-eight publications, including six evidence syntheses, reported on privacy (see supplementary table 9).(8,9,19,26,28,30–34,36,38–42,44,47,51,58,59,68,77,86,98,99,101–122) Eighteen were before-and-after studies, 23 were contemporaneous studies, one used mixed designs, and six were evidence syntheses. Nine had low quality scores but 19 had high quality scores. They were mainly descriptive studies but overwhelmingly favoured single rooms.

Routine care

Twenty-eight studies assessed privacy among adults receiving routine care,(8,26,28,30,31,33,34,36,39,41,42,58,77,99,101,102,105,108,109,112–119) with seven of these reporting statistical analyses.(26,28,30,36,41,42,105,114) Key aspects of privacy in single rooms were improved confidentiality when discussing personal information, use of private bathrooms, and privacy during early post-partum care (e.g., assistance with feeding). However, in the study by Florey and colleagues,(105) 83% of patients in shared rooms also reported feeling that they had adequate privacy. Likewise, the systematic reviews by Taylor and colleagues(34) and Dowdeswell and colleagues(32) found advantages and disadvantages with regards to privacy in all studies they assessed. Patients reported feeling as though they could ask more questions or make more remarks in single rooms than in shared accommodation, and more scored physicians' responses as being empathetic.(31) Qualitative or descriptive studies also strongly supported greater privacy in single rooms.(8,77,99,101,102,108,109,112,115–118,121)

Four studies assessed routine care among children.(86,104,111,120) Boztepe et al(111) found that children did not ranked privacy highly and were more concerned about procedures being painful. In this study many of the children had extensive history of hospitalisation. The other three studies reported greater privacy in single rooms, but children also seemed to enjoy the social aspect of shared accommodation. The main reasons for preferring single rooms were private bathrooms and the capacity for family members to stay. Sleep was an important aspect of care in single rooms for children and parents. (58,86,120)

Intensive care

Nine studies reported on privacy for adults in ICUs, and generally the findings favoured single rooms.(32,34,36,40,44,47,59,68,110) Three studies reported statistical evidence of improved privacy in single rooms among adult patients.(36,40,44) The literature reviews by Dowdeswell and colleagues(32) and Taylor and colleagues(34) showed mixed findings among studies.

Eleven studies addressed neonatal care in ICUs.(9,19,38,40,44,47,51,98,103,106,107) All but two(38,51) favoured single rooms for privacy.

Loneliness/isolation and family contact

Fifty-five publications, five were evidence syntheses, reported patients' views about loneliness or family contact associated with single-room accommodation (see Figure 4 and supplementary Table 10).(9,16,19,25,26,28,30,32,33,36,38,39,42,44,45,47–49,49,50,54,57–59,68,74,77,86,98,99,102,104–110,114,115,117–120,123–132). Twenty were before-and-after studies, 29 were contemporaneous studies, one used mixed study designs, and five were evidence syntheses. Only nine had quality scores less than 50%, while high quality scores were assigned to 17.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Two main themes seemed to be revealed in patients' perspectives: shared accommodation were strongly preferred for social interaction to avoid loneliness/isolation,(9,16,26,28,33,38,47,58,68,77,86,102,104,105,109,114–120,123,124,126,129) whereas single rooms were preferred for privacy (e.g., for bathroom use, during consultations and visits, and to spend with children, particularly neonates).(9,28,32,38,45,47,49,49,50,54,57,59,68,74,77,86,98,104–106,108–110,114,127,130,132)

Noise, disturbance, and sleep

Forty-five publications, four of which were evidence syntheses, reported patients' views about noise, disturbance, and sleep associated with single-room accommodation (see Figure 4 and supplementary Table 11).(8,9,24–26,28,30,32,33,36,38–42,47,54,58,59,68,76,77,86,103,105,107,108,110,112–114,117–119,131,133–141) Sixteen were before-and-after studies, 24 were contemporaneous studies, one used mixed study designs, and four were evidence syntheses. Nine had quality scores less than 50% and 13 had high quality scores.

In general, patients felt that single rooms were quieter and led to less sleep disruption. However, measurement of noise levels showed that there were no substantial objective differences between single rooms and shared accommodation.(30,54,135) One study reported lower noise levels in single rooms, but the difference was not statistically assessed.(76) Stevens et al(54) and Meyer et al(139) found that respiratory support and other medical devices could raise noise levels in single rooms enough to disturb sleep even when ambient noise had been reduced. HCPs also reported that single rooms improved patients' sleep.(9) Poncette and colleagues(100) found that fewer alarms raised in shared accommodation reduced overall noise levels. One study also noted that patients preferred single rooms because they felt they were less likely to disturb other patients.(119) Most studies addressing sleep found that it was improved in single rooms.(28,30,32,33,36,58,59,86,113,114,117,118,136,140) This was generally due to fewer disturbances and/or a perceived quieter environment that in shared accommodation. Hosseini and colleagues(114) and Sakr and colleagues(140) noted that the risk of new-onset insomnia was significantly higher among patients in shared accommodation (95.7% vs 75%, p=0.011).

Humidity and temperature were discussed in one article. Van Enk and colleagues(135) reported that in a NICU with centrally controlled humidity, shared accommodation had non-significantly lower percentage of relative humidity than single rooms but showed much greater variance (26.8% (±17.0) in single rooms vs 26.0% (±89.0)). Both mean values were lower than the recommended range for NICU (30–60%). Temperature could be controlled within individual single rooms and mean values were significantly lower than those in the shared accommodation, which had central temperature control per nursery (mean 73.8^{o}F [range 65.3–77.5^{o}F] in single rooms vs 76.0^{o}F [range 71.1–84.5^{o}F], p=0.0001). More than 85% of readings in both, though, were within the recommended range of 72—78^{o}F, although readings outside the range were too hot in shared accommodation and too cold in single rooms. The authors suggested that thermostats should be allowed to vary only within the recommended range.

Lighting was assessed in three studies, two of which favoured single rooms due to less illumination for neonates (40,54) and one study of patients with delirium that favoured lower light in a shared accommodation.(24)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Satisfaction with care

Fifty-one publications, six of which were evidence syntheses, reported patients' satisfaction with care (see Figure 4 and supplementary Table 12).(8,12,19,25,27,28,30,32,33,35,36,38–40,42,44,49,50,57,58,60,62,74,77,86,99,101,103,105,107–109,111–114,116–119,121,125,128,129,131,133,136,142–146) Fifteen were before-and-after studies, 29 were contemporaneous studies, one used mixed study designs, one was an economic analysis and six were evidence syntheses. The quality scores of ten studies were less than 50% and of 14 were 75–100%.

Overall, results show either little difference between accommodation types or results in favour of single rooms. Single rooms seemed to be favoured most by mothers in maternity units, whereas preference towards shared accommodation seemed to increase with rising age. The economic analysis found that patients were willing to pay for private care to have single rooms.(146)

Routine care

Routine care was assessed in 30 studies (see supplementary table 12).(8,27,28,30,32,33,35,36,39,42,58,77,86,99,101,105,111–114,116–118,121,129,131,133,136,143,144) Patients preferred shared accommodation in seven studies.(33,86,116–118,129,133) Generally they preferred interaction with other patients, and in two reports they stated that they found the shared accommodation more secure and safe.(117,118) Specific reasons given for preferring single rooms were privacy,(30,58,77,99,112,131,133) comfort/environment,(27,42,101,108,143), level of care and information, effect on recovery,(32,36,42,101,113,114,136) and safety.(30,35)

Intensive care

We found 24 reports of intensive care(12,19,25,32,36,38,40,44,50,57–60,62,74,103,107,108,125,128,130,131,143,145). Only two reported findings that favoured shared accommodation. Campbell-Yeo et al(50) found that in an open-bay NICU, mothers reported better self-efficacy and less uncertainty about their babies' health. Also in a NICU, Pineda and colleagues(57) found that the risk of stress among mothers was significantly lower in shared accommodation than in single rooms, although life stress did not differ between accommodation types. By contrast, other assessments of stress found that risk was reduced in single rooms(19,25,60,74,130) or did not differ.(50,62,130) Satisfaction with design/environment, where assessed, favoured single rooms.(59,108)

Findings on satisfaction with maternity care was greater for parents in single rooms in three studies(12,59,60) but did not differ between accommodation types in two.(74,145) Single rooms seemed to have little effect on postpartum depression or irritability, most measures not differing between accommodation types(57,62,74,130,145) and only four findings favouring single rooms.(19,25,50,130)

Only eight of the 51 studies were related to satisfaction with care in other patient populations, involving cardiovascular, cancer, adolescent, or mixed adult care.(12,32,36,58,108,128,131,143) All these studies' findings supported single rooms.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Patient monitoring and safeguarding

Although the impact of single rooms on healthcare staff was not the focus of this review, 14 of the included publications reported the views of HCPs as well as patient-reported outcomes that we used to explore monitoring of patients (see Figure 4 and supplementary Table 13).(11,13,17,21,28,30,47,68,77,106,108,112,114,133) Four were before-and-after studies, eight were contemporaneous studies, one used mixed study designs, and one was an evidence synthesis. No study had a low-quality score. Five of the studies were classified as being of high quality.

Most of the studies presented descriptive/qualitative findings. Three studies reported statistically assessed data, all in relation to routine care and among adult patients. Two(28,114) favoured single rooms, reporting that availability to patients, meeting patients' needs, and access to patients were improved. The fourth study showed no difference between single rooms and shared accommodation for responding to patients' call alerts. One study reported that nurses felt they might spend longer with patients in single rooms, depriving other patients of as much care.(106) In another, safety of patients in units with single rooms was raised as an issue due to increased distances between nurses and patients and impeded observation of patients.(68)

Patient confidentiality

Confidentiality was assessed in 11 studies (see Figure 4 and supplementary Table 14).(26,36,47,68,77,105,106,109,114,115) Five were before-and-after studies, four were contemporaneous studies, one used mixed study designs, and one was an evidence synthesis. Two studies had low quality scores while four had high quality scores.

All studies concluded that patient confidentiality was better maintained when patients were in single rooms, with one study finding no difference for adults with cardiovascular disease in ICU(108) (see supplementary table 14). Malcom et al(115) found that the lack of privacy and confidentiality in shared accommodation affected patients' relationships with other patients.

Availability of beds, space requirements, and capital costs

Sixteen studies reported on beds, space, and costs associated with different accommodation types (see Figure 5 and supplementary Table 15).(10,12,13,21,26,27,38,57,67,90,96,97,106,108,126,147) Nine were before-and-after studies, six were contemporaneous studies, and one used mixed study designs. Two studies had quality scores below 50% and three were classified as being of high quality.

There did not seem to be strong evidence in favour of either accommodation type. The inclusion of single rooms substantially increases the amount of floor space required to achieve the same number of beds as in shared accommodation, with estimates suggesting between 30% and 50% more floor space being required per bed, which increases capital costs.(10,12,26,27,106,126,147) Shared accommodation provides greater flexibility to add beds in times of need.(13,21,57,90,97) Darley and colleagues(67) found that numbers of bed-days lost due to ward closures caused by norovirus outbreaks was greatly reduced after moving to a hospital with 75% single rooms from the previous 10% single rooms.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Length of stay

Fifty-three publications, including two evidence syntheses, reported on length of stay associated with single-room accommodation (see Figure 5 and supplementary Table 16).(7–13,15–20,22–27,35,36,40,41,43,46–49,52,53,55,56,60–63,65,69,73–75,85,91,96,96,107,112,113,125,134,143,147–149) Twenty-eight were before-and-after studies, 23 were contemporaneous studies, one used mixed study designs, and two were evidence syntheses. Five of the studies were classified as being of low quality but only seven fell into the high-quality category. The evidence was highly mixed with no clear benefit from either accommodation type.

Routine care

Of 20 studies assessing routine care, 18 concerned adults and the elderly.(7,8,22,26,27,35,36,41,63,65,69,77,112,113,134,143,147,149) Among these, eight found that length of stay was shorter in single rooms,(7,16,26,27,41,65,112,147,149) but in the study by Maben et al(26) this was true only for an older people's ward and not for a medical assessment unit, and in that by Lawson and Phiri,(27) while it was true for non-surgical orthopaedic patients and psychiatric patients, no difference was seen for surgical orthopaedic patients. One study found that length of stay was shorter in shared accommodation among older patients with dementia, overall and among those who had experienced inpatient falls.(22) No difference in overall length of stay was reported in seven studies, including two evidence syntheses.(8,35,36,63,69,134,143)

The two studies of routine care in children by Kinnula and colleagues showed no difference between accommodation types in one(96) but longer duration of admissions among children in shared accommodation in another.(97)

Intensive care

Of 32 studies assessing length of stay in intensive care, 23 considered neonates(9–11,15,19,23,40,43,46,47,47,48,52,53,55,56,60–62,74,91,107,125,130,148) and nine adults.(12,13,17,18,20,24,73,75,85) As for routine care, the results were highly mixed.

Among the nine studies assessing care of adults in ICUs, five showed no significant differences between single rooms and shared accommodation.(12,13,24,24,75) Teltsch et al(73) assessed care after a change from multi-bed to single rooms and compared the findings to a hospital with no change. The length of stay in the ICU in the comparator hospital increased year on year from 3.8 days to 4.2 days from 2000 to 2005. While higher after the change to single rooms, the length of stay did not change substantially over the same period, and after adjustment was an estimated 10% lower overall (relative ratio 0.90, 95% CI 0–19%). Bracco and colleagues(17) reported that patients were able to stay longer in the same bed in single rooms during infection outbreaks in an ICU, although overall LOS was not significantly different.

In NICUs, statistically significant shorter durations of stay in hospital were reported in three studies. Puumala and colleagues(15) found that stays were shorter for very and extremely preterm babies, but there was no difference between accommodation types for moderately preterm babies, and stays for term and post-term babies were shorter in shared accommodation. Lehtonen et al(23) found that stays were on average 3.4 days shorter (95% CI 3.1–4.7) and van Veenendaal et al(74) found a median difference of 2 days in favour of single rooms. Qualitative/descriptive studies also favoured single rooms in five studies.(9,40,47,107) Three studies identified shorter stays in shared

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

accommodation,(19,56,148) but 13 found no difference between accommodation types(10,11,43,46,48,52,53,55,60–62,125,130).

Costs of care

Nineteen publications, including two evidence syntheses, reported on costs or resource use associated with different types of accommodation (see Figure 5 and supplementary Table 17).(8,16,19,22,25,26,35,41,54,63,91,107,110,132,133,146,148,150) Eight were before-and-after studies, seven were contemporaneous studies, two used mixed study designs, and two were evidence syntheses. Four studies had low quality scores and six had high quality scores.

Several studies reported multiple measures of costs and found evidence supporting both types of accommodation. Therefore, the evidence split was 10 studies finding in favour of single rooms, 10 in favour of shared accommodation and six showing no difference in measures.

Boardman and Forbes recommended taking into account the following construction and running costs, given that single-room facilities required more space to construct: land costs, construction costs, maintenance (refinishing and updating), housekeeping and operating costs, and health care provision (potentially longer distances to cover). Maben et al(26,133) estimated in 2015 that the cost of building a hospital solely comprising single rooms could be around 5% more than building one with predominantly shared accommodation but suggested that the difference becomes marginal over time. Harris and colleagues(25) found that the most cost-effective configuration in terms of construction costs per square foot was a combination of open bays and single rooms.

Findings in favour of single rooms were due to reduced overall staffing costs,(41,150) reduced length of stay,(91,107) reduced waiting and transfer times,(146) higher proportions of patients being discharged to rehabilitation,(63) reduced infections,(91) and operational efficiencies.(35,148) Reasons favouring shared accommodation were lower cleaning and housekeeping costs,(26,133) perceived increased nursing staff,(26,148) and lower labour costs in NICUs.(148)

DISCUSSION

This systematic review identified a substantial body of evidence associated with hospital accommodation, yet no clearly consistent conclusions could be drawn about overall benefits of single rooms versus multi-bed ward spaces. The narrative and heterogeneous nature of much of the evidence also meant that a formal statistical synthesis, such as a meta-analysis, was not feasible. Nevertheless, some themes did emerge and might be worth considering further. Single rooms were most likely to be associated with overall clinical benefit for the most severely ill patients, especially neonates in intensive care, although the evidence is mixed even in these high-risk populations. Patients who preferred single rooms tended to do so for privacy, particularly having a private bathroom, and for reduced disturbances. By contrast, there were distinct patterns of men, older adults, children, and adolescents being more likely to prefer shared accommodation, particularly for the social aspects. While mixed accommodation types seemed to be the most cost-effective approach to construction because the capital cost of single room building is higher than that for shared accommodation, the running costs seem likely to be recouped over time by other efficiencies.

While patients and HCPs expressed preferences, health-care outcomes seem unlikely to be substantially affected by hospital accommodation. This is reassuring because most patients also

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

have little influence over this aspect of their care. Likewise, HCPs might also have little influence over which accommodation type their patients are assigned. Patient or family preferences for single rooms are particularly strong in NICUs and maternity wards, but other groups, in particular men, older adults and adolescents, are more likely to prefer shared accommodation. The split of accommodation and whether the predictable adverse effects of accommodation design can be mitigated in these areas would be worth considering at the planning stages of new buildings.

The average cost per patient of units comprising only single rooms was lower than those consisting of only shared accommodation. Mean direct cost per patient in a single room has been estimated to be 15.5% lower for neonates in ICU and 24% lower for care in maternity units but may be similar or reduced in adults in routine care wards. Shorter length of stay was an important contributor to this difference and could increase the number of patients who can be treated in the beds available. However, the effects found were small and local variations may change the economic picture for a particular hospital. It is also unclear how far the reduced length of stay was due to the single room, and how much was caused by confounding factors associated with being in a new hospital. Nearly all the studies we considered were from high-income regions and mostly based in European or anglophone countries. Thus, policy makers should incorporate local building and labour costs in decisions.

Determining the impact of moving to single-room wards will therefore always need to overcome the impact of confounding factors such as concomitant changes to processes and improvements in other facilities and services that may also have led to the changes, or that may have acted in opposition to the direct effects of the different accommodation.

This study has some limitations. Of 215 articles originally retrieved, we selected 145 for review, which is still a large number. None of the 145 studies used randomised study designs. Randomised controlled studies are not practical to assess hospital accommodation and, therefore, most studies were prone to bias. In particular, in hospitals with mixed single rooms and shared accommodation, patients must be allocated to the rooms, which will be partly due to their medical condition or other personal factors and partly due to bed availability at the time of admission. This introduces selection bias, as the reasons why patients were in single rooms was often not reported. We minimised this bias by excluding studies where the allocation to single rooms or shared accommodation was known to be for an apparent clinical purpose. Additionally, 60 of the publications compared outcomes before and after moving from shared accommodation to single rooms. This introduced confounding, as many factors other than the studied intervention would have changed at the same time, so attributing the outcome to the intervention alone is misleading. The opportunity of building a new hospital is rare. While it provides an ideal platform for before-and-after studies, nearly all of these studies were of a single hospital, so the total number of hospitals studied is low, meaning that uncertainty about risks and benefits remains after this systematic review.

In practical terms, although there are still uncertainties about the true impact of changing to single room wards, the 145 publications synthesised in this report show that the clinical and economic consequences of such a change are likely to be modest. Focussed research on the impact of accommodation type on hospital acquired airborne transmitted infections may be warranted, as may studies of sufficient duration to examine long term productivity changes after opening a new hospital. Because the global effect sizes found were modest, the effects within national systems or for specialist hospitals might be different in size and direction from the global. In particular, none of the included studies were in low or middle income countries, so generalisability to those settings is difficult.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

AUTHORSHIP

All authors wrote sections of the final manuscript. DMcP conceived the study and defined the research question. AM defined the detailed method and arbitrated disagreements. AB and NC conducted the literature screening and data extraction. CS developed the figures and summary tables. RA jointly drafted and edited the final manuscript. AO and WS contributed to conception and organisation of the study design and contributed to editing the manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, a worldwide licence to the Publishers and its licensees in perpetuity, in all forms, formats and media (whether known now or created in the future), to i) publish, reproduce, distribute, display and store the Contribution, ii) translate the Contribution into other languages, create adaptations, reprints, include within collections and create summaries, extracts and/or, abstracts of the Contribution, iii) create any other derivative work(s) based on the Contribution, iv) to exploit all subsidiary rights in the Contribution, v) the inclusion of electronic links from the Contribution to third party material where-ever it may be located; and, vi) licence any third party to do any or all of the above.

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

COMPETING INTERESTS

No authors have had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years. No authors have other relationships or activities that could appear to have influenced the submitted work.

FUNDING

The study was funded by The New Hospital Programme, Department of Health and Social Care, which commissioned the overall research area but had no input into the study design, the collection, analysis, and interpretation of data, the writing of the report, or decision to submit the article for publication. All authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

REGISTRATION

PROSPERO registration number CRD42022311689, registered on 2nd March 2022, after preliminary searches were undertaken and before formal screening began.

DATA AVAILABILITY

All data relevant to the study are included in the article or uploaded as supplementary information

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

REFERENCES

1. UK Government. PM confirms £3.7 billion for 40 hospitals in biggest hospital building programme in a generation [Internet]. GOV.UK. [cited 2022 Jul 11]. Available from: https://www.gov.uk/government/news/pm-confirms-37-billion-for-40-hospitals-in-biggest-hospital-building-programme-in-a-generation

2. Health and Social Care Committee. Oral evidence: Clearing the backlog after the pandemic, HC 599 [Internet]. 2021 [cited 2022 Jul 11]. Available from: https://committees.parliament.uk/oralevidence/2817/pdf/

3. Oliver D. David Oliver: Should single rooms be the default for NHS inpatients? BMJ. 2021 Nov 3;n2612.

4. Pennington H, Isles C. Should hospitals provide all patients with single rooms? BMJ. 2013 Sep 24;347(sep24 2):f5695–f5695.

5. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health. 1998 Jun 1;52(6):377–84.

6. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. BMJ. 2020 Jan 16;368:l6890.

7. Cantoni N, Weisser M, Buser A, Arber C, Stern M, Heim D, et al. Infection prevention strategies in a stem cell transplant unit: impact of change of care in isolation practice and routine use of high dose intravenous immunoglobulins on infectious complications and transplant related mortality - Cantoni - 2009 - European Journal of Haematology - Wiley Online Library [Internet]. [cited 2022 Jul 11]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0609.2009.01249.x

8. Davis M, Elliott R, Hills R, Fry M. Single-Room Ward Design and Its Impact on Service and Patient Outcomes: An Evaluation Study. Orthop Nurs. 2019 Oct;38(5):317–25.

9. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units. J Perinatol. 2010 May;30(5):343–51.

10. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: comparative patient progress in open-ward and single family room units. J Perinatol. 2011 Apr;31(4):281–8.

11. Jansen SJ, Lopriore E, Berkhout RJM, van der Hoeven A, Saccoccia B, de Boer JM, et al. The Effect of Single-Room Care Versus Open-Bay Care on the Incidence of Bacterial Nosocomial Infections in Pre-Term Neonates: A Retrospective Cohort Study. Infect Dis Ther. 2021 Mar;10(1):373–86.

12. Jongerden IP, Slooter AJ, Peelen LM, Wessels H, Ram CM, Kesecioglu J, et al. Effect of intensive care environment on family and patient satisfaction: a before–after study. Intensive Care Med. 2013 Sep 1;39(9):1626–34.

For peer review only

13. Jung J, Choe PG, Choi S, Kim E, Lee HY, Kang CK, et al. Reduction in the acquisition rate of carbapenem-resistant Acinetobacter baumannii (CRAB) after room privatization in an intensive care unit. J Hosp Infect. 2022 Mar 1;121:14–21.

14. Lazar I, Abukaf H, Sofer S, Peled N, Leibovitz E. Impact of Conversion from an Open Ward Design Paediatric Intensive Care Unit Environment to All Isolated Rooms Environment on Incidence of Bloodstream Infections and Antibiotic Resistance in Southern Israel (2000 to 2008) [Internet]. [cited 2022 Jul 11]. Available from: https://journals.sagepub.com/doi/10.1177/0310057X1504300106?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed

15. Puumala SE, Rich RK, Roy L, Reynolds R, Jimenez FE, Opollo JG, et al. Single-family room neonatal intensive care unit design: do patient outcomes actually change? | Journal of Perinatology [Internet]. [cited 2022 Jul 11]. Available from: https://www.nature.com/articles/s41372-019-0584-6

16. Singh I, Okeke J, Edwards C. Outcome of in-patient falls in hospitals with 100% single rooms and multi-bedded wards. Age Ageing. 2015 Nov;44(6):1032–5.

17. Bracco D, Dubois MJ, Bouali R, Eggimann P. Single rooms may help to prevent nosocomial bloodstream infection and cross-transmission of methicillin-resistant Staphylococcus aureus in intensive care units. Intensive Care Med. 2007 May 1;33(5):836–40.

18. Caruso P, Guardian L, Tiengo T, dos Santos LS, Junior PM. ICU Architectural Design Affects the Delirium Prevalence: A Comparison Between Single-Bed and Multibed Rooms*. Crit Care Med. 2014 Oct;42(10):2204–10.

19. Harris DD, Shepley MM, White RD, Kolberg KJS, Harrell JW. The impact of single family room design on patients and caregivers: executive summary. J Perinatol. 2006 Oct;26(3):S38–48.

20. Hyun M, Lee JY, Kwon YS, Kim JY, Park JS, Park S, et al. COVID-19: Comparing the applicability of shared room and single room occupancy. Transbound Emerg Dis. 2021 Jul;68(4):2059–65.

21. Julian S, Burnham CAD, Sellenriek P, Shannon WD, Hamvas A, Tarr PI, et al. Impact of Neonatal Intensive Care Bed Configuration on Rates of Late-Onset Bacterial Sepsis and Methicillin-Resistant Staphylococcus aureus Colonization. Infect Control Hosp Epidemiol. 2015 Oct;36(10):1173–82.

22. Knight S, Singh I. Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards. J Clin Gerontol Geriatr. 2016 Sep;7(3):87–92.

23. Lehtonen L, Lee SK, Kusuda S, Lui K, Norman M, Bassler D, et al. Family Rooms in Neonatal Intensive Care Units and Neonatal Outcomes: An International Survey and Linked Cohort Study. J Pediatr. 2020 Nov;226:112-117.e4.

24. Zaal IJ, Spruyt CF, Peelen LM, van Eijk MMJ, Wientjes R, Schneider MME, et al. Intensive care unit environment may affect the course of delirium. Intensive Care Med. 2013 Mar;39(3):481–8.

25. Harris D, McCuskey M, White R. impact_of_single_family_nicu_rooms_1.pdf [Internet]. 2006 [cited 2022 Jul 12]. Available from: https://www.healthdesign.org/system/files/impact_of_single_family_nicu_rooms_1.pdf

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

26. Maben J, Griffiths P, Penfold C, Simon M, Anderson JE, Robert G, et al. One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. BMJ Qual Saf. 2016 Apr 1;25(4):241–56.

27. Lawson B, Phiri M. Hospital design. Room for improvement. Health Serv J. 2000 Jan 20;110(5688):24–6.

28. Ehrlander W, Ali F, Chretien KC. Multioccupancy hospital rooms: Veterans' experiences and preferences. J Hosp Med. 2009;4(8):E22–7.

29. McKeown K, Haase T, Pratschke J, Twomey S, Donovan H, Engling F. Determinants of care outcomes for patients who die in hospital in Ireland: a retrospective study. BMC Palliat Care. 2015 Dec;14(1):11.

30. Nahas S, Patel A, Duncan J, Nicholl J, Nathwani D. Patient Experience in Single Rooms Compared with the Open Ward for Elective Orthopaedic Admissions. Musculoskeletal Care. 2016 Mar;14(1):57–61.

31. van de Glind I, van Dulmen S, Goossensen A. Physician–patient communication in single-bedded versus four-bedded hospital rooms. Patient Educ Couns. 2008 Nov 1;73(2):215–9.

32. Dowdeswell B, Erskine J, Heasman M. A Report for NHS Estates, England by the EU Health Property Network. :40.

33. Søndergaard SF, Beedholm K, Kolbæk R, Frederiksen K. Patients' and Nurses' Experiences of All Single-Room Hospital Accommodation: A Scoping Review. HERD Health Environ Res Des J. 2022 Jan;15(1):292–314.

34. Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. HERD Health Environ Res Des J. 2018 Jan;11(1):85–100.

35. Voigt J, Mosier M, Darouiche R. Private Rooms in Low Acuity Settings: A Systematic Review of the Literature. HERD Health Environ Res Des J. 2018 Jan;11(1):57–74.

36. OECD, World Health Organization. Improving Healthcare Quality in Europe: Characteristics, Effectiveness and Implementation of Different Strategies [Internet]. OECD; 2019 [cited 2022 Jul 11]. Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/improving-healthcare-quality-in-europe_b11a6e8f-en

37. Rechel B, European Health Property Network, European Observatory on Health Systems and Policies, editors. Capital investment for health: case studies from Europe. Copenhagen, Denmark: European Health Property Network : European Observatory on Health Systems and Policies; 2009. 190 p. (Observatory studies series).

38. Stelwagen M, van Kempen A, Westmaas A, Vet E, Scheele F. Parents' Experiences With a Model of Integrated Maternity and Neonatal Care Designed to Empower Parents. J Obstet Gynecol Neonatal Nurs. 2021 Mar;50(2):181–92.

39. Olson ME, Smith MJ. An evaluation of single-room maternity care. Health Care Manag. 1992 Sep;11(1):43–9.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

40. Carter BS, Carter A, Bennett S. Families' views upon experiencing change in the neonatal intensive care unit environment: from the 'baby barn' to the private room. J Perinatol Off J Calif Perinat Assoc. 2008 Dec;28(12):827–9.

41. Harris SJ, Farren MD, Janssen PA, Klein MC, Lee SK. Single Room Maternity Care: Perinatal Outcomes, Economic Costs, and Physician Preferences. J Obstet Gynaecol Can. 2004 Jul;26(7):633–40.

42. Janssen PA, Klein MC, Harris SJ, Soolsma J, Seymour LC. Single Room Maternity Care and Client Satisfaction. Birth. 2000;27(4):235–43.

43. Lester BM, Hawes K, Abar B, Sullivan M, Miller R, Bigsby R, et al. Single-Family Room Care and Neurobehavioral and Medical Outcomes in Preterm Infants. Pediatrics. 2014 Oct 1;134(4):754–60.

44. Swanson JR, Peters C, Lee BH. NICU redesign from open ward to private room: a longitudinal study of parent and staff perceptions. J Perinatol. 2013 Jun;33(6):466–9.

45. Toivonen M, Lehtonen L, Löyttyniemi E, Axelin A. Effects of single-family rooms on nurse-parent and nurse-infant interaction in neonatal intensive care unit. Early Hum Dev. 2017 Mar 1;106–107:59–62.

46. van der Hoeven A, Bekker V, Jansen SJ, Saccoccia B, Berkhout RJM, Lopriore E, et al. Impact of transition from open bay to single room design neonatal intensive care unit on multidrug-resistant organism colonization rates. J Hosp Infect. 2022 Feb;120:90–7.

47. Bodack E, Schenk O, Karutz H. Die Einrichtung von Einzelzimmern auf neonatologischen Intensivstationen – Auswirkungen auf die Betreuung aus Sicht der Eltern. Z Für Geburtshilfe Neonatol. 2016 Jun;220(3):124–9.

48. Erdeve O, Arsan S, Yigit S, Armangil D, Atasay B, Korkmaz A. The impact of individual room on rehospitalization and health service utilization in preterms after discharge. Acta Paediatr. 2008;97(10):1351–7.

49. Tandberg BS, Flacking R, Markestad T, Grundt H, Moen A. Parent psychological wellbeing in a single-family room versus an open bay neonatal intensive care unit. Baud O, editor. PLOS ONE. 2019 Nov 5;14(11):e0224488.

50. Campbell-Yeo M, Kim T, Disher T, Richardson B, Dol J, Bishop T, et al. Do Single-Family Rooms Increase Parental Presence, Involvement, and Maternal Well-Being in Neonatal Intensive Care? J Perinat Neonatal Nurs. 2021 Oct;35(4):350–61.

51. Dowling DA, Blatz MA, Graham G. Mothers' Experiences Expressing Breast Milk for Their Preterm Infants: Does NICU Design Make a Difference? Adv Neonatal Care. 2012 Dec;12(6):377–84.

52. Erickson C, Kattelmann K, Ren C, Helseth CC, Stevents DC. Traditional open-bay versus single-family room neonatal intensive care unit: a comparison of selected nutrition outcomes. Res Rep Neonatol. 2011 Mar;15.

53. Hourigan SK, Subramanian P, Hasan NA, Ta A, Klein E, Chettout N, et al. Comparison of Infant Gut and Skin Microbiota, Resistome and Virulome Between Neonatal Intensive Care Unit (NICU) Environments. Front Microbiol. 2018 Jun 25;9:1361.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

54. Stevens DC, Helseth CC, Thompson PA, Pottala JV, Khan MA, Munson DP. A Comprehensive Comparison of Open-Bay and Single-Family-Room Neonatal Intensive Care Units at Sanford Children's Hospital. HERD. 2012;5(4):23–39.

55. Grundt H, Tandberg BS, Flacking R, Drageset J, Moen A. Associations Between Single-Family Room Care and Breastfeeding Rates in Preterm Infants. J Hum Lact. 2021 Aug;37(3):593–602.

56. Vohr B, McGowan E, McKinley L, Tucker R, Keszler L, Alksninis B. Differential Effects of the Single-Family Room Neonatal Intensive Care Unit on 18- to 24-Month Bayley Scores of Preterm Infants. J Pediatr. 2017 Jun;185:42-48.e1.

57. Pineda RG, Stransky KE, Rogers C, Duncan MH, Smith GC, Neil J, et al. The single-patient room in the NICU: maternal and family effects. J Perinatol. 2012 Jul;32(7):545–51.

58. Nassery W, Landgren K. Parents' Experience of Their Sleep and Rest When Admitted to Hospital with Their Ill Child: A Qualitative Study. Compr Child Adolesc Nurs. 2019 Oct 2;42(4):265–79.

59. Stevens DC, Helseth CC, Khan MA, Munson DP, Reid EJ. A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. HERD Health Environ Res Des J. 2011 Apr;4(3):110–23.

60. Lester BM, Salisbury AL, Hawes K, Dansereau LM, Bigsby R, Laptook A, et al. 18-Month Follow-Up of Infants Cared for in a Single-Family Room Neonatal Intensive Care Unit. J Pediatr. 2016 Oct;177:84–9.

61. Monson BB, Eaton-Rosen Z, Kapur K, Liebenthal E, Brownell A, Smyser CD, et al. Differential Rates of Perinatal Maturation of Human Primary and Nonprimary Auditory Cortex. eneuro. 2018 Jan;5(1):ENEURO.0380-17.2017.

62. Erdeve O, Arsan S, Canpolat F, Ertem I, Karagol B, Atasay B, et al. Does Individual Room Implemented Family-Centered Care Contribute to Mother–Infant Interaction in Preterm Deliveries Necessitating Neonatal Intensive Care Unit Hospitalization? Am J Perinatol. 2009 Feb;26(02):159–64.

63. Felice Tong YY, Karunaratne S, Youlden D, Gupta S. The Impact of Room-Sharing on Length of Stay After Total Hip or Knee Arthroplasty: A Retrospective Study. Arthroplasty Today. 2021 Apr;8:289-294.e2.

64. Scottish Intercollegiate Guidelines Network, Healthcare Improvement Scotland. Delirium: a booklet for people who have experienced delirium, and for their carers. 2020.

65. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Single-bed rooms in a geriatric ward prevent delirium in older patients. Aging Clin Exp Res. 2020 Jan;32(1):141–7.

66. Bonizzoli M, Bigazzi E, Peduto C, Tucci V, Zagli G, Pecile P, et al. Microbiological survey following the conversion from a bay-room to single-room intensive care unit design. J Hosp Infect. 2011 Jan;77(1):84–6.

67. Darley ESR, Vasant J, Leeming J, Hammond F, Matthews S, Albur M, et al. Impact of moving to a new hospital build, with a high proportion of single rooms, on healthcare-associated infections and outbreaks. J Hosp Infect. 2018 Feb;98(2):191–3.

For peer review only

68. Ferri M, Zygun DA, Harrison A, Stelfox HT. Evidence-based design in an intensive care unit: End-user perceptions. BMC Anesthesiol. 2015 Dec;15(1):57.

69. Gregersen M, Mellemkjær A, Foss CH, Blandfort S. Use of single-bed rooms may decrease the incidence of hospital-acquired infections in geriatric patients: A retrospective cohort study in Central Denmark region. J Health Serv Res Policy. 2021 Oct;26(4):282–8.

70. Halaby T, al Naiemi N, Beishuizen B, Verkooijen R, Ferreira JA, Klont R, et al. Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. Antimicrob Resist Infect Control. 2017 Dec;6(1):117.

71. McDonald EG, Dendukuri N, Frenette C, Lee TC. Time-Series Analysis of Health Care–Associated Infections in a New Hospital With All Private Rooms. JAMA Intern Med. 2019 Nov 1;179(11):1501.

72. Song X, Soghier L, Floyd TT, Harris TR, Short BL, DeBiasi RL. Reassessing the need for active surveillance of extended-spectrum beta-lactamase–producing Enterobacteriaceae in the neonatal intensive care population. Infect Control Hosp Epidemiol. 2018 Dec;39(12):1436–41.

73. Teltsch DY, Hanley J, Loo V, Goldberg P, Gursahaney A, Buckeridge DL. Infection Acquisition Following Intensive Care Unit Room Privatization. Arch Intern Med [Internet]. 2011 Jan 10 [cited 2022 Jul 14];171(1). Available from: http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinternmed.2010.469

74. van Veenendaal NR, van der Schoor SRD, Heideman WH, Rijnhart JJM, Heymans MW, Twisk JWR, et al. Family integrated care in single family rooms for preterm infants and late-onset sepsis: a retrospective study and mediation analysis. Pediatr Res. 2020 Oct;88(4):593–600.

75. Vietri NJ, Dooley DP, Davis CE, Longfield JN, Meier PA, Whelen AC. The effect of moving to a new hospital facility on the prevalence of methicillin-resistant Staphylococcus aureus. Am J Infect Control. 2004 Aug;32(5):262–7.

76. Walsh WF, McCullough KL, White RD. Room for improvement: nurses' perceptions of providing care in a single room newborn intensive care setting. Adv Neonatal Care Off J Natl Assoc Neonatal Nurses. 2006 Oct;6(5):261–70.

77. Bevan V, Edwards C, Woodhouse K, Singh I. Dignified care for older people: Mixed methods evaluation of the impact of the hospital environment - single rooms or multi-bedded wards: Healthy Aging Res. 2016;5(13):1–8.

78. Bocquet A, Wintenberger C, Lupo J, Morand P, Pavese P, Gallouche M, et al. Description of an influenza outbreak in a French university hospital and risk factors of nosocomial influenza. Eur J Clin Microbiol Infect Dis. 2021 Apr;40(4):879–84.

79. Cobo J, Asensio Á, Moreno S, Navas E, Pintado V, Oliva J, et al. Risk factors for nosocomial transmission of multidrug-resistant tuberculosis due to Mycobacterium bovis among HIV-infected patients. :6.

80. Everts RJ, Hanger HC, Jennings LC, Hawkins A, Sainsbury R. Outbreaks of influenza A among elderly hospital inpatients. N Z Med J. 1996 Jul 26;109(1026):272–4.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

81. Ford-Jones EL, Mindorff CM, Gold R, Petric M. THE INCIDENCE OF VIRAL-ASSOCIATED DIARRHEA AFTER ADMISSION TO A PEDIATRIC HOSPITAL. Am J Epidemiol. 1990 Apr;131(4):711–8.

82. Fraenkel Cj, Inghammar M, Söderlund-Strand A, Johansson PJH, Böttiger B. Risk factors for hospital norovirus outbreaks: impact of vomiting, genotype, and multi-occupancy rooms. J Hosp Infect. 2018 Apr;98(4):398–403.

83. Jou J, Ebrahim J, Shofer FS, Hamilton KW, Stern J, Han JH. Environmental Transmission of *Clostridium difficile* : Association Between Hospital Room Size and *C. difficile* Infection. Infect Control Hosp Epidemiol. 2015 May;36(5):564–8.

84. Lorenz SG, Dreher HM. Hospital Room Design and Health Outcomes of the Aging Adult. PA P E R S. 2011;4(2):14.

85. Mattner F, Rüden AS, Mattner L, Chaberny IF, Ziesing S, Strueber M, et al. Thoracic organ transplantation may not increase the risk of bacterial transmission in intensive care units. Int J Hyg Environ Health. 2007 Mar;210(2):139–45.

86. Morgan H. Single and shared accommodation for young patients in hospital: Helen Morgan considers the importance of designing hospital units that ensure patient safety and security without limiting the opportunity for socialisation. Paediatr Care. 2010 Sep 28;22(8):20–4.

87. Munier-Marion E, Bénet T, Régis C, Lina B, Morfin F, Vanhems P. Hospitalization in double-occupancy rooms and the risk of hospital-acquired influenza: a prospective cohort study. Clin Microbiol Infect. 2016 May;22(5):461.e7-461.e9.

88. Park SH, Stockbridge EL, Miller TL, O'Neill L. Private patient rooms and hospital-acquired methicillin-resistant Staphylococcus aureus: A hospital-level analysis of administrative data from the United States. Klein EY, editor. PLOS ONE. 2020 Jul 9;15(7):e0235754.

89. Pilmis B, Billard-Pomares T, Martin M, Clarempuy C, Lemezo C, Saint-Marc C, et al. Can environmental contamination be explained by particular traits associated with patients? J Hosp Infect. 2020 Mar;104(3):293–7.

90. Quach C, Shah R, Rubin LG. Burden of Healthcare-Associated Viral Respiratory Infections in Children's Hospitals. J Pediatr Infect Dis Soc. 2018 Feb 19;7(1):18–24.

91. Sadatsafavi H, Niknejad B, Zadeh R, Sadatsafavi M. Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. J Crit Care. 2016 Feb;31(1):194–200.

92. Stiller A, Schröder C, Gropmann A, Schwab F, Behnke M, Geffers C, et al. ICU ward design and nosocomial infection rates: a cross-sectional study in Germany. J Hosp Infect. 2017 Jan;95(1):71–5.

93. Vaisman A, Jula M, Wagner J, Winston LG. Examining the association between hospital-onset Clostridium difficile infection and multiple-bed room exposure: a case-control study. Infect Control Hosp Epidemiol. 2018 Sep;39(9):1068–73.

94. Washam MC, Ankrum A, Haberman BE, Staat MA, Haslam DB. Risk Factors for *Staphylococcus aureus* Acquisition in the Neonatal Intensive Care Unit: A Matched Case-Case-Control Study. Infect Control Hosp Epidemiol. 2018 Jan;39(1):46–52.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

95. O'Neill L, Park SH, Rosinia F. The role of the built environment and private rooms for reducing central line-associated bloodstream infections. Kamolz LP, editor. PLOS ONE. 2018 Jul 27;13(7):e0201002.

96. Kinnula SE, Renko M, Tapiainen T, Knuutinen M, Uhari M. Hospital-associated infections during and after care in a paediatric infectious disease ward. J Hosp Infect. 2008 Apr;68(4):334–40.

97. Kinnula S, Buettcher M, Tapiainen T, Renko M, Vepsäläinen K, Lantto R, et al. Hospital-associated infections in children: a prospective post-discharge follow-up survey in three different paediatric hospitals. J Hosp Infect. 2012 Jan;80(1):17–24.

98. Liu LX, Mozafarinia M, Axelin A, Feeley N. Parents' Experiences of Support in NICU Single-Family Rooms. Neonatal Netw NN. 2019 Mar 1;38(2):88–97.

99. Reid J, Wilson K, Anderson KE, Maguire CPJ. Older inpatients' room preference: single versus shared accommodation. Age Ageing. 2015 Mar;44(2):331–3.

100. Poncette AS, Wunderlich MM, Spies C, Heeren P, Vorderwülbecke G, Salgado E, et al. Patient Monitoring Alarms in an Intensive Care Unit: Observational Study With Do-It-Yourself Instructions. J Med Internet Res. 2021 May 28;23(5):e26494.

101. Janssen PA, Dennis CL, Reime B. Development and psychometric testing of The Care in Obstetrics: Measure for Testing Satisfaction (COMFORTS) scale. Res Nurs Health. 2006 Feb;29(1):51–60.

102. Anåker A. "It's Lonely": Patients' Experiences of the Physical Environment at a Newly Built Stroke Unit. Des J. :12.

103. Carlson B, Walsh S, Wergin T, Schwarzkopf K, Ecklund S. Challenges in design and transition to a private room model in the neonatal intensive care unit. Adv Neonatal Care Off J Natl Assoc Neonatal Nurses. 2006 Oct;6(5):271–80.

104. Curtis P, Northcott A. The impact of single and shared rooms on family-centred care in children's hospitals. J Clin Nurs. 2017 Jun;26(11–12):1584–96.

105. Florey L, Flynn R, Isles C. Patient Preferences for Single Rooms or Shared Accommodation in a District General Hospital. Scott Med J. 2009 May;54(2):5–8.

106. Jones L, Peters K, Rowe J, Sheeran N. The Influence of Neonatal Nursery Design on Mothers' Interactions in the Nursery. J Pediatr Nurs. 2016 Oct;31(5):e301-312.

107. Milford C, Zapalo B, Davis G. Transition to an Individual-Room NICU Design: Process and Outcome Measures. Neonatal Netw. 2008 Sep;27(5):299–305.

108. Real K, Fay L. Using Systems Theory to Examine Patient and Nurse Structures, Processes, and Outcomes in Centralized and Decentralized Units. :16.

109. Roos AKØ, Skaug EA, Grøndahl VA, Helgesen AK. Trading company for privacy: A study of patients' experiences. Nurs Ethics. 2020 Jun;27(4):1089–102.

110. Apple M. A Comparative Evaluation of Swedish Intensive Care Patient Rooms. HERD Health Environ Res Des J. 2014 Apr;7(3):78–93.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

111. Boztepe H, Çınar S, Ay A. School-age children's perception of the hospital experience. J Child Health Care. 2017 Jun;21(2):162–70.

112. Deitrick LM, Bokovoy J, Panik A. The "Dance" Continues ... Evaluating Differences in Call Bell Use Between Patients in Private Rooms and Patients in Double Rooms Using Ethnography. J Nurs Care Qual. 2010 Oct;25(4):279–87.

113. Douglas CH, Douglas MR. Patient-centred improvements in health-care built environments: perspectives and design indicators. Health Expect. 2005 Sep;8(3):264–76.

114. Hosseini SB, Bagheri M. Comparison of Patient Satisfaction with Single Patient Rooms Versus Shared Patient Rooms. Ann Mil Health Sci Res [Internet]. 2018 Jul 8 [cited 2022 Jul 20];15(4). Available from: https://brief.land/amhsr/articles/80199.html

115. Malcolm HA. Does privacy matter? Former patients discuss their perceptions of privacy in shared hospital rooms. Nurs Ethics. 2005 Mar;12(2):156–66.

116. Nash P, Vanhoof J, Hall S, Arulmani U, Tarzynski-Potempa R, Unnebrink K, et al. Randomized Crossover Comparison of Injection Site Pain with 40 mg/0.4 or 0.8 mL Formulations of Adalimumab in Patients with Rheumatoid Arthritis. Rheumatol Ther. 2016 Dec;3(2):257–70.

117. Persson E, Määttä S. To provide care and be cared for in a multiple-bed hospital room: *Care in a multiple-bed hospital room*. Scand J Caring Sci. 2012 Dec;26(4):663–70.

118. Persson E, Anderberg P, Kristensson Ekwall A. A room of one's own - Being cared for in a hospital with a single-bed room design. Scand J Caring Sci. 2015 Jun;29(2):340–6.

119. Rowlands J, Noble S. How does the environment impact on the quality of life of advanced cancer patients? A qualitative study with implications for ward design. Palliat Med. 2008 Sep;22(6):768–74.

120. Schalkers I, Dedding CWM, Bunders JFG. '[I would like] a place to be alone, other than the toilet' - Children's perspectives on paediatric hospital care in the Netherlands. Health Expect. 2015 Dec;18(6):2066–78.

121. Bradbury-Jones C, Rattray J, Jones M, MacGillivray S. Promoting the health, safety and welfare of adults with learning disabilities in acute care settings: a structured literature review. J Clin Nurs. 2013;22(11–12):1497–509.

122. Mental Welfare Commission for Scotland. Psychiatr Bull. 1991 Apr;15(4):254–5.

123. Anåker A, von Koch L, Sjöstrand C, Bernhardt J, Elf M. A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction—The significance of the built environment. Martinuzzi A, editor. PLOS ONE. 2017 Jul 20;12(7):e0177477.

124. Cusack L, Wiechula R, Schultz T, Dollard J, Maben J. Anticipated advantages and disadvantages of a move to 100% single-room hospital in Australia: A case study. J Nurs Manag. 2019 Jul;27(5):963–70.

125. Kainiemi E, Hongisto P, Lehtonen L, Pape B, Axelin A. Effects of single family room architecture on parent–infant closeness and family centered care in neonatal environments—a single-center pre–post study. J Perinatol. 2021 Sep;41(9):2244–51.

For peer review only

126. Rosbergen ICM, Tonello I, Clark RA, Grimley RS. Does hospital design impact on patient activity levels and time spent alone? Disabil Rehabil. 2022 Jun 19;44(13):3173–80.

127. Darcy Mahoney A, White RD, Velasquez A, Barrett TS, Clark RH, Ahmad KA. Impact of restrictions on parental presence in neonatal intensive care units related to coronavirus disease 2019. J Perinatol. 2020 Sep;40(S1):36–46.

128. de Matos LBN, Fumis RRL, Nassar Junior AP, Lacerda FH, Caruso P. Single-Bed or Multibed Room Designs Influence ICU Staff Stress and Family Satisfaction, But Do Not Influence ICU Staff Burnout. HERD. 2020 Apr;13(2):234–42.

129. Pease NJ, Finlay IG. Do patients and their relatives prefer single cubicles or shared wards? Palliat Med. 2002 Jul;16(5):445–6.

130. Tandberg BS, Frøslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. J Perinat Neonatal Nurs. 2018 Dec;32(4):E22–32.

131. Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. HERD Health Environ Res Des J. 2018 Jan;11(1):85–100.

132. Chaudhury H, Mahmood A, Valente M. The use of single patient rooms versus miltiple occupancy rooms in acute care environments [Internet]. 2004 [cited 2022 Jul 21]. Available from: https://www.healthdesign.org/sites/default/files/use_of_single_patient_rooms_v_multiple_occ._rooms-acute_care.pdf

133. Maben J, Griffiths P, Penfold C, Simon M, Pizzo E, Anderson J, et al. Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation [Internet]. Southampton (UK): NIHR Journals Library; 2015 [cited 2022 Jul 21]. (Health Services and Delivery Research). Available from: http://www.ncbi.nlm.nih.gov/books/NBK274434/

134. Pyrke RJL, McKinnon MC, McNeely HE, Ahern C, Langstaff KL, Bieling PJ. Evidence-Based Design Features Improve Sleep Quality Among Psychiatric Inpatients. HERD Health Environ Res Des J. 2017 Oct;10(5):52–63.

135. Van Enk RA, Steinberg F. Comparison of Private Room with Multiple-Bed Ward Neonatal Intensive Care Unit Environments. HERD Health Environ Res Des J. 2011 Oct;5(1):52–63.

136. Eberhard-Gran M, Eskild A, Opjordsmoen S, Schei B. Maternity care - sleep, rest and satisfaction. :10.

137. Edéll-Gustafsson U, Angelhoff C, Johnsson E, Karlsson J, Mörelius E. Hindering and buffering factors for parental sleep in neonatal care. A phenomenographic study. J Clin Nurs. 2015 Mar;24(5–6):717–27.

138. Foo CT, O'Driscoll DM, Ogeil RP, Lubman D, Young AC. Barriers to sleep in acute hospital settings. Sleep Breath. 2022 Jun;26(2):855–63.

139. Meyer TJ, Eveloff SE, Bauer MS, Schwartz WA, Hill NS, Millman RP. Adverse Environmental Conditions in the Respiratory and Medical ICU Settings. Chest. 1994 Apr;105(4):1211–6.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

140. Sakr N, Hallit S, Mattar H. Incidence of and Factors Associated with New-Onset Insomnia Among Lebanese Hospitalised Patients: A single-centre study. Sultan Qaboos Univ Med J SQUMJ. 2021 Jun 21;21(2):e210-220.

141. Tegnestedt C, Günther A, Reichard A, Bjurström R, Alvarsson J, Martling CR, et al. Levels and sources of sound in the intensive care unit - an observational study of three room types: Levels and sources of sound in a multidisciplinary ICU. Acta Anaesthesiol Scand. 2013 Sep;57(8):1041–50.

142. Stevens DC, Helseth CC, Khan MA, Munson DP, Reid EJ. A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. HERD Health Environ Res Des J. 2011 Apr;4(3):110–23.

143. Labarère J, Fourny M, Jean-Phillippe V, Marin-Pache S, Patrice F. Refinement and validation of a French in-patient experience questionnaire. Int J Health Care Qual Assur. 2004 Jan 1;17(1):17–25.

144. Miller NO, Friedman SB, Coupey SM. Adolescent preferences for rooming during hospitalization. J Adolesc Health. 1998 Aug;23(2):89–93.

145. Watson J, DeLand M, Gibbins S, MacMillan York E, Robson K. Improvements in Staff Quality of Work Life and Family Satisfaction Following the Move to Single-Family Room NICU Design. Adv Neonatal Care. 2014 Apr;14(2):129–36.

146. Boardman AE, Forbes D. A Benefit-Cost Analysis of Private and Semi-Private Hospital Rooms. J Benefit-Cost Anal. 2011 Jan 3;2(1):1–27.

147. Ruka K, Kenichi K, Juno K. Study on the effect of private rooms in wards on bed management COMPASRtAuTdIyVEonSTthUeDIeEfSfeOcNt oHfOpSriPvIaTtAeLr-BoEoDmMs AinNwAGaErdMsEoNnT bBeEdTWmEaEnNagement. :9.

148. Stevens DC, Thompson PA, Helseth CC, Hsu B, Khan MA, Munson DP. A comparison of the direct cost of care in an open-bay and single-family room NICU. J Perinatol. 2014 Nov;34(11):830–5.

149. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Analgesic and psychoactive medications and the risk of falls in relation to delirium in single-bed rooms compared to multiple-bed rooms in geriatric inpatients. Aging Clin Exp Res. 2020 Aug;32(8):1493–9.

150. Reed G, Schmid M. Nursing Implementation of Single-Room Maternity Care. J Obstet Gynecol Neonatal Nurs. 1986 Sep;15(5):386–9.

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

FIGURE LEGENDS

Figure 1. Selection of papers for review

Figure 2. Percentage of studies reporting data in favour of either single-room or shared-room design, according to the type of data available and outcome reported

Figure 3. Clinical outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

Figure 4. Patient-experience outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

Figure 5. Economic outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

For peer review only

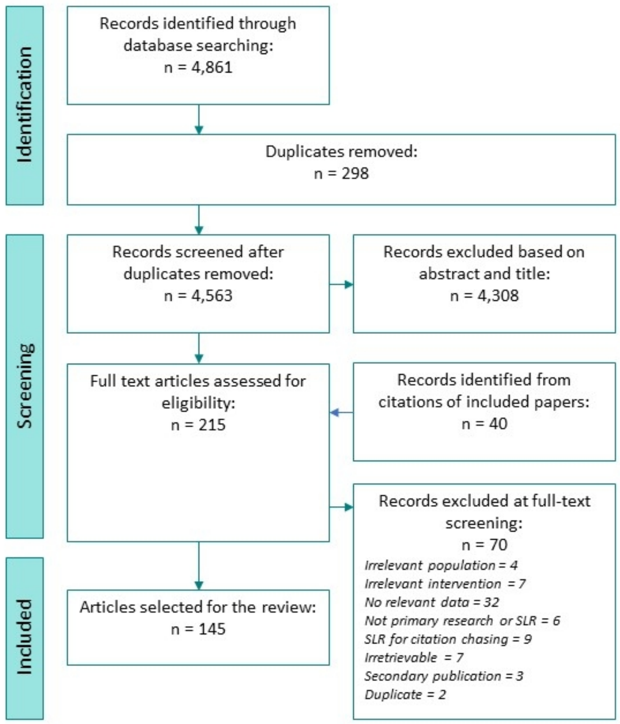

Figure 1. Selection of papers for review

190x275mm (96 x 96 DPI)

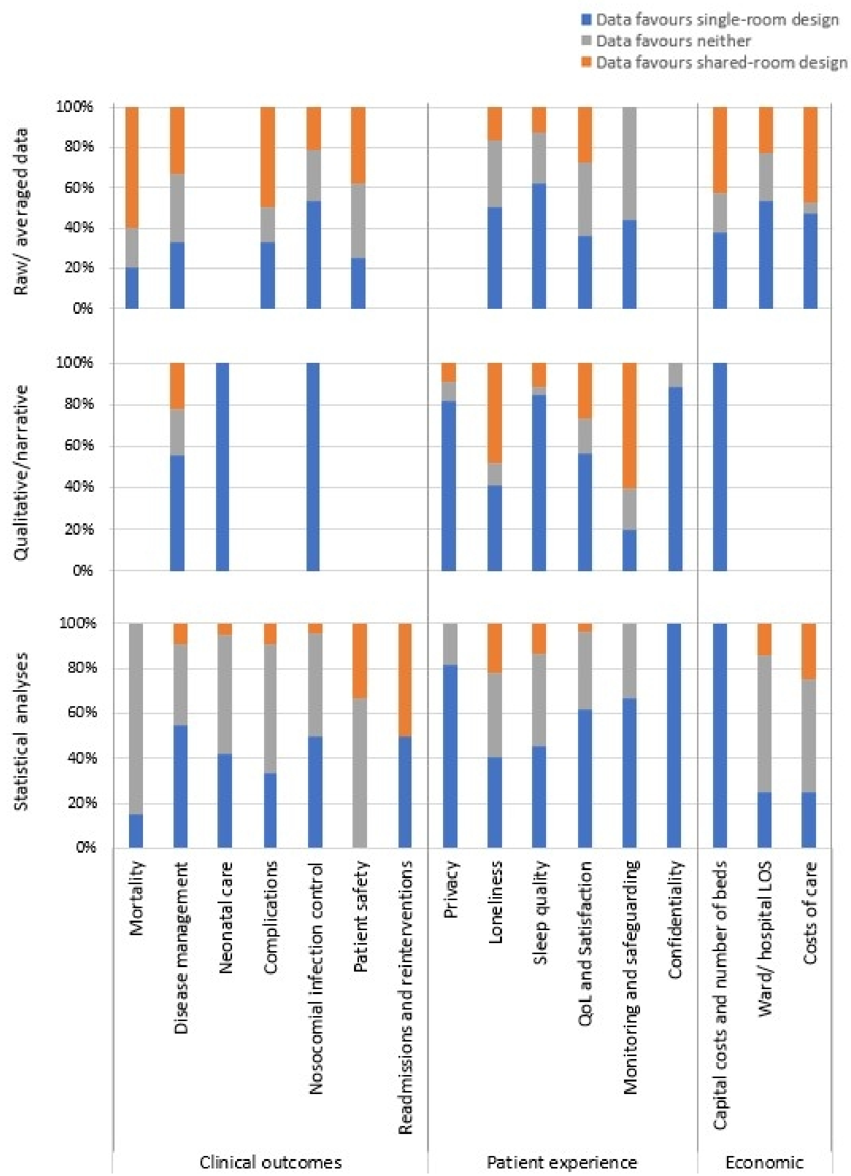

Figure 2. Percentage of studies reporting data in favour of either single-room or shared-room design, according to the type of data available and outcome reported

144x199mm (96 x 96 DPI)

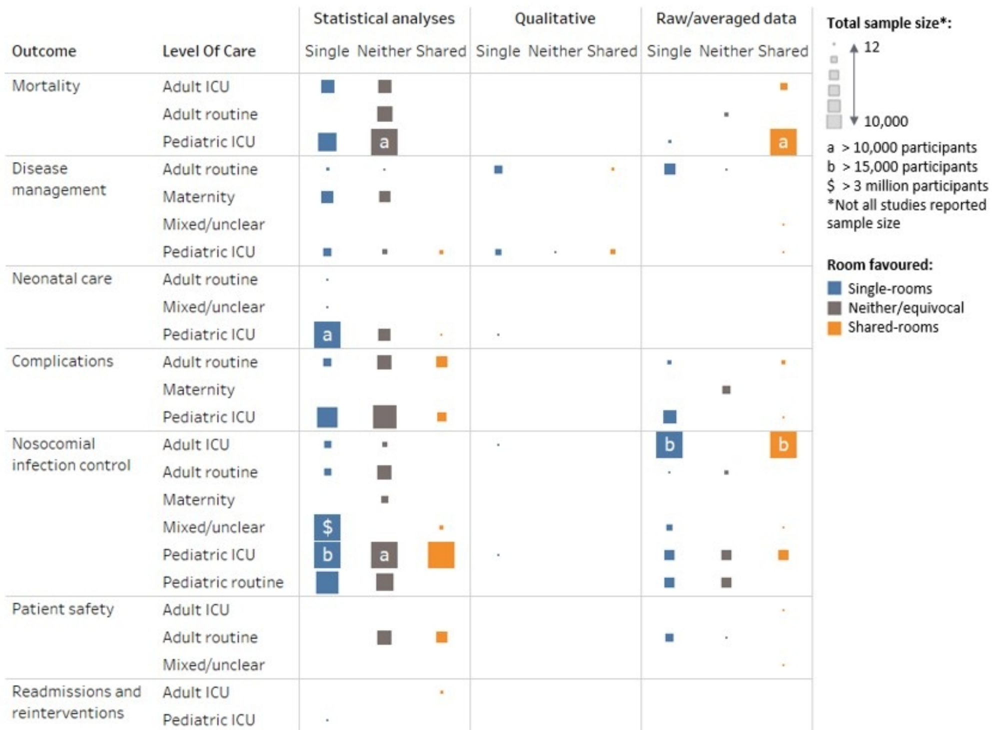

Figure 3. Clinical outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

221x165mm (96 x 96 DPI)

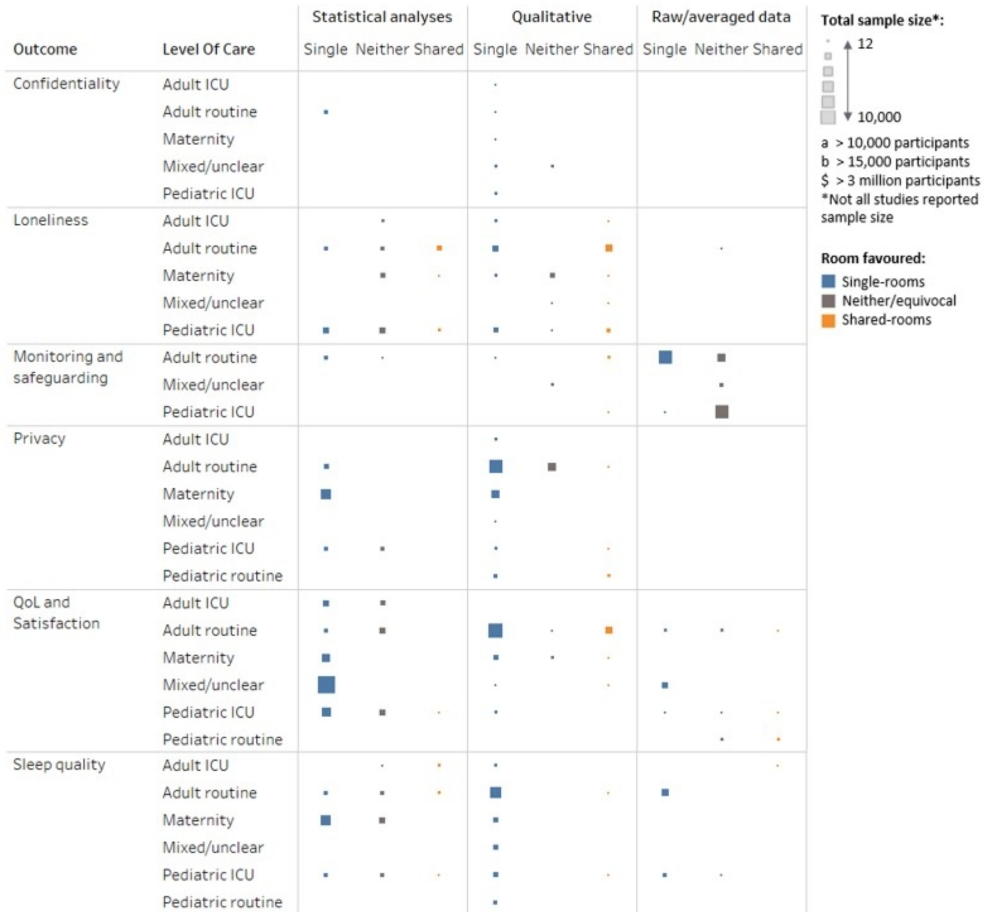

Figure 4. Patient-experience outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

209x195mm (96 x 96 DPI)

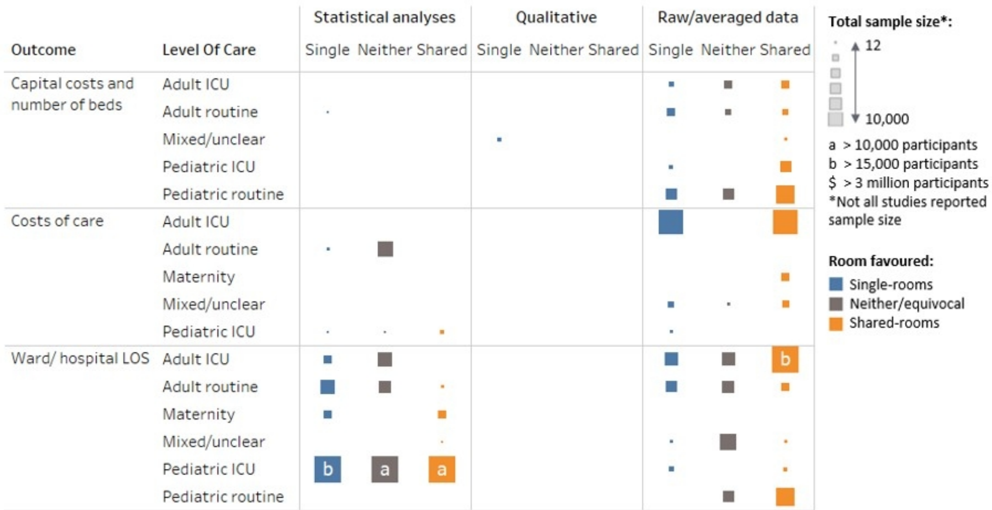

Figure 5. Economic outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

239x126mm (96 x 96 DPI)

Health Economics Unit

Appendix

The data presented in summary tables 2–17 have been condensed substantially from what was reported in the papers. For each table there is one row per paper, detailing the setting and population samples in the study, and the outcomes reported according to whether the data were in favour of a single-room design, a shared-room design, or neither in favour nor against either design. Where statistical analyses were conducted the statistical significance is reported in the tables however no other numerical data is presented. Where no formal analysis was reported only the label pertaining to the outcome data are presented. For example, if the proportion of deaths was lower in the single-room design then "% deaths" is reported in the table under the heading "Data favours single-room design", or if qualitative analysis of interviews reports that patients would prefer a shared-room design because is it more sociable then "Qualitative (patient preference, social)" is reported in the table under the heading "Data favours shared-room design".

List of tables

!

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Key and abbreviations
a=adjusted
u=univariate analysis
m=multivariate analysis
NS=not statistically significant ($p<0.05$ is considered statistically significant)
BSI, bloodstream infection; LOS=length of stay; PEMR=physician estimate of mortality risk; SFR=Single family room; SRMC=Single room maternity care

Text is in italics if it is unclear where the true benefit lies, for example where the data is significantly greater for one room type compared to another but the interpretation of benefit may be subjective.

Cells coloured in blue are where a formal comparative statistical analysis was reported.

Table 1. Summary of study quality scores

Citation	Study methodology	QA score
Adamson 2003[1]	SLR	82%
Anåker et al 2017[2]	Prospective observational, before and after hospital relocation	59%
Anåker et al 2019[3]	Qualitative, before and after hospital relocation	90%
Apple 2014[4]	Prospective observational, qualitative	52%
Bevan et al 2016[5]	Prospective observational	59%
Blandfort et al 2019[6]	Prospective observational, before and after hospital relocation	67%
Blandfort et al 2019[7]	Prospective observational, before and after hospital relocation	67%
Boardman & Forbes 2011[8]	Economic analysis	91%
Bocquet et al 2021[9]	Retrospective observational, case-control	74%
Bodack et al 2016[10]	Prospective observational	56%
Bonizzoli et al 2011[11]	Retrospective observational, before and after hospital relocation	30%
Boztepe et al 2017[12]	Prospective observational	63%
Bracco et al 2007[13]	Prospective observational	74%
Bradbury-Jones et al 2013[14]	SLR	86%
Campbell-Yeo et al 2021[15]	Prospective case–control, before and after hospital relocation	74%
Cantoni et al 2009[16]	Retrospective observational, before and after hospital relocation	67%
Carlson et al 2006[17]	Prospective observational, before and after hospital relocation	33%
Carter et al 2008[18]	Prospective observational, before and after hospital relocation	33%
Caruso et al 2014[19]	Retrospective observational	74%
Cobo et al 2001[20]	Retrospective case–control	74%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Curtis & Northcott 2017[21]	Qualitative, before and after hospital relocation	80%
Cusack et al 2019[22]	Observational before hospital relocation	56%
Darcy Mahoney et al 2020[23]	Prospective observational	59%
Darley et al 2018[24]	Retrospective observational, before and after hospital relocation	56%
Davis et al 2019[25]	Retrospective observational, before and after hospital relocation	67%
Deitrick et al 2010[26]	Qualitative	90%
de Matos et al 2020[27]	Prospective observational	63%
Domanico et al 2010[28]	Prospective observational, before and after hospital relocation	63%
Domanico et al 2011[29]	Prospective observational, before and after hospital relocation	63%
Douglas & Douglas 2005[30]	Qualitative	90%
Dowdeswell et al 2004[31]	SLR	36%
Dowling et al 2012[32]	Prospective case–control, before and after hospital relocation	63%
Eberhard-Gran et al 2000[33]	Prospective case–control	59%
Edéll-Gustafsson et al 2015[34]	Qualitative	90%
Ehrlander et al 2009[35]	Retrospective observational	78%
Erdeve et al 2008[36]	Prospective case–control	74%
Erdeve et al 2009[37]	Prospective case–control	78%
Erickson et al 2011[38]	Prospective observational before and after hospital relocation	67%
Everts et al 1996[39]	Prospective observational	52%
Felice Tong et al 2018[40]	Retrospective case–control	78%
Ferri et al 2015[41]	Qualitative, before and after hospital relocation	100%
Florey et al 2009[42]	Retrospective case–control, before and after hospital relocation	44%
Foo 2022 et al[43]	Prospective observational	74%
Ford-Jones et al 1990[44]	Prospective observational	52%
Fraenkel et al 2018[45]	Retrospective case-control	67%
Gregersen et al 2021[46]	Retrospective observational, before and after hospital relocation	70%
Grundt et al 2021[47]	Prospective case-control	67%
Halaby et al 2017[48]	Retrospective observational, before and after hospital relocation	48%
Harris et al 2004[49]	Prospective case–control, before and after hospital relocation	74%
Harris et al 2006[50]	Retrospective observational	63%
Harris et al 2006[51]	Retrospective observational	52%
Hosseini & Bagheri 2017[52]	Prospective observational	63%
Hourigan et al 2018[53]	Prospective observational, before and after hospital relocation	63%
Hyun et al 2021[54]	Retrospective case–control	78%
Jansen et al 2021[55]	Retrospective observational, before and after hospital relocation	63%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Janssen et al 2000[56]	Prospective case–control, before and after hospital relocation	56%
Janssen et al 2006[57]	Prospective observational	59%
Jones et al 2016[58]	Qualitative, before and after hospital relocation	100%
Jongerden et al 2013[59]	Prospective observational, before and after hospital relocation	67%
Jou et al 2015[60]	Retrospective case–control	74%
Julian et al 2015[61]	Retrospective observational	78%
Jung et al 2022[62]	Retrospective observational, before and after hospital relocation	67%
Kainiemi et al 2021[63]	Prospective observational, before and after hospital relocation	59%
Kinnula et al 2008[64]	Prospective observational	63%
Kinnula et al 2012[65]	Prospective observational	67%
Knight & Singh 2016[66]	Prospective observational	59%
Kosuge et al 2013[67]	Prospective observational, before and after hospital relocation	41%
Labarère et al 2004[68]	Prospective observational	70%
Lawson & Phiri 2000[69]	Prospective observational, before and after hospital relocation	41%
Lazar et al 2015[70]	Prospective observational, before and after hospital relocation	48%
Lehtonen et al 2020[71]	Prospective observational	74%
Lester et al 2014[72]	Prospective observational, before and after hospital relocation	63%
Lester et al 2016[73]	Prospective observational, before and after hospital relocation	59%
Liu et al 2019[74]	Qualitative	100%
Lorenz & Dreher 2011[75]	Retrospective case–control	78%
Maben et al 2015[76]	Report, before and after hospital relocation with control hospitals	78%
Maben et al 2016[77]	Prospective observational, before and after hospital relocation with control hospitals	67%
Malcolm 2005[78]	Qualitative	80%
Mattner et al 2007[79]	Prospective observational	74%
McDonald et al 2019[80]	Prospective observational, before and after hospital relocation	48%
McKeown et al 2015[81]	Retrospective observational	48%
Mental Welfare Commission Scotland 1991[82]	Report	30%
Meyer et al 1994[83]	Prospective observational	59%
Milford et al 2008[84]	Prospective observational, before and after hospital relocation	30%
Miller et al 1998[85]	Prospective observational	59%
Monson et al 2018[86]	Prospective case–control	78%
Morgan 2010[87]	Prospective observational	44%
Munier-Marion et al 2016[88]	Prospective observational	74%
Nahas et al 2016[89]	Retrospective observational	56%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Nash et al 2021[90]	Prospective observational/ qualitative	63%
Nassery & Landgen 2019[91]	Qualitative	90%
OECD & World Health Organization 2019[92]	Report	14%
Olson & Smith1992[93]	Prospective observational	52%
O'Neill et al 2018[94]	Retrospective observational	74%
Park et al 2020[95]	Retrospective observational	63%
Pease & Finlay 2002[96]	Prospective observational	48%
Persson & Määttä 2012[97]	Qualitative	90%
Persson et al 2015[98]	Qualitative	90%
Pilmis et al 2020[99]	Prospective observational	63%
Pineda et al 2012[100]	Prospective case–control	70%
Poncette et al 2021[101]	Retrospective observational	56%
Puumala et al 2020[102]	Retrospective observational, before and after hospital relocation	67%
Pyrke et al 2017[103]	Prospective observational, before and after hospital relocation	59%
Quach et al 2018[104]	Retrospective case–control	59%
Real et al 2018[105]	Prospective observational, before and after hospital relocation	56%
Reed & Shmid 1986[106]	Narrative report, before and after hospital relocation	10%
Reid et al 2015[107]	Prospective observational, before and after hospital relocation	48%
Roos et al 2020[108]	Qualitative, before and after hospital relocation	90%
Rosbergen et al 2020[109]	Prospective observational, before and after hospital relocation	74%
Rowlands & Noble 2008[110]	Qualitative	90%
Sadatsafavi et al 2016[111]	Retrospective economic analysis	100%
Sadatsafavi et al 2019[112]	Retrospective economic analysis, before and after hospital relocation	100%
Sakr et al 2021[113]	Prospective observational	74%
Schalkers et al 2015[114]	Qualitative	100%
Scottish Intercollegiate Guidelines Network 2014[115]	Guideline	73%
Singh et al 2015[116]	Retrospective observational, before and after hospital relocation	70%
Singh et al 2016[117]	Prospective observational	70%
Søndergaard et al 2022[118]	SLR	91%
Song et al 2018[119]	Retrospective observational, before and after hospital relocation	63%
Stelwagen et al 2021[120]	Qualitative	100%
Stevens et al 2011[121]	Prospective observational, before and after hospital relocation	52%
Stevens et al 2012[122]	Prospective observational, before and after hospital relocation	44%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Stevens et al 2014[123]	Prospective observational, before and after hospital relocation	56%
Stiller et al 2017[124]	Retrospective observational	59%
Swanson et al 2013[125]	Prospective observational, before and after hospital relocation	37%
Tandberg et al 2018[126]	Prospective observational	70%
Tandberg et al 2019[127]	Prospective case–control	67%
Tandberg et al 2019[128]	Prospective observational	67%
Taylor et al 2018[129]	SLR	91%
Tegnestedt et al 2013[130]	Prospective observational	70%
Teltsch et al 2011[131]	Retrospective case–control, before and after hospital relocation	67%
Toivonen et al 2017[132]	Prospective case–control, before and after hospital relocation	63%
Vaisman et al 2018[133]	Retrospective case–control	67%
van de Glind et al 2008[134]	Prospective observational	74%
van der Hoeven et al 2022[135]	Retrospective observational, before and after hospital relocation	63%
Van Enk & Steinberg 2011[136]	Prospective observational, before and after hospital relocation	44%
van Veenendaal et al 2020[137]	Retrospective observational, before and after hospital relocation	70%
Van Veenendaal et al 2022[138]	Prospective observational	70%
Vietri et al 2004[139]	Prospective case–control, before and after hospital relocation	59%
Vohr et al 2017[140]	Prospective observational, before and after hospital relocation	67%
Voigt et al 2018[141]	SLR	86%
Walsh et al 2006[142]	Prospective observational, before and after hospital relocation	33%
Washam et al 2018[143]	Retrospective case–control	78%
Watson et al 2014[144]	Prospective observational, before and after hospital relocation	44%
Zaal et al 2013[145]	Prospective observational	67%

Quality is graded by colour: green, good; orange, medium; red, poor. Abbreviation: SLR, systematic literature review.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 2. Summary of studies reporting mortality data

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation										
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine		% deaths	
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital	Orthopaedic	Elective	Routine		*p*=0.664	
Domanico 2010,[28] Domanico 2011[29]	63%	United States	Neonates	161 carers, 1 hospital, 2 units	Paediatric	NR	NICU	% deaths		
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients, 1 hospital, 2 units	Premature neonates	Maternity care	NICU		p=0.38 all-cause mortality p=0.96 infection-related mortality	
Jongerden 2013[59]	67%	Netherlands	Adults	323 patients, 1 hospital	Mixed, Adults	Mixed	ICU		p=0.98	
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU		p=0.168	
Lazar 2015[70]	48%	Israel	Children	4162 patients, 1 hospital	Children	Mixed	PICU		p=0.22	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Premature neonates	Emergency	NICU			% deaths
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital	Internal medicine, Geriatric	Mixed	Routine		p=0.12 one-year mortality *p*=0.35 inpatient mortality *p*=0.29 30-day discharge mortality	
Contemporaneous comparison										
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at	Mixed, Post surgery,	Mixed	ICU	*p*<0.001		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				admission), 1 hospital, 1 ward	Medical admission					
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.18	
Harris 2006[50]	63%	United States	Neonates	21 parents, 75 HCPs, 11 hospitals	Neonates	Emergency	NICU			% deaths
Hyun 2021[54]	78%	South Korea	Adults	666 patients, 1 hospital	Respiratory, COVID-19	Emergency	ICU			% deaths
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU		p=0.56 CLOS or mortality	
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p>0.95 inpatient mortality p=0.33 30-day mortality	
Lehtonen 2020[71]	74%	10 countries	Neonates	4662 patients, 331 units	Neonates	Emergency	ICU	OR 0.76, 0.64-0.89, major morbidity or mortality	OR 0.85, 0.70-1.02, mortality only	
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.72, % deaths	

For peer review only

Health Economics Unit

Table 3. Summary of studies reporting data on patient care and disease management

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed		Medication errors 9 months after the move	Fewer medication errors immediately after the move
Before and after a hospital relocation										
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Lower % medical deterioration requiring rapid response or clinical review		
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards relocation	Orthopaedic patients	Unclear	Routine	Lower use of painkillers % responders % verbal outbursts % threatening behaviour		
Contemporaneous comparison										
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Mixed	Unclear	Routine			Qualitative (feelings of safety)
McKeown 2015[81]	48%	Ireland	Unclear	880 patients. 24 hospitals	End of life	Emergency, Elective	Routine	Perceived acceptability of patient's death Symptom management Symptom experience Patient care		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.020, cleanliness p=0.015, staff pain management	p=0.190, toileting help given	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, pain control		
Van de Glind 2008[134]	74%	Netherlands	Adults	52 encounters, 1 hospital	Urology	Unclear	Routine	p=0.003, greater duration of physician-patient encounter % encounter time patient speaks is greater Patients disclose more emotional cues, and information cues p=0.031, more physician responses to the patient cues	% encounter time physician speaks was no different Patients disclose more emotional cues	
Evidence synthesis										
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Hospital acquired infection treatment; Hand-hygiene; Cleaning and decontamination; Recovery; In situ medical treatment Family involvement Environment match the patient's progress		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed		Pain scores	
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical,	Unclear	Routine	Sleep quality Personal control Environment		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
					Internal medicine			Recovery time		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed			Restraint use e.g., rails
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine		Medication errors and usage	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 4. Summary of studies reporting data on maternity and neonatal care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation										
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	Parental presence and involvement (mother and partner feeding)		
Carter 2008[18]	33%	United States	Adults	1 hospital 53 parents	Neonates	Emergency	ICU	All p's<0.05 parent perceptions of access to staff		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	PEMR 2-3: patient progress: *p*<0.001, total apnoea events *p*<0.001, apnoea events/day *p*=0.031, days on mother's breastmilk; *p*=0.001, days on mother's breastmilk per LOS; *p*=0.003, interval to enteral feeding; *p*<0.001, interval to breastmilk feeding; *p*=0.048, days on parenteral nutrition; *p*=0.004, days on parenteral nutrition per LOS	PEMR 2-3 p=0.94, gestational age p=0.92, admission weight p=NS, acuity p=0.45, weight gain p=0.17, length gain p=0.17, head circumference gain p=0.84, total CPAP days p=0.7, CPAP days/LOS p=0.17, total caffeine days p=0.11, total caffeine days/LOS *p*=0.765, interval to formula feeding PEMR 4:	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									p=0.47, gestational age p=0.49, admission weight p=NS, acuity p=0.76, weight gain p=0.47, length gain p=0.70, head circumference gain p=0.59, total CPAP days p=0.94, CPAP days/LOS p=0.82, total caffeine days p=0.94, total caffeine days/LOS p=0.70, total apnoea events p=0.18, apnoea events/day *p*=0.937, interval to enteral feeding *p*=0.571, interval to formula feeding *p*=0.818, days on parenteral nutrition *p*=0.937, days on parenteral nutrition per LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Dowling 2012[32]	63%	United States	Neonates	40 mothers, 1 hospital	Neonates	Emergency	ICU		p=NS., all breastfeeding measures	
Erickson 2011[38]	67%	United States	Neonates	73 patients, 1 hospital	Preterm neonates	Emergency	NICU	p=0.04, time to enteral nutrition	p=0.05, weight gain/day p=0.30, weight gain/day normalized to kg birth weight p=0.47, time to parenteral nutrition	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 new hospital unit established	Pregnant women	Maternity	Routine	p=0.04, continuous or intermittent electronic foetal monitoring p=0.03, IV therapy p=0.01, 1-minute Apgar <7	p=NS for augmentation of labour, 20-minutes initial electronic foetal monitoring at admission, epidural, narcotics, mode of delivery, and episiotomy	
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital	Neonates	Emergency	ICU		*p*=0.30, receiving some maternal or donor breastmilk	*p*=0.04, primarily receiving maternal or donor breastmilk
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital relocation	Pregnant women	Maternity	Routine	p<0.001, patient satisfaction with amount of nurse interaction for physical, emotional, and	p=0.10, baby received supplementation with water p=0.25, p=0.05 clear discharge instructions of	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								spiritual needs, in labour, and postpartum p<0.001, patient satisfaction with nurse response time, teaching time, information received, feeding related teaching p<0.001, number of babies who received supplementation with formula p<0.001, number breastfeeding p=0.044, number breastfed within 1-2 hours post-delivery p=0.01, clear discharge instructions of when expect a call from the community health nurse p<0.001, clear instructions of how to use car seat, and nurse reviewed handouts	when to call the doctor, and when to make an appointment respectively	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital relocation	Neonates	Emergency	ICU	Narrative - reduced stress $p<0.0001$, reduced pain		
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Neonates	Emergency	ICU	$p<0.001$, interval to oral feeding		
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	$p<0.05$, nurse preferred single rooms $p<0.01$, nurse think single room is better for premature neonates	$p>0.05$, nurses think open rooms are better for ventilated/ critically ill infant	
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital relocation	Neonates	Emergency	ICU	$p=0.04$, interval to enteric nutrition	p=NS., other nutrition parameters	
Swanson 2013[125]	37%	United States	Neonates, Carers, HCPs	55 parent surveys, 42 AP surveys, 151 NN surveys 1 hospital relocation	Neonates	Emergency	NICU	$p<0.05$, Advanced neonatal practitioner perceptions of development, facility and privacy $p<0.05$, Neonatal nurses perceptions of development, facility and privacy.	Advanced neonatal practitioners: p=NS., teamwork, communication, safety Neonatal nurses: p=NS., communication, safety Parents: p=NS, development and safety	Neonatal nurses: $p<0.05$, teamwork

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Toivonen 2017[132]	63%	Finland	Neonates	20 nurses, 1 hospital relocation	Neonates	Emergency	ICU	p=0.001, duration of nurse-parent interactions p<0.0001, duration of nurse-family interactions	p=0.349, number of nurse-parent interactions p=0.471, number of nurse-infant interactions p=0.073, duration of nurse-infant interactions p=0.488, number of nurse-family interactions	
Van der Hoeven 2022[135]	63%	Netherlands	Infants	1293 infants, 1 hospital	Infants	Unclear	ICU	p<0.001, weight at discharge p=0.003, rate of weight gain	p=0.13, gestational age at full enteral feeding	
Contemporaneous comparison										
Bodack 2016[10]	55%	Germany	Neonates	35 sets of parents	Premature neonates	Maternity care	NICU	Qualitative (quality of care)	Qualitative (communication)	
Erdeve 2008[36]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.084, Routine visits p=0.046, acute care visits p=0.154, number of breastfed infants	p=0.005, more total applications to health services p=0.001, more consultations by phone
Grundt 2021[47]	67%	Norway	Neonates	77 patients, 66 mothers, 2 hospitals, 2 units	Premature neonates	Maternity	NICU	*p*=0.08, *p*=0.06, volume breastmilk produced 7, 14, days post-delivery, respectively p<0.001, *p*=0.02,	*p*=0.71, number of sessions at the breast *p*=0.46, mother breastfeeding self-efficacy *p*=0.51, p=0.33,	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								infants breastfed directly and exclusively at discharge, at term, respectively p<0.001, *p*=0.003, p=0.00, infants partly directly breastfed at discharge, at term, and 4 months corrected age, respectively p=0.00[a] use of nipple shields	infants exclusively directly breastfed, or on solids, at 4 months corrected age, respectively *p*=0.33, *p* =0.61, use of nipple shields adjusted for post-menstrual age 33 weeks, 34 weeks, respectively	
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p=0.005, weight at discharge p=0.017, rate of weight gain p=0.015, interval to full enteral feeding		
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU		p=0.75, breastmilk feeding at discharge	
Stelwagen 2021[120]	100%	Netherlands	Adults	1 hospital 36 parents	Neonates	Emergency	ICU	Narrative - apnoea and periodic breathing		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU	Greater birth weight, length, and head circumference	p=0.45, p=0.42, breastmilk feeding exclusively at discharge, and term +4 months	Greater weight at term +4 months

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
										greater length at term +4 months
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital relocation	Neonates	Emergency	NICU	$p<0.001$, weight gain per day $p<0.001$, weight gain at discharge $p=0.002$, human milk at 1 week $p=0.001$, human milk at 4 weeks $p<0.001$, volume of milk		

For peer review only

Health Economics Unit

Table 5. Summary of studies reporting data on complications of disease

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Pressure ulcers per 1,000 patient-days
Before and after a hospital relocation										
Blandfort 2019[7]	67%	Denmark	Adults, Elderly	1014 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	p=0.02, incidence of delirium	p=0.57, duration of first episode of delirium	
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine	Number of patients with infections (total, pneumonia, CMV-reactivation, CMV-primary, invasive mould, other) Infection rates (pneumonia: clinical diagnosis)		Number of patients with infections (microbiologically documented, primary sepsis) Infection rates (sepsis, pneumonia, pneumonia: microbiological diagnosis)
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.243, hospital-acquired pressure injuries	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 new hospital unit established	Pregnant women	Maternity	Routine		p=NS for rates of postpartum haemorrhage, pyrexia, rates of thick meconium, and cases of meconium aspiration	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital relocation	Neonates	Emergency	ICU	Less stress (some related to increased maternal involvement) p<0.0001, maternal involvement related to lower pain scores p<0.0001, increased maternal involvement in care of the neonate p<0.0001, reduction in pain due to the SFR NICU alone		
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			p<0.01, hip fractures due to falls
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital relocation	Neonates	Emergency	ICU		OR 1.267, 0.929-1.730, serious adverse outcomes	
Lester 2016[73]	59%	United States	Neonates	216 patients, 1 hospital relocation	Premature neonates	Maternity	ICU		p=0.90, periventricular leukomalacia p=0.80, retinopathy of prematurity (stage 3, 4, 5) p=0.16, sepsis p=0.13, bronchopulmonary dysplasia	p=0.09, necrotising enterocolitis p=0.08, intraventricular haemorrhage (grade3/4)
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-	Preterm neonates	Emergency	NICU		p=0.35, bronchopulmonary dysplasia	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				born control infants, 1 hospital					p=0.38, infection	
Contemporaneous comparison										
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRSA carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	Organ failure		
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU	p<0.01 delirium prevalence p<0.01 medical admissions p<0.01 postoperative admissions	p=0.33 number of days with delirium	
Erdeve 2008,[36] Erdeve 2009[37]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.720 clinical risk index for babies p=0.673 neonatal therapeutic intensity scoring system	
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine		p=0.70 thromboembolic events within 30-days p=0.21 superficial wound infection within 30-days Deep wound infections p=0.70	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									medical complications within 30-days	
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		*p*>0.95, patients with hip fracture as result of inpatient fall	
Lehtonen 2020[71]	74%	Canada, Australia, New Zealand, Finland, Israel, Japan, Spain, Sweden, Switzerland, Italy	Neonates	4662 patients, 331 units	Preterm neonates	Emergency	ICU	OR 0.76, 0.64-0.89, death or any major morbidity	OR 0.95, 0.84-1.08, composite of mortality or any morbidity OR 0.84, 0.71-1.00, sepsis OR 1.10, 0.95-1.27, Broncho-pulmonary dysplasia OR 1.14, 0.95-1.37, Intraventricular haemorrhage / Periventricular leukomalacia OR 0.81, 0.66-0.99, Retinopathy of prematurity treatment	
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital relocation	Neonates	Emergency	NICU	Bayley composites: p=0.02 Cognitive p=0.04 Language p=0.006 Expressive communication p=0.08 Motor p=0.04 Fine motor Bayley III composite scores:	Bayley composites: p=0.14 receptive communication p=0.67 gross motor p=0.11 normal neurologic examination	Suspicious neurological examination Abnormal neurological examination

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.05, cognitive p=0.02, language p=0.07, motor		
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p=0.05, sepsis		
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.53, crude risk of delirium	
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05 Reduced medical errors		
Scottish Intercollegiate Guidelines Network 2019[115]	Report 73%	United Kingdom	Adults	NR	At risk for delirium	NR	Routine	Managing patients with delirium		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	ICU delirium		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Table 6. Summary of studies reporting data on prevention of infection

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	*Clostridium difficile* in older people's ward (Control new-build hospital)		*Clostridium difficile* in older people's ward (Study hospital)
Before and after a hospital relocation										
Bonizzoli 2011[11]	30%	Italy	Unclear	818 patients, 1 unit	Trauma	Unclear	ICU	Isolates of MRSA, *Proteus mirabilis*, *Escherichia coli*, *Serratia marcescens*, and *Enterobacter* spp $p<0.01$, amoxicillin/ clavulanate use, ceftriaxone use $p<0.05$ oxacillin use, vancomycin use		
Darley 2018[24]	56%	United Kingdom	Unclear	1 hospital relocation	Unclear	Unclear	Routine	$p=0.04$, *Escherichia coli* bacteraemia $p=0.01$, hospital-acquired *Clostridium difficile* infection	$p=0.22$, hospital acquired methicillin-sensitive *Staphylococcus aureus* bacteraemia	
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	Incidence of nosocomial sepsis (*Candida albicans*, CONS, *Enterococcus*	Incidence of nosocomial sepsis (*Escherichia coli*)	Incidence of nosocomial sepsis (*Enterobacter cloacae*, *Klebsiella pneumoniae*)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								faecalis, MRSA, *Staphylococcus aureus*, total)		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.251, hospital acquired MRSA infections p=0.865, MRSA present on admission	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Patient perception (6 patients perceived better infection prevention)		
Gregersen 2021[46]	70%	Denmark	Elderly	446 patients, 1 hospital relocation	Geriatric	Unclear	Routine	% hospital-acquired infections p=0.01, p=0.03[a] time from admission to first hospital-acquired infection p=0.004 urinary tract infections	p=0.74, pneumonia p=0.50, gastritis p=0.09, sepsis p=0.22, other (wound infection, nephritis, and erysipelas)	
Halaby 2017[48]	48%	Netherlands	Unclear	16 beds, 1 hospital	Unclear	Unclear	ICU	p=0.001, transmission of any Multidrug resistant bacteria p=0.0015,	p=0.37 transmission of *Morganella* spp	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								transmission of *Citrobacter* spp p=0.0005 transmission of *Enterobacter* spp	p=0.99, transmission of *Proteus* spp p=0.25, transmission of *Serratia* spp p=0.39, transmission of *Pseudomonas* spp	
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital	Premature neonates	Emergency	NICU	p=0.0001, fewer positive skin swabs p=0.0003, fewer positive environmental swab samples Presence of antibiotic resistance genes (including resistome and virulome)	p=NS comparison of the entire bacterial community at the genus level Potential human pathogenic viruses in 2-week stool, discharge stool and skin samples Species alpha diversity	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients 1 hospital, 2 units	Premature neonates	Maternity care	NICU		p=0.62, incidence density per 1000 patient-days p=0.59, cumulative incidence per 100 infants p=0.66, skin and/or soft tissue infection p=0.15, conjunctivitis	
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU	p<0.001[a], CRAB acquisition		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lazar 2015[70]	48%	Israel	Children	4162 patients, 1 hospital	Children	Mixed	PICU	p=0.01, incidence of BSI p=0.03, nosocomial BSI	p=0.26, community-acquired BSI	
McDonald 2019[80]	48%	Canada	Unclear	1 hospital relocation	Mixed	Mixed	Mixed	Enterococcus, MRSA, and *Clostridium difficile* infections per 10,000 patient-, days	p=NS, decline in rates of *Clostridium difficile* and MRSA infection	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Premature neonates	Emergency	NICU	p=0.02, sepsis in preterm infants (<28 weeks preterm)	p=0.43, sepsis in preterm infants (28 – 32 weeks preterm) p=0.42, sepsis in preterm infants (32 – 37 weeks preterm)	p=0.001 sepsis in term/post-term infants (>37 weeks)
Song 2018[119]	63%	United States	Neonates	171 patients, 1 hospital	Premature neonates	Emergency	NICU	hospital-acquired ESBL-E incidence		
Teltsch 2011[131]	67%	Canada	Adults	19343 patients, 2 hospitals	Unclear	Unclear	ICU	positive cultures per 10,000 patient-days for yeast, coagulase-negative *Staphylococcus* spp, *Enterococcus* spp, *Staphylococcus aureus*, *Escherichia* spp, *Pseudomonas* spp, *Klebsiella* spp, *Clostridium difficile*, *Corynebacterium* spp,		Positive cultures per 10,000 patient-days for *Enterobacter* spp, *Haemophilus* spp, MRSA, *Streptococcus viridans*, *Acinetobacter* spp, *Streptococcus pneumoniae*, Group B *Streptococcus* spp, *Neisseria* spp

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								Stenotrophomonas maltophilia, *Citrobacter* spp, *Proteus mirabilis*, *Serratia* spp, fungi, VRE, *Lactobacillus* spp, anaerobic cocci, *Morganella* spp, *Bacteroides* spp, *Moraxella* spp		
Van der Hoeven 2022[135]	63%	Netherlands	Neonates	1293 patients, 1 hospital	Premature neonates	Unclear	NICU	Infection of multidrug-resistant organisms Colonisation of third-generation cephalosporin resistant bacteria	Multidrug-resistant organisms: Bacteraemia Colonisation of third-generation cephalosporin resistant bacteria Third-generation cephalosporin resistant bacteria: Bacteraemia	Colonisation of multidrug-resistant organisms
Van Veenendaal 2020[137]	70%	Netherlands	Neonates	1152 patients, 1 hospital	Neonates	Emergency	NICU	% treated for early-onset sepsis Overall late-onset sepsis OR 0.55, 0.34-0.90 OR[a] 0.49, 0.30-0.81 Late-onset probable sepsis OR 0.64, 0.38-1.08 OR[a] 0.56, 0.32-0.96	Culture-proven late-onset sepsis OR 0.83, 0.44-1.56 OR[a] 0.74, 0.39-1.41 Symptoms of late-onset sepsis OR 0.22, 0.05-1.01 OR[a] 0.24, 0.05-1.08 Late-onset sepsis OR 0.40, 0.16-1.03 OR[a] 0.34, 0.13-1.91	
Vietri 2004[139]	59%	United States	Adults	261 patients, 1 hospital	Mixed	Unclear	Routine		Positive MRSA culture	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital	Premature neonates	Emergency	NICU	*p*=0.09, sepsis or necrotizing enterocolitis ≥ Bell stage IIA	*p*=0.052, late-onset sepsis	
Walsh 2006[142]	33%	United States	Neonates	127 nurses, 1 hospital	Neonates	Emergency	NICU	p<0.05, catheter-related BSI		
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute medical illness	Emergency	Routine	Patient perception of hygiene and infection risk		
Bocquet 2021[9]	74%	France	Adults, Children	233 patients, 1 hospital	Mixed, Influenza	Elective, Emergency	Routine	Nosocomial cases Community-acquired cases		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRSA carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	p<0.001[u,m], risk of BSI p<0.05[u,m], risk of MRSA acquisition p=0.001[u,m], risk of *Pseudomonas* spp acquisition p<0.001[u] p<0.03[m], risk of *Candida* spp acquisition		
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.19 acquired infections	
Cobo 2001[20]	74%	Spain	Adults	50 patients, 1 hospital, 2 wards	Respiratory, HIV	Unclear	Routine		p=0.052, likelihood of multi-drug resistant tuberculosis due to	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Mycobacterium bovis	
Everts 1996[39]	52%	New Zealand	Elderly	27 patients, 1 hospital	Unclear	Rehabilitation	Routine	Cases of clinical influenza		
Ford-Jones 1990[44]	52%	Canada	Children	1530 patients	Cardiological, General admission, Neurosurgical	Unclear	Routine	Cases of nosocomial diarrhoea (GA and neurosurgical unit)	Cases of nosocomial diarrhoea (cardiological unit)	
Fraenkel 2018[45]	67%	Sweden	Adults, Children, Elderly	251 patients, 8 hospitals	Mixed (all hospitalised patients who acquired norovirus during admission)	Unclear	Routine	p<0.01, norovirus		
Harris 2006[50]	63%	United States	Neonates	21 parents, 75 HCPs, 11 hospitals	Neonates	Emergency	NICU		Nosocomial BSI	Nosocomial pneumonia
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU	p=0.039, MRSA colonization rate for each additional one patient	p=0.10, incidence of MRSA colonization p=0.89, *Clostridium difficile* infection rate	
Jou 2015[60]	74%	United States	Adults	225 patients, 1 hospital	Mixed	Elective	Mixed			p=0.001, nosocomial *Clostridium difficile* infection p<0.001, malignancy

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine	p=0.03, risk for hospital acquired infection		
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine	p<0.001, risk for hospital acquired infection during hospitalization (1 hospital)	p=0.56, risk for hospital acquired infection during hospitalization (1 hospital) p=NS, risk of hospital acquired infection after discharge (3 hospitals)	
Liu 2019[74]	100%	Canada	Adults	1 hospital 15 parents of hospitalised infants	Neonates	Emergency	ICU	Parents' perception (reduced spread of infection)		
Lorenz 2011[75]	78%	United States	Adults, Elderly	166 patients, 1 hospital	Medical, Surgical, Oncologic	Unclear	Routine		p=NS, hospital-acquired infections	
Mattner 2007[79]	74%	Germany	Adults	336 patients, 1 hospital	Cardiovascular, Thoracic surgery	Mixed	ICU		Enterococci OR 1.06, 0.36-3.12 p=0.91	
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-born control infants, 1 hospital	Preterm neonates	Emergency	NICU		p=0.38, infection	
Morgan 2010[87]	44%	United Kingdom, United States	Adolescents, Adults, Children	146 patients, 114 HCP, 2 hospitals	Unclear	Mixed	Routine	HCP preference for isolation and infection control		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Munier-Marion 2016[88]	74%	France	Adults	93 patients, 1 hospital	Geriatric, Mixed, Surgical	Unclear	Routine	p=0.028, p=0.039[a], risk of hospital-acquired influenza	p=0.16, influenza vaccination coverage	
O'Neill 2018[94]	74%	United States	Mixed	>1 million patients, 218 hospitals with >50% private rooms, 117 with >50% bay rooms	Mixed	Mixed	Mixed	p<0.001, p=0.005[a], central-line-associated BSIs p<0.001, central-line-associated BSIs related mortality		
Park 2020[95]	63%	United States	Mixed	2,670,855 discharges, 340 hospitals	Mixed	Mixed	Mixed	p<0.001, p<0.001[a], hospital-acquired MRSA infections		
Pilmis 2020[99]	63%	France	Adults	107 patients, 1 hospital	Mixed	Unclear	Routine	p=0.13[u], p=0.0005[m], contamination		
Quach 2018[104]	59%	Canada, United States	Children	83,334 patient-days, 2 hospitals	Mixed	Mixed	Mixed	p<0.0001, hospital-acquired respiratory viral infections		
Sadatsafavi 2016[111]	100%	Canada	Unclear	8811 patient-days, 1 hospital (simulation)	Medical, Surgical	Unclear	ICU	Annual cases of MRSA acquisition, Pseudomonas species acquisition, and Candida species colonization		
Stiller 2017[124]	59%	Germany	Unclear	534 units	Unclear	Unclear	ICU	Polymicrobial BSI OR 0.66, 0.51-0.86		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Premature neonates	Emergency	NICU		p=0.36, septicaemia	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Vaisman 2018[133]	67%	United States	Adults	189 patients, 512/515 controls, 1 hospital	Unclear	Unclear	Routine		P=NS, hospital-onset *Clostridium difficile*	
Washam 2018[143]	78%	United States	Neonates	1751 patients, 1 hospital	Neonates	Emergency	NICU	p=0.03[u], p=0.03[m], MRSA		
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, hospital-acquired infections		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	7 studies found advantages only	3 studies found mixed results 4 studies found no difference	
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine	10 studies	5 studies	16 studies

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 7 Summary of studies reporting data on patient safety

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Falls per 1,000 patient-days
Before and after a hospital relocation										
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.599 Falls in hospital p=0.491 Unwitnessed fall p=0.082 Second fall	
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine		Falls per 1,000 occupied bed days	
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			p<0.01, p<0.01[a], falls per 1,000 patient-bed days p<0.001, falls per in-patient faller
Contemporaneous comparison										
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p=0.83, number of patients who sustained inpatient falls	p=0.035, falls per inpatient faller
Lorenz 2011[75]	78%	United States	Adults, Elderly	166 patients, 1 hospital	Medical, Surgical, Oncologic	Unclear	Routine		p=0.37, likelihood of falls	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Poncette 2021[101]	55%	Germany	Unclear	21 beds, 1 hospital	Unclear	Unclear	ICU			Alarms raised per bed
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, patient falls		
Taylor 2018[129]	SLR 91%	International	Adults	NR	Mixed	Mixed	Mixed		No difference	1 study found disadvantages only
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine		5 studies found no difference	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 8. Summary of studies reporting data on readmissions and reinterventions

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Contemporaneous comparison										
Erdeve 2008[36]	74%	Turkey	Infants	60 infants, 1 hospital	Preterm neonates	Emergency	ICU	p<0.05, hospitalisation		
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine			p=0.03, return to theatre within 6 weeks

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 9. Summary of studies reporting views on privacy

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Qualitative (privacy, comfort, personal control, visitor flexibility)		
Before and after a hospital relocation										
Anåker 2019[3]	90%	Sweden	Adults	16 patients, 1 hospital	Stroke	Rehabilitation	Routine	Qualitative (privacy, personal control)		
Carlson 2006[17]	33%	United States	Neonates	1 hospital, Patients unclear	Neonates	Emergency	ICU	Parent-reported privacy		
Carter 2008[18]	33%	United States	Adults	1 hospital 53 parents	Neonates	Emergency	ICU	p<0.001, patients' perception of privacy		
Curtis 2017[21]	80%	United Kingdom	Children	1 hospital, 4 wards 17 patients, 60 caregivers, 60 HCPs	Paediatric	Unclear	Routine	Qualitative (privacy)		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Perception of privacy		
Domanico 2010[28]	63%	United States	Parents	1 hospital, 2 units 161 caregivers	Paediatric	NR	NICU	p<0.001, privacy for bonding (long-stay) Transitional parent perceptions: privacy for bonding and for breastfeeding	p=NS, privacy for bonding (short stay) p=0.111 (short stay), p=0.076 (long stay), privacy for breastfeeding	
Dowling 2012[32]	63%	United States	Parents	1 hospital 40 mothers	Neonates	Emergency	ICU		p=NS, comfortable pumping breastmilk	
Ferri 2015[41]	100%	Canada	Unclear	1 hospital, 39 HCPs (13 nurses,	Unclear	Unclear	ICU	Qualitative (privacy)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				7 respiratory therapists), 5 HCPs (other), 6 physicians, 4 family members 4 support staff						
Florey 2009[42]	44%	United Kingdom	Adults	2 hospitals, 1 before and after move, 80 patients	Medical and surgical, Adults	Unclear	Routine	p<0.001, discussing personal matters p<0.001, patient preference		
Harris 2004[49]	74%	Canada	Adults	1 hospital, 976 patients	Pregnant women	Maternity	Routine	p=0.01, physicians' perception of privacy		
Janssen 2000[56]	56%	Canada	Adults	1 hospital, 426 patients	Pregnant women	Maternity	Routine	p<0.001, respect shown by caregiver for privacy *p<0.001, greater number of different nurses, doctors, and staff who interacted with the patient*		
Jones 2016[58]	100%	Australia	Adults, Neonates	1 hospital relocation 66 mothers, 51 nurses	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (privacy)		
Milford 2008[84]	30%	United States	Neonates	1 hospital, patients unclear	Neonates	Emergency	ICU	Staff perceptions of privacy		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital	Cardio-vascular	Unclear	Routine	Privacy	Communication Help from staff	
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine	Qualitative (privacy)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Qualitative (privacy)		
Stevens 2011[121]	52%	United States	Adults	1 hospital, 147 patients	Neonates	Emergency	ICU	Patient-reported privacy		
Swanson 2013[125]	37%	United States	Adults	1 hospital 55 parents	Neonates	Emergency	ICU	$p<0.05$, nurses', patients', and advanced practitioners' perceptions of privacy		
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Adults	3 ICUs 81 HCP	Mixed	Unclear	ICU	Staff perceptions of privacy		
Bevan 2016[5]	59%	United Kingdom	Adults, elderly	2 hospitals 50 patients	Aged 65+ years with acute illness	Emergency	Routine	Qualitative (privacy)		
Bodack 2016[10]	56%	Germany	Adults	1 hospital 35 pairs of parents of 40 neonates	Neonates	Emergency	ICU	Patient reported privacy		
Boztepe 2017[12]	63%	Turkey	Children	1 hospital, 1 ward 130	Children	Mixed	Routine			Lack of privacy
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Patient preference for privacy		
Douglas 2005[30]	90%	United Kingdom	Adults	1 hospital 785 patients (post discharge)	Adults	Unclear	Routine		*Mixed results*	
Ehrlander 2009[35]	78%	United States	Adults, elderly Adults	1 hospital 117 patients	Adults	Unclear	Routine	$p<0.01$, adequate privacy		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Harris 2006[50]	63%	United States	Adults	5 NICU units SFR=2 Open-bay=3 HCPs=75 Parents=21	Neonates	Maternity	Level 3, NICU	Parent preference for privacy		
Hosseini 2017[52]	63%	Iran	Adults	2 hospitals 132 patients	Adults, Medical or surgical	Unclear	Routine	p<0.001, adequate privacy		
Janssen 2006[57]	59%	Canada	Adults	1 hospital, 2 wards 415 patients	Pregnant women	Maternity	Routine	Patient satisfaction with for respect for privacy		
Liu 2019[74]	100%	Canada	Adults	1 hospital 15 parents of hospitalised infants	Neonates	Emergency	ICU	Privacy enabled the learning and practice of caregiving skills		
Malcolm 2005[78]	80%	New Zealand	Adults	Hospitals unclear, 12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine	Qualitative (privacy)		Qualitative (supportive)
Morgan 2010[87]	44%	United Kingdom, United States	Children	2 hospitals 146 patients, 114 HCP	Children	Mixed	Routine	Patient perception (privacy) HCP perception (privacy, dignity, confidentiality)		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic	Elective	Routine	p=0.004, better privacy		
Nash 2021[90]	63%	Australia	Adults	4 hospitals 602 patients	Indigenous Adults	Theoretical	Routine	Qualitative (privacy)		
Nassery 2019[91]	90%	Sweden	Adults	1 hospital, 13 interviews (9 individual parents and 4 pairs of parents)	Children	Unclear	Mixed	Qualitative (privacy, comfort)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Olson 1992[93]	52%	United States	Adults	1 hospital 351 patients, 28 HCP	Pregnant women	Maternity	Routine	Patient preference (privacy)		
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses 1 hospital	Orthopaedic, Surgical	Unclear	Routine	Patients in shared rooms signalled their need for privacy		
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine	Feelings of homeliness		
Rowlands 2008[110]	90%	United Kingdom	Adults	1 hospital 12	Adults with advanced cancer	Unclear	Routine	Patient preference (privacy)		
Schalkers 2015[114]	100%	Netherlands	Children	8 hospitals 63 patients	Children	Mixed	Routine	Qualitative (children's preferences for privacy)		
Stelwagen 2021[120]	100%	Netherlands	Adults	1 hospital 36 parents	Neonates	Emergency	ICU			Privacy violations felt more in single rooms
Van de Glind 2008[134]	74%	Netherlands	Adults	1 hospital 52 encounters	Urology	Unclear	Routine		Frequency or content of intimate communications	
Evidence synthesis										
Bradbury-Jones 2013[14]	SLR 86%	International	Adults	NR	Mixed, Vulnerable, Learning difficulties	Unclear	Unclear	Side rooms ensure privacy		
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	More privacy, which contributes to better outcomes	No quantifiable evidence of improved outcomes	
Mental Welfare Commission Scotland 1991[82]	Report 30%	United Kingdom	Unclear	258 patients, 28 hospitals	Psychiatric	Unclear	Routine	Easier to meet with visitors		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, improved patient privacy		
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Privacy, personal control and self-empowerment		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		All studies reported advantages and disadvantages	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 10. Summary of studies reporting views on patients' loneliness/isolation and family contact

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed (all patients in hospital)	Unclear	Mixed		Mixed findings regarding communication	Not isolated More interactions with other patients
Before and after a hospital relocation										
Anåker 2017[2]	59%	Sweden	Adults	59 patients, 1 hospital	Stroke	Rehabilitation	Routine			Not isolated Availability of interactions with physicians, nurses, nurse assistants, physiotherapists, occupational therapists, speech and language therapist, significant other, other team member, and interpreters
Anåker 2019[3]	90%	Sweden	Adults	16 patients, 1 hospital	Stroke	Rehabilitation	Routine			Less feeling of loneliness and emptiness Have company to talk to
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Private toilet and showing facilities		Less feeling of loneliness and isolation Greater companionship and goodwill

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	More parental presence and involvement, including time with skin-to-skin contact, singing/ talking/ reading to infant, bathing, diaper changes, and providing comfort during painful procedures. More time partner spent holding infants clothed Partner attended rounds at least once during stay	Mothers' attendance at rounds Time mothers spent bathing infants	*More time mothers spent holding infants clothed*
Curtis 2017[21]	80%	United Kingdom	Children	17 patients, 60 caregivers, 60 HCPs, 1 hospital, 4 wards	Paediatric	Unclear	Routine	Enhanced family support		Socialisation Not isolated
Cusack 2019[22]	56%	Australia	Adults, HCP	43 nurses, 15 patients, 1 hospital	Unclear	Unclear	Routine			Not isolated
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	$p=0.012$, ability to relax with child (long stay)	$p=0.065$, perceptions of meeting other parents (short stay) $p=0.142$ (short stay), $p=0.542$ (long stay), other	Socialisation $p=0.036$, perceptions of meeting other parents (long stay)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									parents made stay easier p=0.879, ability to relax with child (short stay)	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Increased visitor presence Increased visitor-provider interaction Accommodates Routine and emergency care Patient satisfaction Confidentiality/ privacy		Socialisation Camaraderie
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine	p=0.002, better for visitors		p<0.001, less loneliness
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital	Pregnant women	Maternity	Routine		*Patient satisfaction regardless of room design:* *p=0.005, time spent with support person* *p=0.007, time spent with baby* *p=0.39, amount of rest*	
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (personal control, homeliness, accommodates overnight stay, facilitates mother-		p<0.05, more support Qualitative objections to single rooms

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								infant connection, confidence, parental skills, breastfeeding, and bonding)		(inconsistent or lack of information, poor interpersonal skills, loneliness, isolation; shared rooms - shared information from other patients, and other patient-nurse interactions)
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU	p<0.0001, parents', mother's, and father's presence	p=NS, skin-to-skin contact with either parent, mother, or father	
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital	Cardio-vascular	Unclear	Routine	Qualitative (visitor comfort, better family dynamic)		
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine		% feeling lonely	
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Visiting hours		Less boredom Not isolated
Rosbergen 2020[109]	74%	Australia	Adults, Elderly	73 patients, 1 hospital relocation	Stroke, Neurological	Emergency, Rehabilitation	Routine	p=0.02, physical activity	P=NS, social activity Cognitive activity	Less feeling of loneliness
Singh 2016[116]	70%	United Kingdom	Adults, Elderly	100 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			p=0.03[a], less feeling of loneliness
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital Before	Neonates	Emergency	ICU	Space for family Accommodations for parents		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				and after relocation						
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.017, family-centred care		
Toivonen 2017[132]	63%	Finland	Neonates	20 nurses, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p<0.0001, total nurse–family interaction time p=0.001, total nurse–parent interaction time	p=NS, total nurse–infant interaction time	
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU	Qualitative support for single rooms (family involvement, family presence during care)		
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	More secure/ confident caring for baby		Contact and exchange of knowledge with other parents
Darcy Mahoney 2020[23]	59%	United States, International	Neonates	NR, 277 units	Paediatric, new-born	NR	NICU	p=0.018, parental presence following COVID-19 restrictions p=0.013, parental presence during rounds prior to COVID-19 restrictions	p=NS, parental presence prior to COVID-19 restrictions p=0.6, parental presence during rounds prior to COVID-19 restrictions	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
De Matos 2020[27]	63%	Brazil	Unclear	176 family visitors, 1 hospital, 4 ICU units	Cancer	Unclear	ICU		p=0.52, stress within 24 hrs p=0.15, stress within 7 days	
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Accommodates visitors	p=0.913, loneliness	*>50% enjoy conversation with room mate and gave help to room mate*
Erdeve 2008[36]	74%	Turkey	Infants	60 infants 1 hospital	Preterm neonates	Emergency	ICU			*Time spent with infants during non-hospitalised time*
Harris 2006,[50] Harris 2006[51]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU		Contact with other parents	
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p<0.001, visitor convenience		p<0.001, less feeling of loneliness
Liu 2019[74]	100%	Canada	Neonates	15 parents, 1 hospital	Neonates	Emergency	ICU	Qualitative (engage in parenting activities beyond basic caregiving)	Qualitative (isolation)	
Malcolm 2005[78]	80%	New Zealand	Adolescents, Adults	12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine			Qualitative (camaraderie and support)
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Staff perception of discussions with families		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine	Patients' privacy Visitor times Undisturbed sleep Personal control		Patients: Communication Company Entertainment HCPs: Interaction with other patients Company
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic	Elective	Routine		p=0.754, isolation p=0.638, loneliness	
Nash 2021[90]	63%	United Kingdom	Adults, Elderly	100 patients,	Adults >65 years, recovering from acute illness	Emergency	Routine	Company of family, not strangers		Qualitative (not isolated, social interactions)
Nassery 2019[91]	90%	Sweden	Children	13 parents, 1 hospital	Children	Unclear	Mixed	Qualitative (patient preference, privacy, stress, quieter)		Qualitative (shared experience and advice)
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine		*Mothers satisfied with visiting hours*	
Pease 2002[96]	48%	United Kingdom	Unclear	50 patients, 1 hospital	Oncologic, Terminal	Unclear	Routine			Qualitative (not isolated)
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses, 1 hospital	Orthopaedic, Surgical	Unclear	Routine			Qualitative (not isolated)
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine			Qualitative (not isolated, company, social contact)
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU	$p=0.021^a$, time parents spent	p=NS, time parents spent holding the infant	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								visiting the infant (week 1-2) p=0.039, time spent cuddling, visiting, and with skin-to-skin contact (week 1-2) p=0.026, p=0.017[a], time parents spent visiting the infant during weeks 3-4 p=0.062, p=0.047[a], time parents spent visiting the infant by LOS	p=0.193, time parents spent visiting the infant (week 5–term) p=0.593, interval to first time parents hold infant p=0.810, days spent cuddling infant (week 1–2) p=0.548, days spent cuddling infant (week 3–4) p=0.592, days spent cuddling infant (week 5–term) p=0.361, days spent cuddling infant by LOS p=0.496, days with skin-to-skin (week 1–2) p=0.111, days with skin-to-skin contact (week 3–4) p=0.489, days with skin-to-skin contact (week 5–term) p=0.360, days with skin-to-skin contact by LOS	
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine	Qualitative (privacy)		Qualitative (social interactions)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Schalkers 2015[114]	100%	Netherlands	Children	8 hospitals 63 patients	Children	Mixed	Routine			Qualitative (company, patient preference if they have similarities with other patients)
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Qualitative (family communication and closeness, personal control, privacy, tranquillity, comfort, practicing parenting skills)		Qualitative (not isolated, ability to distance themselves from invasive procedures)
Swanson 2013[125]	37%	United States	Neonates, Carers	55 parents, 1 hospital	Neonates	Emergency	NICU	$p<0.05$ advanced practitioners' satisfaction with communication		$p<0.05$, nurse satisfaction with communication $p<0.05$, nurse satisfaction with team
Tandberg 2018[126]	70%	Norway	Neonates	64 patients, 115 parents, 2 hospitals	Neonates, Premature neonates	Emergency	ICU	$p<0.001$, time mother and father present during first 14 days $p=0.02$, mother's skin-to-skin contact per 24 h $p=0.05$, father's skin-to-skin contact per 24 h $p=0.02$, guidance provided by the staff meets needs of mothers	$p=0.53$, guidance provided by the staff meets needs of fathers $p=0.21$, fathers felt their opinions were considered	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.04, mothers felt their opinions were considered p<0.001 (mothers), p=0.01 (fathers), participation in doctor visits, respectively p=0.05 (mothers), p<0.001 (fathers), emotion support received from staff		
Tandberg 2019[127]	67%	Norway	Infants	77 infants, 132 parents, 2 hospitals	Infants	Emergency	ICU	p<0.0001, mother's and father's presence in week 1 p<0.0001, mother's and father's presence per day up to week 34		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU	p<0.001, mother's presence in week 1 p value<0.001, father's presence in week 1 p<0.001, mother's presence overall and continuous p<0.001, father's presence overall and continuous p<0.001, skin-to-skin contact per day in week 1		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, total skin-to-skin contact per day		
Van Veenendaal 2022[138]	70%	Netherlands	Neonates	182 parents, 3 hospitals	Fathers of neonates	Emergency	ICU	p<0.001, p<0.001[a], total presence p<0.001, p<0.001[a], presence >8 h p<0.001, p=0.009[a], total participation p<0.001, p=0.005[a], participation in medical care p=0.23, p=0.04[a], information gathering p<0.001, p=0.005[a], advocacy and leadership p=0.006, p=0.005[a], time spent with neonate	p=0.04, p=0.13[a], participation in daily care p=0.69, p=0.57[a], time spent comforting neonate	
Evidence synthesis										
Adamson 2003[1]	SLR 82%	United States, International	Mixed	Unclear	Mixed	Mixed	Mixed	Interaction with family members and flexibility for accommodating family members		
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Qualitative (frequency of visitors, privacy)		
OECD WHO 2019 [92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, social support Communication with family		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Quiet, private, better /easier communication		Not isolated and not lonely
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		All studies reported advantages and disadvantages	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 11. Summary of studies reporting patient's views on noise, disturbance and sleep

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Patient perceptions (comfort, noise levels, privacy)		
Before and after a hospital relocation										
Carlson 2006[17]	33%	United States	Neonates	Unclear, 1 hospital	Neonates	Emergency	ICU	Patient perceptions (noise levels)		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital	Neonates	Emergency	NICU	$p<0.001$, noise level $p<0.001$, lighting		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	*Adequate sleep reported but no comparison with shared room*		
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	Actual noise levels	Patient perceptions (noise levels) $p=0.890$, noise disturbance (short stay) $p=0.657$, noise disturbance (long stay)	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs (13 nurses, 7 respiratory therapists), 5 HCPS (other),	Unclear	Unclear	ICU	Qualitative (less disruption)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				6 physicians, 4 family members 4 support staff, 1 hospital						
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine	p=0.019, noise disturbance		
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	p<0.001, physicians' perceptions of noise		
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital, Before and after relocation	Pregnant women	Maternity	Routine	p<0.001, any noise disturbance p<0.001, talking/ visiting by hospital neighbours p=0.08, staff talking at the nursing station p<0.001, crying babies	p=0.30, talking/visiting by hospital staff p=0.28, women in labour	
Maben 2015[76]	78%	United Kingdom	Unclear	24 staff, 32 patients, 1 hospital (relocated), 2 control hospitals	All patients in hospital	Mixed	Mixed	Patient perceived benefit		
Milford 2008[84]	30%	United States	Neonates	Unclear, 1 hospital	Neonates	Emergency	ICU	Higher staff satisfaction		
Pyrke 2017[103]	59%	Canada	Adults	47 patients, 1 hospital relocation	Psychiatric	Emergency	Routine		p=0.399, sleep disturbed p=0.065, time spent asleep	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	Perceived noise level		
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Restfulness		
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p<0.001, actual noise level p<0.05, lighting	Noise level adjacent to baby's ear	
Van Enk 2011[136]	44%	United States	Neonates	90 beds, 1 hospital	Neonates	Emergency	NICU	p=0.04, actual noise level (day time) *p=0.05, less illumination (day time)* *p=0.01, lower temperature (night time)* *p=0.001, lower temperature (day and night combined)* *p<0.0001, lower humidity (night time)*	p=0.35, actual noise level (night time) p=0.08, actual noise level (day or night time) p=0.49, illumination (night time) p=0.60, temperature (day time)	*p<0.0001, lower humidity (day time)* *p<0.0001, lower humidity (day and night combined)*
Walsh 2006[142]	33%	Unclear	Neonates	127 nurses, 1 hospital	Neonates	Emergency	NICU	Actual noise levels		
Contemporaneous comparison										

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU	Qualitative (privacy, fewer disturbances)		
Bevan 2016[5]	59%	United Kingdom	Adults, elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (less noise disturbance)		
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	Qualitative (fewer disturbances)		
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine			Qualitative (adequate rest and sleep due to the presence of a roommate)
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine	Fewer night-time disturbances		
Eberhard-Gran 2000[33]	59%	Norway	Adults	160 patients, Unclear (one municipality)	Adults, Pregnant women	Maternity	Routine	More sleep/ rest Enough sleep/ rest (women ≥ 30 years old) OR 8.1, 1.7-39.3 amount of sleep and rest at Akershus	Enough sleep/rest OR 2.9, 0.3-30.3 amount of sleep and rest at Kongsvinger	
Edéll-Gustafsson 2015[34]	90%	Sweden	Neonates	12 parents, 1 unit	Neonates	Emergency	ICU	Qualitative (privacy, personal control)		Qualitative (not confined)
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Qualitative (peace and quiet)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Foo 2022[43]	74%	Australia	Adults	60 patients, 1 hospital	Cardio-respiratory, Obstetric, Sleep disorders, Other	Unclear	Routine		p>0.05, number of interruptions in 24-h p>0.05, number of disturbances at night p=0.11, other measures of discomfort	
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU	Parent satisfaction with physical environment		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, surgical	Unclear	Routine			p<0.001, better scores for sleep disorders
Meyer 1994[83]	59%	United States	Unclear	Unclear, 1 hospital	Mixed	Mixed	Mixed	p<0.05, actual noise levels (day time) p<0.05, actual noise levels (night time) lower maximum illumination (day and night time)	Maximum period of uninterrupted sleep	
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine	Qualitative (quiet sleep)		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.003, good sleep at night	p=0.127, noise level	
Nassery 2019[91]	90%	Sweden	Children	13 interviews (9 individual parents, 4 pairs of	Children	Unclear	Mixed	Less stress sleeping alone		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				parents), 1 hospital						
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	*Mothers satisfied with room but no comparison with shared rooms*		
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses 1 hospital, 2 wards	Orthopaedic, Surgical	Unclear	Routine	Less disturbance		
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine	Sleep undisturbed		
Poncette 2021[101]	56%	Germany	Unclear	21 beds, 1 hospital	Unclear	Unclear	ICU			Less alarms raised
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine	Qualitative (less stress related to disturbing others)		
Sakr 2021[113]	74%	Lebanon	Adults	75 patients, 1 hospital	Internal medicine, Surgical	Mixed	Routine	p=0.011, fewer cases of new onset insomnia	p=0.272, patient perceived impact of room on new onset insomnia	
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital	Neonates	Emergency	ICU	Qualitative (privacy)		Qualitative (less surprise when staff appear at bedside)
Tegnestedt 2013[130]	70%	Sweden	Adults, Elderly	15 patients 1 hospital	Adults	Emergency	ICU		p=0.777 (7am to 3pm), p=0.885(3pm to 11pm), p=0.832 (11pm to 7am), actual noise	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU			p <0.001 lower light intensity
Evidence synthesis										
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Quieter (less sleep disturbance, better outcomes)		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, better sleep		
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Quieter (less sleep disturbance)		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		Mixed findings on sleep outcomes	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 12. Summary of studies reporting patients' views on satisfaction with care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Patient preference (privacy, ensuites)		Patient preference (social interaction)
Before and after a hospital relocation										
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	Postpartum depression scores Post-traumatic stress disorder scores	Parental stressor scores EQ-5D-5L self-reported health	Perceived maternal self-efficacy Intolerance of uncertainty
Carlson 2006[17]	33%	United States	Neonates	1 hospital, Patients unclear	Neonates	Emergency	ICU	Patient perception (improved lighting control)		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital Before and after relocation	Neonates	Emergency	NICU	p<0.001 parent perceptions of security		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Patient satisfaction but no comparison with shared room		
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine		patient preference based on previous experience inconclusive	
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital	Pregnant women	Maternity	Routine	p<0.001, patient opinions in care considered p<0.001, information given to inform choices		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, patient choices supporter by caregivers p<0.001, assistance given to support person p<0.001, comfort measures for labour pain p<0.001, comfort measures for pain after birth		
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital	Mixed, Adults	Mixed	ICU	p=0.02, overall family satisfaction p=0.007, family satisfaction with care p=0.02, overall patient satisfaction p=0.01, patient satisfaction with care	p=0.12, family satisfaction with decision making p=0.21, patient satisfaction with decision making	
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU		Patient perceptions: (mothers and fathers, respectively) p=0.19, p=0.33, overall scores p=0.11, p=0.94, extent staff listen to mothers/fathers p=0.24, p=0.18, participation in baby's care	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									p=0.09, p=0.45, guidance provided by staff met needs p=0.71, p=0.16, opinion considered regarding care of baby p=0.51, p=0.16, mothers/fathers trust in staff caring for baby p=0.28, p=0.92, staff trust in mothers/fathers caring for baby p=0.12, p=0.89, participation in discussions during rounds p=0.51, p=0.41, information given by staff met needs p=0.70, p=0.87, staff offer emotional support	
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards	Psychiatric and Orthopaedic	Unclear	Routine	Patient perceptions (spatially, visually)		
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p<0.001, mother's overall satisfaction p<0.0001, mother's stress p<0.001 mother's satisfaction with family-centred care		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.0001 mother's involvement in infant care		
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Positive staff perceptions		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	p<0.05, patients' satisfaction with design		
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine	100% patients prefer private toilet *84.8% of patients in single rooms would prefer single rooms* *37.2% of patients in shared room would prefer single rooms*		
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital	Neonates	Emergency	ICU	p<0.001, parent satisfaction with environment p=0.018, overall parent satisfaction p=0.04, total parent satisfaction score		
Swanson 2013[125]	37%	United States	Neonates, Carers	55 parents, 1 hospital	Neonates	Emergency	NICU	p<0.05, nurse perception of facilities p<0.05, practitioners' perceptions of facilities		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.05, parents' perceptions of facilities		
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (privacy, personal control, private toilet) p=0.038, patients perceived a high-level of care		
Boztepe 2017[12]	63%	Turkey	Children	130 patients, 1 hospital, 1 ward	Children	Mixed	Routine		Only 15.4% expected a large or single room	
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Patient preference (privacy)		
de Matos 2020[27]	63%	Brazil	Unclear	176 family visitors, 1 hospital, 4 ICU units	Cancer	Unclear	ICU	p=0.02, patient satisfaction Satisfaction of family members		
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine	Patient satisfaction with needs met		
Eberhard-Gran 2000[33]	59%	Norway	Adults	160 patients, Unclear (one municipality)	Adults, Pregnant women	Maternity	Routine	OR[a] 18, 2.2-149.1 more likely to be satisfied with care	Satisfaction with rooms Satisfaction with sleep and rest Satisfaction with LOS	
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Patient preference	p=0.309, fear of dying	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Erdeve 2009[37]	78%	Turkey	Adults, Neonates	60 infants, 49 mothers, 2 hospitals	Preterm neonates	Emergency	NICU		p=0.206, depression scores p=0.06, postpartum depression rate p=0.161, vulnerable child scores p=0.219, parenting stress scores	
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU	p<0.05, window view and proximity to infant during sleep Less stressful and less depressing		
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU	Less stressful and less depressing, better physical environment.		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p<0.001, patients' overall satisfaction p<0.001, patients' total satisfaction		
Janssen 2006[57]	59%	Canada	Adults	415 patients, 1 hospital, 2 wards	Pregnant women	Maternity	Routine	p<0.001, patients' overall satisfaction p<0.001, confidence in neonatal care p<0.001, provision of choice p<0.001, physical environment		
Labarère 2004[68]	70%	France	Adults	4095 patients, 1 hospital	Mixed	Mixed	Mixed	p<0.01, overall patient experience		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Miller 1998[85]	59%	United States	Adolescents, Adults	94 patients, 1 hospital	Inpatients, Outpatients	Unclear	Routine	% patients overall stating ideal rooming arrangements % inpatients stating ideal rooming arrangements % female inpatients stating ideal rooming arrangements % inpatients aged 15 to 17 and 18 to 21 stating ideal rooming arrangements % female outpatients stating ideal rooming arrangements	% outpatients aged 12 to 14 stating ideal rooming arrangements	% male inpatients and outpatients stating ideal rooming arrangements % inpatients aged 12 to 14 stating ideal rooming arrangements % outpatients stating ideal rooming arrangements % outpatients aged 15 to 17 and 18 to 21 stating ideal rooming arrangements
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine			% patient preference
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.014, feeling of safety Qualitative (privacy, security, pain management, cleanliness)	p=0.061, overall patient satisfaction	
Nash 2021[90]	63%	Australia	Adults	602 patients, 4 hospitals	Unclear	Unclear	Routine			Patient preference
Nassery 2019[91]	90%	Sweden	Children	13 interviews (9 individual parents, 4 pairs of	Children	Unclear	Mixed	Parents preference		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				parents), 1 hospital						
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	Nurse preference *Mother satisfaction*		
Pease 2002[96]	48%	United Kingdom	Unclear	50 patients, 1 hospital	Oncologic, Terminal	Unclear	Routine	Family preference		Patient preference
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses, 1 hospital, 2 wards	Orthopaedic, Surgical	Unclear	Routine			Qualitative (security and safety)
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine			Qualitative (security, company, not isolated)
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU		$p=0.512$, maternal depression $p=0.152$, trait anxiety $p=0.830$, state anxiety $p=0.071$, life stress $p=0.603$, avoidance coping $p=0.967$, emotion-oriented coping $p=0.506$, task-oriented coping $p=0.951$, social support	$p=0.040^a$, stress levels
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine			Satisfaction for older/bedridden patients

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine		Qualitative (desire for choice of room)	
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Qualitative (privacy, safety, homeliness, feelings of central engagement with child care)		
Tandberg 2019[127]	67%	Norway	Infants	77 infants, 132 parents, 2 hospitals	Infants	Emergency	ICU	Mothers: p=0.005, depression at day 14 p=0.04, anxiety at day 14 p=0.0001, role alteration at day 14 p=0.06, role alteration at discharge Fathers: p=0.06, environmental stress at day 14 p=0.003, role alteration at day 14 p=0.003, environmental stress at discharge p=0.004, role alteration at discharge	Mothers: p=0.12 Maternal distress at day 14 p=0.43 depression, and p=0.48, anxiety at discharge p=0.13, distress at discharge p=0.65, depression and p=0.54, anxiety at 4-month corrected age p=0.60, distress at 4-month corrected age p=0.62, dysfunctional interaction with child p=0.23, perceived child to be difficult p=0.42, stress p=0.51, attachment	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Fathers: p=0.17, depression and p=0.25, anxiety at day 14 p=0.57, depression and p=0.73, anxiety at discharge p=0.92, depression and p=0.11, anxiety at 4-month corrected age p=0.16, dysfunctional interaction with child p=0.77, perceived child to be difficult p=0.68, stress p=0.49, attachment	
Van Veenendaal 2022[138]	70%	Netherlands	Neonates	182 parents, 3 hospitals	Fathers of neonates	Emergency	ICU	p=0.001[a], stress overall p=0.011[a], stress related to environment p<0.001[a,] stress related to role alteration	p=0.83[a], depression and anxiety p=0.26[a], self-efficacy p=0.27[a], impaired parent-newborn bonding p=0.32, satisfaction with care	
Watson 2014[144]	44%	Canada	Neonates	85 families, 1 hospital	Neonates	Emergency	NICU	p=0.008, privacy p=0.0001, comfort p=0.009, interaction with other families	p=0.05, getting to know baby p=0.05, feeling irritable, anxious, depressed or sad	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.04. confidence feeding baby p=0.04, easy to comfort baby *p=0.003, family adjusted to having the baby home*	p=0.05, satisfied with care baby received	
Economic analysis										
Boardman 2011[8]	91%	Canada	Unclear	537 beds, 1 hospital	Mixed	Mixed	Mixed	Patients and willingness to pay for single over shared rooms		
Evidence synthesis										
Bradbury-Jones 2013[14]	SLR 86%	International	Adults	NR	Mixed, Vulnerable, Learning difficulties	Unclear	Unclear		Mixed views among patients with learning disabilities	
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Quicker mobility recovery Sense of self-reliance Personal control leads to happier patients.		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	12 studies showed single rooms positively affect patient satisfaction	4 studies showed no difference	1 study showed single rooms don’t positively affect patient satisfaction
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine			Communication and interaction with kindred spirits was appreciated

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
										Bedridden / older patients were less satisfied with single rooms.
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	Patient perceptions of dignity		
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine	1 study found advantages for feelings of safety 1 study found advantages for patient preference 1 study found advantage or no difference for patient preference	1 study found mixed findings for feelings of safety All studies found mixed findings regarding concern for others 1 study found mixed findings for patient preference	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 13. Summary of studies reporting data on patient monitoring and safeguarding

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed		*Qualitative (regular visits by staff to single-rooms)*	
Before and after a hospital relocation										
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine		Staffing ratio	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients 1 hospital, 2 units	Premature neonates	Maternity care	NICU		Nurse-to-patient ratio	
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU			Nurse perception (parallel patient interactions, get caught in single rooms so can't attend to other families)
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU		Nurse-to-patient ratio	
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute medical illness	Emergency	Routine	Patient perceptions (isolation)		
Bodack 2016[10]	55%	Germany	Neonates	35 pairs of parents	Premature neonates	Maternity care	NICU	Somewhat less frequent		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								adequate monitoring		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	*Standard nurse-to-patient ratio 1:2*		
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Mixed	Unclear	Routine	p=0.025, patient perception of nurse availability		
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Better response to call lights. More visits to anticipate patient needs.		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p=0.19, access to nurses		
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU		Nurse-to-patient ratio	
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine		p=0.244, response to call bell	
Early vs late response to new unit design										

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff 1 hospital, 1 unit	Unclear	Unclear	ICU	75 negative comments on shared-room design		Qualitative (less safety concerns related to distance between patient and care provider)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 14. Summary of studies reporting views on patient confidentiality

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Qualitative (confidentiality)		
Before and after a hospital relocation										
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Qualitative (patient perceptions of confidentiality)		
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (nurse perceptions of confidentiality, facilitating care)		
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 move	Medical and surgical, Adults	Unclear	Routine	$p<0.001$ ability to have confidential discussions		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine		Patient satisfaction with confidentiality	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Qualitative (patient perceptions of confidentiality)		
Contemporaneous comparison										
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	Qualitative (easier to guarantee confidentiality)		
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (patient perceptions of confidentiality)		
Hosseini 2017[52]	63%	Iran	Adults	2 hospitals 132 patients	Adults, Medical or surgical	Unclear	Routine	$p<0.001$ comfortable discussing personal problems		
Malcolm 2005[78]	80%	New Zealand	Adolescents, Adults	12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine	Qualitative (patients in shared rooms felt a lack of privacy and confidentiality which affected relationships with other patients)		
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	$p<0.05$, improved patient confidentiality		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 2. Summary of studies reporting data on availability of beds, space requirements, and capital costs

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Higher space requirement for single-bed wards Building costs per bed
Before and after a hospital relocation										
Darley 2018[24]	56%	United Kingdom	Unclear	1 hospital relocation	Unclear	Unclear	Routine	Ward closures per year Bed days lost per 100,000		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	Number of patients accommodated; Total space		
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Capacity		Room space
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital Before and after relocation	Mixed, Adults	Mixed	ICU	Number of beds Space per bed		
Jung 2022[62]	67%	Korea	Adults	901 patients, 1 hospital Before and after renovation	Adult, mixed	Unclear	ICU		Number of isolated rooms	Number of beds
Kosuge 2013[67]	41%	Japan	Unclear	555 beds, 1 hospital	Surgical, Internal medicine	Unclear	Routine	Number of beds (working, general, per nursing unit) Wards in total	Number of beds (tuberculosis)	Number of beds (mental, cases of floor transfer)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Total number of people / day and the wards	
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards (pre-/post-relocation)	Orthopaedic	Unclear	Routine	Number of beds		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	Qualitative (larger rooms promote more space for family)		
Rosbergen 2020[109]	74%	Australia	Adults, Elderly	73 patients, 1 hospital relocation	Stroke, Neurological	Emergency, Rehabilitation	Routine	p=0.007, number of single bedrooms in acute stroke unit/ neurology p<0.001, number of single bedrooms in inpatient rehab unit Ward length Total communal floor space	Number of any bedrooms, acute stroke unit/ neurology	Number of any bedrooms, inpatient rehabilitation unit
Contemporaneous comparison										
Julian 2015[61]	78%	United States	Neonates	1823 patients, 1 hospital, 1 unit	Neonates	Mixed	NICU			Bed capacity
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine	Single rooms usage (approx. 90%)	Number of rooms	
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine			Bed capacity
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU			Number of beds; Room/ward area

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Quach 2018[104]	59%	Canada, United States	Children	83,334 patient-days, 2 hospitals	Children	Mixed	Mixed			Bed capacity
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital	Neonates	Emergency	ICU	Capacity; Room/ward area		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 16. Summary of studies reporting data on length of stay

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	LOS (per 1,000 patient-days): new hospital older people's ward, control new-build hospital older people's ward, steady-state control hospital medical assessment unit		LOS (per 1,000 patient-days): new hospital assessment unit, control new-build hospital medical assessment unit, steady-state control hospital older people's ward
Before and after a hospital relocation										
Blandfort 2019[6]	67%	Denmark	Elderly	964 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	p=0.35, median LOS		
Blandfort 2019[7]	67%	Denmark	Elderly	1014 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	Fewer cases with LOS ≥ 14 days	Minimum LOS	Maximum LOS
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine	LOS Duration of catheterisation Number of patients catheterised		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital Before and after relocation	Neonates	Emergency	NICU	LOS		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.698, ward LOS p=0.226, hospital LOS	
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	LOS		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150,	Paediatric	NR	NICU		p=0.340, LOS for PEMR 2 and 3 patients	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				PEMRs 4=12), 1 hospital, 2 units					p=0.890, LOS for PEMR 4 patients	
Erickson 2011[38]	67%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Preterm neonates	Emergency	NICU		*p*=0.73, LOS	
Gregersen 2021[46]	70%	Denmark	Elderly	446 patients, 1 hospital relocation	Geriatric	Unclear	Routine		*p*=0.50, hospital LOS	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	p<0.001, total LOS p<0.001, postpartum LOS		p=0.01, length of first stage labour p=0.002, length of second stage labour p=0.002, intrapartum LOS
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU		p=0.52, LOS	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients, 1 hospital, 2 units relocation	Premature neonates	Maternity	NICU		p=0.36, hospital LOS	
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital Before and after relocation	Mixed, Adults	Mixed	ICU		p=0.25, ICU LOS: family p=0.11, ICU LOS: patients p=0.25, hospital LOS: family p=0.60, hospital LOS: patients	
Jung 2022[62]	67%	Korea	Adults	901 patients, 1 hospital Before and after renovation	Adult, mixed	Unclear	ICU		p=0.575, ICU LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU		p=0.1784, hospital LOS	
Kosuge 2013[67]	41%	Japan	Unclear	555 beds, 1 hospital	Surgical, Internal medicine	Unclear	Routine	Average hospital LOS (surgery, internal medicine)		
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards (pre-/post-relocation)	Psychiatric and Orthopaedic	Unclear	Routine	p<0.05, hospital LOS (orthopaedic patients not undergoing operation) Hospital LOS overall (psychiatric patients) ICU LOS (psychiatric patients)	Hospital LOS (orthopaedic patients undergoing operation)	
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Average LOS		
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-born control infants, 1 hospital	Preterm neonates	Emergency	NICU		p=0.81, LOS	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.02, LOS for extremely preterm infants p<0.0001, LOS for very preterm infants	p=0.71, LOS for moderately pre-term	p<0.0001, overall median hospital LOS p<0.0001, LOS for term/post term infants
Pyrke 2017[103]	59%	Canada	Adults	47 patients, 1 hospital relocation	Psychiatric	Emergency	Routine		*p*=0.832, LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Sadatsafavi 2019[112]	100%	United States	Neonates	NR, 1 hospital (theoretical)	Neonates	NR	ICU	Mean benefit–cost ratio 1.298 (95% CI: 1.282–1.315) when reduced LOS considered		
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine	p<0.01, LOS		
Stevens 2014[123]	44%	United States	Neonates	73 patients, 1 hospital	Neonates	Emergency	ICU			p=0.0052, hospital LOS
Teltsch 2011[131]	67%	Canada	Adults	19343 patients, 2 hospitals, Before and after relocation or control	Adults	Unclear	ICU			Average ICU LOS (year 2000, 2001, 2002, 2003, 2004, 2005, and total)
van der Hoeven 2022[135]	63%	Netherlands	Infants	1293 infants, 1 hospital Before and after relocation	Infants	Unclear	ICU		p=0.49, hospital LOS	
van Veenendaal 2020[137]	70%	Netherlands	Neonates	1152 infants, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.016, LOS		
Vietri 2004[139]	59%	United States	Adults	261 Adults, 1 hospital Before and after relocation	Mixed	Unclear	ICU		p=NS, ICU LOS	
Contemporaneous comparison										
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	LOS		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at	Mixed, Post surgery, Medical admission	Mixed	ICU	*LOS in the same bed*	LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				admission), 1 hospital, 1 ward						
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.44, ICU LOS	
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	LOS		
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine		LOS	
Erdeve 2008,[36] Erdeve 2009[37]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.929, NICU LOS	
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine		p=0.36, overall LOS p=0.73, LOS for total hip arthroplasty p=0.55, LOS for knee arthroplasty	
Grundt 2021[47]	67%	Norway	Neonates	77 patients, 66 mothers, 2 hospitals, 2 units	Premature neonates	Maternity	NICU		p=0.16, LOS	
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU	Patient transfers		Average LOS Average discharges
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU			Average LOS
Hyun 2021[54]	78%	South Korea	Adults	666 patients, 1 hospital	Respiratory, COVID-19	Emergency	ICU	p=0.001, hospital LOS		
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine		hospital LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine			Mean hospital LOS
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine			p=0.001, overall LOS p=0.01, LOS (patients who experienced an inpatient fall)
Labarère 2004[68]	70%	France	Adults	4095 patients, 1 hospital	Mixed	Mixed	Mixed		hospital LOS	
Lehtonen 2020[71]	74%	International	Neonates	4662 patients, 331 units	Preterm neonates	Emergency	ICU	Overall LOS OR[a] −3.4 (−4.7 to −3.1)		
Mattner 2007[79]	74%	Germany	Adults	336 patients, 1 hospital	Cardiovascular Adults	Mixed	ICU	p=0.004, LOS		
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital Before and after relocation	Neonates	Emergency	NICU			p=0.07, hospital LOS
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU		p=0.16, LOS	
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU		p=0.382, LOS	
Lester 2016[73]	59%	United States	Neonates	216 patients, 1 hospital	Premature neonates	Maternity	ICU		p=0.06, LOS	
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.56, LOS	
Evidence synthesis										
OECD WHO 2019[92]	14%	Europe	NR	NR	Mixed	Mixed	Mixed		p=NS. LOS	
Voigt 2018[141]	86%	International	NR	NR	NR	Unclear	Routine		LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 17. Summary of studies reporting data on costs of care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2015[76]	78%	United Kingdom	Unclear	24 staff, 32 patients, 1 hospital (relocated), 2 control hospitals	All patients in hospital	Mixed	Mixed		Cost impact (changes in falls, LOS, medication errors, hospital-acquired infections)	
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Cleaning costs per bed Nursing staff full-time equivalent Nursing staff costs
Before and after a hospital relocation										
Davis [25]2019	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.311, discharge to home p=0.406, transfer to other facility	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	Reduction in overall staffing costs after opening single-room maternity care		
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Cost savings due to reduced LOS		
Reed 1986[106]	10%	United States	Adults	No. of patients unclear, 1 hospital	Pregnant women	Maternity care	Routine	Number of staff required		
Sadatsafavi 2019[112]	100%	United States	Neonates	1 hospital (theoretical)	Neonates	NR	ICU	Investment justifiable when direct costs considered, mean benefit–cost ratio 1.794 (1.783–1.804) Investment justifiable when LOS considered		Investment not justifiable when nosocomial infections considered, mean benefit–cost ratio 0.730 (0.724-0.735)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine		p=0.74, discharge to home p =0.21, discharge to new care home	
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Direct cost (infants with equal comorbidities, duration of hospitalisation)	Costs per square foot	p[a]=statistically significant, need for nursing and all unit staff
Stevens 2014[123]	44%	United States	Neonates	73 patients, 1 hospital	Neonates	Emergency	ICU	p<0.0001, lower costs for supplies p<0.0001, lower depreciation in costs Full adjustment of the model shows a cost advantage for SFR	p=0.2316, total direct costs p=0.1551, other costs General linear model: p=0.2854, admission p=0.2485, severity p=0.2806, duration of respiratory support	p=0.0373, direct costs for NICU labour p=0.0002, direct costs for other labour costs (therapies, radiology, pharmacy)
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU			Number of staff equired
Boardman 2011[8]	91%	Canada	Unclear	537 beds, 1 hospital	Mixed	Mixed	Mixed	Reduced transfers and waiting time Net social benefits taking into account upfront and ongoing costs and annual benefits		Cost of a bed per day Up-front land and construction costs On-going annual maintenance, housekeeping, operating, additional nursing and phsycian costs
Felice Tong 2018 [40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine	p=0.002[u], p=0.002[m] discharge to rehabilitation		
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU			Construction costs per square foot
Harris 2006[51]	63%	Canada	Adults	976 patients, 1 hospital, Before and	Pregnancy	Maternity	Routine			Average costs per square foot[a]

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

				after new unit established						
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p=0.17, discharged to home p=0.19, discharged to new care home	
Sadatsafavi 2016[111]	100%	Canada	Unclear	8811 patient-days, 1 hospital	Medical and surgical	Unclear	ICU	Costs due to hospital acquired infection		Construction and operating costs
Evidence synthesis										
Adamson 2003[1]	82%	United States, International	Mixed	Unclear	Mixed	Mixed	Mixed			Costs per patient by floor plan type
Voigt 2018[141]	86%	International	NR	NR	NR	Unclear	Routine	Operational efficiencies		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

References

1. Adamson D. The Use of Single Patient Rooms vs. Multiple Occupancy Rooms in Acute Care Environments | Semantic Scholar [Internet]. 2003 [cited 2022 May 4]. Available from: https://www.semanticscholar.org/paper/The-Use-of-Single-Patient-Rooms-vs.-Multiple-Rooms-Chaudhury-Mahmood/252452e8fa872a517c15d6ecf70c74f82a363271
2. Anåker A, Von Koch L, Sjöstrand C, Bernhardt J, Elf M. A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction—The significance of the built environment. PLOS ONE. 2017 Jul 1;12(7):e0177477.
3. Anåker A, Von Koch L, Heylighen A, Elf M. 'It's Lonely': Patients' Experiences of the Physical Environment at a Newly Built Stroke Unit. Health Environments Research & Design Journal. 2019;12(3):141–52.
4. Apple M. A Comparative Evaluation of Swedish Intensive Care Patient Rooms. HERD. 2014 Apr;7(3):78–93.
5. Bevan V, Edwards C, Woodhouse K, Singh I. Dignified care for older people: Mixed methods evaluation of the impact of the hospital environment - single rooms or multi-bedded wards: Healthy Aging Research. 2016;5(13):1–8.
6. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Analgesic and psychoactive medications and the risk of falls in relation to delirium in single-bed rooms compared to multiple-bed rooms in geriatric inpatients. Aging Clinical and Experimental Research 2019 32:8. 2019 Aug 28;32(8):1493–9.
7. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Single-bed rooms in a geriatric ward prevent delirium in older patients. Aging Clinical and Experimental Research 2019 32:1. 2019 Mar 21;32(1):141–7.
8. Boardman AE, Forbes D. A Benefit-Cost Analysis of Private and Semi-Private Hospital Rooms. J Benefit Cost Anal. 2011 Jan 3;2(1):1–27.
9. Bocquet A, Wintenberger C, Lupo J, Morand P, Pavese P, Gallouche M, et al. Description of an influenza outbreak in a French university hospital and risk factors of nosocomial influenza. Eur J Clin Microbiol Infect Dis. 2021 Apr;40(4):879–84.
10. Bodack E, Schenk O, Karutz H. Die Einrichtung von Einzelzimmern auf neonatologischen Intensivstationen – Auswirkungen auf die Betreuung aus Sicht der Eltern. Z Geburtshilfe Neonatol. 2016 Jun;220(3):124–9.
11. Bonizzoli M, Bigazzi E, Peduto C, Tucci V, Zagli G, Pecile P, et al. Microbiological survey following the conversion from a bay-room to single-room intensive care unit design. Journal of Hospital Infection. 2011 Jan;77(1):84–6.
12. Boztepe H, Çınar S, Ay A. School-age children's perception of the hospital experience. J Child Health Care. 2017 Jun;21(2):162–70.
13. Bracco D, Dubois MJ, Bouali R, Eggimann P. Single rooms may help to prevent nosocomial bloodstream infection and cross-transmission of methicillin-resistant Staphylococcus aureus in intensive care units. Intensive Care Med. 2007 May 1;33(5):836–40.
14. Bradbury-Jones C, Rattray J, Jones M, MacGillivray S. Promoting the health, safety and welfare of adults with learning disabilities in acute care settings: a structured literature review. Journal of Clinical Nursing. 2013;22(11–12):1497–509.
15. Campbell-Yeo M, Kim T, Disher T, Richardson B, Dol J, Bishop T, et al. Do Single-Family Rooms Increase Parental Presence, Involvement, and Maternal Well-Being in Neonatal Intensive Care? Journal of Perinatal & Neonatal Nursing. 2021 Oct;35(4):350–61.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

16. Cantoni N, Weisser M, Buser A, Arber C, Stern M, Heim D, et al. Infection prevention strategies in a stem cell transplant unit: impact of change of care in isolation practice and routine use of high dose intravenous immunoglobulins on infectious complications and transplant related mortality - Cantoni - 2009 - European Journal of Haematology - Wiley Online Library [Internet]. [cited 2022 Jul 11]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0609.2009.01249.x
17. Carlson B, Walsh S, Wergin T, Schwarzkopf K, Ecklund S. Challenges in design and transition to a private room model in the neonatal intensive care unit. Adv Neonatal Care. 2006 Oct;6(5):271–80.
18. Carter BS, Carter A, Bennett S. Families' views upon experiencing change in the neonatal intensive care unit environment: from the 'baby barn' to the private room. J Perinatol. 2008 Dec;28(12):827–9.
19. Caruso P, Guardian L, Tiengo T, dos Santos LS, Junior PM. ICU Architectural Design Affects the Delirium Prevalence: A Comparison Between Single-Bed and Multibed Rooms*. Critical Care Medicine. 2014 Oct;42(10):2204–10.
20. Cobo J, Asensio Á, Moreno S, Navas E, Pintado V, Oliva J, et al. Risk factors for nosocomial transmission of multidrug-resistant tuberculosis due to Mycobacterium bovis among HIV-infected patients. :6.
21. Curtis P, Northcott A. The impact of single and shared rooms on family-centred care in children's hospitals. Journal of Clinical Nursing. 2017 Jun;26(11–12):1584–96.
22. Cusack L, Wiechula R, Schultz T, Dollard J, Maben J. Anticipated advantages and disadvantages of a move to 100% single-room hospital in Australia: A case study. J Nurs Manag. 2019 Jul;27(5):963–70.
23. Darcy Mahoney A, White RD, Velasquez A, Barrett TS, Clark RH, Ahmad KA. Impact of restrictions on parental presence in neonatal intensive care units related to coronavirus disease 2019. J Perinatol. 2020 Sep;40(S1):36–46.
24. Darley ESR, Vasant J, Leeming J, Hammond F, Matthews S, Albur M, et al. Impact of moving to a new hospital build, with a high proportion of single rooms, on healthcare-associated infections and outbreaks. J Hosp Infect. 2018 Feb;98(2):191–3.
25. Davis M, Elliott R, Hills R, Fry M. Single-Room Ward Design and Its Impact on Service and Patient Outcomes: An Evaluation Study. Orthopaedic Nursing. 2019 Oct;38(5):317–25.
26. Deitrick LM, Bokovoy J, Panik A. The "Dance" Continues ... Evaluating Differences in Call Bell Use Between Patients in Private Rooms and Patients in Double Rooms Using Ethnography. Journal of Nursing Care Quality. 2010 Oct;25(4):279–87.
27. de Matos LBN, Fumis RRL, Nassar Junior AP, Lacerda FH, Caruso P. Single-Bed or Multibed Room Designs Influence ICU Staff Stress and Family Satisfaction, But Do Not Influence ICU Staff Burnout. HERD. 2020 Apr;13(2):234–42.
28. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units. Journal of perinatology : official journal of the California Perinatal Association. 2010 May;30(5):343–51.
29. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: comparative patient progress in open-ward and single family room units. Journal of Perinatology 2010 31:4. 2011 Nov 11;31(4):281–8.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

30. Douglas CH, Douglas MR. Patient-centred improvements in health-care built environments: perspectives and design indicators. Health Expect. 2005 Sep;8(3):264–76.
31. Dowdeswell B, Erskine J, Heasman M. A Report for NHS Estates, England by the EU Health Property Network. :40.
32. Dowling DA, Blatz MA, Graham G. Mothers' Experiences Expressing Breast Milk for Their Preterm Infants: Does NICU Design Make a Difference? Advances in Neonatal Care. 2012 Dec;12(6):377–84.
33. Eberhard-Gran M, Eskild A, Opjordsmoen S, Schei B. Maternity care - sleep, rest and satisfaction. :10.
34. Edéll-Gustafsson U, Angelhoff C, Johnsson E, Karlsson J, Mörelius E. Hindering and buffering factors for parental sleep in neonatal care. A phenomenographic study. J Clin Nurs. 2015 Mar;24(5–6):717–27.
35. Ehrlander W, Ali F, Chretien KC. Multioccupancy hospital rooms: Veterans' experiences and preferences. Journal of Hospital Medicine. 2009;4(8):E22–7.
36. Erdeve O, Arsan S, Yigit S, Armangil D, Atasay B, Korkmaz A. The impact of individual room on rehospitalization and health service utilization in preterms after discharge. Acta paediatrica (Oslo, Norway : 1992). 2008 Oct;97(10):1351–7.
37. Erdeve O, Arsan S, Canpolat FE, Ertem IO, Karagol BS, Atasay B, et al. Does individual room implemented family- centered care contribute to mother-infant interaction in preterm deliveries necessitating neonatal intensive care unit hospitalization? American Journal of Perinatology. 2009 Feb 19;26(2):159–64.
38. Erickson C, Kattelmann K, Remington J, Cuirong Ren, Carol Helseth, Stevens D. Traditional open-bay versus single-family room neonatal intensive care unit: a comparison of selected nutrition outcomes. Research and Reports in Neonatology. 2011 Mar;15.
39. Everts RJ, Hanger HC, Jennings LC, Hawkins A, Sainsbury R. Outbreaks of influenza A among elderly hospital inpatients. The New Zealand Medical Journal. 1996 Jul 1;109(1026):272–4.
40. Felice Tong YY, Karunaratne S, Youlden D, Gupta S. The Impact of Room-Sharing on Length of Stay After Total Hip or Knee Arthroplasty: A Retrospective Study. Arthroplasty Today. 2021 Apr;8:289-294.e2.
41. Ferri M, Zygun DA, Harrison A, Stelfox HT. Evidence-based design in an intensive care unit: End-user perceptions. BMC Anesthesiology. 2015 Apr 25;15(1):1–9.
42. Florey L, Flynn R, Isles C. Patient Preferences for Single Rooms or Shared Accommodation in a District General Hospital. Scott Med J. 2009 May;54(2):5–8.
43. Foo CT, O'Driscoll DM, Ogeil RP, Lubman D, Young AC. Barriers to sleep in acute hospital settings. Sleep Breath. 2022 Jun;26(2):855–63.
44. Ford-Jones EL, Mindorff CM, Gold R, Petric M. THE INCIDENCE OF VIRAL-ASSOCIATED DIARRHEA AFTER ADMISSION TO A PEDIATRIC HOSPITAL. American Journal of Epidemiology. 1990 Apr;131(4):711–8.
45. Fraenkel Cj, Inghammar M, Söderlund-Strand A, Johansson PJH, Böttiger B. Risk factors for hospital norovirus outbreaks: impact of vomiting, genotype, and multi-occupancy rooms. Journal of Hospital Infection. 2018 Apr;98(4):398–403.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

46. Gregersen M, Mellemkjær A, Foss CH, Blandfort S. Use of single-bed rooms may decrease the incidence of hospital-acquired infections in geriatric patients: A retrospective cohort study in Central Denmark region. J Health Serv Res Policy. 2021 Oct;26(4):282–8.
47. Grundt H, Tandberg BS, Flacking R, Drageset J, Moen A. Associations Between Single-Family Room Care and Breastfeeding Rates in Preterm Infants. J Hum Lact. 2021 Aug;37(3):593–602.
48. Halaby T, al Naiemi N, Beishuizen B, Verkooijen R, Ferreira JA, Klont R, et al. Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. Antimicrob Resist Infect Control. 2017 Dec;6(1):117.
49. Harris SJ, Farren MD, Janssen PA, Klein MC, Lee SK. Single room maternity care: perinatal outcomes, economic costs,and physician preferences. Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du Canada : JOGC. 2004;26(7):633–40.
50. Harris DD, Shepley MM, White RD, Kolberg KJS, Harrell JW. The impact of single family room design on patients and caregivers: executive summary. Journal of Perinatology 2006 26:3. 2006 Sep 28;26(3):S38–48.
51. Harris D, Shepley M, White R. Impact of Single Family NICU Rooms | The Center for Health Design [Internet]. 2006 [cited 2022 May 4]. Available from: https://www.healthdesign.org/chd/knowledge-repository/impact-single-family-nicu-rooms
52. Hosseini SB, Bagheri M. Comparison of Patient Satisfaction with Single Patient Rooms Versus Shared Patient Rooms. Ann Mil Health Sci Res [Internet]. 2018 Jul 8 [cited 2022 Jul 20];15(4). Available from: https://brief.land/amhsr/articles/80199.html
53. Hourigan SK, Subramanian P, Hasan NA, Ta A, Klein E, Chettout N, et al. Comparison of Infant Gut and Skin Microbiota, Resistome and Virulome Between Neonatal Intensive Care Unit (NICU) Environments. Front Microbiol. 2018 Jun 25;9:1361.
54. Hyun M, Lee JY, Kwon YS, Kim JY, Park JS, Park S, et al. COVID-19: Comparing the applicability of shared room and single room occupancy. Transbound Emerg Dis. 2021 Jul;68(4):2059–65.
55. Jansen SJ, Lopriore E, Berkhout RJM, van der Hoeven A, Saccoccia B, de Boer JM, et al. The Effect of Single-Room Care Versus Open-Bay Care on the Incidence of Bacterial Nosocomial Infections in Pre-Term Neonates: A Retrospective Cohort Study. Infectious Diseases and Therapy. 2021 Mar 1;10(1):373–86.
56. Janssen PA, Klein MC, Harris SJ, Soolsma J, Seymour LC. Single room maternity care and client satisfaction. Birth (Berkeley, Calif). 2000;27(4):235–43.
57. Janssen PA, Dennis CL, Reime B. Development and psychometric testing of the care in obstetrics: Measure for testing satisfaction (COMFORTS) scale. Research in Nursing & Health. 2006 Feb 1;29(1):51–60.
58. Jones L, Peters K, Rowe J, Sheeran N. The Influence of Neonatal Nursery Design on Mothers' Interactions in the Nursery. J Pediatr Nurs. 2016 Oct;31(5):e301-312.
59. Jongerden IP, Slooter AJ, Peelen LM, Wessels H, Ram CM, Kesecioglu J, et al. Effect of intensive care environment on family and patient satisfaction: a before–after study. Intensive Care Med. 2013 Sep 1;39(9):1626–34.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

60. Jou J, Ebrahim J, Shofer FS, Hamilton KW, Stern J, Han JH. Environmental Transmission of *Clostridium difficile* : Association Between Hospital Room Size and *C. difficile* Infection. Infect Control Hosp Epidemiol. 2015 May;36(5):564–8.
61. Julian S, Burnham CAD, Sellenriek P, Shannon WD, Hamvas A, Tarr PI, et al. Impact of Neonatal Intensive Care Bed Configuration on Rates of Late-Onset Bacterial Sepsis and Methicillin-Resistant Staphylococcus aureus Colonization. Infection Control & Hospital Epidemiology. 2015 Oct;36(10):1173–82.
62. Jung J, Choe PG, Choi S, Kim E, Lee HY, Kang CK, et al. Reduction in the acquisition rate of carbapenem-resistant Acinetobacter baumannii (CRAB) after room privatization in an intensive care unit. Journal of Hospital Infection. 2022 Mar 1;121:14–21.
63. Kainiemi E, Hongisto P, Lehtonen L, Pape B, Axelin A. Effects of single family room architecture on parent–infant closeness and family centered care in neonatal environments—a single-center pre–post study. J Perinatol. 2021 Sep;41(9):2244–51.
64. Kinnula SE, Renko M, Tapiainen T, Knuutinen M, Uhari M. Hospital-associated infections during and after care in a paediatric infectious disease ward. J Hosp Infect. 2008 Apr;68(4):334–40.
65. Kinnula S, Buettcher M, Tapiainen T, Renko M, Vepsäläinen K, Lantto R, et al. Hospital-associated infections in children: a prospective post-discharge follow-up survey in three different paediatric hospitals. The Journal of hospital infection. 2012 Jan;80(1):17–24.
66. Knight S, Singh I. Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards. Journal of Clinical Gerontology and Geriatrics. 2016 Sep;7(3):87–92.
67. KOSUGE R, KOBAYASHI K, KAKEHI A. COMPARATIVE STUDIES ON HOSPITAL-BED MANAGEMENT BETWEEN ALL SINGLE-ROOM WARDS AND MIXED MULTI-BED ROOM WARDS. Journal of Architecture and Planning (Transactions of AIJ). 2013;78(686):765–73.
68. Labarère J, Fourny M, Jean-Phillippe V, Marin-Pache S, Patrice F. Refinement and validation of a French in-patient experience questionnaire. International Journal of Health Care Quality Assurance. 2004 Jan 1;17(1):17–25.
69. Lawson B, Phiri M. Hospital design. Room for improvement. The Health Service Journal. 2000 Jan 1;110(5688):24–6.
70. Lazar I, Abukaf H, Sofer S, Peled N, Leibovitz E. Impact of Conversion from an Open Ward Design Paediatric Intensive Care Unit Environment to All Isolated Rooms Environment on Incidence of Bloodstream Infections and Antibiotic Resistance in Southern Israel (2000 to 2008) [Internet]. [cited 2022 Jul 11]. Available from: https://journals.sagepub.com/doi/10.1177/0310057X1504300106?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed
71. Lehtonen L, Lee SK, Kusuda S, Lui K, Norman M, Bassler D, et al. Family Rooms in Neonatal Intensive Care Units and Neonatal Outcomes: An International Survey and Linked Cohort Study. The Journal of Pediatrics. 2020 Nov;226:112-117.e4.
72. Lester BM, Hawes K, Abar B, Sullivan M, Miller R, Bigsby R, et al. Single-family room care and neurobehavioral and medical outcomes in preterm infants. Pediatrics. 2014;134(4):754–60.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

73. Lester BM, Salisbury AL, Hawes K, Dansereau LM, Bigsby R, Laptook A, et al. 18-Month Follow-Up of Infants Cared for in a Single-Family Room Neonatal Intensive Care Unit. The Journal of pediatrics. 2016;177:84–9.
74. Liu LX, Mozafarinia M, Axelin A, Feeley N. Parents' Experiences of Support in NICU Single-Family Rooms. Neonatal Netw. 2019 Mar 1;38(2):88–97.
75. Lorenz SG, Dreher HM. Hospital Room Design and Health Outcomes of the Aging Adult. PA P E R S. 2011;4(2):14.
76. Maben J, Griffiths P, Penfold C, Simon M, Pizzo E, Anderson J, et al. Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation. Health Services and Delivery Research. 2015 Feb;3(3):1–304.
77. Maben J, Griffiths P, Penfold C, Simon M, Anderson JE, Robert G, et al. One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. BMJ quality & safety. 2016 Apr 1;25(4):241–56.
78. Malcolm HA. Does privacy matter? Former patients discuss their perceptions of privacy in shared hospital rooms. Nurs Ethics. 2005 Mar;12(2):156–66.
79. Mattner F, Rüden AS, Mattner L, Chaberny IF, Ziesing S, Strueber M, et al. Thoracic organ transplantation may not increase the risk of bacterial transmission in intensive care units. International Journal of Hygiene and Environmental Health. 2007 Mar;210(2):139–45.
80. McDonald EG, Dendukuri N, Frenette C, Lee TC. Time-Series Analysis of Health Care–Associated Infections in a New Hospital With All Private Rooms. JAMA Intern Med. 2019 Nov 1;179(11):1501.
81. McKeown K, Haase T, Pratschke J, Twomey S, Donovan H, Engling F. Determinants of care outcomes for patients who die in hospital in Ireland: a retrospective study. BMC Palliat Care. 2015 Dec;14(1):11.
82. Mental Welfare Commission for Scotland. Psychiatr bull. 1991 Apr;15(4):254–5.
83. Meyer TJ, Eveloff SE, Bauer MS, Schwartz WA, Hill NS, Millman RP. Adverse Environmental Conditions in the Respiratory and Medical ICU Settings. Chest. 1994 Apr;105(4):1211–6.
84. Milford C, Zapalo B, Davis G. Transition to an Individual-Room NICU Design: Process and Outcome Measures. Neonatal Network. 2008 Sep;27(5):299–305.
85. Miller NO, Friedman SB, Coupey SM. Adolescent preferences for rooming during hospitalization. Journal of Adolescent Health. 1998 Aug;23(2):89–93.
86. Monson BB, Eaton-Rosen Z, Kapur K, Liebenthal E, Brownell A, Smyser CD, et al. Differential Rates of Perinatal Maturation of Human Primary and Nonprimary Auditory Cortex. eNeuro. 2018 Jan;5(1):ENEURO.0380-17.2017.
87. Morgan H. Single and shared accommodation for young patients in hospital [Internet]. 2010 [cited 2022 Jul 20]. Available from: https://journals.rcni.com/doi/abs/10.7748/paed2010.10.22.8.20.c7997

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

88. Munier-Marion E, Bénet T, Régis C, Lina B, Morfin F, Vanhems P. Hospitalization in double-occupancy rooms and the risk of hospital-acquired influenza: a prospective cohort study. Clinical Microbiology and Infection. 2016 May;22(5):461.e7-461.e9.
89. Nahas S, Patel A, Duncan J, Nicholl J, Nathwani D. Patient Experience in Single Rooms Compared with the Open Ward for Elective Orthopaedic Admissions. Musculoskeletal Care. 2016 Mar;14(1):57–61.
90. Nash D, O'Rourke T, Memmott P, Haynes M. Indigenous Preferences for Inpatient Rooms in Australian Hospitals: A Mixed-Methods Study in Cross-Cultural Design. HERD. 2021 Jan;14(1):174–89.
91. Nassery W, Landgren K. Parents' Experience of Their Sleep and Rest When Admitted to Hospital with Their Ill Child: A Qualitative Study. Comprehensive Child and Adolescent Nursing. 2019 Oct 2;42(4):265–79.
92. OECD, World Health Organization. Improving Healthcare Quality in Europe: Characteristics, Effectiveness and Implementation of Different Strategies [Internet]. OECD; 2019 [cited 2022 Jul 11]. Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/improving-healthcare-quality-in-europe_b11a6e8f-en
93. Olson ME, Smith MJ. An evaluation of single-room maternity care. The Health Care Manager. 1992 Sep;11(1):43–9.
94. O'Neill L, Park SH, Rosinia F. The role of the built environment and private rooms for reducing central line-associated bloodstream infections. Kamolz LP, editor. PLoS ONE. 2018 Jul 27;13(7):e0201002.
95. Park SH, Stockbridge EL, Miller TL, O'Neill L. Private patient rooms and hospital-acquired methicillin-resistant Staphylococcus aureus: A hospital-level analysis of administrative data from the United States. PLOS ONE. 2020 Jul 9;15(7):e0235754.
96. Pease NJ, Finlay IG. Do patients and their relatives prefer single cubicles or shared wards? Palliat Med. 2002 Jul;16(5):445–6.
97. Persson E, Määttä S. To provide care and be cared for in a multiple-bed hospital room. Scandinavian Journal of Caring Sciences. 2012 Dec 1;26(4):663–70.
98. Persson E, Anderberg P, Kristensson Ekwall A. A room of one's own--Being cared for in a hospital with a single-bed room design. Scandinavian journal of caring sciences. 2015 Jun 1;29(2):340–6.
99. Pilmis B, Billard-Pomares T, Martin M, Clarempuy C, Lemezo C, Saint-Marc C, et al. Can environmental contamination be explained by particular traits associated with patients? Journal of Hospital Infection. 2020 Mar;104(3):293–7.
100. Pineda RG, Stransky KE, Rogers C, Duncan MH, Smith GC, Neil J, et al. The single-patient room in the NICU: maternal and family effects. Journal of perinatology : official journal of the California Perinatal Association. 2012 Jul;32(7):545–51.
101. Poncette AS, Wunderlich MM, Spies C, Heeren P, Vorderwülbecke G, Salgado E, et al. Patient Monitoring Alarms in an Intensive Care Unit: Observational Study With Do-It-Yourself Instructions. J Med Internet Res. 2021 May 28;23(5):e26494.
102. Puumala SE, Rich RK, Roy L, Reynolds R, Jimenez FE, Opollo JG, et al. Single-family room neonatal intensive care unit design: do patient outcomes actually change? | Journal of Perinatology [Internet]. [cited 2022 Jul 11]. Available from: https://www.nature.com/articles/s41372-019-0584-6

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

103. Pyrke RJL, McKinnon MC, McNeely HE, Ahern C, Langstaff KL, Bieling PJ. Evidence-Based Design Features Improve Sleep Quality Among Psychiatric Inpatients. HERD. 2017 Oct;10(5):52–63.
104. Quach C, Shah R, Rubin LG. Burden of Healthcare-Associated Viral Respiratory Infections in Children's Hospitals. Journal of the Pediatric Infectious Diseases Society. 2018 Feb 19;7(1):18–24.
105. Real K, Fay L. Using Systems Theory to Examine Patient and Nurse Structures, Processes, and Outcomes in Centralized and Decentralized Units. :16.
106. Reed G, Schmid M. Nursing Implementation of Single-Room Maternity Care. Journal of Obstetric, Gynecologic & Neonatal Nursing. 1986 Sep;15(5):386–9.
107. Reid J, Wilson K, Anderson KE, Maguire CPJ. Older inpatients' room preference: single versus shared accommodation. Age and Ageing. 2015 Mar;44(2):331–3.
108. Roos AKØ, Skaug EA, Grøndahl VA, Helgesen AK. Trading company for privacy: A study of patients' experiences. Nurs Ethics. 2020 Jun;27(4):1089–102.
109. Rosbergen ICM, Tonello I, Clark RA, Grimley RS. Does hospital design impact on patient activity levels and time spent alone? Disability and Rehabilitation. 2022 Jun 19;44(13):3173–80.
110. Rowlands J, Noble S. How does the environment impact on the quality of life of advanced cancer patients? A qualitative study with implications for ward design. Palliat Med. 2008 Sep;22(6):768–74.
111. Sadatsafavi H, Niknejad B, Zadeh R, Sadatsafavi M. Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. J Crit Care. 2016 Feb;31(1):194–200.
112. Sadatsafavi H, Niknejad B, Shepley M, Sadatsafavi M. Probabilistic Return-on-Investment Analysis of Single-Family Versus Open-Bay Rooms in Neonatal Intensive Care Units—Synthesis and Evaluation of Early Evidence on Nosocomial Infections, Length of Stay, and Direct Cost of Care. Journal of Intensive Care Medicine. 2019 Feb 1;34(2):115–25.
113. Sakr N, Hallit S, Mattar H. Incidence of and Factors Associated with New-Onset Insomnia Among Lebanese Hospitalised Patients: A single-centre study. Sultan Qaboos Univ Med J. 2021 Jun 21;21(2):e210-220.
114. Schalkers I, Dedding CWM, Bunders JFG. '[I would like] a place to be alone, other than the toilet' - Children's perspectives on paediatric hospital care in the Netherlands. Health Expect. 2015 Dec;18(6):2066–78.
115. Scottish Intercollegiate Guidelines Network. Sign 50: a guideline developer's handbook. Healthcare Improvement Scotland; 2014.
116. Singh I, Okeke J, Edwards C. Outcome of in-patient falls in hospitals with 100% single rooms and multi-bedded wards. Age and Ageing. 2015;44(6):1032–5.
117. Singh I. (PDF) Loneliness among Older People in Hospitals: A Comparative Study between Single Rooms and Multi- Bedded Wards to Evaluate Current Health Service within the Same Organisation [Internet]. 2016 [cited 2022 May 4]. Available from:

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

https://www.researchgate.net/publication/304495269_Loneliness_among_Older_People_in_Hospitals_A_Comparative_Study_between_Single_Rooms_and_Multi-_Bedded_Wards_to_Evaluate_Current_Health_Service_within_the_Same_Organisation
118. Søndergaard SF, Beedholm K, Kolbæk R, Frederiksen K. Patients' and Nurses' Experiences of All Single-Room Hospital Accommodation: A Scoping Review. HERD. 2022 Jan;15(1):292–314.
119. Song X, Soghier L, Floyd TT, Harris TR, Short BL, DeBiasi RL. Reassessing the need for active surveillance of extended-spectrum beta-lactamase–producing Enterobacteriaceae in the neonatal intensive care population. Infect Control Hosp Epidemiol. 2018 Dec;39(12):1436–41.
120. Stelwagen M, van Kempen A, Westmaas A, Vet E, Scheele F. Parents' Experiences With a Model of Integrated Maternity and Neonatal Care Designed to Empower Parents. Journal of Obstetric, Gynecologic & Neonatal Nursing. 2021 Mar;50(2):181–92.
121. Stevens DC, Helseth CC, Khan MA, Munson DP, Reid EJ. A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. HERD. 2011 Apr;4(3):110–23.
122. Stevens DC, Helseth CC, Thompson PA, Pottala JV, Khan MA, Munson DP. A Comprehensive Comparison of Open-Bay and Single-Family-Room Neonatal Intensive Care Units at Sanford Children's Hospital. HERD. 2012 Jul;5(4):23–39.
123. Stevens DC, Thompson PA, Helseth CC, Hsu B, Khan MA, Munson DP. A comparison of the direct cost of care in an open-bay and single-family room NICU. Journal of Perinatology 2014 34:11. 2014 Sep 25;34(11):830–5.
124. Stiller A, Schröder C, Gropmann A, Schwab F, Behnke M, Geffers C, et al. ICU ward design and nosocomial infection rates: a cross-sectional study in Germany. Journal of Hospital Infection. 2017 Jan;95(1):71–5.
125. Swanson JR, Peters C, Lee BH. NICU redesign from open ward to private room: a longitudinal study of parent and staff perceptions. J Perinatol. 2013 Jun;33(6):466–9.
126. Tandberg BS, Frøslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. J Perinat Neonatal Nurs. 2018 Dec;32(4):E22–32.
127. Tandberg BS, Flacking R, Markestad T, Grundt H, Moen A. Parent psychological wellbeing in a single-family room versus an open bay neonatal intensive care unit. PLOS ONE. 2019 Nov 1;14(11):e0224488.
128. Tandberg BS, Frøslie KF, Markestad T, Flacking R, Grundt H, Moen A. Single-family room design in the neonatal intensive care unit did not improve growth. Acta Paediatrica. 2019 Jun 1;108(6):1028–35.
129. Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. HERD. 2018 Jan;11(1):85–100.
130. Tegnestedt C, Günther A, Reichard A, Bjurström R, Alvarsson J, Martling CR, et al. Levels and sources of sound in the intensive care unit - an observational study of three room types: Levels and sources of sound in a multidisciplinary ICU. Acta Anaesthesiol Scand. 2013 Sep;57(8):1041–50.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

131. Teltsch DY, Hanley J, Loo V, Goldberg P, Gursahaney A, Buckeridge DL. Infection Acquisition Following Intensive Care Unit Room Privatization. Arch Intern Med [Internet]. 2011 Jan 10 [cited 2022 Jul 14];171(1). Available from: http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinternmed.2010.469
132. Toivonen M, Lehtonen L, Löyttyniemi E, Axelin A. Effects of single-family rooms on nurse-parent and nurse-infant interaction in neonatal intensive care unit. Early Human Development. 2017 Mar 1;106–107:59–62.
133. Vaisman A, Jula M, Wagner J, Winston LG. Examining the association between hospital-onset Clostridium difficile infection and multiple-bed room exposure: a case-control study. Infect Control Hosp Epidemiol. 2018 Sep;39(9):1068–73.
134. van de Glind I, van Dulmen S, Goossensen A. Physician–patient communication in single-bedded versus four-bedded hospital rooms. Patient Education and Counseling. 2008 Nov 1;73(2):215–9.
135. van der Hoeven A, Bekker V, Jansen SJ, Saccoccia B, Berkhout RJM, Lopriore E, et al. Impact of transition from open bay to single room design neonatal intensive care unit on multidrug-resistant organism colonization rates. Journal of Hospital Infection. 2022 Feb;120:90–7.
136. Van Enk RA, Steinberg F. Comparison of Private Room with Multiple-Bed Ward Neonatal Intensive Care Unit Environments. HERD. 2011 Oct;5(1):52–63.
137. van Veenendaal NR, van der Schoor SRD, Heideman WH, Rijnhart JJM, Heymans MW, Twisk JWR, et al. Family integrated care in single family rooms for preterm infants and late-onset sepsis: a retrospective study and mediation analysis. Pediatr Res. 2020 Oct;88(4):593–600.
138. van Veenendaal NR, van der Schoor SRD, Broekman BFP, de Groof F, van Laerhoven H, van den Heuvel MEN, et al. Association of a Family Integrated Care Model With Paternal Mental Health Outcomes During Neonatal Hospitalization. JAMA Netw Open. 2022 Jan 24;5(1):e2144720.
139. Vietri NJ, Dooley DP, Davis CE, Longfield JN, Meier PA, Whelen AC. The effect of moving to a new hospital facility on the prevalence of methicillin-resistant Staphylococcus aureus. Am J Infect Control. 2004 Aug;32(5):262–7.
140. Vohr B, McGowan E, McKinley L, Tucker R, Keszler L, Alksninis B. Differential Effects of the Single-Family Room Neonatal Intensive Care Unit on 18- to 24-Month Bayley Scores of Preterm Infants. J Pediatr. 2017 Jun;185:42-48.e1.
141. Voigt J, Mosier M, Darouiche R. Private Rooms in Low Acuity Settings: A Systematic Review of the Literature. HERD. 2018 Jan;11(1):57–74.
142. Walsh WF, McCullough KL, White RD. Room for improvement: nurses' perceptions of providing care in a single room newborn intensive care setting. Adv Neonatal Care. 2006 Oct;6(5):261–70.
143. Washam MC, Ankrum A, Haberman BE, Staat MA, Haslam DB. Risk Factors for *Staphylococcus aureus* Acquisition in the Neonatal Intensive Care Unit: A Matched Case-Case-Control Study. Infect Control Hosp Epidemiol. 2018 Jan;39(1):46–52.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

144. Watson J, DeLand M, Gibbins S, MacMillan York E, Robson K. Improvements in Staff Quality of Work Life and Family Satisfaction Following the Move to Single-Family Room NICU Design. Advances in Neonatal Care. 2014 Apr;14(2):129–36.
145. Zaal IJ, Spruyt CF, Peelen LM, van Eijk MMJ, Wientjes R, Schneider MME, et al. Intensive care unit environment may affect the course of delirium. Intensive Care Med. 2013 Mar;39(3):481–8.

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Appendix: Search Strategy

1. Searches

We ran systematic searches of Medline via PubMed and Embase via embase.com and supplemented these databases with additional searches of Google Scholar and the National Institute for Health and Care Excellence website using the search strategy below.

Embase search strategy

	Search terms	Number of hits (17 Feb 2022)
1	'hospital design'/exp OR 'hospital design' OR 'hospital management'/exp OR 'hospital management' OR 'health care facility'/exp OR 'health care facility'	2,538,404
2	(single OR multi*) NEAR/2 (room* OR bay* OR bed* OR accommodation)	6,553
3	1 AND 2	2,005

PubMed search strategy

	Search terms	Number of hits (17 Feb 2022)
1	"Hospital Design and Construction"[Mesh] OR "Hospital Administration"[Mesh] OR "Health Facility Environment"[Mesh]	289,082
2	((single OR multiple) AND (room OR room* OR bay OR bays OR bed OR beds OR accommodation))	70,205
3	1 AND 2	2,599

Google scholar search strategy

	Search terms	Number of hits (14 Feb 2022)
1	Hospital AND ("single room" OR "multiple room" OR "single bed" OR "multiple bay")	42

NICE website

	Search terms	Number of hits (14 Feb 2022)
1	"single room"	215

We have used NICE's online Evidence Search tool (https://www.evidence.nhs.uk).

This search strategy yields ***4,563 abstracts for screening*** after deduplication, once the additional sources have been included.

2. Inclusion criteria

The inclusion criteria for the review are set out below.

Criterion	Inclusion criterion	Exclusion criterion
Population	Adults, adolescents or children who are inpatients in an acute hospital for more than 24 hours Includes: Those requiring level 0 or 1 care Neonates, children and young adults (everyone under age 18) Pregnant/labouring women Vulnerable adults (those requiring assistance while living in the community) Those with dementia or delirium Those requiring level 2 or 3 care Those primarily receiving rehabilitation Those admitted for elective care Those admitted for emergency care	Patients admitted to long-stay, community or other non-acute hospitals Patients admitted as day cases to an acute hospital Patients attending Accident and Emergency or medical assessment units but not admitted to an acute hospital
Interventions	Staying in a single room for the whole admission	Patients who are relocated to a single room during their admission (e.g. for isolation due to contracting infectious disease or for terminal care)
Comparison	Staying in a multi-bed bay or room	No direct comparison
Outcomes	In-hospital mortality 30-day, or longer, mortality Morbidity such as falls, deterioration, new pressure ulcers and additional diagnoses Experience of patient safety incidents Hospital-acquired infection Quantitative, qualitative and patient-reported measures of experience Length of stay Cost of stay Experience of accommodation change during admission, or number of bed moves during admission Impact on caregivers and family of dependent patient	Non-clinically relevant outcomes Impact on healthcare professionals and support staff
Study methodology	Comparative clinical trials and observational studies Systematic reviews of relevant studies Study protocols: index separately	Non-comparative observational studies Narrative reviews, opinion pieces, letters, editorials Conference abstracts with no relevant data
Study size	Any	
Language and location	Any	

3. Studies excluded at full text screening

Citation	Reason for exclusion
Adabi, G. *et al.* (2019). Barriers to sleep in patients hospitalised with an acute exacerbation of chronic obstructive pulmonary disease. *J Sleep Res.* 28(SUPPL 1).	Outcome: No relevant data reported
Alzheimer's Disease International (2020) World Alzheimer Report 2020 Design Dignity Dementia: dementia-related design and the built environment, Volume 1 https://www.alzint.org/u/WorldAlzheimerReport2020Vol1.pdf	Outcome: No relevant data reported
Baillie, J. (2015). Hospitals single-room design evaluated. *Health Estate* 69(1): 27-30.	Irretrievable
Bernhardt, J. and Cumming, T. (2013). The elephant in the single room debate: keeping patients active. *BMJ Clin Res Ed.* 347.	Outcome: No relevant data reported
Dean, E. (2010). Patient opinion divided on the introduction of single rooms. *Nurs Stand.* 24(40): 12-13.	Outcome: No relevant data reported
Dean, E. (2015). Study finds ideal ward has a mix of single rooms and multi-bed bays. *Nurs Stand.* 29(28): 11.	Outcome: No relevant data reported
Dulny, G. *et al.* (2013). An analysis of risk factors of *Clostridium difficile* infection in patients hospitalized in the teaching hospital in 2008. *Przeglad epidemiologiczny* 67(3): 445-50, 547-51.	Intervention: No data on single room
Kelly, R. *et al.* (2019). The experience of person-centred practice in a 100% single-room environment in acute care settings-A narrative literature review. *J Clin Nurs.* 28(13-14): 2369-2385.	Outcome: No relevant data reported
Lerner, A. O. *et al.* (2019). Environmental contamination by carbapenem-resistant Acinetobacter baumannii: The effects of room type and cleaning methods. *Infect Control Hosp Epidemiol.* 41(2): 166-171.	Outcome: No relevant data reported
LI, M. *et al.* (2020). Construction and application of three-dimensional evaluation model of single bed efficiency in hospital. *Chin J Hosp Admin*: 127-130.	Irretrievable
Linqvist Leonardsen, AC *et al.* (2016). A qualitative study of patient experiences of decentralized acute healthcare services. *Scand J Prim Health Care* 34(3): 317-324.	Population: not acute hospital
Mental Welfare Commission for Scotland (2015) Making progress: older functional assessment wards. https://www.mwcscot.org.uk/sites/default/files/2019-06/making_progress_older_adult_functional_assessment_wards.pdf	Outcome: No relevant data reported
NIHR Evidence (2015) NIHR Alert: One size does not fit all – evaluating the move to a hospital with 100% single rooms. https://evidence.nihr.ac.uk/alert/one-size-does-not-fit-all-evaluating-the-move-to-a-hospital-with-100-single-rooms/	Secondary to Maben 2016 #1802
NIHR Journals Library Health Services and Delivery Research (2015) Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation. https://www.journalslibrary.nihr.ac.uk/hsdr/hsdr03030/#/abstract	Duplicate of Maben 2015 #1804
Oliver, D. (2021). David Oliver: Should single rooms be the default for NHS inpatients? *BMJ* 375:n2612.	Outcome: No relevant data reported
Pennington, H. and Isles, C. (2013). Should hospitals provide all patients with single rooms? *BMJ* 347: f5695.	Outcome: No relevant data reported

Citation	Reason for exclusion
Ali, E. (2020) Single-room maternity care: Systematic review and narrative synthesis. *Nurs Open.* 7(6):1661-1670. https://pubmed.ncbi.nlm.nih.gov/33072349	SLR: citation chase
Royal College of Psychiatrists (2020) Next steps for funding mental healthcare in England: Infrastructure. Version 2 https://www.rcpsych.ac.uk/docs/default-source/improving-care/better-mh-policy/policy/next-steps-for-funding-mental-healthcare---infrastructure-royal-college-of-psychiatrists-august-2020.pdf	Outcome: No relevant data reported
Russo, PL *et al.* (2018). Establishing the prevalence of healthcare-associated infections in Australian hospitals: Protocol for the Comprehensive Healthcare Associated Infection National Surveillance (CHAINS) study. *BMJ Open* 8(11).	Outcome: No relevant data reported
Semret, M. *et al.* (2016). Cleaning the grey zones of hospitals: A prospective, crossover, interventional study. *Am J Infect Control* 44(12): 1582-1588.	Intervention: No data on single room
Sengupta, S. *et al.* (2021). Not All Multi.drug Resistant Organism (MDRO)S are Alike-Lessons from Candida Auris in Singapore. *Antimicrobial Resistance and Infection Control* 10(SUPPL 2).	Outcome: No relevant data reported
Shannon, MM. *et al.* (2019). Can the physical environment itself influence neurological patient activity? *Disabil Rehabil*. 41(10): 1177-1189.	Intervention: No data on single room
Simon, M. *et al.* (2016). Is single room hospital accommodation associated with differences in healthcare-associated infection, falls, pressure ulcers or medication errors? A natural experiment with non-equivalent controls. *J Health Serv Res Policy* 21(3): 147-155.	Secondary publication to Maben 2016, no additional data
Teo, R. *et al.* (2015). Patients' preference: Single rooms or shared wards? *Scottish Med J* 59(4): e40.	Outcome: No relevant data reported
Welsh Government (2020) National care review of NHS learning disability hospitals provision https://gov.wales/sites/default/files/publications/2020-03/national-care-review-of-learning-disabilities-hospital-inpatient-provision.pdf	Outcome: No relevant data reported
Fairhall, K. *et al.* (2009). Single-bed versus multi-bed hospital rooms: The case for patient safety. *World Health Design* 7: 57-61.	Irretrievable
BaHammam, A. (2006). Sleep quality of patients with acute myocardial infarction outside the ccu environment: A preliminary study. *Med Sci Monit* 12(4): CR168-CR172.	Outcome: No relevant data reported
Harris, S., Farren, M., Janssen, P., Klein, M., & Lee, S. (2004). Single room maternity care offers an efficient and physician friendly environment, without compromising perinatal outcomes. *J Obstetr Gynecol Canada* 26, 633–640.	Irretrievable
Ishii, H. *et al.* (2007). Advantages of silent and air-conditioned environment on polysomnography. *Respir Circul* 55(2): 233-236.	Irretrievable
Isles, LF., Flynn, R., & Isles, C. (2009). Patient preferences for single rooms or shared accommodation in a district general hospital. *Scottish Med J*. 54, 5–8.	DUPLICATE
Jones, R. *et al.* (2016). The effects of single-family rooms on parenting behavior and maternal psychological factors. *J Obstet Gynecol Neonatal Nurs* 45(3): 359-370.	Irretrievable
Feeley, N. *et al.* (2020). A comparative study of mothers of infants hospitalized in an open ward neonatal intensive care unit and a combined pod and single-family room design. *BMC Pediatrics* 20(1).	Outcome: No relevant data reported
Herr, CE. *et al.* (2003). Additional costs for preventing the spread of methicillin-resistant *Staphylococcus aureus* and a strategy for reducing these costs on a surgical ward. *Infect Control Hosp Epidemiol* 24(9): 673-678.	Intervention: No data on single room

Citation	Reason for exclusion
Hurst, K. (2009). Do single rooms require more staff than other wards? *Nurs Stand* 24(4): 16.	Population: only data is on staff workload
Jobe, AH. (2017). The single-family room neonatal intensive care unit – critical for improving outcomes? *J Pediatr* 185: 10-12.	Outcome: No relevant data reported
Joshi, R. *et al.* (2018). Does the architectural layout of a NICU affect alarm pressure? A comparative clinical audit of a single-family room and an open bay area NICU using a retrospective study design. *BMJ Open* 8(6): e022813.	Outcome: No relevant data reported
Langley, JM. and Hanakowski, M. (2000). Variation in risk for nosocomial chickenpox after inadvertent exposure. *J Hosp Infect* 44(3): 224-226.	Outcome: No relevant data reported
McKinley, LT. *et al.* (2022). Implementation of a nutrition care bundle and improved weight gain of extremely preterm infants to 36 weeks postmenstrual age. *J Pediatr* 241: 42-47.e42.	Outcome: No relevant data reported
Mental Welfare Commission for Scotland (2018) Young person monitoring report 2017-2018 https://www.mwcscot.org.uk/sites/default/files/2019-06/young_person_monitoring_report_2017-18.pdf	Outcome: No relevant data reported
National Nursing Research Unit (2009) Policy + Issue 17: Splendid Isolation? The pros and cons of single occupancy rooms for the NHS https://www.kcl.ac.uk/nmpc/research/nnru/policy/policy-plus-issues-by-theme/hownursingcareisdelivered/policyissue17.pdf	METHOD
Pellikka, HK. *et al.* (2020). Finnish parents' responsibilities for their infant's care when they stayed in a single family room in a neonatal intensive care unit. *J Pediatr Nurs* 53: e28-e34.	Outcome: No relevant data reported
Rose, P. and Blythe, S. (2008). Use of single rooms on the children's ward: Part 1. *Paediatr Nurs* 20(10): 13-17.	SLR
Rose, P. and Blythe, S. (2009). Use of single rooms on the children's ward, Part 2: Guideline for practice. *Paediatr Nurs* 21(1): 31-35.	Outcome: No relevant data reported
Saha, S. *et al.* (2022). Mapping the impact of ICU design on patients, families and the ICU team: A scoping review. *J Crit Care* 67: 3-13.	SLR
Servel, AC. and Rideau Batista Novais, A. (2016). [Single-family rooms for neonatal intensive care units impacts on preterm newborns, families, and health-care staff. A systematic literature review]. *Arch Pediatr* 23(9): 921-926.	SLR
Shahheidari, M. and Homer, C. (2012). Impact of the design of neonatal intensive care units on neonates, staff, and families: a systematic literature review. *J Perinat Neonat Nurs* 26(3): 260-266.	SLR
Shin, JH. *et al*. (2000). Nosocomial cluster of Candida lipolytica fungemia in pediatric patients. Eur J Clin Microbiol Infect Dis 19(5): 344-349.	Intervention: No data on single room
Soleimani, F. *et al.* (2020). Impacts of the design of a neonatal intensive care unit (single-family room care and open-ward care) on clinical and environmental outcomes. *Crescent J Med Biol Sci* 7(1): 1-6.	SLR
Stolker, JJ. *et al.* (2006). Are patients' views on seclusion associated with lack of privacy in the ward? Arch Psychiatr Nurs 20(6): 282-7.	Outcome: No relevant data reported
Tse, Y. (2013). Children thrive on companionship, not single rooms. *BMJ Clin. Res. Ed.* 347: f6335.	METHOD
van de Glind, I. *et al.* (2007). Do patients in hospitals benefit from single rooms? A literature review. *Health Policy* 84(2-3): 153-161.	SLR

Citation	Reason for exclusion
Van Eijk, M. *et al.* (2010). Quality and quantity of sleep in multiple versus single patient room intensive care units. *Intensive Care Med* 36: S189.	Outcome: No relevant data reported
van Veenendaal, NR. *et al.* (2019). Hospitalising preterm infants in single family rooms versus open bay units: a systematic review and meta-analysis. *Lancet Child Adolesc Health* 3(3): 147-157.	SLR
van Veenendaal, NR. *et al.* (2020). Hospitalising preterm infants in single family rooms versus open bay units: A systematic review and meta-analysis of impact on parents. *EClinicalMedicine* 23.	SLR
Vohr, BR. (2019). The importance of parent presence and involvement in the single-family room and open-bay NICU. *Acta Paediatr* 108(6): 986-988.	METHOD
WHO Regional Office for Europe – WHO Europe (2009) Capital investment for health. Case studies from Europe (2009) https://www.euro.who.int/__data/assets/pdf_file/0014/43322/E92798.pdf	METHOD
Yamaguchi, K. *et al.* (2019). A Study on Operation Architectural Design and Planning of Single-Room PICU in JAPAN Children's Hospital. Sustainable Urban Environments: Research, Design and Planning for the Next 50 Years, EDRA.	Outcome: No relevant data reported
Bigazzi, E., Turrisi, L.,Zagli, G.,Pecile, P.,Bonizzoli, M.,Peris, A. (2010). Bay rooms vs single-bed rooms in intensive care unit nosocomial infections: a case-control study. *CritCare* 14(Suppl.1):P458-P.http://dx.doi.org/10.1186/cc8690[PubMedPMID: PMC2934264].	Outcome: No relevant data reported
Stevens, D., Thompson, P., Helseth, C., Pottala, J., Khan, M., Munson, D. (2011). A comparison of outcomes of care in an open bay and single family room neonatal intensive care facility. *J Neonat Perinat Med* 4: 189–200.	Irretrievable
Gotlieb, JB. (2000). Understanding the effects of nurses, patients' hospital rooms and patients' perception of control on the perceived quality of a hospital. *Health Mark Q* 18:1–14.	Outcome: No relevant data reported
Hamel, M., Zoutman, D., O'Callaghan, C. (2010). Exposure to hospital roommates as a risk factor for health care–associated infection. *Am J Infect Control* 38:173–81.	Intervention: No data on single room
Heddema, ER. & van Benthem, BHB. (2011). Decline in incidence of *Clostridium difficile* infection after relocation to a new hospital building with single rooms. *J Hosp Infect* 79, 93–98.	METHOD
Okeke, J., Daniel, J., Naseem, A. *et al.* (2013). Impact of all single rooms with ensuite facility in an acute care hospital in Wales (UK). *Age Ageing* 42(Suppl 3):iii1–11.	Outcome: No relevant data reported
Okeke, J., Aithal, S., Edwards, C., Ramakrishna, S., & Singh, I. (2014). Outcome of inpatient falls in single bedded and multi-bedded bays. *Age Ageing* 43, ii1–ii11. https://doi.org/10.1093/ageing/afu124.	Outcome: No relevant data reported
Shaughnessy, MK., Micielli, RL., DePestel, DD. *et al.* (2011) Evaluation of hospital room assignment and acquisition of Clostridium difficile infection. *Infect Control Hosp Epidemiol* 32(3):201–6. [PubMed: 21460503]	Intervention: No data on single room
Shepley, MM., Harris, DD., White, R. (2008). Open-bay and single family room neonatal intensive care units – caregiver satisfaction and stress. *Environ Behav* 40(2):249–268.	Population: Impact on staff only
Singh, I., Edwards, C., Okeke, J. (2015). Impact of cognitive impairment on inpatient falls in single room setting and its adverse outcomes. *J Gerontol Geriatr Res* S4. S4eS001.	Secondary publication of Singh 2015, no additional

Citation	Reason for exclusion
	relevant data about single rooms
Ulrich, RS. (2006). Effects of single versus multi-bed accommodation and outcomes. Presented at the Symposium on Single-Bed Ward Accommodation, Cardiff, Wales.	METHOD
van Oel, CJ., Mlihi, M., & Freeke, A. (2021). Design models for single patient rooms tested for patient preferences. *HERD*, 14(1), 31-46. https://doi.org/10.1177/1937586720937995	Outcome: No relevant data reported
Williams, C., & Gardiner, C. (2015). Preference for a single or shared room in a UK inpatient hospice: Patient, family and staff perspectives. *BMJ Support Palliat Care* 5, 169–174. doi: 10.1136/bmjspcare-2013-000514	Population: hospice – not acute hospital

For peer review only

BMJ Open

The clinical, humanistic, and economic outcomes, including experiencing of patient safety events, associated with admitting patients to single rooms compared with shared accommodation for acute hospital admissions. A systematic review and narrative synthesis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068932.R1
Article Type:	Original research
Date Submitted by the Author:	16-Feb-2023
Complete List of Authors:	Bertuzzi, Andrea; Crystallise Ltd Martin, Alison; Crystallise Ltd Clarke, Nicola; Crystallise Ltd Springate, Cassandra; Crystallise Ltd Ashton, Rachel; Ashton Editorial Consulting; NHS England and NHS Improvement Midlands The Health Economics Unit, Smith, Wayne; NHS England and NHS Improvement Midlands The Health Economics Unit Orlowski, Andi; Health Economics Unit; Imperial College London, Department of Primary Care and Public Health McPherson, Duncan; NHS England, New Hospital Programme
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Health policy
Keywords:	Economics < TROPICAL MEDICINE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

For peer review only

The clinical, humanistic, and economic outcomes, including experiencing of patient safety events, associated with admitting patients to single rooms compared with shared accommodation for acute hospital admissions. A systematic review and narrative synthesis.

Authors

Andrea Bertuzzi,[2] Alison Martin (0000-0003-4660-278X),[2] Nicola Clarke,[2] Cassandra Springate (0000-0003-1846-6901),[2] Rachel Ashton (0000-0003-1755-7975),[3] Wayne Smith (0000-0002-4297-1978),[3] Andi Orlowski (0000-0002-1463-9206),[3] Duncan McPherson (0000-0002-2560-8552)[1]

[1]New Hospital Programme, NHS England and Improvement, Skipton House, 80 London Road, London SE1 6LH, UK

[2]Crystallise Ltd, 17 High Street, Stanford le Hope, Essex SS17 0HD, UK

[3]The Health Economics Unit, NHS Midlands and Lancashire Commissioning Support Unit, Heron House, 120 Grove Road, Stoke on Trent ST4 4LX, UK

Correspondence to: Dr Duncan McPherson, NHS England and Improvement, Skipton House, 80 London Road, London, SE1 6LH. duncan.mcpherson1@nhs.net.

Word count, excluding title page, abstract, references, figures and tables 7221

For peer review only

Abstract

Objectives: Assess the impact of single rooms versus multioccupancy accommodation on inpatient health-care outcomes and processes.

Design: Systematic review and narrative synthesis.

Data Sources: Medline, Embase, Google Scholar and the National Institute for Health and Care Excellence website up to 17 February 2022.

Eligibility Criteria: Eligible papers assessed the effect on inpatients staying in hospital of being assigned to a either a single room or shared accommodation, except where that assignment was for a direct clinical reason like preventing infection spread.

Data extraction and synthesis: Data were extracted and synthesised narratively, according to the methods of Campbell et al.

Results: Of 4,861 citations initially identified, 145 were judged to be relevant to this review. Five main method types were reported. All studies had methodological issues that potentially biased the results by not adjusting for confounding factors that are likely to have contributed to the outcomes. Ninety-two papers compared clinical outcomes for patients in single rooms versus shared accommodation. No clearly consistent conclusions could be drawn about overall benefits of single rooms. Single rooms were most likely to be associated with a small overall clinical benefit for the most severely ill patients, especially neonates in intensive care. Patients who preferred single rooms tended to do so for privacy, and for reduced disturbances. By contrast,some groups were more likely to prefer shared accommodation to avoid loneliness. Greater costs associated with building single rooms were small and likely to be recouped over time by other efficiencies.

Conclusions: The lack of difference between inpatient accommodation types in a large number of studies suggests that there would be little effect on clinical outcomes, particularly in routine care. Patients in intensive care areas are most likely to benefit from single rooms. Most patients preferred single rooms for privacy and some preferred shared accommodation for avoiding loneliness.

Strengths and Limitations

- This study is a systematic review of a very large, diverse set of papers
- It addresses a topic that is directly of interest to patients using both traditional clinical and patient reported outcomes
- Meta-analysis was not undertaken because of limitations in the underlying data

Keywords

hospital design; hospital construction; hospital management; hospital administration; health care facility environment; single room; single accommodation; single bedroom; multiple bedroom; single bedroom; multiple bedroom; multiple accommodation; multiple beds

For peer review only

Introduction

Hospital bed capacity in England has roughly halved over the past 30 years.[1] With pledges from the UK government to replace, refurbish, or reconfigure NHS tens of hospitals by 2030.[2] There is an opportunity not only to increase bed numbers but also to choose accommodation types: a single rooms or multioccupancy spaces, or a mixture of both. It is important to get this right at the start, as once each hospital is built it is difficult to change the proportion of single rooms to shared accommodation. However, there is no settled, obvious evidence base on which to base decisions.[3] Arguments for building exclusively single rooms include patients' dignity and control over the environment and improved infection control, while those against cite the importance of some patients' preference for company (particularly during longer stays), feelings of safety being in the presence of other patients, and, of note, the lack of understanding about infection control in single rooms.[4,5]

For some situations isolation of the patient in a single room is part of the clinical intervention. For example, a patient with severe immune compromise may be isolated to protect them from acquiring infection. Similarly, patients with highly transmissible infections may be isolated to prevent spread of infection. A single room is also used where privacy is extremely important, for example delivery units on maternity wards or for dying patients and their families. For most patients, though, there are ranges of risks and benefits and reasons for their preferences, including what would count as a good experience of hospital admission.[6]

This study set out to find published evidence to investigate whether inpatient stays in single rooms or in shared accommodation (i.e., multioccupancy rooms, bays, or wards), have been associated with any impact on the processes undertaken by the hospital and on patients' outcomes. A wide range of clinical, social, and economic outcomes were included from the primary perspective of patients across a range of acute hospital types. Staff perspectives, while not formally assessed, were included if reported as part of a study on patient and caregiver views. The objective was to compare staying in a single room versus shared accommodation for care in which the type of accommodation was not part of the intervention itself. This systematic review protocol has been registered with PROSPERO, registration number CRD42022311689. Ethics approval was not required for this study.

Methods

Identification of papers

We performed a systematic literature review of content in Medline (via PubMed) and Embase for comparative clinical trials, observational studies, and systematic literature reviews published in any language up to 17 February 2022. Additional searches were performed via Google Scholar and the National Institute for Health and Care Excellence. We used combinations of "hospital", design", "management", "health care facility", "single", "multi", "room", "bay", "bed", and "accommodation", optimised for the search platform (see supplementary information – Appendix: Search Strategy). Eligible papers addressed care of adult and/or paediatric inpatients staying in hospital for routine, emergency, or intensive care and who were assigned to a particular accommodation type (single room or shared accommodation). We excluded papers that assessed long-stay patients, day patients, and those attending accident and emergency departments who were not later admitted to an acute hospital; patients who were relocated to a single room during admission (e.g., for isolation after contracting and infectious disease or for terminal care); no direct comparison condition for staying in a single room; non-clinical outcomes; and impact of care on health-care professionals and/or support staff. We also excluded narrative reviews, perspective papers, letters, editorials, and conference abstracts with no relevant data.

For peer review only

Retrieved abstracts were screened by two researchers (AB and NC) using the inclusion criteria in the appendix. Disagreements were resolved by discussion with the project leader. Shortlisted papers were retrieved as full texts. The reference lists of all papers included in this analysis were reviewed to identify any additional publications of primary research that met the inclusion criteria. Full papers were screened for relevance by two researchers (AB and AM) independently.

The quality of each paper was assessed by the same researcher using the Downs and Black checklist for observational studies[7] and the Joanna Briggs Institute checklists (https://jbi.global/critical-appraisal-tools) for qualitative studies and for systematic reviews. These checklists enable assessment of reporting quality, generalisability of findings, biases in measurements of intervention and outcome, confounding in the selection of participants, and power (whether negative findings could be the result of chance). Each quality assessment checklist score was converted to a percentage of the maximum possible score and were categorised for the purposes of this report into high (75–100%), moderate (50–74%), or low quality (<50%; see supplementary table 1).

Data extraction and synthesis

Data were extracted into an Excel spreadsheet and checked, with final adjudication by the project leader (AM), and were synthesised narratively, according to the methods of Campbell et al.[8] Data extracted from systematic literature reviews were cross-checked to avoid double-counting. The fields for extraction were study methodology, baseline characteristics of participants (when provided), clinical outcomes, non-clinical outcomes, resource use, and costs. The clinical outcomes of interest were in-hospital mortality, overall mortality (≥30 days), morbidity (e.g., falls, deterioration, new pressure ulcers, and complications), patient safety incidents, and hospital-acquired infections. Non-clinical outcomes of interest were patient and family member experiences, length of stay, cost of stay, experience of accommodation change and number of changes (for the same type of care) during admission, and impact on the caregivers and family members of dependent patients. Outcomes were assessed based on the measures used in the original articles. Extracted data were sorted by outcome and then by population and setting. Relevant data for each outcome were summarised narratively by comparing heterogeneity across studies in terms of whether differences were statistically significant and in favour of single room or shared accommodation.

Statistical analysis

As substantial heterogeneity across studies (e.g., how data were reported, study methods, etc) was expected, formal meta-analysis was not deemed feasible. Thus, no formal measures of heterogeneity or overall effect size were performed, and all data reported are descriptive. To aid comparison and assess consistency of the conclusions, data are presented in summary tables.

Certainty of findings was assessed based on whether the direction of benefit was consistently statistically significant for single rooms or shared accommodation (across all studies or those with the lowest risk of bias) or was inconsistent or not statistically significant.

There are special areas of hospitals where responses to the intervention might differ, such as intensive-care or paediatric units and areas for women in labour. Therefore, we aimed to present data separately by different subgroups.

For peer review only

Patient and Public Involvement

Patients and the public were not involved in designing this study. The study aim was to establish what is already published in peer reviewed literature on the topic, including the views of patients, their parents or caregivers, and the public.

Results

Study characteristics

The initial searches returned 4,861 potentially relevant abstracts. After screening and removal of duplicates, 145 publications were included in this review (Figure 1). There were six main types of studies: 60 before-and-after comparisons (shared accommodation followed by relocation to single-rooms); 75 comparisons of patients allocated to single rooms compared with others simultaneously in shared accommodation; 18 qualitative studies recording the views of patients, caregivers, or healthcare professionals on accommodation preferences; 10 evidence syntheses, including systematic literature reviews, guidelines and other reports; and three economic evaluations of accommodation type (Figure 2). Some studies incorporated more than one design.

All studies had methodological issues that potentially biased the results by not adjusting for confounding factors that are likely to have contributed to the outcomes. In the 60 before-and-after trials, many factors other than accommodation changed due to moving into new facilities, such as unfamiliarity with new layouts and logistics. In the 75 contemporaneous comparisons, reasons for bed space allocations were not generally reported (e.g., availability, severity of illness), making their effects on the differences in outcomes unclear. Approximately one-third of studies overall (35 of 104) did not report any baseline characteristics of the study participants, and the rest reported few details other than age and sex. This heterogeneity and uncertainty about the comparability of study populations meant that a formal meta-analysis of outcomes was considered infeasible. Overall, only 25 of the studies included reported p values for differences in baseline characteristics between patients admitted to multi- vs single-bed room. Of these 25, only five reported significant differences in any parameters ($p \leq 0.05$): one study reports lower caregiver's age at the time of patient's admission,[9] three report lower gestational age of infants admitted to single rooms in NICU,[10–12] and one reports a higher proportion of female patients were admitted to single rooms.[13] The latter study however also notes that patients admitted to single rooms were frailer due to multiple comorbidities and functional dependence. This heterogeneity and uncertainty about the comparability of study populations meant that a formal meta-analysis of outcomes was considered infeasible.

The quality of studies varied widely. Thirty-four studies were assigned high quality scores (75–100%) with a range of 78–100% (see supplementary table 1). Twenty-three studies were classified as being of low quality (<50%) with a range of 10–48%.

Mortality

Eighteen studies reported mortality (see Figure 3 and supplementary Table 2).[9,14–30] Ten were before-and-after studies and the others were contemporary studies. Only one article scored less than 50% for quality and two had high quality scores. Six studies involved neonates/infants, one assessed children, and the remainder were concerned with adult/elderly care. The numbers of deaths were low, meaning that the studies might have been underpowered to detect small or moderate effects, for example a small difference in mortality. Likewise, whether reported increases

For peer review

in mortality reflected true increases in risk or were due to confounding factors (e.g., unreported reasons for patients being allocated single rooms) is unclear.

Routine care

Four studies involved patients receiving routine care,[14,15,22,28], all in adults, none of which found a significant difference in mortality between those in single rooms versus shared accommodation, including up to 1 year after discharge.

Intensive care

Six studies assessed mortality among adults in ICUs.[9,19,23,24,26,30] One study by Bracco and colleagues[23] favoured single rooms. That study included 2,522 adults in ICUs in Canada and reported mortality of 2.9% among those in single rooms or cubicles compared with 8.3% among those in shared accommodation ($p<0.001$). A study of 666 adults in ICUs in Korea with COVID-19 favoured shared accommodation, reporting 2.4% mortality versus 4.6% among those treated in single rooms but no statistical analysis of the difference was reported.[26] The other studies showed no differences between accommodation types.

Seven studies assessed mortality specifically among neonates in ICU.[16–18,21,25,27,29] Three favoured single rooms. Lehtonen et al.[29] assessed 4,662 neonates in 331 neonatal ICUs (NICUs) across 10 countries (Canada, Australia, New Zealand, Finland, Israel, Japan, Spain, Sweden, Switzerland, Italy) and found that those cared for in units with single rooms had lower odds of death or any major morbidity than those in units with no such facilities (adjusted odds ratio 0.76; 95% CI 0.64–0.89). Two papers reported reduced mortality in single rooms among a small population of neonates in intensive care, but statistical significance was not reported.[16,17] By contrast, two studies favoured shared accommodation. Puumala and colleagues[21] reported a lower percentage of deaths among 9,995 neonates. Harris et al.[25,31] assessed NICUs in 11 hospitals in the USA and found fewer deaths among neonates nursed in units with shared accommodation compared with units with single rooms. However, statistical significance was not reported in either.

Lazar et al[20] was the only study to assess children in a paediatric ICU and found no difference between accommodations types.

Patient care and disease management

Twelve publications reported on outcomes related to patient care and disease management (see Figure 3 and supplementary Table 3).[3,15,32–41] All were in adults or non-specified age groups. Three were before-and-after studies, four were contemporaneous studies, and five were evidence syntheses. Four studies had quality scores below 50% but four had scores greater than 75%. All papers assessed routine care.

Most findings favoured single rooms. Significance was shown for improvements in cleanliness,[36] pain management[36], and interactions between patients and medical staff,[37] and other findings were descriptive. A study in Australia of 1,569 orthopaedic patients had fewer emergency calls due to deterioration in condition after a move to single rooms compared with patients in shared accommodation.[15] As room allocation was based partly on severity of illness, nurses tended to position themselves nearer higher-risk patients to aid visualisation. Lawson and Phiri[33] found better patient satisfaction with care and lower analgesic use in orthopaedic patients in single rooms.

For peer review only

Three systematic reviews found that patients in single rooms may have faster recovery due to better sleep and a more pleasant environment,[39] but there was no consistent effect on use of medication.[40] An OECD WHO report concluded that single-room occupancy was associated with reduced pain scores, but due to a lack of detail had a very low quality score (14%).[42]

Findings in favour of shared accommodation were feelings of safety[34] and less use of restraints.[3] In a comparison of only single rooms after a move to a new hospital with only shared accommodation in the previous hospital, falls and medication errors in the medical assessment unit increased notably immediately but by 9 months had fallen to levels lower than previously.[32] However, in the single-room ward for older adults, falls and pressure ulcers significantly increased after the move and remained higher than before moving. No similar trends were seen after the move in a control hospital with 50% single rooms and 50% shared accommodation, and this was the preferred choice of nurses before and after the move (38% and 40%, respectively).

Maternity and neonatal care

Twenty-three studies were found that assessed maternity and neonatal care (see Figure 3 and supplementary Table 4). Most (n=14) were before-and after studies and the remainder were contemporaneous studies.[10,12,17,18,21,43–60] Three studies were low quality and only one had a high-quality score. Many of these studies included statistically assessed findings, with most favouring single rooms or showing no difference between accommodation types.

Maternity care

Nine studies considered maternity care and perceptions of mothers and family members.[44,45,47,49,50,52–55]

Harris and colleagues[46] assessed 976 low-risk patients, 583 of whom received all care in single rooms and 393 in separate labour, delivery, and recovery areas. While overall use of intrapartum interventions was similar, maternal outcomes were better in single rooms. After discharge, Erdeve et al[53] reported that mothers of babies in NICUs who received care in shared accommodation had significantly more acute care visits ($p=0.046$), telephone consultations ($p=0.01$), and rehospitalizations ($p<0.05$) than those cared for in single rooms, and the reasons were more likely to be for issues related to prematurity like feeding difficulties compared with anatomical disorders. This perception is supported by the findings of Janssen et al,[47] which showed that mother in single rooms rated information and instructions at discharge as being clearer than those in shared accommodation.

Multiple studies indicated that satisfaction with care teams was greater in single rooms, including duration and quality of interactions and needs met.[44,45,47–50,52] In one study participants felt that parental presence was greater in single rooms than in shared accommodation.[54] In a US study, women reported less pain in single rooms than in shared accommodation.[48]

Neonatal care

Fourteen papers reported on outcomes in neonatal care.[10,12,17,21,43,46–48,51,56–60] Many of the results for neonates in ICUs showed no differences in outcomes between accommodation types. Significant improvements were seen in breastfeeding outcomes[17,21,58,61] and weight gain[51,61] in favour of single rooms. However, Tandberg et al[12] reported that longer-term weight gain (4 months) was better after neonatal care in shared accommodation. In two studies, reduced apnoea events were associated with single rooms,[17,62] and in another study less need for mechanical ventilation was reported in single rooms.[58] Significantly reduced neonatal pain scores were also reported.[48]

Complications of disease

Twenty-three articles assessed disease complications (see Figure 3 and supplementary Table 5).[3,14,15,22–24,28–30,32,46,48,53,57,59,63–68] Nine were before-and-after studies, 10 were contemporaneous studies, one used a mix of study designs, and three were evidence syntheses. Two articles had quality scores below 50% and two had scores greater than 75%. Findings generally favoured single rooms or showed no differences between accommodation types.

Routine care

Eight papers assessed complications specifically in routine care and all assessed care of adults.[14,17,22,28,46,67–69] Only one study reported results with significance assessed, which showed reduced incidence of delirium among older adults with dementia nursed in single rooms (hazard ratio 0.66, 95% CI 0.48–0.93, p<0.02).[69] The Scottish guidelines on delirium recommend reducing light and noise and having familiar items around patients with or at risk of developing delirium,[68] which might be supported by this finding.

In a small relocation study (n=64)[32] pressure injuries seemed to be increased around tenfold in single rooms and falls in 50% or 100% shared accommodation, but a substantial change in case mix made this finding difficult to interpret. By contrast, in a larger non-controlled UK relocation study (n=1,569), no significant difference was noted between different types of accommodation.

The findings for other complications, such as hip fracture rates following falls, thromboembolic events, infections, and other medical complications were not significantly different among orthopaedic patients in single rooms compared with those in shared accommodation in an Australian study.[67] Patients in single rooms were more likely to be female and much more likely to have private health insurance, which may have biased the outcomes.

Intensive care

Twelve papers specified assessments in ICU settings, of which three assessed adults[23,24,30] and nine concerned neonatal care.[29,48,53,57,59,64,64–66] In one study of 1,253 adults in Brazil,[24] delirium was significantly less likely among those in ICU single rooms than in shared accommodation, but no significant difference was seen between groups of elderly patients in different types of ICU accommodation in the Netherlands.[30] Organ failure was reported to be significantly lower in patients managed in single rooms in one study.[23] However, few data are available in adults and most studies reported no differences between accommodation types.

An international study of 4,662 preterm neonates found a significantly lower risk of death or any major morbidity, including sepsis and retinopathy of prematurity, among those nursed in NICUs with single family rooms (odds ratio 0.76, 95% CI 0.64-0.89).[29] In contrast, another study showed lower rates of necrotising enterocolitis and intraventricular haemorrhage in shared accommodation.[51]

For peer review only

However, in other studies, rates of these and other serious complications were similar in all ward types.[51,59,62,64] Lester et al[64] found that neonatal stress levels were reduced among babies in NICU single maternity care rooms compared with those in shared accommodation.

Prevention of infection

Fifty-one studies discussed prevention of infection (see Figure 3 and supplementary Table 6).[3,12,15,17–21,23–25,27,32,40,41,51,56,59,65,70–102] Twenty were before-and-after studies, 28 were contemporaneous studies, one used a mix of study designs, and three were evidence syntheses. Seven had low quality scores and nine had high quality scores. More than half (n=33) studies reported statistically analysed data.

Routine care

Routine care was assessed in adults in 10 studies[15,73,79,81,83,84,88,91,93,97] and eight involved mixed age populations and care levels that stated or were assumed to include adults and routine care.[32,40,41,71,75,76,92,99] Hospital-acquired infection rates were shown to be reduced in single rooms in six studies.[32,41,71,73,75,91,92] However, in Maben et al,[32] this finding depended on the ward mix: *Clostridium difficile* infections were reduced in single rooms where the split with shared accommodation was half and half, whereas all shared accommodation performed better than all single rooms. In Darley et al[71] this finding was only for *C difficile*, whereas hospital-acquired MRSA rates did not differ by accommodation type. Bocquet et al[82] and Munier-Marion et al[91] found reduced nosocomial influenza infections in single rooms and one study showed a reduced risk of norovirus infection.[86] By contrast, McDonald and colleagues[75] noted reduced infection rates for *Enterococcus* spp, *C difficile*, and MRSA. In a systematic review, Voigt et al[40] concluded that the quality of evidence did not support the use of single rooms over shared accommodation. Indeed, only two studies showed increased infections in shared accommodation.[32,87] Nevertheless, in one study patients[81] preferred single rooms for infection prevention. In a study of more than 1 million patients of all ages across 2018 hospitals in the USA, O'Neill and colleagues[99] found that single rooms were significantly associated with reductions in central-line-associated bloodstream infections.

Seven studies assessed routine care in children.[82,85,90,94,100,101] Two found a decrease in nosocomial infections in single rooms – one overall[82] and one for diarrhoea in gastrointestinal and neurosurgical units,[85] but the latter found no difference between accommodation types in a cardiological unit. In two large studies in Finland (n=1,927 and n=5,119), Kinnula and colleagues[100,101] saw increases in hospital-acquired infections among children admitted to shared accommodation in an infectious disease ward because there was no grouping by aetiology. All hospital-acquired infections with symptoms during the hospital stay and 49% of those manifesting after discharge led to diarrhoea. The risk of infection was doubled among children sharing accommodation with patients who had respiratory infections (OR 2.3, 95% CI: 1.1–4.8; p=0.03). Risk decreased per year of age. Among 83,334 children assessed in two hospitals, Quach et al[94] found significantly increased rates of respiratory infections when accommodation was more than 50% single rooms (rate per 1,000 patient-days 1.33, 95% CI 1.29–1.37).

For peer review only

Intensive care

Outcomes in ICUs were reported specifically in 26 studies, 11 in adults and mixed-age populations,[19,23,24,70,72,74,77,89,95,96,102] one in children,[20] and 14 in neonates.[12,17,18,21,25,27,51,56,59,65,76,78,80,98]

Among adult populations, only one study showed outcomes in favour of shared accommodation, with reductions per 10,000 patient-days in cultures positive for *Enterobacter* spp, *Haemophilus*, *Streptococcus viridans*, *Acinetobacter* spp, *Streptococcus pneumoniae*, Group B *Streptococcus* spp, *Neisseria* spp, and MRSA.[77] However, in the same study, single rooms showed lower rates of infections with many common organisms, such as *Staphylococcus* spp, *C difficile*, and *Pseudomonas* spp. Four studies showed significant data on reduced bacterial infection and transmission in single rooms based on isolates and antibiotic use,[23,70,74,95] although in the study by Halaby et al,[74] transmission of *Morganella* spp, *Proteus* spp, *Serratia* spp, and *Pseudomonas* spp did not differ between accommodation types. Two studies indicated reduced risks of bloodstream infections in single rooms.[23,96] As for routine care, patients perceived infection prevention to be better in single rooms than in share spaces.[72]

Among neonates and among children in ICUs, the findings were mixed. In favour of shared accommodation, four studies reported reduced cases of nosocomial sepsis,[17,21] one reduced colonisation with multidrug-resistant organisms,[51] and one nosocomial infections with pneumonia.[25] Four studies indicated no difference between accommodation types for sepsis or septicaemia and/or found that the use of single rooms was associated with fewer sepsis cases.[12,21,59,78] Only one study showed an increase in sepsis in shared accommodation, and that was specifically in neonates born at or after term.[21]

Patient safety

11 studies considered patient safety (see Figure 3 and supplementary Table 7).[3,15,22,28,32,40,41,69,88,103,104]. Three were before-and-after studies, four were contemporaneous studies, one used mixed design, and three were evidence syntheses. Two had low quality scores and three had high quality scores. Most of the studies assessed routine care or mixed care populations, and generally the populations were adults and elderly people.

Overall, the data showed no differences between accommodation types or favoured shared accommodation. Only the OECD study indicated reduced risk of falls in single rooms,[41] but the quality of this study was deemed to be very low due to reporting very few details of the research. Significantly lower rates of falls were seen in multi-bed accommodation in two studies.[22,28] The study of Poncette et al,[104] which analysed alarm data in an ICU, found that the number of alarms per bed per day was higher in single rooms than in shared accommodation.

Readmissions and reinterventions

Only two studies reported on readmissions and reinterventions (see Figure 3 and supplementary Table 8). They were both contemporaneous studies and one had a quality score of 74% and one of 78%. One showed that single rooms were associated with lower rates of rehospitalisation.[53] The other favoured shared accommodation, with fewer patients returning to theatre within 6 weeks of treatment.[67]

For peer review only

Privacy

Forty-eight publications, including six evidence syntheses, reported on privacy (see supplementary table 9).[3,5,15,16,25,32,34,36–39,41,43–47,49,52,55,61,62,72,81,90,102,103,105–125] Eighteen were before-and-after studies, 23 were contemporaneous studies, one used mixed designs, and six were evidence syntheses. Nine had low quality scores but 19 had high quality scores. They were mainly descriptive studies but overwhelmingly favoured single rooms.

Routine care

Twenty-eight studies assessed privacy among adults receiving routine care,[3,5,15,32,34,36,37,39,41,44,46,47,61,81,103,105,106,109,112,115–122] with seven of these reporting statistical analyses.[32,34,36,41,46,47,109,117] Key aspects of privacy in single rooms were improved confidentiality when discussing personal information, use of private bathrooms, and privacy during early post-partum care (e.g., assistance with feeding). However, in the study by Florey and colleagues,[109] 83% of patients in shared rooms also reported feeling that they had adequate privacy. Likewise, the systematic reviews by Taylor and colleagues[3] and Dowdeswell and colleagues[38] found advantages and disadvantages with regards to privacy in all studies they assessed. Patients reported feeling as though they could ask more questions or make more remarks in single rooms than in shared accommodation, and more scored physicians' responses as being empathetic.[37] Qualitative or descriptive studies also strongly supported greater privacy in single rooms.[5,15,81,103,105,106,112,115,118–121,124]

Four studies assessed routine care among children.[90,108,114,123] Boztepe et al[114] found that children did not ranked privacy highly and were more concerned about procedures being painful. In this study many of the children had extensive history of hospitalisation. The other three studies reported greater privacy in single rooms, but children also seemed to enjoy the social aspect of shared accommodation. The main reasons for preferring single rooms were private bathrooms and the capacity for family members to stay. Sleep was an important aspect of care in single rooms for children and parents. [61,90,123]

Intensive care

Nine studies reported on privacy for adults in ICUs, and generally the findings favoured single rooms.[3,38,41,45,49,52,62,72,113] Three studies reported statistical evidence of improved privacy in single rooms among adult patients.[41,45,49] The literature reviews by Dowdeswell and colleagues[38] and Taylor and colleagues[3] showed mixed findings among studies.

Eleven studies addressed neonatal care in ICUs.[16,25,43,45,49,52,55,102,107,110,111] All but two[43,55] favoured single rooms for privacy.

Loneliness/isolation and family contact

Fifty-five publications, five were evidence syntheses, reported patients' views about loneliness or family contact associated with single-room accommodation (see Figure 4 and supplementary Table 10).[5,11,12,16,22,25,31,32,34,36,38,39,41,43,44,47,49,50,52–54,57,60–62,72,78,81,90,102,103,106,108–113,117,118,120–123,126–134]. Twenty were before-and-after studies, 29 were contemporaneous studies, one used mixed study designs, and five were evidence syntheses. Only nine had quality scores less than 50%, while high quality scores were assigned to 17.

For peer review only

Two main themes seemed to be revealed in patients' perspectives: shared accommodation were strongly preferred for social interaction to avoid loneliness/isolation,[5,16,22,32,34,39,43,52,61,72,81,90,106,108,109,117–123,126,127,129,132] whereas single rooms were preferred for privacy (e.g., for bathroom use, during consultations and visits, and to spend with children, particularly neonates).[5,11,12,16,34,38,43,50,52,54,57,60,62,72,78,81,90,102,108–110,112,113,117,130,134]

Noise, disturbance, and sleep

Forty-five publications, four of which were evidence syntheses, reported patients' views about noise, disturbance, and sleep associated with single-room accommodation (see Figure 4 and supplementary Table 11).[15,16,30–32,34,36,38,39,41,43–47,52,57,61,62,72,80,81,90,107,109,111–113,115–117,120–122,133,135–143] Sixteen were before-and-after studies, 24 were contemporaneous studies, one used mixed study designs, and four were evidence syntheses. Nine had quality scores less than 50% and 13 had high quality scores.

In general, patients felt that single rooms were quieter and led to less sleep disruption. However, measurement of noise levels showed that there were no substantial objective differences between single rooms and shared accommodation.[36,57,137] One study reported lower noise levels in single rooms, but the difference was not statistically assessed.[80] Stevens et al[57] and Meyer et al[141] found that respiratory support and other medical devices could raise noise levels in single rooms enough to disturb sleep even when ambient noise had been reduced. HCPs also reported that single rooms improved patients' sleep.[16] Poncette and colleagues[104] found that fewer alarms raised in shared accommodation reduced overall noise levels. One study also noted that patients preferred single rooms because they felt they were less likely to disturb other patients.[122] Most studies addressing sleep found that it was improved in single rooms.[34,36,38,39,41,61,62,90,116,117,120,121,138,142] This was generally due to fewer disturbances and/or a perceived quieter environment that in shared accommodation. Hosseini and colleagues[117] and Sakr and colleagues[142] noted that the risk of new-onset insomnia was significantly higher among patients in shared accommodation (95.7% vs 75%, $p=0.011$).

Humidity and temperature were discussed in one article. Van Enk and colleagues[137] reported that in a NICU with centrally controlled humidity, shared accommodation had non-significantly lower percentage of relative humidity than single rooms but showed much greater variance (26.8% (±17.0) in single rooms vs 26.0% (±89.0)). Both mean values were lower than the recommended range for NICU (30–60%). Temperature could be controlled within individual single rooms and mean values were significantly lower than those in the shared accommodation, which had central temperature control per nursery (mean 73.8°F [range 65.3–77.5°F] in single rooms vs 76.0°F [range 71.1–84.5°F], $p=0.0001$). More than 85% of readings in both, though, were within the recommended range of 72—78°F, although readings outside the range were too hot in shared accommodation and too cold in single rooms. The authors suggested that thermostats should be allowed to vary only within the recommended range.

Lighting was assessed in three studies, two of which favoured single rooms due to less illumination for neonates [45,57] and one study of patients with delirium that favoured lower light in a shared accommodation.[30]

Satisfaction with care

Fifty-one publications, six of which were evidence syntheses, reported patients' satisfaction with care (see Figure 4 and supplementary Table 12).[5,9,12,15,25,31,33,34,36,38–41,43–45,47,49,54,60,61,64,66,78,81,90,103,105,107,109,111,112,114–117,119–122,124,128,131–133,135,138,144–148] Fifteen were before-and-after studies, 29 were contemporaneous studies, one used mixed study designs, one was an economic analysis and six were evidence syntheses. The quality scores of ten studies were less than 50% and of 14 were 75–100%.

Overall, results show either little difference between accommodation types or results in favour of single rooms. Single rooms seemed to be favoured most by mothers in maternity units, whereas preference towards shared accommodation seemed to increase with rising age. The economic analysis found that patients were willing to pay for private care to have single rooms.[148]

Routine care

Routine care was assessed in 30 studies (see supplementary table 12).[15,33,34,36,38–41,44,47,61,81,90,103,105,109,114–117,119–121,124,132,133,135,138,145,146] Patients preferred shared accommodation in seven studies.[39,90,119–121,132,135] Generally they preferred interaction with other patients, and in two reports they stated that they found the shared accommodation more secure and safe.[120,121] Specific reasons given for preferring single rooms were privacy,[36,61,81,103,115,133,135] comfort/environment,[33,47,105,112,145], level of care and information, effect on recovery,[38,41,47,105,116,117,138] and safety.[36,40]

Intensive care

We found 24 reports of intensive care[9,11,25,31,38,41,43,45,49,54,60–62,64,66,78,107,111,112,128,131,133,145,147]. Only two reported findings that favoured shared accommodation. Campbell-Yeo et al[54] found that in an open-bay NICU, mothers reported better self-efficacy and less uncertainty about their babies' health. Also in a NICU, Pineda and colleagues[60] found that the risk of stress among mothers was significantly lower in shared accommodation than in single rooms, although life stress did not differ between accommodation types. By contrast, other assessments of stress found that risk was reduced in single rooms[11,25,31,64,78] or did not differ.[11,54,66] Satisfaction with design/environment, where assessed, favoured single rooms.[62,112]

Findings on satisfaction with maternity care was greater for parents in single rooms in three studies[9,62,64] but did not differ between accommodation types in two.[78,147] Single rooms seemed to have little effect on postpartum depression or irritability, most measures not differing between accommodation types[11,60,66,78,147] and only four findings favouring single rooms.[11,25,31,54]

Only eight of the 51 studies were related to satisfaction with care in other patient populations, involving cardiovascular, cancer, adolescent, or mixed adult care.[9,38,41,61,112,131,133,145] All these studies' findings supported single rooms.

Patient monitoring and safeguarding

Although the impact of single rooms on healthcare staff was not the focus of this review, 14 of the included publications reported the views of HCPs as well as patient-reported outcomes that we used to explore monitoring of patients (see Figure 4 and supplementary Table

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

13).[18,19,23,27,34,36,52,72,81,110,112,115,117,135] Four were before-and-after studies, eight were contemporaneous studies, one used mixed study designs, and one was an evidence synthesis. No study had a low-quality score. Five of the studies were classified as being of high quality.

Most of the studies presented descriptive/qualitative findings. Three studies reported statistically assessed data, all in relation to routine care and among adult patients. Two[34,117] favoured single rooms, reporting that availability to patients, meeting patients' needs, and access to patients were improved. The fourth study showed no difference between single rooms and shared accommodation for responding to patients' call alerts. One study reported that nurses felt they might spend longer with patients in single rooms, depriving other patients of as much care.[110] In another, safety of patients in units with single rooms was raised as an issue due to increased distances between nurses and patients and impeded observation of patients.[72]

Patient confidentiality

Confidentiality was assessed in 11 studies (see Figure 4 and supplementary Table 14).[5,32,41,52,72,81,109,110,117,118] Five were before-and-after studies, four were contemporaneous studies, one used mixed study designs, and one was an evidence synthesis. Two studies had low quality scores while four had high quality scores.

All studies concluded that patient confidentiality was better maintained when patients were in single rooms, with one study finding no difference for adults with cardiovascular disease in ICU[112] (see supplementary table 14). Malcom et al[118] found that the lack of privacy and confidentiality in shared accommodation affected patients' relationships with other patients.

Availability of beds, space requirements, and capital costs

Sixteen studies reported on beds, space, and costs associated with different accommodation types (see Figure 5 and supplementary Table 15).[9,17,19,27,32,33,43,60,71,94,100,101,110,112,129,149] Nine were before-and-after studies, six were contemporaneous studies, and one used mixed study designs. Two studies had quality scores below 50% and three were classified as being of high quality.

There did not seem to be strong evidence in favour of either accommodation type. The inclusion of single rooms substantially increases the amount of floor space required to achieve the same number of beds as in shared accommodation, with estimates suggesting between 30% and 50% more floor space being required per bed, which increases capital costs.[9,17,32,33,110,129,149] Shared accommodation provides greater flexibility to add beds in times of need.[19,27,60,94,101] Darley and colleagues[71] found that numbers of bed-days lost due to ward closures caused by norovirus outbreaks was greatly reduced after moving to a hospital with 75% single rooms from the previous 10% single rooms.

Length of stay

Fifty-three publications, including two evidence syntheses, reported on length of stay associated with single-room accommodation (see Figure 5 and supplementary Table 16).[9,10,12,14–19,21–26,28–33,40,41,45,46,48,51–53,56,58,59,64–67,69,73,77–79,89,95,100,100,111,115,116,128,136,145,149–151] Twenty-eight were before-and-after studies, 23 were contemporaneous studies, one used mixed study designs, and two were evidence syntheses. Five of the studies were classified as being of low quality but only seven fell into the high-quality category. The evidence was highly mixed with no clear benefit from either accommodation type.

Routine care

Of 20 studies assessing routine care, 18 concerned adults and the elderly.[14,15,28,32,33,40,41,46,67,69,73,81,115,116,136,145,149,151] Among these, eight found that length of stay was shorter in single rooms,[14,22,32,33,46,69,115,149,151] but in the study by Maben et al[32] this was true only for an older people's ward and not for a medical assessment unit, and in that by Lawson and Phiri,[33] while it was true for non-surgical orthopaedic patients and psychiatric patients, no difference was seen for surgical orthopaedic patients. One study found that length of stay was shorter in shared accommodation among older patients with dementia, overall and among those who had experienced inpatient falls.[28] No difference in overall length of stay was reported in seven studies, including two evidence syntheses.[15,40,41,67,73,136,145]

The two studies of routine care in children by Kinnula and colleagues showed no difference between accommodation types in one[100] but longer duration of admissions among children in shared accommodation in another.[101]

Intensive care

Of 32 studies assessing length of stay in intensive care, 23 considered neonates[10,11,16–18,21,25,29,45,48,51–53,56,58,59,64–66,78,95,111,128,150] and nine adults.[9,19,23,24,26,30,77,79,89] As for routine care, the results were highly mixed.

Among the nine studies assessing care of adults in ICUs, five showed no significant differences between single rooms and shared accommodation.[9,19,30,30,79] Teltsch et al[77] assessed care after a change from multi-bed to single rooms and compared the findings to a hospital with no change. The length of stay in the ICU in the comparator hospital increased year on year from 3.8 days to 4.2 days from 2000 to 2005. While higher after the change to single rooms, the length of stay did not change substantially over the same period, and after adjustment was an estimated 10% lower overall (relative ratio 0.90, 95% CI 0–19%). Bracco and colleagues[23] reported that patients were able to stay longer in the same bed in single rooms during infection outbreaks in an ICU, although overall LOS was not significantly different.

In NICUs, statistically significant shorter durations of stay in hospital were reported in three studies. Puumala and colleagues[21] found that stays were shorter for very and extremely preterm babies, but there was no difference between accommodation types for moderately preterm babies, and stays for term and post-term babies were shorter in shared accommodation. Lehtonen et al[29] found that stays were on average 3.4 days shorter (95% CI 3.1–4.7) and van Veenendaal et al[78] found a median difference of 2 days in favour of single rooms. Qualitative/descriptive studies also favoured single rooms in five studies.[16,45,52,111] Three studies identified shorter stays in shared accommodation,[25,59,150] but 13 found no difference between accommodation types[10,11,17,18,48,51,53,56,58,64–66,128].

Costs of care

For peer review only

Nineteen publications, including two evidence syntheses, reported on costs or resource use associated with different types of accommodation (see Figure 5 and supplementary Table 17).[15,22,25,28,31,32,40,46,57,67,95,111,113,134,135,148,150,152] Eight were before-and-after studies, seven were contemporaneous studies, two used mixed study designs, and two were evidence syntheses. Four studies had low quality scores and six had high quality scores.

Several studies reported multiple measures of costs and found evidence supporting both types of accommodation. Therefore, the evidence split was 10 studies finding in favour of single rooms, 10 in favour of shared accommodation and six showing no difference in measures.

Boardman and Forbes recommended taking into account the following construction and running costs, given that single-room facilities required more space to construct: land costs, construction costs, maintenance (refinishing and updating), housekeeping and operating costs, and health care provision (potentially longer distances to cover). Maben et al[32,135] estimated in 2015 that the cost of building a hospital solely comprising single rooms could be around 5% more than building one with predominantly shared accommodation but suggested that the difference becomes marginal over time. Harris and colleagues[31] found that the most cost-effective configuration in terms of construction costs per square foot was a combination of open bays and single rooms.

Findings in favour of single rooms were due to reduced overall staffing costs,[46,152] reduced length of stay,[95,111] reduced waiting and transfer times,[148] higher proportions of patients being discharged to rehabilitation,[67] reduced infections,[95] and operational efficiencies.[40,150] Reasons favouring shared accommodation were lower cleaning and housekeeping costs,[32,135] perceived increased nursing staff,[32,150] and lower labour costs in NICUs.[150]

Discussion

This systematic review identified a substantial body of evidence associated with hospital accommodation, yet no clearly consistent conclusions could be drawn about overall benefits of single rooms versus multi-bed ward spaces. The narrative and heterogeneous nature of much of the evidence also meant that a formal statistical synthesis, such as a meta-analysis, was not feasible. Nevertheless, some themes did emerge and might be worth considering further. Single rooms were most likely to be associated with overall clinical benefit for the most severely ill patients, especially neonates in intensive care, although the evidence is mixed even in these high-risk populations. Patients who preferred single rooms tended to do so for privacy, particularly having a private bathroom, and for reduced disturbances. By contrast, there were distinct patterns of men, older adults, children, and adolescents being more likely to prefer shared accommodation, particularly for the social aspects. While mixed accommodation types seemed to be the most cost-effective approach to construction because the capital cost of single room building is higher than that for shared accommodation, the running costs seem likely to be recouped over time by other efficiencies.

While patients and HCPs expressed preferences, health-care outcomes seem unlikely to be substantially affected by hospital accommodation. This is reassuring because most patients also have little influence over this aspect of their care. Likewise, HCPs might also have little influence over which accommodation type their patients are assigned. Patient or family preferences for single rooms are particularly strong in NICUs and maternity wards, but other groups, in particular men, older adults and adolescents, are more likely to prefer shared accommodation. The split of

For peer review only

accommodation and whether the predictable adverse effects of accommodation design can be mitigated in these areas would be worth considering at the planning stages of new buildings.

The average cost per patient of units comprising only single rooms was lower than those consisting of only shared accommodation. Mean direct cost per patient in a single room has been estimated to be 15.5% lower for neonates in ICU and 24% lower for care in maternity units but may be similar or reduced in adults in routine care wards. Shorter length of stay was an important contributor to this difference and could increase the number of patients who can be treated in the beds available. However, the effects found were small and local variations may change the economic picture for a particular hospital. It is also unclear how far the reduced length of stay was due to the single room, and how much was caused by confounding factors associated with being in a new hospital. Nearly all the studies we considered were from high-income regions and mostly based in European or anglophone countries. Thus, policy makers should incorporate local building and labour costs in decisions.

Determining the impact of moving to single-room wards will therefore always need to overcome the impact of confounding factors such as concomitant changes to processes and improvements in other facilities and services that may also have led to the changes, or that may have acted in opposition to the direct effects of the different accommodation.

A number of other systematic reviews have been conducted on this topic. Ten scoping or systematic literature reviews were identified by our search, of which only one was able to conduct a meta-analysis of outcome data in premature infants.[78] As no quantitative synthesis was undertaken in most cases, the analyses were not adjusted for potential confounding factors such as the interaction between outcomes from patients sharing a room or potential bias from sicker patients being more or less likely to be nursed in single rooms. In neonatal ICUs, three systematic reviews with only a narrative synthesis found that single rooms were usually found to improve privacy and parental involvement, improved sleep and reduced hospital-acquired infections, but that these outcomes were usually based on a small number of non-randomised studies.[153–155] The meta-analysis found sepsis rates were significantly lower and exclusive breastfeeding at discharge was significantly higher in single family rooms There were no significant differences in cognitive development, length of admission, growth, complications of ICU admission and mortality. Four other systematic reviews[3,40,156,157] and two scoping reviews[39,158] assessed outcomes in a more general hospital population and generally found mixed evidence of benefits from single rooms, with each review identifying between 12 and 44 studies that reported advantages, disadvantages and neutral findings for most clinical outcomes, but a more positive result for patient privacy and satisfaction.

This study has some limitations. Of 215 articles originally retrieved, we selected 145 for review, which is still a large number. None of the 145 studies used randomised study designs. Randomised controlled studies are not practical to assess hospital accommodation and, therefore, most studies were prone to bias. In particular, in hospitals with mixed single rooms and shared accommodation, patients must be allocated to the rooms, which will be partly due to their medical condition or other personal factors and partly due to bed availability at the time of admission. This introduces selection bias, as the reasons why patients were in single rooms was often not reported. We minimised this bias by excluding studies where the allocation to single rooms or shared accommodation was known to be for an apparent clinical purpose. Additionally, 60 of the publications compared outcomes before and after moving from shared accommodation to single rooms. This introduced confounding, as many factors other than the studied intervention would have changed at the same time, so attributing the outcome to the intervention alone is misleading. The opportunity of building a new hospital is rare. While it provides an ideal platform for before-and-after studies, nearly all of these

For peer review only

studies were of a single hospital, so the total number of hospitals studied is low, meaning that uncertainty about risks and benefits remains after this systematic review.

In practical terms, although there are still uncertainties about the true impact of changing to single room wards, the 145 publications synthesised in this report show that the clinical and economic consequences of such a change are likely to be modest. Focussed research on the impact of accommodation type on hospital acquired airborne transmitted infections may be warranted, as may studies of sufficient duration to examine long term productivity changes after opening a new hospital. Because the global effect sizes found were modest, the effects within national systems or for specialist hospitals might be different in size and direction from the global. In particular, none of the included studies were in low-income or middle-income countries, so generalisability to those settings is difficult. Additional research might explore how the trend for sicker patients to be nursed in beds closer to the nursing station interacts with the choice of single or shared accommodation. How much outcomes of patients in shared rooms might be dependent on each other also warrants investigation. This would help clarify the main uncertainties within this review and would therefore allow some adjustment to be made to the assessment of the impact of single rooms on clinically important outcomes.

Contributorship

AB, AM , NC, CS, RA, WS, AO, and DMcP wrote sections of the final manuscript. DMcP conceived the study and defined the research question. AM defined the detailed method and arbitrated disagreements. AB and NC conducted the literature screening and data extraction. CS developed the figures and summary tables. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethical Approval Statement

This study did not require ethics approval as it was a study of preexisting published literature, not human participants or animals.

Competing interests

No, there are no competing interests for any author

Data sharing statement

All data relevant to the study are included in the article or uploaded as supplementary information.

Funding

The study was funded by The New Hospital Programme, Department of Health and Social Care, which commissioned the overall research area but had no input into the study design, the collection, analysis, and interpretation of data, the writing of the report, or decision to submit the article for publication. All authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Registration

PROSPERO registration number CRD42022311689, registered on 2nd March 2022, after preliminary searches were undertaken and before formal screening began.

For peer review only

References

1 Ewbank L, Thompson J, McKenna H, *et al.* NHS hospital bed numbers: past, present, future. The King's Fund. 2021.https://www.kingsfund.org.uk/publications/nhs-hospital-bed-numbers (accessed 30 Jan 2023).

2 UK Government. PM confirms £3.7 billion for 40 hospitals in biggest hospital building programme in a generation. GOV.UK. 2020.https://www.gov.uk/government/news/pm-confirms-37-billion-for-40-hospitals-in-biggest-hospital-building-programme-in-a-generation (accessed 11 Jul 2022).

3 Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. *HERD* 2018;**11**:85–100. doi:10.1177/1937586718755110

4 Pennington H, Isles C. Should hospitals provide all patients with single rooms? *BMJ* 2013;**347**:f5695–f5695. doi:10.1136/bmj.f5695

5 Roos AKØ, Skaug EA, Grøndahl VA, *et al.* Trading company for privacy: A study of patients' experiences. *Nurs Ethics* 2020;**27**:1089–102. doi:10.1177/0969733019874497

6 Webster CS, Jowsey T, Lu LM, *et al.* Capturing the experience of the hospital-stay journey from admission to discharge using diaries completed by patients in their own words: a qualitative study. *BMJ Open* 2019;**9**:e027258. doi:10.1136/bmjopen-2018-027258

7 Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health* 1998;**52**:377–84. doi:10.1136/jech.52.6.377

8 Campbell M, McKenzie JE, Sowden A, *et al.* Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ* 2020;**368**:l6890. doi:10.1136/bmj.l6890

9 Jongerden IP, Slooter AJ, Peelen LM, *et al.* Effect of intensive care environment on family and patient satisfaction: a before–after study. *Intensive Care Med* 2013;**39**:1626–34. doi:10.1007/s00134-013-2966-0

10 Erickson C, Kattelmann K, Ren C, *et al.* Traditional open-bay versus single-family room neonatal intensive care unit: a comparison of selected nutrition outcomes. *Res Rep Neonatol* 2011;**1**:15–20. doi:10.2147/RRN.S15539

11 Tandberg BS, Frøslie KF, Flacking R, *et al.* Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. *J Perinat Neonatal Nurs* 2018;**32**:E22–32. doi:10.1097/JPN.0000000000000359

12 Tandberg BS, Flacking R, Markestad T, *et al.* Parent psychological wellbeing in a single-family room versus an open bay neonatal intensive care unit. *PLoS ONE* 2019;**14**:e0224488. doi:10.1371/journal.pone.0224488

13 Singh I, Krishnan M, Edwards C, *et al.* Loneliness among Older People in Hospitals: A Comparative Study between Single Rooms and Multi-Bedded Wards to Evaluate Current Health Service within the Same Organisation. *Gerontol Geriatr Res* 2016;**2**:1015.

14 Cantoni N, Weisser M, Buser A, *et al.* Infection prevention strategies in a stem cell transplant unit: impact of change of care in isolation practice and routine use of high dose intravenous

For peer review only

immunoglobulins on infectious complications and transplant related mortality. *Eur J Haematol* 2009;**83**:130–8. doi:10.1111/j.1600-0609.2009.01249.x

15 Davis M, Elliott R, Hills R, *et al.* Single-Room Ward Design and Its Impact on Service and Patient Outcomes: An Evaluation Study. *Orthop Nurs* 2019;**38**:317–25. doi:10.1097/NOR.0000000000000593

16 Domanico R, Davis DK, Coleman F, *et al.* Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units. *J Perinatol* 2010;**30**:343–51. doi:10.1038/jp.2009.195

17 Domanico R, Davis DK, Coleman F, *et al.* Documenting the NICU design dilemma: comparative patient progress in open-ward and single family room units. *J Perinatol* 2011;**31**:281–8. doi:10.1038/jp.2010.120

18 Jansen SJ, Lopriore E, Berkhout RJM, *et al.* The Effect of Single-Room Care Versus Open-Bay Care on the Incidence of Bacterial Nosocomial Infections in Pre-Term Neonates: A Retrospective Cohort Study. *Infect Dis Ther* 2021;**10**:373–86. doi:10.1007/s40121-020-00380-9

19 Jung J, Choe PG, Choi S, *et al.* Reduction in the acquisition rate of carbapenem-resistant Acinetobacter baumannii (CRAB) after room privatization in an intensive care unit. *J Hosp Infect* 2022;**121**:14–21. doi:10.1016/j.jhin.2021.12.012

20 Lazar I, Abukaf H, Sofer S, *et al.* Impact of Conversion from an Open Ward Design Paediatric Intensive Care Unit Environment to All Isolated Rooms Environment on Incidence of Bloodstream Infections and Antibiotic Resistance in Southern Israel (2000 to 2008). *Anaesth Intensive Care* 2015;**43**:34–41. doi:10.1177/0310057X1504300106

21 Puumala SE, Rich RK, Roy L, *et al.* Single-family room neonatal intensive care unit design: do patient outcomes actually change? *J Perinatol* 2020;**40**:867–74. doi:10.1038/s41372-019-0584-6

22 Singh I, Okeke J, Edwards C. Outcome of in-patient falls in hospitals with 100% single rooms and multi-bedded wards. *Age Ageing* 2015;**44**:1032–5. doi:10.1093/ageing/afv124

23 Bracco D, Dubois M-J, Bouali R, *et al.* Single rooms may help to prevent nosocomial bloodstream infection and cross-transmission of methicillin-resistant Staphylococcus aureus in intensive care units. *Intensive Care Med* 2007;**33**:836–40. doi:10.1007/s00134-007-0559-5

24 Caruso P, Guardian L, Tiengo T, *et al.* ICU Architectural Design Affects the Delirium Prevalence: A Comparison Between Single-Bed and Multibed Rooms*. *Crit Care Med* 2014;**42**:2204–10. doi:10.1097/CCM.0000000000000502

25 Harris DD, Shepley MM, White RD, *et al.* The impact of single family room design on patients and caregivers: executive summary. *J Perinatol* 2006;**26**:S38–48. doi:10.1038/sj.jp.7211583

26 Hyun M, Lee JY, Kwon YS, *et al.* COVID-19: Comparing the applicability of shared room and single room occupancy. *Transbound Emerg Dis* 2021;**68**:2059–65. doi:10.1111/tbed.13853

27 Julian S, Burnham C-AD, Sellenriek P, *et al.* Impact of Neonatal Intensive Care Bed Configuration on Rates of Late-Onset Bacterial Sepsis and Methicillin-Resistant Staphylococcus aureus Colonization. *Infect Control Hosp Epidemiol* 2015;**36**:1173–82. doi:10.1017/ice.2015.144

For peer review only

28 Knight S, Singh I. Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards. *J Clin Gerontol Geriatr* 2016;**7**:87–92. doi:10.1016/j.jcgg.2016.03.002

29 Lehtonen L, Lee SK, Kusuda S, *et al.* Family Rooms in Neonatal Intensive Care Units and Neonatal Outcomes: An International Survey and Linked Cohort Study. *J Pediatr* 2020;**226**:112-117.e4. doi:10.1016/j.jpeds.2020.06.009

30 Zaal IJ, Spruyt CF, Peelen LM, *et al.* Intensive care unit environment may affect the course of delirium. *Intensive Care Med* 2013;**39**:481–8. doi:10.1007/s00134-012-2726-6

31 Harris D, McCuskey M, White R. The impact of single family NICU rooms. 2006. https://www.healthdesign.org/system/files/impact_of_single_family_nicu_rooms_1.pdf (accessed 12 Jul 2022).

32 Maben J, Griffiths P, Penfold C, *et al.* One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. *BMJ Qual Saf* 2016;**25**:241–56. doi:10.1136/bmjqs-2015-004265

33 Lawson B, Phiri M. Hospital design. Room for improvement. *Health Serv J* 2000;**110**:24–6.

34 Ehrlander W, Ali F, Chretien KC. Multioccupancy hospital rooms: Veterans' experiences and preferences. *Journal of Hospital Medicine* 2009;**4**:E22–7. doi:10.1002/jhm.491

35 McKeown K, Haase T, Pratschke J, *et al.* Determinants of care outcomes for patients who die in hospital in Ireland: a retrospective study. *BMC Palliat Care* 2015;**14**:11. doi:10.1186/s12904-015-0014-2

36 Nahas S, Patel A, Duncan J, *et al.* Patient Experience in Single Rooms Compared with the Open Ward for Elective Orthopaedic Admissions. *Musculoskeletal Care* 2016;**14**:57–61. doi:10.1002/msc.1110

37 van de Glind I, van Dulmen S, Goossensen A. Physician–patient communication in single-bedded versus four-bedded hospital rooms. *Patient Educ Couns* 2008;**73**:215–9. doi:10.1016/j.pec.2008.07.004

38 Dowdeswell B, Erskine J, Heasman M. Hospital Ward Configuration Determinants Influencing Single Room Provision. A Report for NHS Estates, England by the EU Health Property Network. 2004. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=91223495002f5a83411e51fbe4e589be5ad80218

39 Søndergaard SF, Beedholm K, Kolbæk R, *et al.* Patients' and Nurses' Experiences of All Single-Room Hospital Accommodation: A Scoping Review. *HERD* 2022;**15**:292–314. doi:10.1177/19375867211047548

40 Voigt J, Mosier M, Darouiche R. Private Rooms in Low Acuity Settings: A Systematic Review of the Literature. *HERD* 2018;**11**:57–74. doi:10.1177/1937586717702597

41 OECD, World Health Organization. *Improving Healthcare Quality in Europe: Characteristics, Effectiveness and Implementation of Different Strategies*. OECD 2019. doi:10.1787/b11a6e8f-en

For peer review only

42 Rechel B, Erskine J, Dowdeswell B, *et al. Capital investment for health: case studies from Europe*. Copenhagen, Denmark: : European Health Property Network : European Observatory on Health Systems and Policies 2009. file:///C:/Users/rasht/Downloads/9789289041782-eng.pdf

43 Stelwagen M, van Kempen A, Westmaas A, *et al.* Parents' Experiences With a Model of Integrated Maternity and Neonatal Care Designed to Empower Parents. *J Obstet Gynecol Neonatal Nurs* 2021;**50**:181–92. doi:10.1016/j.jogn.2020.11.001

44 Olson ME, Smith MJ. An evaluation of single-room maternity care. *Health Care Superv* 1992;**11**:43–9.

45 Carter BS, Carter A, Bennett S. Families' views upon experiencing change in the neonatal intensive care unit environment: from the "baby barn" to the private room. *J Perinatol* 2008;**28**:827–9. doi:10.1038/jp.2008.102

46 Harris SJ, Farren MD, Janssen PA, *et al.* Single Room Maternity Care: Perinatal Outcomes, Economic Costs, and Physician Preferences. *J Obstet Gynaecol Canada* 2004;**26**:633–40. doi:10.1016/S1701-2163(16)30610-7

47 Janssen PA, Klein MC, Harris SJ, *et al.* Single Room Maternity Care and Client Satisfaction. *Birth* 2000;**27**:235–43. doi:10.1046/j.1523-536x.2000.00235.x

48 Lester BM, Hawes K, Abar B, *et al.* Single-Family Room Care and Neurobehavioral and Medical Outcomes in Preterm Infants. *Pediatrics* 2014;**134**:754–60. doi:10.1542/peds.2013-4252

49 Swanson JR, Peters C, Lee BH. NICU redesign from open ward to private room: a longitudinal study of parent and staff perceptions. *J Perinatol* 2013;**33**:466–9. doi:10.1038/jp.2012.157

50 Toivonen M, Lehtonen L, Löyttyniemi E, *et al.* Effects of single-family rooms on nurse-parent and nurse-infant interaction in neonatal intensive care unit. *Early Hum Dev* 2017;**106–107**:59–62. doi:10.1016/j.earlhumdev.2017.01.012

51 van der Hoeven A, Bekker V, Jansen SJ, *et al.* Impact of transition from open bay to single room design neonatal intensive care unit on multidrug-resistant organism colonization rates. *J Hosp Infect* 2022;**120**:90–7. doi:10.1016/j.jhin.2021.12.006

52 Bodack E, Schenk O, Karutz H. Die Einrichtung von Einzelzimmern auf neonatologischen Intensivstationen – Auswirkungen auf die Betreuung aus Sicht der Eltern. *Z Geburtshilfe Neonatol* 2016;**220**:124–9. doi:10.1055/s-0042-102886

53 Erdeve O, Arsan S, Yigit S, *et al.* The impact of individual room on rehospitalization and health service utilization in preterms after discharge. *Acta Paediatrica* 2008;**97**:1351–7. doi:10.1111/j.1651-2227.2008.00889.x

54 Campbell-Yeo M, Kim T, Disher T, *et al.* Do Single-Family Rooms Increase Parental Presence, Involvement, and Maternal Well-Being in Neonatal Intensive Care? *J Perinat Neonatal Nurs* 2021;**35**:350–61. doi:10.1097/JPN.0000000000000600

55 Dowling DA, Blatz MA, Graham G. Mothers' Experiences Expressing Breast Milk for Their Preterm Infants: Does NICU Design Make a Difference? *Adv Neonatal Care* 2012;**12**:377–84. doi:10.1097/ANC.0b013e318265b299

For peer review only

56 Hourigan SK, Subramanian P, Hasan NA, *et al.* Comparison of Infant Gut and Skin Microbiota, Resistome and Virulome Between Neonatal Intensive Care Unit (NICU) Environments. *Front Microbiol* 2018;**9**:1361. doi:10.3389/fmicb.2018.01361

57 Stevens DC, Helseth CC, Thompson PA, *et al.* A Comprehensive Comparison of Open-Bay and Single-Family-Room Neonatal Intensive Care Units at Sanford Children's Hospital. *HERD* 2012;**5**:23–39. doi:10.1177/193758671200500403

58 Grundt H, Tandberg BS, Flacking R, *et al.* Associations Between Single-Family Room Care and Breastfeeding Rates in Preterm Infants. *J Hum Lact* 2021;**37**:593–602. doi:10.1177/0890334420962709

59 Vohr B, McGowan E, McKinley L, *et al.* Differential Effects of the Single-Family Room Neonatal Intensive Care Unit on 18- to 24-Month Bayley Scores of Preterm Infants. *J Pediatr* 2017;**185**:42-48.e1. doi:10.1016/j.jpeds.2017.01.056

60 Pineda RG, Stransky KE, Rogers C, *et al.* The single-patient room in the NICU: maternal and family effects. *J Perinatol* 2012;**32**:545–51. doi:10.1038/jp.2011.144

61 Nassery W, Landgren K. Parents' Experience of Their Sleep and Rest When Admitted to Hospital with Their Ill Child: A Qualitative Study. *Compr Child Adolesc Nurs* 2019;**42**:265–79. doi:10.1080/24694193.2018.1528310

62 Stevens DC, Helseth CC, Khan MA, *et al.* A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. *HERD* 2011;**4**:110–23. doi:10.1177/193758671100400309

63 Rechel B, European Health Property Network, European Observatory on Health Systems and Policies, editors. *Capital investment for health: case studies from Europe*. Copenhagen, Denmark: : European Health Property Network : European Observatory on Health Systems and Policies 2009.

64 Lester BM, Salisbury AL, Hawes K, *et al.* 18-Month Follow-Up of Infants Cared for in a Single-Family Room Neonatal Intensive Care Unit. *J Pediatr* 2016;**177**:84–9. doi:10.1016/j.jpeds.2016.06.069

65 Monson BB, Eaton-Rosen Z, Kapur K, *et al.* Differential Rates of Perinatal Maturation of Human Primary and Nonprimary Auditory Cortex. *eNeuro* 2018;**5**:ENEURO.0380-17.2017. doi:10.1523/ENEURO.0380-17.2017

66 Erdeve O, Arsan S, Canpolat F, *et al.* Does Individual Room Implemented Family-Centered Care Contribute to Mother–Infant Interaction in Preterm Deliveries Necessitating Neonatal Intensive Care Unit Hospitalization? *Amer J Perinatol* 2009;**26**:159–64. doi:10.1055/s-0028-1095186

67 Felice Tong YY, Karunaratne S, Youlden D, *et al.* The Impact of Room-Sharing on Length of Stay After Total Hip or Knee Arthroplasty: A Retrospective Study. *Arthroplasty Today* 2021;**8**:289-294.e2. doi:10.1016/j.artd.2021.03.017

68 Scottish Intercollegiate Guidelines Network, Healthcare Improvement Scotland. *Delirium: a booklet for people who have experienced delirium, and for their carers.* 2020.

69 Blandfort S, Gregersen M, Rahbek K, *et al.* Single-bed rooms in a geriatric ward prevent delirium in older patients. *Aging Clin Exp Res* 2020;**32**:141–7. doi:10.1007/s40520-019-01173-y

For peer review only

70 Bonizzoli M, Bigazzi E, Peduto C, *et al.* Microbiological survey following the conversion from a bay-room to single-room intensive care unit design. *J Hosp Infect* 2011;**77**:84–6. doi:10.1016/j.jhin.2010.07.018

71 Darley ESR, Vasant J, Leeming J, *et al.* Impact of moving to a new hospital build, with a high proportion of single rooms, on healthcare-associated infections and outbreaks. *J Hosp Infect* 2018;**98**:191–3. doi:10.1016/j.jhin.2017.06.027

72 Ferri M, Zygun DA, Harrison A, *et al.* Evidence-based design in an intensive care unit: End-user perceptions. *BMC Anesthesiol* 2015;**15**:57. doi:10.1186/s12871-015-0038-4

73 Gregersen M, Mellemkjær A, Foss CH, *et al.* Use of single-bed rooms may decrease the incidence of hospital-acquired infections in geriatric patients: A retrospective cohort study in Central Denmark region. *J Health Serv Res Policy* 2021;**26**:282–8. doi:10.1177/1355819621994866

74 Halaby T, al Naiemi N, Beishuizen B, *et al.* Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. *Antimicrob Resist Infect Control* 2017;**6**:117. doi:10.1186/s13756-017-0275-z

75 McDonald EG, Dendukuri N, Frenette C, *et al.* Time-Series Analysis of Health Care–Associated Infections in a New Hospital With All Private Rooms. *JAMA Intern Med* 2019;**179**:1501. doi:10.1001/jamainternmed.2019.2798

76 Song X, Soghier L, Floyd TT, *et al.* Reassessing the need for active surveillance of extended-spectrum beta-lactamase–producing Enterobacteriaceae in the neonatal intensive care population. *Infect Control Hosp Epidemiol* 2018;**39**:1436–41. doi:10.1017/ice.2018.260

77 Teltsch DY, Hanley J, Loo V, *et al.* Infection Acquisition Following Intensive Care Unit Room Privatization. *Arch Intern Med* 2011;**171**:32–8. doi:10.1001/archinternmed.2010.469

78 van Veenendaal NR, van der Schoor SRD, Heideman WH, *et al.* Family integrated care in single family rooms for preterm infants and late-onset sepsis: a retrospective study and mediation analysis. *Pediatr Res* 2020;**88**:593–600. doi:10.1038/s41390-020-0875-9

79 Vietri NJ, Dooley DP, Davis CE, *et al.* The effect of moving to a new hospital facility on the prevalence of methicillin-resistant Staphylococcus aureus. *Am J Infect Control* 2004;**32**:262–7. doi:10.1016/j.ajic.2003.12.006

80 Walsh WF, McCullough KL, White RD. Room for improvement: nurses' perceptions of providing care in a single room newborn intensive care setting. *Adv Neonatal Care* 2006;**6**:261–70. doi:10.1016/j.adnc.2006.06.002

81 Bevan V, Edwards C, Woodhouse K, *et al.* Dignified care for older people: Mixed methods evaluation of the impact of the hospital environment - single rooms or multi-bedded wards: *Healthy Aging Res* 2016;**5**:1–8. doi:10.1097/01.HXR.0000511879.99010.5d

82 Bocquet A, Wintenberger C, Lupo J, *et al.* Description of an influenza outbreak in a French university hospital and risk factors of nosocomial influenza. *Eur J Clin Microbiol Infect Dis* 2021;**40**:879–84. doi:10.1007/s10096-020-04070-9

For peer review only

83 Cobo J, Asensio Á, Moreno S, *et al.* Risk factors for nosocomial transmission of multidrug-resistant tuberculosis due to Mycobacterium bovis among HIV-infected patients. *Int J Tuberc Lung Dis* 2001;**5**:413–8.

84 Everts RJ, Hanger HC, Jennings LC, *et al.* Outbreaks of influenza A among elderly hospital inpatients. *N Z Med J* 1996;**109**:272–4.

85 Ford-Jones EL, Mindorff CM, Gold R, *et al.* The incidence of viral-associated diarrhea after admission to a pediatric hospital. *American Journal of Epidemiology* 1990;**131**:711–8. doi:10.1093/oxfordjournals.aje.a115555

86 Fraenkel Cj, Inghammar M, Söderlund-Strand A, *et al.* Risk factors for hospital norovirus outbreaks: impact of vomiting, genotype, and multi-occupancy rooms. *Journal of Hospital Infection* 2018;**98**:398–403. doi:10.1016/j.jhin.2018.01.011

87 Jou J, Ebrahim J, Shofer FS, *et al.* Environmental Transmission of *Clostridium difficile*: Association Between Hospital Room Size and *C. difficile* Infection. *Infect Control Hosp Epidemiol* 2015;**36**:564–8. doi:10.1017/ice.2015.18

88 Lorenz SG, Dreher HM. Hospital Room Design and Health Outcomes of the Aging Adult. *HERD* 2011;**4**:14.

89 Mattner F, Rüden AS, Mattner L, *et al.* Thoracic organ transplantation may not increase the risk of bacterial transmission in intensive care units. *Int J Hyg Environ Health* 2007;**210**:139–45. doi:10.1016/j.ijheh.2006.08.008

90 Morgan H. Single and shared accommodation for young patients in hospital. *Paediatr Nurs* 2010;**22**:20–4. doi:10.7748/paed2010.10.22.8.20.c7997

91 Munier-Marion E, Bénet T, Régis C, *et al.* Hospitalization in double-occupancy rooms and the risk of hospital-acquired influenza: a prospective cohort study. *Clin Microbiol Infect* 2016;**22**:461.e7-461.e9. doi:10.1016/j.cmi.2016.01.010

92 Park S-H, Stockbridge EL, Miller TL, *et al.* Private patient rooms and hospital-acquired methicillin-resistant Staphylococcus aureus: A hospital-level analysis of administrative data from the United States. *PLoS ONE* 2020;**15**:e0235754. doi:10.1371/journal.pone.0235754

93 Pilmis B, Billard-Pomares T, Martin M, *et al.* Can environmental contamination be explained by particular traits associated with patients? *J Hosp Infect* 2020;**104**:293–7. doi:10.1016/j.jhin.2019.12.011

94 Quach C, Shah R, Rubin LG. Burden of Healthcare-Associated Viral Respiratory Infections in Children's Hospitals. *J Pediatr Infect Dis Soc* 2018;**7**:18–24. doi:10.1093/jpids/piw072

95 Sadatsafavi H, Niknejad B, Zadeh R, *et al.* Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. *J Crit Care* 2016;**31**:194–200. doi:10.1016/j.jcrc.2015.10.010

96 Stiller A, Schröder C, Gropmann A, *et al.* ICU ward design and nosocomial infection rates: a cross-sectional study in Germany. *J Hosp Infect* 2017;**95**:71–5. doi:10.1016/j.jhin.2016.10.011

For peer review only

97 Vaisman A, Jula M, Wagner J, *et al.* Examining the association between hospital-onset Clostridium difficile infection and multiple-bed room exposure: a case-control study. *Infect Control Hosp Epidemiol* 2018;**39**:1068–73. doi:10.1017/ice.2018.163

98 Washam MC, Ankrum A, Haberman BE, *et al.* Risk Factors for *Staphylococcus aureus* Acquisition in the Neonatal Intensive Care Unit: A Matched Case-Case-Control Study. *Infect Control Hosp Epidemiol* 2018;**39**:46–52. doi:10.1017/ice.2017.234

99 O'Neill L, Park S-H, Rosinia F. The role of the built environment and private rooms for reducing central line-associated bloodstream infections. *PLoS ONE* 2018;**13**:e0201002. doi:10.1371/journal.pone.0201002

100 Kinnula SE, Renko M, Tapiainen T, *et al.* Hospital-associated infections during and after care in a paediatric infectious disease ward. *J Hosp Infect* 2008;**68**:334–40. doi:10.1016/j.jhin.2008.02.004

101 Kinnula S, Buettcher M, Tapiainen T, *et al.* Hospital-associated infections in children: a prospective post-discharge follow-up survey in three different paediatric hospitals. *J Hosp Infect* 2012;**80**:17–24. doi:10.1016/j.jhin.2011.09.007

102 Liu LX, Mozafarinia M, Axelin A, *et al.* Parents' Experiences of Support in NICU Single-Family Rooms. *Neonatal Netw* 2019;**38**:88–97. doi:10.1891/0730-0832.38.2.88

103 Reid J, Wilson K, Anderson KE, *et al.* Older inpatients' room preference: single versus shared accommodation. *Age Ageing* 2015;**44**:331–3. doi:10.1093/ageing/afu158

104 Poncette A-S, Wunderlich MM, Spies C, *et al.* Patient Monitoring Alarms in an Intensive Care Unit: Observational Study With Do-It-Yourself Instructions. *J Med Internet Res* 2021;**23**:e26494. doi:10.2196/26494

105 Janssen PA, Dennis C-L, Reime B. Development and psychometric testing of The Care in Obstetrics: Measure for Testing Satisfaction (COMFORTS) scale. *Res Nurs Health* 2006;**29**:51–60. doi:10.1002/nur.20112

106 Anåker A, von Koch L, Heylighen A, *et al.* "It's Lonely": Patients' Experiences of the Physical Environment at a Newly Built Stroke Unit. *HERD* 2019;**12**:141–52.

107 Carlson B, Walsh S, Wergin T, *et al.* Challenges in design and transition to a private room model in the neonatal intensive care unit. *Adv Neonatal Care* 2006;**6**:271–80. doi:10.1016/j.adnc.2006.06.008

108 Curtis P, Northcott A. The impact of single and shared rooms on family-centred care in children's hospitals. *J Clin Nurs* 2017;**26**:1584–96. doi:10.1111/jocn.13485

109 Florey L, Flynn R, Isles C. Patient Preferences for Single Rooms or Shared Accommodation in a District General Hospital. *Scott Med J* 2009;**54**:5–8. doi:10.1258/rsmsmj.54.2.5

110 Jones L, Peters K, Rowe J, *et al.* The Influence of Neonatal Nursery Design on Mothers' Interactions in the Nursery. *J Pediatr Nurs* 2016;**31**:e301-312. doi:10.1016/j.pedn.2016.05.005

111 Milford C, Zapalo B, Davis G. Transition to an Individual-Room NICU Design: Process and Outcome Measures. *Neonatal Netw* 2008;**27**:299–305. doi:10.1891/0730-0832.27.5.299

For peer review only

112 Real K, Fay L. Using Systems Theory to Examine Patient and Nurse Structures, Processes, and Outcomes in Centralized and Decentralized Units. *HERD* 2018;**11**:22–37. doi:10.1177/1937586718763794

113 Apple M. A Comparative Evaluation of Swedish Intensive Care Patient Rooms. *HERD* 2014;**7**:78–93. doi:10.1177/193758671400700306

114 Boztepe H, Çınar S, Ay A. School-age children's perception of the hospital experience. *J Child Health Care* 2017;**21**:162–70. doi:10.1177/1367493517690454

115 Deitrick LM, Bokovoy J, Panik A. The "Dance" Continues ... Evaluating Differences in Call Bell Use Between Patients in Private Rooms and Patients in Double Rooms Using Ethnography. *J Nurs Care Qual* 2010;**25**:279–87. doi:10.1097/NCQ.0b013e3181dde039

116 Douglas CH, Douglas MR. Patient-centred improvements in health-care built environments: perspectives and design indicators. *Health Expect* 2005;**8**:264–76. doi:10.1111/j.1369-7625.2005.00336.x

117 Hosseini SB, Bagheri M. Comparison of Patient Satisfaction with Single Patient Rooms Versus Shared Patient Rooms. *Ann Mil Health Sci Res* 2017;**15**:e80199. doi:10.5812/amh.80199

118 Malcolm HA. Does privacy matter? Former patients discuss their perceptions of privacy in shared hospital rooms. *Nurs Ethics* 2005;**12**:156–66. doi:10.1191/0969733005ne772oa

119 Nash P, Vanhoof J, Hall S, *et al.* Randomized Crossover Comparison of Injection Site Pain with 40 mg/0.4 or 0.8 mL Formulations of Adalimumab in Patients with Rheumatoid Arthritis. *Rheumatol Ther* 2016;**3**:257–70. doi:10.1007/s40744-016-0041-3

120 Persson E, Määttä S. To provide care and be cared for in a multiple-bed hospital room: care in a multiple-bed hospital room. *Scand J Caring Sci* 2012;**26**:663–70. doi:10.1111/j.1471-6712.2012.00976.x

121 Persson E, Anderberg P, Kristensson Ekwall A. A room of one's own - Being cared for in a hospital with a single-bed room design. *Scand J Caring Sci* 2015;**29**:340–6. doi:10.1111/scs.12168

122 Rowlands J, Noble S. How does the environment impact on the quality of life of advanced cancer patients? A qualitative study with implications for ward design. *Palliat Med* 2008;**22**:768–74. doi:10.1177/0269216308093839

123 Schalkers I, Dedding CWM, Bunders JFG. '[I would like] a place to be alone, other than the toilet' - Children's perspectives on paediatric hospital care in the Netherlands. *Health Expect* 2015;**18**:2066–78. doi:10.1111/hex.12174

124 Bradbury-Jones C, Rattray J, Jones M, *et al.* Promoting the health, safety and welfare of adults with learning disabilities in acute care settings: a structured literature review. *Journal of Clinical Nursing* 2013;**22**:1497–509. doi:10.1111/jocn.12109

125 Mental Welfare Commission for Scotland. *Psychiatr bull* 1991;**15**:254–5. doi:10.1192/pb.15.4.254-a

For peer review only

126 Anåker A, von Koch L, Sjöstrand C, *et al.* A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction—The significance of the built environment. *PLoS ONE* 2017;**12**:e0177477. doi:10.1371/journal.pone.0177477

127 Cusack L, Wiechula R, Schultz T, *et al.* Anticipated advantages and disadvantages of a move to 100% single-room hospital in Australia: A case study. *J Nurs Manag* 2019;**27**:963–70. doi:10.1111/jonm.12753

128 Kainiemi E, Hongisto P, Lehtonen L, *et al.* Effects of single family room architecture on parent–infant closeness and family centered care in neonatal environments—a single-center pre–post study. *J Perinatol* 2021;**41**:2244–51. doi:10.1038/s41372-021-01137-z

129 Rosbergen ICM, Tonello I, Clark RA, *et al.* Does hospital design impact on patient activity levels and time spent alone? *Disabil Rehabil* 2022;**44**:3173–80. doi:10.1080/09638288.2020.1861117

130 Darcy Mahoney A, White RD, Velasquez A, *et al.* Impact of restrictions on parental presence in neonatal intensive care units related to coronavirus disease 2019. *J Perinatol* 2020;**40**:36–46. doi:10.1038/s41372-020-0753-7

131 de Matos LBN, Fumis RRL, Nassar Junior AP, *et al.* Single-Bed or Multibed Room Designs Influence ICU Staff Stress and Family Satisfaction, But Do Not Influence ICU Staff Burnout. *HERD* 2020;**13**:234–42. doi:10.1177/1937586719878445

132 Pease NJ, Finlay IG. Do patients and their relatives prefer single cubicles or shared wards? *Palliat Med* 2002;**16**:445–6. doi:10.1191/0269216302pm577xx

133 Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. *HERD* 2018;**11**:85–100. doi:10.1177/1937586718755110

134 Chaudhury H, Mahmood A, Valente M. The use of single patient rooms versus multiple occupancy rooms in acute care environments. 2004.https://www.healthdesign.org/sites/default/files/use_of_single_patient_rooms_v_multiple_occ._rooms-acute_care.pdf (accessed 21 Jul 2022).

135 Maben J, Griffiths P, Penfold C, *et al. Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation*. Southampton (UK): : NIHR Journals Library 2015. http://www.ncbi.nlm.nih.gov/books/NBK274434/ (accessed 21 Jul 2022).

136 Pyrke RJL, McKinnon MC, McNeely HE, *et al.* Evidence-Based Design Features Improve Sleep Quality Among Psychiatric Inpatients. *HERD* 2017;**10**:52–63. doi:10.1177/1937586716684758

137 Van Enk RA, Steinberg F. Comparison of Private Room with Multiple-Bed Ward Neonatal Intensive Care Unit Environments. *HERD* 2011;**5**:52–63. doi:10.1177/193758671100500105

138 Eberhard-Gran M, Eskild A, Opjordsmoen S, *et al.* Postnatal care--sleep, rest and satisfaction. *Tidsskr Nor Laegeforen* 2000;**120**:1405–9.

139 Edéll-Gustafsson U, Angelhoff C, Johnsson E, *et al.* Hindering and buffering factors for parental sleep in neonatal care. A phenomenographic study. *J Clin Nurs* 2015;**24**:717–27. doi:10.1111/jocn.12654

For peer review only

140 Foo CT, O'Driscoll DM, Ogeil RP, *et al.* Barriers to sleep in acute hospital settings. *Sleep Breath* 2022;**26**:855–63. doi:10.1007/s11325-021-02415-y

141 Meyer TJ, Eveloff SE, Bauer MS, *et al.* Adverse Environmental Conditions in the Respiratory and Medical ICU Settings. *Chest* 1994;**105**:1211–6. doi:10.1378/chest.105.4.1211

142 Sakr N, Hallit S, Mattar H. Incidence of and Factors Associated with New-Onset Insomnia Among Lebanese Hospitalised Patients: A single-centre study. *Sultan Qaboos Univ Med J* 2021;**21**:e210-220. doi:10.18295/squmj.2021.21.02.009

143 Tegnestedt C, Günther A, Reichard A, *et al.* Levels and sources of sound in the intensive care unit - an observational study of three room types: Levels and sources of sound in a multidisciplinary ICU. *Acta Anaesthesiol Scand* 2013;**57**:1041–50. doi:10.1111/aas.12138

144 Stevens DC, Helseth CC, Khan MA, *et al.* A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. *HERD* 2011;**4**:110–23. doi:10.1177/193758671100400309

145 Labarère J, Fourny M, Jean-Phillippe V, *et al.* Refinement and validation of a French in-patient experience questionnaire. *Int J Health Care Qual Assur Inc Leadersh Health Serv* 2004;**17**:17–25. doi:10.1108/09526860410515909

146 Miller NO, Friedman SB, Coupey SM. Adolescent preferences for rooming during hospitalization. *J Adolesc Health* 1998;**23**:89–93. doi:10.1016/S1054-139X(98)00015-9

147 Watson J, DeLand M, Gibbins S, *et al.* Improvements in Staff Quality of Work Life and Family Satisfaction Following the Move to Single-Family Room NICU Design. *Adv Neonatal Care* 2014;**14**:129–36. doi:10.1097/ANC.0000000000000046

148 Boardman AE, Forbes D. A Benefit-Cost Analysis of Private and Semi-Private Hospital Rooms. *J Benefit Cost Anal* 2011;**2**:1–27. doi:10.2202/2152-2812.1050

149 Ruka K, Kenichi K, Juno K. Comparative studies on hospital-bed management between all single-room wards and mixed multi-bed room wards. *Journal of Architecture and Planning (Transactions of AIJ)* 2013;**78**:765–73.

150 Stevens DC, Thompson PA, Helseth CC, *et al.* A comparison of the direct cost of care in an open-bay and single-family room NICU. *J Perinatol* 2014;**34**:830–5. doi:10.1038/jp.2014.178

151 Blandfort S, Gregersen M, Rahbek K, *et al.* Analgesic and psychoactive medications and the risk of falls in relation to delirium in single-bed rooms compared to multiple-bed rooms in geriatric inpatients. *Aging Clin Exp Res* 2020;**32**:1493–9. doi:10.1007/s40520-019-01335-y

152 Reed G, Schmid M. Nursing Implementation of Single-Room Maternity Care. *J Obstet Gynecol Neonatal Nurs* 1986;**15**:386–9. doi:10.1111/j.1552-6909.1986.tb01411.x

153 Servel A-C, Rideau Batista Novais A. Single-family rooms for neonatal intensive care units impacts on preterm newborns, families, and health-care staff. A systematic literature review. *Arch Pediatr* 2016;**23**:921–6. doi:10.1016/j.arcped.2016.04.022

154 Shahheidari M, Homer C. Impact of the design of neonatal intensive care units on neonates, staff, and families: a systematic literature review. *J Perinat Neonatal Nurs* 2012;**26**:260–6; quiz 267–8. doi:10.1097/JPN.0b013e318261ca1d

For peer review only

155 Soleimani F, Azari N, Ghiasvand H, *et al.* Do NICU developmental care improve cognitive and motor outcomes for preterm infants? A systematic review and meta-analysis. *BMC Pediatr* 2020;**20**:67. doi:10.1186/s12887-020-1953-1

156 van de Glind I, de Roode S, Goossensen A. Do patients in hospitals benefit from single rooms? A literature review. *Health Policy* 2007;**84**:153–61. doi:10.1016/j.healthpol.2007.06.002

157 Kelly R, Brown D, McCance T, *et al.* The experience of person-centred practice in a 100% single-room environment in acute care settings-A narrative literature review. *J Clin Nurs* 2019;**28**:2369–85. doi:10.1111/jocn.14729

158 Saha S, Noble H, Xyrichis A, *et al.* Mapping the impact of ICU design on patients, families and the ICU team: A scoping review. *Journal of Critical Care* 2022;**67**:3–13. doi:10.1016/j.jcrc.2021.07.002

For peer review only

Figure Legends

Figure 1. Selection of papers for review

Figure 2. Percentage of studies reporting data in favour of either single-room or shared-room design, according to the type of data available and outcome reported

Figure 3. Clinical outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

Figure 4. Patient-experience outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

Figure 5. Economic outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

For peer review only

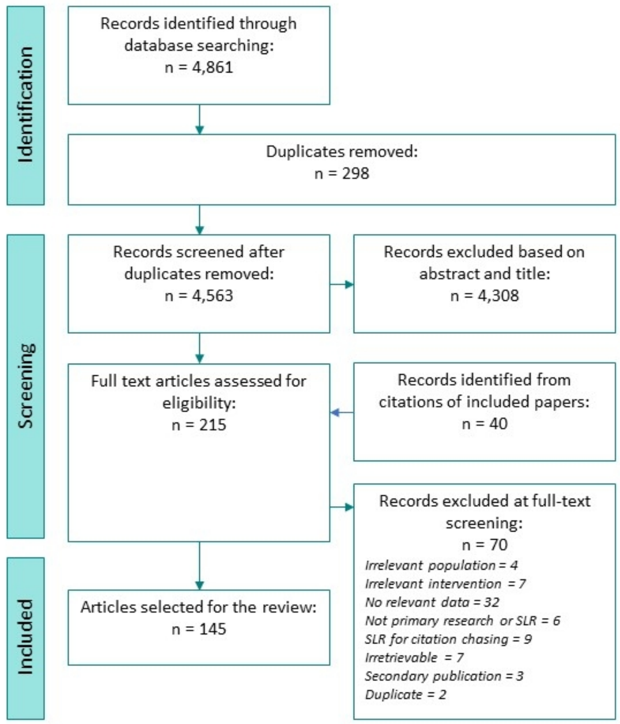

Figure 1. Selection of papers for review

190x275mm (96 x 96 DPI)

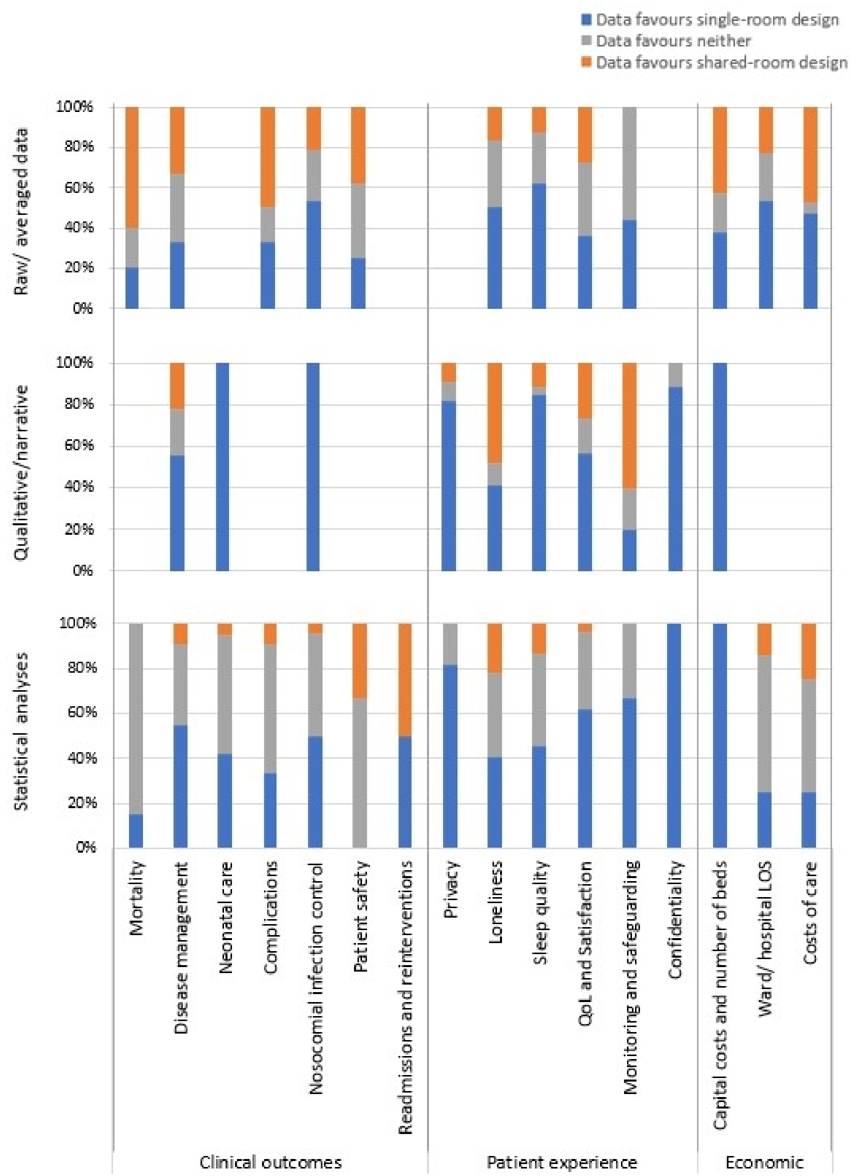

Figure 2. Percentage of studies reporting data in favour of either single-room or shared-room design, according to the type of data available and outcome reported

144x199mm (96 x 96 DPI)

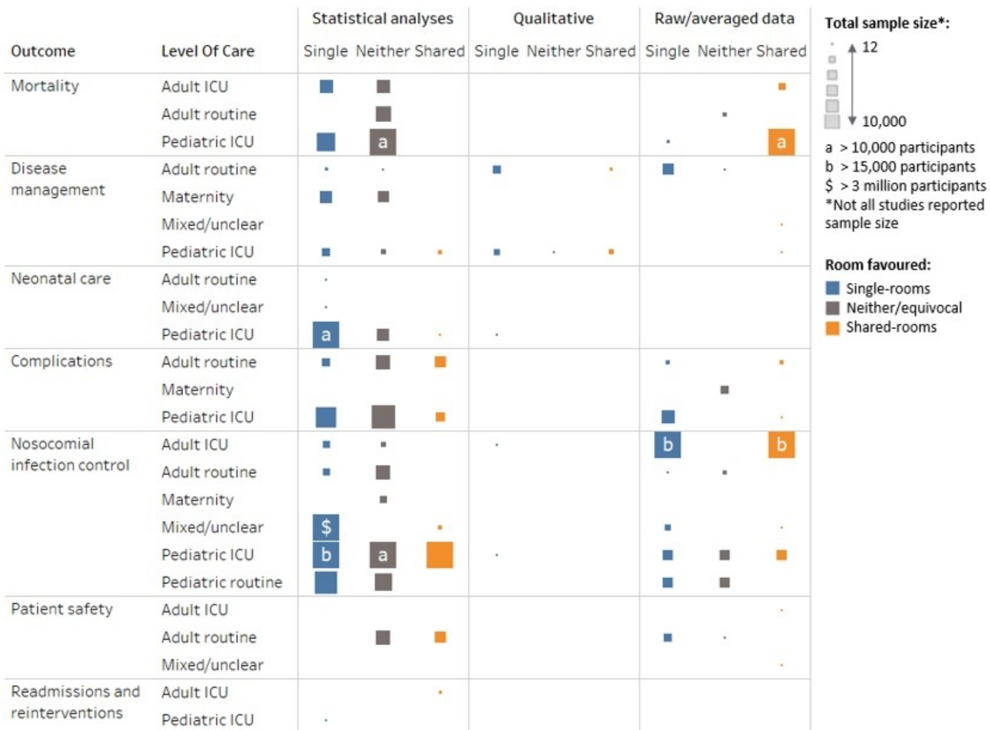

Figure 3. Clinical outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

221x165mm (96 x 96 DPI)

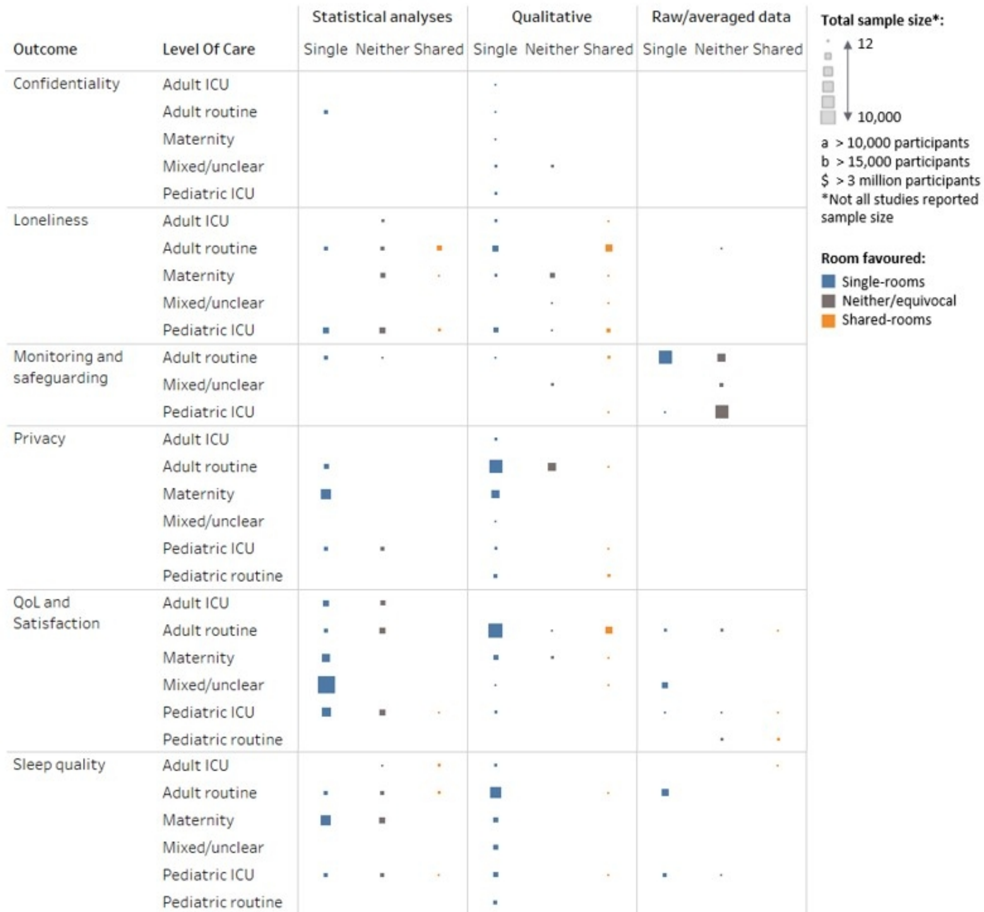

Figure 4. Patient-experience outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

209x195mm (96 x 96 DPI)

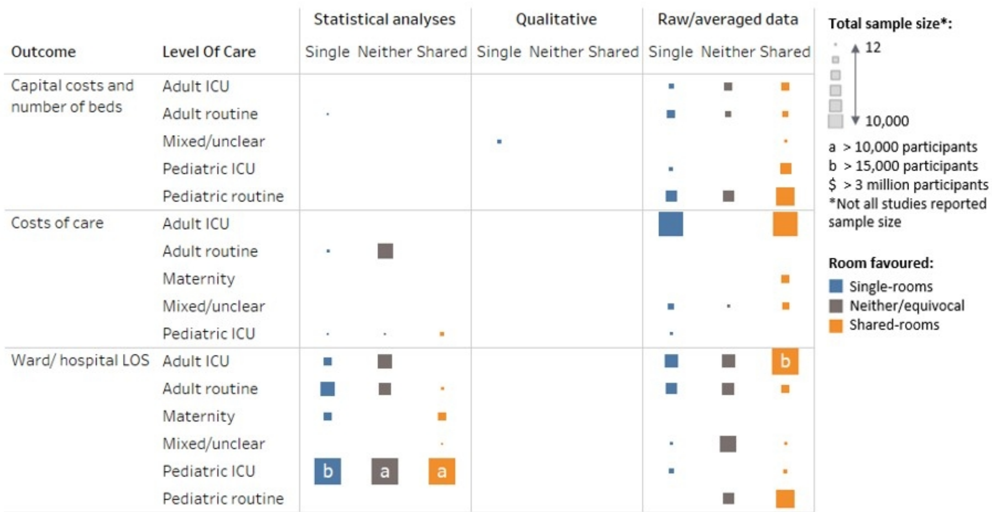

Figure 5. Economic outcomes represented by the total sample size with data for that outcome, by level of care and the type of data reported and room design favoured

239x126mm (96 x 96 DPI)

Health Economics Unit

Appendix

The data presented in summary tables 2–17 have been condensed substantially from what was reported in the papers. For each table there is one row per paper, detailing the setting and population samples in the study, and the outcomes reported according to whether the data were in favour of a single-room design, a shared-room design, or neither in favour nor against either design. Where statistical analyses were conducted the statistical significance is reported in the tables however no other numerical data is presented. Where no formal analysis was reported only the label pertaining to the outcome data are presented. For example, if the proportion of deaths was lower in the single-room design then "% deaths" is reported in the table under the heading "Data favours single-room design", or if qualitative analysis of interviews reports that patients would prefer a shared-room design because is it more sociable then "Qualitative (patient preference, social)" is reported in the table under the heading "Data favours shared-room design".

List of tables

!

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Key and abbreviations

[a]=adjusted

[u]=univariate analysis

[m]=multivariate analysis

NS=not statistically significant (p<0.05 is considered statistically significant)

BSI, bloodstream infection; LOS=length of stay; PEMR=physician estimate of mortality risk; SFR=Single family room; SRMC=Single room maternity care

Text is in italics if it is unclear where the true benefit lies, for example where the data is significantly greater for one room type compared to another but the interpretation of benefit may be subjective.

Cells coloured in blue are where a formal comparative statistical analysis was reported.

Table 1. Summary of study quality scores

Citation	Study methodology	QA score
Adamson 2003[1]	SLR	82%
Anåker et al 2017[2]	Prospective observational, before and after hospital relocation	59%
Anåker et al 2019[3]	Qualitative, before and after hospital relocation	90%
Apple 2014[4]	Prospective observational, qualitative	52%
Bevan et al 2016[5]	Prospective observational	59%
Blandfort et al 2019[6]	Prospective observational, before and after hospital relocation	67%
Blandfort et al 2019[7]	Prospective observational, before and after hospital relocation	67%
Boardman & Forbes 2011[8]	Economic analysis	91%
Bocquet et al 2021[9]	Retrospective observational, case-control	74%
Bodack et al 2016[10]	Prospective observational	56%
Bonizzoli et al 2011[11]	Retrospective observational, before and after hospital relocation	30%
Boztepe et al 2017[12]	Prospective observational	63%
Bracco et al 2007[13]	Prospective observational	74%
Bradbury-Jones et al 2013[14]	SLR	86%
Campbell-Yeo et al 2021[15]	Prospective case–control, before and after hospital relocation	74%
Cantoni et al 2009[16]	Retrospective observational, before and after hospital relocation	67%
Carlson et al 2006[17]	Prospective observational, before and after hospital relocation	33%
Carter et al 2008[18]	Prospective observational, before and after hospital relocation	33%
Caruso et al 2014[19]	Retrospective observational	74%
Cobo et al 2001[20]	Retrospective case–control	74%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Curtis & Northcott 2017[21]	Qualitative, before and after hospital relocation	80%
Cusack et al 2019[22]	Observational before hospital relocation	56%
Darcy Mahoney et al 2020[23]	Prospective observational	59%
Darley et al 2018[24]	Retrospective observational, before and after hospital relocation	56%
Davis et al 2019[25]	Retrospective observational, before and after hospital relocation	67%
Deitrick et al 2010[26]	Qualitative	90%
de Matos et al 2020[27]	Prospective observational	63%
Domanico et al 2010[28]	Prospective observational, before and after hospital relocation	63%
Domanico et al 2011[29]	Prospective observational, before and after hospital relocation	63%
Douglas & Douglas 2005[30]	Qualitative	90%
Dowdeswell et al 2004[31]	SLR	36%
Dowling et al 2012[32]	Prospective case–control, before and after hospital relocation	63%
Eberhard-Gran et al 2000[33]	Prospective case–control	59%
Edéll-Gustafsson et al 2015[34]	Qualitative	90%
Ehrlander et al 2009[35]	Retrospective observational	78%
Erdeve et al 2008[36]	Prospective case–control	74%
Erdeve et al 2009[37]	Prospective case–control	78%
Erickson et al 2011[38]	Prospective observational before and after hospital relocation	67%
Everts et al 1996[39]	Prospective observational	52%
Felice Tong et al 2018[40]	Retrospective case–control	78%
Ferri et al 2015[41]	Qualitative, before and after hospital relocation	100%
Florey et al 2009[42]	Retrospective case–control, before and after hospital relocation	44%
Foo 2022 et al[43]	Prospective observational	74%
Ford-Jones et al 1990[44]	Prospective observational	52%
Fraenkel et al 2018[45]	Retrospective case-control	67%
Gregersen et al 2021[46]	Retrospective observational, before and after hospital relocation	70%
Grundt et al 2021[47]	Prospective case-control	67%
Halaby et al 2017[48]	Retrospective observational, before and after hospital relocation	48%
Harris et al 2004[49]	Prospective case–control, before and after hospital relocation	74%
Harris et al 2006[50]	Retrospective observational	63%
Harris et al 2006[51]	Retrospective observational	52%
Hosseini & Bagheri 2017[52]	Prospective observational	63%
Hourigan et al 2018[53]	Prospective observational, before and after hospital relocation	63%
Hyun et al 2021[54]	Retrospective case–control	78%
Jansen et al 2021[55]	Retrospective observational, before and after hospital relocation	63%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Janssen et al 2000[56]	Prospective case–control, before and after hospital relocation	56%
Janssen et al 2006[57]	Prospective observational	59%
Jones et al 2016[58]	Qualitative, before and after hospital relocation	100%
Jongerden et al 2013[59]	Prospective observational, before and after hospital relocation	67%
Jou et al 2015[60]	Retrospective case–control	74%
Julian et al 2015[61]	Retrospective observational	78%
Jung et al 2022[62]	Retrospective observational, before and after hospital relocation	67%
Kainiemi et al 2021[63]	Prospective observational, before and after hospital relocation	59%
Kinnula et al 2008[64]	Prospective observational	63%
Kinnula et al 2012[65]	Prospective observational	67%
Knight & Singh 2016[66]	Prospective observational	59%
Kosuge et al 2013[67]	Prospective observational, before and after hospital relocation	41%
Labarère et al 2004[68]	Prospective observational	70%
Lawson & Phiri 2000[69]	Prospective observational, before and after hospital relocation	41%
Lazar et al 2015[70]	Prospective observational, before and after hospital relocation	48%
Lehtonen et al 2020[71]	Prospective observational	74%
Lester et al 2014[72]	Prospective observational, before and after hospital relocation	63%
Lester et al 2016[73]	Prospective observational, before and after hospital relocation	59%
Liu et al 2019[74]	Qualitative	100%
Lorenz & Dreher 2011[75]	Retrospective case–control	78%
Maben et al 2015[76]	Report, before and after hospital relocation with control hospitals	78%
Maben et al 2016[77]	Prospective observational, before and after hospital relocation with control hospitals	67%
Malcolm 2005[78]	Qualitative	80%
Mattner et al 2007[79]	Prospective observational	74%
McDonald et al 2019[80]	Prospective observational, before and after hospital relocation	48%
McKeown et al 2015[81]	Retrospective observational	48%
Mental Welfare Commission Scotland 1991[82]	Report	30%
Meyer et al 1994[83]	Prospective observational	59%
Milford et al 2008[84]	Prospective observational, before and after hospital relocation	30%
Miller et al 1998[85]	Prospective observational	59%
Monson et al 2018[86]	Prospective case–control	78%
Morgan 2010[87]	Prospective observational	44%
Munier-Marion et al 2016[88]	Prospective observational	74%
Nahas et al 2016[89]	Retrospective observational	56%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Nash et al 2021[90]	Prospective observational/ qualitative	63%
Nassery & Landgen 2019[91]	Qualitative	90%
OECD & World Health Organization 2019[92]	Report	14%
Olson & Smith1992[93]	Prospective observational	52%
O'Neill et al 2018[94]	Retrospective observational	74%
Park et al 2020[95]	Retrospective observational	63%
Pease & Finlay 2002[96]	Prospective observational	48%
Persson & Määttä 2012[97]	Qualitative	90%
Persson et al 2015[98]	Qualitative	90%
Pilmis et al 2020[99]	Prospective observational	63%
Pineda et al 2012[100]	Prospective case–control	70%
Poncette et al 2021[101]	Retrospective observational	56%
Puumala et al 2020[102]	Retrospective observational, before and after hospital relocation	67%
Pyrke et al 2017[103]	Prospective observational, before and after hospital relocation	59%
Quach et al 2018[104]	Retrospective case–control	59%
Real et al 2018[105]	Prospective observational, before and after hospital relocation	56%
Reed & Shmid 1986[106]	Narrative report, before and after hospital relocation	10%
Reid et al 2015[107]	Prospective observational, before and after hospital relocation	48%
Roos et al 2020[108]	Qualitative, before and after hospital relocation	90%
Rosbergen et al 2020[109]	Prospective observational, before and after hospital relocation	74%
Rowlands & Noble 2008[110]	Qualitative	90%
Sadatsafavi et al 2016[111]	Retrospective economic analysis	100%
Sadatsafavi et al 2019[112]	Retrospective economic analysis, before and after hospital relocation	100%
Sakr et al 2021[113]	Prospective observational	74%
Schalkers et al 2015[114]	Qualitative	100%
Scottish Intercollegiate Guidelines Network 2014[115]	Guideline	73%
Singh et al 2015[116]	Retrospective observational, before and after hospital relocation	70%
Singh et al 2016[117]	Prospective observational	70%
Søndergaard et al 2022[118]	SLR	91%
Song et al 2018[119]	Retrospective observational, before and after hospital relocation	63%
Stelwagen et al 2021[120]	Qualitative	100%
Stevens et al 2011[121]	Prospective observational, before and after hospital relocation	52%
Stevens et al 2012[122]	Prospective observational, before and after hospital relocation	44%

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Stevens et al 2014[123]	Prospective observational, before and after hospital relocation	56%
Stiller et al 2017[124]	Retrospective observational	59%
Swanson et al 2013[125]	Prospective observational, before and after hospital relocation	37%
Tandberg et al 2018[126]	Prospective observational	70%
Tandberg et al 2019[127]	Prospective case–control	67%
Tandberg et al 2019[128]	Prospective observational	67%
Taylor et al 2018[129]	SLR	91%
Tegnestedt et al 2013[130]	Prospective observational	70%
Teltsch et al 2011[131]	Retrospective case–control, before and after hospital relocation	67%
Toivonen et al 2017[132]	Prospective case–control, before and after hospital relocation	63%
Vaisman et al 2018[133]	Retrospective case–control	67%
van de Glind et al 2008[134]	Prospective observational	74%
van der Hoeven et al 2022[135]	Retrospective observational, before and after hospital relocation	63%
Van Enk & Steinberg 2011[136]	Prospective observational, before and after hospital relocation	44%
van Veenendaal et al 2020[137]	Retrospective observational, before and after hospital relocation	70%
Van Veenendaal et al 2022[138]	Prospective observational	70%
Vietri et al 2004[139]	Prospective case–control, before and after hospital relocation	59%
Vohr et al 2017[140]	Prospective observational, before and after hospital relocation	67%
Voigt et al 2018[141]	SLR	86%
Walsh et al 2006[142]	Prospective observational, before and after hospital relocation	33%
Washam et al 2018[143]	Retrospective case–control	78%
Watson et al 2014[144]	Prospective observational, before and after hospital relocation	44%
Zaal et al 2013[145]	Prospective observational	67%

Quality is graded by colour: green, good; orange, medium; red, poor. Abbreviation: SLR, systematic literature review.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 2. Summary of studies reporting mortality data

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation										
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine		% deaths	
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital	Orthopaedic	Elective	Routine		p=0.664	
Domanico 2010,[28] Domanico 2011[29]	63%	United States	Neonates	161 carers, 1 hospital, 2 units	Paediatric	NR	NICU	% deaths		
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients, 1 hospital, 2 units	Premature neonates	Maternity care	NICU		p=0.38 all-cause mortality p=0.96 infection-related mortality	
Jongerden 2013[59]	67%	Netherlands	Adults	323 patients, 1 hospital	Mixed, Adults	Mixed	ICU		p=0.98	
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU		p=0.168	
Lazar 2015[70]	48%	Israel	Children	4162 patients, 1 hospital	Children	Mixed	PICU		p=0.22	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Premature neonates	Emergency	NICU			% deaths
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital	Internal medicine, Geriatric	Mixed	Routine		p=0.12 one-year mortality p=0.35 inpatient mortality p=0.29 30-day discharge mortality	
Contemporaneous comparison										
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at	Mixed, Post surgery,	Mixed	ICU	p<0.001		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				admission), 1 hospital, 1 ward	Medical admission					
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.18	
Harris 2006[50]	63%	United States	Neonates	21 parents, 75 HCPs, 11 hospitals	Neonates	Emergency	NICU			% deaths
Hyun 2021[54]	78%	South Korea	Adults	666 patients, 1 hospital	Respiratory, COVID-19	Emergency	ICU			% deaths
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU		p=0.56 CLOS or mortality	
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p>0.95 inpatient mortality p=0.33 30-day mortality	
Lehtonen 2020[71]	74%	10 countries	Neonates	4662 patients, 331 units	Neonates	Emergency	ICU	OR 0.76, 0.64-0.89, major morbidity or mortality	OR 0.85, 0.70-1.02, mortality only	
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.72, % deaths	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 3. Summary of studies reporting data on patient care and disease management

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed		Medication errors 9 months after the move	Fewer medication errors immediately after the move
Before and after a hospital relocation										
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Lower % medical deterioration requiring rapid response or clinical review		
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards relocation	Orthopaedic patients	Unclear	Routine	Lower use of painkillers % responders % verbal outbursts % threatening behaviour		
Contemporaneous comparison										
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Mixed	Unclear	Routine			Qualitative (feelings of safety)
McKeown 2015[81]	48%	Ireland	Unclear	880 patients. 24 hospitals	End of life	Emergency, Elective	Routine	Perceived acceptability of patient's death Symptom management Symptom experience Patient care		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.020, cleanliness p=0.015, staff pain management	p=0.190, toileting help given	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, pain control		
Van de Glind 2008[134]	74%	Netherlands	Adults	52 encounters, 1 hospital	Urology	Unclear	Routine	p=0.003, greater duration of physician-patient encounter % encounter time patient speaks is greater Patients disclose more emotional cues, and information cues p=0.031, more physician responses to the patient cues	% encounter time physician speaks was no different Patients disclose more emotional cues	
Evidence synthesis										
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Hospital acquired infection treatment; Hand-hygiene; Cleaning and decontamination; Recovery; In situ medical treatment Family involvement Environment match the patient's progress		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed		Pain scores	
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical,	Unclear	Routine	Sleep quality Personal control Environment		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
					Internal medicine			Recovery time		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed			Restraint use e.g., rails
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine		Medication errors and usage	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 4. Summary of studies reporting data on maternity and neonatal care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation										
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	Parental presence and involvement (mother and partner feeding)		
Carter 2008[18]	33%	United States	Adults	1 hospital 53 parents	Neonates	Emergency	ICU	All p's<0.05 parent perceptions of access to staff		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	PEMR 2-3: patient progress: p<0.001, total apnoea events p<0.001, apnoea events/day p=0.031, days on mother's breastmilk; p=0.001, days on mother's breastmilk per LOS; p=0.003, interval to enteral feeding; p<0.001, interval to breastmilk feeding; p=0.048, days on parenteral nutrition; p=0.004, days on parenteral nutrition per LOS	PEMR 2-3 p=0.94, gestational age p=0.92, admission weight p=NS, acuity p=0.45, weight gain p=0.17, length gain p=0.17, head circumference gain p=0.84, total CPAP days p=0.7, CPAP days/LOS p=0.17, total caffeine days p=0.11, total caffeine days/LOS p=0.765, interval to formula feeding PEMR 4:	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									p=0.47, gestational age p=0.49, admission weight p=NS, acuity p=0.76, weight gain p=0.47, length gain p=0.70, head circumference gain p=0.59, total CPAP days p=0.94, CPAP days/LOS p=0.82, total caffeine days p=0.94, total caffeine days/LOS p=0.70, total apnoea events p=0.18, apnoea events/day *p*=0.937, interval to enteral feeding *p*=0.571, interval to formula feeding *p*=0.818, days on parenteral nutrition *p*=0.937, days on parenteral nutrition per LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Dowling 2012[32]	63%	United States	Neonates	40 mothers, 1 hospital	Neonates	Emergency	ICU		p=NS., all breastfeeding measures	
Erickson 2011[38]	67%	United States	Neonates	73 patients, 1 hospital	Preterm neonates	Emergency	NICU	p=0.04, time to enteral nutrition	p=0.05, weight gain/day p=0.30, weight gain/day normalized to kg birth weight p=0.47, time to parenteral nutrition	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 new hospital unit established	Pregnant women	Maternity	Routine	p=0.04, continuous or intermittent electronic foetal monitoring p=0.03, IV therapy p=0.01, 1-minute Apgar <7	p=NS for augmentation of labour, 20-minutes initial electronic foetal monitoring at admission, epidural, narcotics, mode of delivery, and episiotomy	
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital	Neonates	Emergency	ICU		*p*=0.30, receiving some maternal or donor breastmilk	*p*=0.04, primarily receiving maternal or donor breastmilk
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital relocation	Pregnant women	Maternity	Routine	p<0.001, patient satisfaction with amount of nurse interaction for physical, emotional, and	p=0.10, baby received supplementation with water p=0.25, p=0.05 clear discharge instructions of	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								spiritual needs, in labour, and postpartum p<0.001, patient satisfaction with nurse response time, teaching time, information received, feeding related teaching p<0.001, number of babies who received supplementation with formula p<0.001, number breastfeeding p=0.044, number breastfed within 1-2 hours post-delivery p=0.01, clear discharge instructions of when expect a call from the community health nurse p<0.001, clear instructions of how to use car seat, and nurse reviewed handouts	when to call the doctor, and when to make an appointment respectively	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital relocation	Neonates	Emergency	ICU	Narrative - reduced stress p<0.0001, reduced pain		
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Neonates	Emergency	ICU	p<0.001, interval to oral feeding		
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	*p*<0.05, nurse preferred single rooms *p*<0.01, nurse think single room is better for premature neonates	*p*>0.05, nurses think open rooms are better for ventilated/ critically ill infant	
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital relocation	Neonates	Emergency	ICU	*p*=0.04, interval to enteric nutrition	p=NS., other nutrition parameters	
Swanson 2013[125]	37%	United States	Neonates, Carers, HCPs	55 parent surveys, 42 AP surveys, 151 NN surveys 1 hospital relocation	Neonates	Emergency	NICU	p<0.05, Advanced neonatal practitioner perceptions of development, facility and privacy p<0.05, Neonatal nurses perceptions of development, facility and privacy.	Advanced neonatal practitioners: p=NS., teamwork, communication, safety Neonatal nurses: p=NS., communication, safety Parents: p=NS, development and safety	Neonatal nurses: p<0.05, teamwork

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Toivonen 2017[132]	63%	Finland	Neonates	20 nurses, 1 hospital relocation	Neonates	Emergency	ICU	p=0.001, duration of nurse-parent interactions p<0.0001, duration of nurse-family interactions	p=0.349, number of nurse-parent interactions p=0.471, number of nurse-infant interactions p=0.073, duration of nurse-infant interactions p=0.488, number of nurse-family interactions	
Van der Hoeven 2022[135]	63%	Netherlands	Infants	1293 infants, 1 hospital	Infants	Unclear	ICU	p<0.001, weight at discharge p=0.003, rate of weight gain	p=0.13, gestational age at full enteral feeding	
Contemporaneous comparison										
Bodack 2016[10]	55%	Germany	Neonates	35 sets of parents	Premature neonates	Maternity care	NICU	Qualitative (quality of care)	Qualitative (communication)	
Erdeve 2008[36]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.084, Routine visits p=0.046, acute care visits p=0.154, number of breastfed infants	p=0.005, more total applications to health services p=0.001, more consultations by phone
Grundt 2021[47]	67%	Norway	Neonates	77 patients, 66 mothers, 2 hospitals, 2 units	Premature neonates	Maternity	NICU	*p*=0.08, *p*=0.06, volume breastmilk produced 7, 14, days post-delivery, respectively p<0.001, *p*=0.02,	*p*=0.71, number of sessions at the breast *p*=0.46, mother breastfeeding self-efficacy *p*=0.51, p=0.33,	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								infants breastfed directly and exclusively at discharge, at term, respectively p<0.001, *p*=0.003, p=0.00, infants partly directly breastfed at discharge, at term, and 4 months corrected age, respectively p=0.00ª use of nipple shields	infants exclusively directly breastfed, or on solids, at 4 months corrected age, respectively *p*=0.33, *p* =0.61, use of nipple shields adjusted for post-menstrual age 33 weeks, 34 weeks, respectively	
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p=0.005, weight at discharge p=0.017, rate of weight gain p=0.015, interval to full enteral feeding		
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU		p=0.75, breastmilk feeding at discharge	
Stelwagen 2021[120]	100%	Netherlands	Adults	1 hospital 36 parents	Neonates	Emergency	ICU	Narrative - apnoea and periodic breathing		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU	Greater birth weight, length, and head circumference	p=0.45, p=0.42, breastmilk feeding exclusively at discharge, and term +4 months	Greater weight at term +4 months

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
										greater length at term +4 months
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital relocation	Neonates	Emergency	NICU	$p<0.001$, weight gain per day $p<0.001$, weight gain at discharge $p=0.002$, human milk at 1 week $p=0.001$, human milk at 4 weeks $p<0.001$, volume of milk		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 5. Summary of studies reporting data on complications of disease

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Pressure ulcers per 1,000 patient-days
Before and after a hospital relocation										
Blandfort 2019[7]	67%	Denmark	Adults, Elderly	1014 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	p=0.02, incidence of delirium	p=0.57, duration of first episode of delirium	
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine	Number of patients with infections (total, pneumonia, CMV-reactivation, CMV-primary, invasive mould, other) Infection rates (pneumonia: clinical diagnosis)		Number of patients with infections (microbiologically documented, primary sepsis) Infection rates (sepsis, pneumonia, pneumonia: microbiological diagnosis)
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.243, hospital-acquired pressure injuries	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 new hospital unit established	Pregnant women	Maternity	Routine		p=NS for rates of postpartum haemorrhage, pyrexia, rates of thick meconium, and cases of meconium aspiration	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital relocation	Neonates	Emergency	ICU	Less stress (some related to increased maternal involvement) p<0.0001, maternal involvement related to lower pain scores p<0.0001, increased maternal involvement in care of the neonate p<0.0001, reduction in pain due to the SFR NICU alone		
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			p<0.01, hip fractures due to falls
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital relocation	Neonates	Emergency	ICU		OR 1.267, 0.929-1.730, serious adverse outcomes	
Lester 2016[73]	59%	United States	Neonates	216 patients, 1 hospital relocation	Premature neonates	Maternity	ICU		p=0.90, periventricular leukomalacia p=0.80, retinopathy of prematurity (stage 3, 4, 5) p=0.16, sepsis p=0.13, bronchopulmonary dysplasia	p=0.09, necrotising enterocolitis p=0.08, intraventricular haemorrhage (grade3/4)
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-	Preterm neonates	Emergency	NICU		p=0.35, bronchopulmonary dysplasia	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				born control infants, 1 hospital					p=0.38, infection	
Contemporaneous comparison										
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRSA carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	Organ failure		
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU	p<0.01 delirium prevalence p<0.01 medical admissions p<0.01 postoperative admissions	p=0.33 number of days with delirium	
Erdeve 2008,[36] Erdeve 2009[37]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.720 clinical risk index for babies p=0.673 neonatal therapeutic intensity scoring system	
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine		p=0.70 thromboembolic events within 30-days p=0.21 superficial wound infection within 30-days Deep wound infections p=0.70	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									medical complications within 30-days	
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		*p*>0.95, patients with hip fracture as result of inpatient fall	
Lehtonen 2020[71]	74%	Canada, Australia, New Zealand, Finland, Israel, Japan, Spain, Sweden, Switzerland, Italy	Neonates	4662 patients, 331 units	Preterm neonates	Emergency	ICU	OR 0.76, 0.64-0.89, death or any major morbidity	OR 0.95, 0.84-1.08, composite of mortality or any morbidity OR 0.84, 0.71-1.00, sepsis OR 1.10, 0.95-1.27, Broncho-pulmonary dysplasia OR 1.14, 0.95-1.37, Intraventricular haemorrhage / Periventricular leukomalacia OR 0.81, 0.66-0.99, Retinopathy of prematurity treatment	
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital relocation	Neonates	Emergency	NICU	Bayley composites: p=0.02 Cognitive p=0.04 Language p=0.006 Expressive communication p=0.08 Motor p=0.04 Fine motor Bayley III composite scores:	Bayley composites: p=0.14 receptive communication p=0.67 gross motor p=0.11 normal neurologic examination	Suspicious neurological examination Abnormal neurological examination

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.05, cognitive p=0.02, language p=0.07, motor		
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p=0.05, sepsis		
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.53, crude risk of delirium	
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05 Reduced medical errors		
Scottish Intercollegiate Guidelines Network 2019[115]	Report 73%	United Kingdom	Adults	NR	At risk for delirium	NR	Routine	Managing patients with delirium		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	ICU delirium		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 6. Summary of studies reporting data on prevention of infection

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	*Clostridium difficile* in older people's ward (Control new-build hospital)		*Clostridium difficile* in older people's ward (Study hospital)
Before and after a hospital relocation										
Bonizzoli 2011[11]	30%	Italy	Unclear	818 patients, 1 unit	Trauma	Unclear	ICU	Isolates of MRSA, *Proteus mirabilis*, *Escherichia coli*, *Serratia marcescens*, and *Enterobacter* spp p<0.01, amoxicillin/ clavulanate use, ceftriaxone use p<0.05 oxacillin use, vancomycin use		
Darley 2018[24]	56%	United Kingdom	Unclear	1 hospital relocation	Unclear	Unclear	Routine	p=0.04, *Escherichia coli* bacteraemia p=0.01, hospital-acquired *Clostridium difficile* infection	p=0.22, hospital acquired methicillin-sensitive *Staphylococcus aureus* bacteraemia	
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	Incidence of nosocomial sepsis (*Candida albicans*, CONS, *Enterococcus*	Incidence of nosocomial sepsis (*Escherichia coli*)	Incidence of nosocomial sepsis (*Enterobacter cloacae*, *Klebsiella pneumoniae*)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								faecalis, MRSA, *Staphylococcus aureus*, total)		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.251, hospital acquired MRSA infections p=0.865, MRSA present on admission	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Patient perception (6 patients perceived better infection prevention)		
Gregersen 2021[46]	70%	Denmark	Elderly	446 patients, 1 hospital relocation	Geriatric	Unclear	Routine	% hospital-acquired infections p=0.01, p=0.03[a] time from admission to first hospital-acquired infection p=0.004 urinary tract infections	p=0.74, pneumonia p=0.50, gastritis p=0.09, sepsis p=0.22, other (wound infection, nephritis, and erysipelas)	
Halaby 2017[48]	48%	Netherlands	Unclear	16 beds, 1 hospital	Unclear	Unclear	ICU	p=0.001, transmission of any Multidrug resistant bacteria p=0.0015,	p=0.37 transmission of *Morganella* spp	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								transmission of *Citrobacter* spp p=0.0005 transmission of *Enterobacter* spp	p=0.99, transmission of *Proteus* spp p=0.25, transmission of *Serratia* spp p=0.39, transmission of *Pseudomonas* spp	
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital	Premature neonates	Emergency	NICU	p=0.0001, fewer positive skin swabs p=0.0003, fewer positive environmental swab samples Presence of antibiotic resistance genes (including resistome and virulome)	p=NS comparison of the entire bacterial community at the genus level Potential human pathogenic viruses in 2-week stool, discharge stool and skin samples Species alpha diversity	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients 1 hospital, 2 units	Premature neonates	Maternity care	NICU		p=0.62, incidence density per 1000 patient-days p=0.59, cumulative incidence per 100 infants p=0.66, skin and/or soft tissue infection p=0.15, conjunctivitis	
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU	p<0.001[a], CRAB acquisition		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Lazar 2015[70]	48%	Israel	Children	4162 patients, 1 hospital	Children	Mixed	PICU	p=0.01, incidence of BSI p=0.03, nosocomial BSI	p=0.26, community-acquired BSI	
McDonald 2019[80]	48%	Canada	Unclear	1 hospital relocation	Mixed	Mixed	Mixed	Enterococcus, MRSA, and *Clostridium difficile* infections per 10,000 patient-, days	p=NS, decline in rates of *Clostridium difficile* and MRSA infection	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital	Premature neonates	Emergency	NICU	p=0.02, sepsis in preterm infants (<28 weeks preterm)	p=0.43, sepsis in preterm infants (28 – 32 weeks preterm) p=0.42, sepsis in preterm infants (32 – 37 weeks preterm)	p=0.001 sepsis in term/post-term infants (>37 weeks)
Song 2018[119]	63%	United States	Neonates	171 patients, 1 hospital	Premature neonates	Emergency	NICU	hospital-acquired ESBL-E incidence		
Teltsch 2011[131]	67%	Canada	Adults	19343 patients, 2 hospitals	Unclear	Unclear	ICU	positive cultures per 10,000 patient-days for yeast, coagulase-negative *Staphylococcus* spp, *Enterococcus* spp, *Staphylococcus aureus*, *Escherichia* spp, *Pseudomonas* spp, *Klebsiella* spp, *Clostridium difficile*, *Corynebacterium* spp,		Positive cultures per 10,000 patient-days for *Enterobacter* spp, *Haemophilus* spp, MRSA, *Streptococcus viridans*, *Acinetobacter* spp, *Streptococcus pneumoniae*, Group B *Streptococcus* spp, *Neisseria* spp

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								Stenotrophomonas maltophilia, *Citrobacter* spp, *Proteus mirabilis*, *Serratia* spp, fungi, VRE, *Lactobacillus* spp, anaerobic cocci, *Morganella* spp, *Bacteroides* spp, *Moraxella* spp		
Van der Hoeven 2022[135]	63%	Netherlands	Neonates	1293 patients, 1 hospital	Premature neonates	Unclear	NICU	Infection of multidrug-resistant organisms Colonisation of third-generation cephalosporin resistant bacteria	Multidrug-resistant organisms: Bacteraemia Colonisation of third-generation cephalosporin resistant bacteria Third-generation cephalosporin resistant bacteria: Bacteraemia	Colonisation of multidrug-resistant organisms
Van Veenendaal 2020[137]	70%	Netherlands	Neonates	1152 patients, 1 hospital	Neonates	Emergency	NICU	% treated for early-onset sepsis Overall late-onset sepsis OR 0.55, 0.34-0.90 OR[a] 0.49, 0.30-0.81 Late-onset probable sepsis OR 0.64, 0.38-1.08 OR[a] 0.56, 0.32-0.96	Culture-proven late-onset sepsis OR 0.83, 0.44-1.56 OR[a] 0.74, 0.39-1.41 Symptoms of late-onset sepsis OR 0.22, 0.05-1.01 OR[a] 0.24, 0.05-1.08 Late-onset sepsis OR 0.40, 0.16-1.03 OR[a] 0.34, 0.13-1.91	
Vietri 2004[139]	59%	United States	Adults	261 patients, 1 hospital	Mixed	Unclear	Routine		Positive MRSA culture	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital	Premature neonates	Emergency	NICU	*p*=0.09, sepsis or necrotizing enterocolitis ≥ Bell stage IIA	*p*=0.052, late-onset sepsis	
Walsh 2006[142]	33%	United States	Neonates	127 nurses, 1 hospital	Neonates	Emergency	NICU	p<0.05, catheter-related BSI		
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute medical illness	Emergency	Routine	Patient perception of hygiene and infection risk		
Bocquet 2021[9]	74%	France	Adults, Children	233 patients, 1 hospital	Mixed, Influenza	Elective, Emergency	Routine	Nosocomial cases Community-acquired cases		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRSA carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	$p<0.001^{u,m}$, risk of BSI $p<0.05^{u,m}$, risk of MRSA acquisition $p=0.001^{u,m}$, risk of *Pseudomonas* spp acquisition $p<0.001^{u}$ $p<0.03^{m}$, risk of *Candida* spp acquisition		
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.19 acquired infections	
Cobo 2001[20]	74%	Spain	Adults	50 patients, 1 hospital, 2 wards	Respiratory, HIV	Unclear	Routine		p=0.052, likelihood of multi-drug resistant tuberculosis due to	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Mycobacterium bovis	
Everts 1996[39]	52%	New Zealand	Elderly	27 patients, 1 hospital	Unclear	Rehabilitation	Routine	Cases of clinical influenza		
Ford-Jones 1990[44]	52%	Canada	Children	1530 patients	Cardiological, General admission, Neurosurgical	Unclear	Routine	Cases of nosocomial diarrhoea (GA and neurosurgical unit)	Cases of nosocomial diarrhoea (cardiological unit)	
Fraenkel 2018[45]	67%	Sweden	Adults, Children, Elderly	251 patients, 8 hospitals	Mixed (all hospitalised patients who acquired norovirus during admission)	Unclear	Routine	p<0.01, norovirus		
Harris 2006[50]	63%	United States	Neonates	21 parents, 75 HCPs, 11 hospitals	Neonates	Emergency	NICU		Nosocomial BSI	Nosocomial pneumonia
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU	p=0.039, MRSA colonization rate for each additional one patient	p=0.10, incidence of MRSA colonization p=0.89, *Clostridium difficile* infection rate	
Jou 2015[60]	74%	United States	Adults	225 patients, 1 hospital	Mixed	Elective	Mixed			p=0.001, nosocomial *Clostridium difficile* infection p<0.001, malignancy

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine	p=0.03, risk for hospital acquired infection		
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine	p<0.001, risk for hospital acquired infection during hospitalization (1 hospital)	p=0.56, risk for hospital acquired infection during hospitalization (1 hospital) p=NS, risk of hospital acquired infection after discharge (3 hospitals)	
Liu 2019[74]	100%	Canada	Adults	1 hospital 15 parents of hospitalised infants	Neonates	Emergency	ICU	Parents' perception (reduced spread of infection)		
Lorenz 2011[75]	78%	United States	Adults, Elderly	166 patients, 1 hospital	Medical, Surgical, Oncologic	Unclear	Routine		p=NS, hospital-acquired infections	
Mattner 2007[79]	74%	Germany	Adults	336 patients, 1 hospital	Cardiovascular, Thoracic surgery	Mixed	ICU		Enterococci OR 1.06, 0.36-3.12 p=0.91	
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-born control infants, 1 hospital	Preterm neonates	Emergency	NICU		p=0.38, infection	
Morgan 2010[87]	44%	United Kingdom, United States	Adolescents, Adults, Children	146 patients, 114 HCP, 2 hospitals	Unclear	Mixed	Routine	HCP preference for isolation and infection control		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Munier-Marion 2016[88]	74%	France	Adults	93 patients, 1 hospital	Geriatric, Mixed, Surgical	Unclear	Routine	p=0.028, p=0.039[a], risk of hospital-acquired influenza	p=0.16, influenza vaccination coverage	
O'Neill 2018[94]	74%	United States	Mixed	>1 million patients, 218 hospitals with >50% private rooms, 117 with >50% bay rooms	Mixed	Mixed	Mixed	p<0.001, p=0.005[a], central-line-associated BSIs p<0.001, central-line-associated BSIs related mortality		
Park 2020[95]	63%	United States	Mixed	2,670,855 discharges, 340 hospitals	Mixed	Mixed	Mixed	p<0.001, p<0.001[a], hospital-acquired MRSA infections		
Pilmis 2020[99]	63%	France	Adults	107 patients, 1 hospital	Mixed	Unclear	Routine	p=0.13[u], p=0.0005[m], contamination		
Quach 2018[104]	59%	Canada, United States	Children	83,334 patient-days, 2 hospitals	Mixed	Mixed	Mixed	p<0.0001, hospital-acquired respiratory viral infections		
Sadatsafavi 2016[111]	100%	Canada	Unclear	8811 patient-days, 1 hospital (simulation)	Medical, Surgical	Unclear	ICU	Annual cases of MRSA acquisition, Pseudomonas species acquisition, and Candida species colonization		
Stiller 2017[124]	59%	Germany	Unclear	534 units	Unclear	Unclear	ICU	Polymicrobial BSI OR 0.66, 0.51-0.86		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Premature neonates	Emergency	NICU		p=0.36, septicaemia	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Vaisman 2018[133]	67%	United States	Adults	189 patients, 512/515 controls, 1 hospital	Unclear	Unclear	Routine		P=NS, hospital-onset *Clostridium difficile*	
Washam 2018[143]	78%	United States	Neonates	1751 patients, 1 hospital	Neonates	Emergency	NICU	p=0.03[u], p=0.03[m], MRSA		
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, hospital-acquired infections		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	7 studies found advantages only	3 studies found mixed results 4 studies found no difference	
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine	10 studies	5 studies	16 studies

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 7 Summary of studies reporting data on patient safety

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Falls per 1,000 patient-days
Before and after a hospital relocation										
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.599 Falls in hospital p=0.491 Unwitnessed fall p=0.082 Second fall	
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine		Falls per 1,000 occupied bed days	
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			p<0.01, p<0.01[a], falls per 1,000 patient-bed days p<0.001, falls per in-patient faller
Contemporaneous comparison										
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p=0.83, number of patients who sustained inpatient falls	p=0.035, falls per inpatient faller
Lorenz 2011[75]	78%	United States	Adults, Elderly	166 patients, 1 hospital	Medical, Surgical, Oncologic	Unclear	Routine		p=0.37, likelihood of falls	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Poncette 2021[101]	55%	Germany	Unclear	21 beds, 1 hospital	Unclear	Unclear	ICU			Alarms raised per bed
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	$p<0.05$, patient falls		
Taylor 2018[129]	SLR 91%	International	Adults	NR	Mixed	Mixed	Mixed		No difference	1 study found disadvantages only
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine		5 studies found no difference	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 8. Summary of studies reporting data on readmissions and reinterventions

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Contemporaneous comparison										
Erdeve 2008[36]	74%	Turkey	Infants	60 infants, 1 hospital	Preterm neonates	Emergency	ICU	p<0.05, hospitalisation		
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine			p=0.03, return to theatre within 6 weeks

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 9. Summary of studies reporting views on privacy

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Qualitative (privacy, comfort, personal control, visitor flexibility)		
Before and after a hospital relocation										
Anåker 2019[3]	90%	Sweden	Adults	16 patients, 1 hospital	Stroke	Rehabilitation	Routine	Qualitative (privacy, personal control)		
Carlson 2006[17]	33%	United States	Neonates	1 hospital, Patients unclear	Neonates	Emergency	ICU	Parent-reported privacy		
Carter 2008[18]	33%	United States	Adults	1 hospital 53 parents	Neonates	Emergency	ICU	p<0.001, patients' perception of privacy		
Curtis 2017[21]	80%	United Kingdom	Children	1 hospital, 4 wards 17 patients, 60 caregivers, 60 HCPs	Paediatric	Unclear	Routine	Qualitative (privacy)		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Perception of privacy		
Domanico 2010[28]	63%	United States	Parents	1 hospital, 2 units 161 caregivers	Paediatric	NR	NICU	p<0.001, privacy for bonding (long-stay) Transitional parent perceptions: privacy for bonding and for breastfeeding	p=NS, privacy for bonding (short stay) p=0.111 (short stay), p=0.076 (long stay), privacy for breastfeeding	
Dowling 2012[32]	63%	United States	Parents	1 hospital 40 mothers	Neonates	Emergency	ICU		p=NS, comfortable pumping breastmilk	
Ferri 2015[41]	100%	Canada	Unclear	1 hospital, 39 HCPs (13 nurses,	Unclear	Unclear	ICU	Qualitative (privacy)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				7 respiratory therapists), 5 HCPs (other), 6 physicians, 4 family members 4 support staff						
Florey 2009[42]	44%	United Kingdom	Adults	2 hospitals, 1 before and after move, 80 patients	Medical and surgical, Adults	Unclear	Routine	p<0.001, discussing personal matters p<0.001, patient preference		
Harris 2004[49]	74%	Canada	Adults	1 hospital, 976 patients	Pregnant women	Maternity	Routine	p=0.01, physicians' perception of privacy		
Janssen 2000[56]	56%	Canada	Adults	1 hospital, 426 patients	Pregnant women	Maternity	Routine	p<0.001, respect shown by caregiver for privacy *p<0.001, greater number of different nurses, doctors, and staff who interacted with the patient*		
Jones 2016[58]	100%	Australia	Adults, Neonates	1 hospital relocation 66 mothers, 51 nurses	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (privacy)		
Milford 2008[84]	30%	United States	Neonates	1 hospital, patients unclear	Neonates	Emergency	ICU	Staff perceptions of privacy		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital	Cardio-vascular	Unclear	Routine	Privacy	Communication Help from staff	
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine	Qualitative (privacy)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Qualitative (privacy)		
Stevens 2011[121]	52%	United States	Adults	1 hospital, 147 patients	Neonates	Emergency	ICU	Patient-reported privacy		
Swanson 2013[125]	37%	United States	Adults	1 hospital 55 parents	Neonates	Emergency	ICU	p<0.05, nurses', patients', and advanced practitioners' perceptions of privacy		
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Adults	3 ICUs 81 HCP	Mixed	Unclear	ICU	Staff perceptions of privacy		
Bevan 2016[5]	59%	United Kingdom	Adults, elderly	2 hospitals 50 patients	Aged 65+ years with acute illness	Emergency	Routine	Qualitative (privacy)		
Bodack 2016[10]	56%	Germany	Adults	1 hospital 35 pairs of parents of 40 neonates	Neonates	Emergency	ICU	Patient reported privacy		
Boztepe 2017[12]	63%	Turkey	Children	1 hospital, 1 ward 130	Children	Mixed	Routine			Lack of privacy
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Patient preference for privacy		
Douglas 2005[30]	90%	United Kingdom	Adults	1 hospital 785 patients (post discharge)	Adults	Unclear	Routine		*Mixed results*	
Ehrlander 2009[35]	78%	United States	Adults, elderly Adults	1 hospital 117 patients	Adults	Unclear	Routine	p<0.01, adequate privacy		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Harris 2006[50]	63%	United States	Adults	5 NICU units SFR=2 Open-bay=3 HCPs=75 Parents=21	Neonates	Maternity	Level 3, NICU	Parent preference for privacy		
Hosseini 2017[52]	63%	Iran	Adults	2 hospitals 132 patients	Adults, Medical or surgical	Unclear	Routine	p<0.001, adequate privacy		
Janssen 2006[57]	59%	Canada	Adults	1 hospital, 2 wards 415 patients	Pregnant women	Maternity	Routine	Patient satisfaction with for respect for privacy		
Liu 2019[74]	100%	Canada	Adults	1 hospital 15 parents of hospitalised infants	Neonates	Emergency	ICU	Privacy enabled the learning and practice of caregiving skills		
Malcolm 2005[78]	80%	New Zealand	Adults	Hospitals unclear, 12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine	Qualitative (privacy)		Qualitative (supportive)
Morgan 2010[87]	44%	United Kingdom, United States	Children	2 hospitals 146 patients, 114 HCP	Children	Mixed	Routine	Patient perception (privacy) HCP perception (privacy, dignity, confidentiality)		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic	Elective	Routine	p=0.004, better privacy		
Nash 2021[90]	63%	Australia	Adults	4 hospitals 602 patients	Indigenous Adults	Theoretical	Routine	Qualitative (privacy)		
Nassery 2019[91]	90%	Sweden	Adults	1 hospital, 13 interviews (9 individual parents and 4 pairs of parents)	Children	Unclear	Mixed	Qualitative (privacy, comfort)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Olson 1992[93]	52%	United States	Adults	1 hospital 351 patients, 28 HCP	Pregnant women	Maternity	Routine	Patient preference (privacy)		
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses 1 hospital	Orthopaedic, Surgical	Unclear	Routine	Patients in shared rooms signalled their need for privacy		
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine	Feelings of homeliness		
Rowlands 2008[110]	90%	United Kingdom	Adults	1 hospital 12	Adults with advanced cancer	Unclear	Routine	Patient preference (privacy)		
Schalkers 2015[114]	100%	Netherlands	Children	8 hospitals 63 patients	Children	Mixed	Routine	Qualitative (children's preferences for privacy)		
Stelwagen 2021[120]	100%	Netherlands	Adults	1 hospital 36 parents	Neonates	Emergency	ICU			Privacy violations felt more in single rooms
Van de Glind 2008[134]	74%	Netherlands	Adults	1 hospital 52 encounters	Urology	Unclear	Routine		Frequency or content of intimate communications	
Evidence synthesis										
Bradbury-Jones 2013[14]	SLR 86%	International	Adults	NR	Mixed, Vulnerable, Learning difficulties	Unclear	Unclear	Side rooms ensure privacy		
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	More privacy, which contributes to better outcomes	No quantifiable evidence of improved outcomes	
Mental Welfare Commission Scotland 1991[82]	Report 30%	United Kingdom	Unclear	258 patients, 28 hospitals	Psychiatric	Unclear	Routine	Easier to meet with visitors		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, improved patient privacy		
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Privacy, personal control and self-empowerment		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		All studies reported advantages and disadvantages	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 10. Summary of studies reporting views on patients' loneliness/isolation and family contact

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed (all patients in hospital)	Unclear	Mixed		Mixed findings regarding communication	Not isolated More interactions with other patients
Before and after a hospital relocation										
Anåker 2017[2]	59%	Sweden	Adults	59 patients, 1 hospital	Stroke	Rehabilitation	Routine			Not isolated Availability of interactions with physicians, nurses, nurse assistants, physiotherapists, occupational therapists, speech and language therapist, significant other, other team member, and interpreters
Anåker 2019[3]	90%	Sweden	Adults	16 patients, 1 hospital	Stroke	Rehabilitation	Routine			Less feeling of loneliness and emptiness Have company to talk to
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Private toilet and showing facilities		Less feeling of loneliness and isolation Greater companionship and goodwill

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	More parental presence and involvement, including time with skin-to-skin contact, singing/ talking/ reading to infant, bathing, diaper changes, and providing comfort during painful procedures. More time partner spent holding infants clothed Partner attended rounds at least once during stay	Mothers' attendance at rounds Time mothers spent bathing infants	*More time mothers spent holding infants clothed*
Curtis 2017[21]	80%	United Kingdom	Children	17 patients, 60 caregivers, 60 HCPs, 1 hospital, 4 wards	Paediatric	Unclear	Routine	Enhanced family support		Socialisation Not isolated
Cusack 2019[22]	56%	Australia	Adults, HCP	43 nurses, 15 patients, 1 hospital	Unclear	Unclear	Routine			Not isolated
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	p=0.012, ability to relax with child (long stay)	p=0.065, perceptions of meeting other parents (short stay) p=0.142 (short stay), p=0.542 (long stay), other	Socialisation p=0.036, perceptions of meeting other parents (long stay)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									parents made stay easier p=0.879, ability to relax with child (short stay)	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Increased visitor presence Increased visitor-provider interaction Accommodates Routine and emergency care Patient satisfaction Confidentiality/ privacy		Socialisation Camaraderie
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine	p=0.002, better for visitors		p<0.001, less loneliness
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital	Pregnant women	Maternity	Routine		*Patient satisfaction regardless of room design:* *p=0.005, time spent with support person* *p=0.007, time spent with baby* *p=0.39, amount of rest*	
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (personal control, homeliness, accommodates overnight stay, facilitates mother-		p<0.05, more support Qualitative objections to single rooms

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								infant connection, confidence, parental skills, breastfeeding, and bonding)		(inconsistent or lack of information, poor interpersonal skills, loneliness, isolation; shared rooms - shared information from other patients, and other patient-nurse interactions)
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU	p<0.0001, parents', mother's, and father's presence	p=NS, skin-to-skin contact with either parent, mother, or father	
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital	Cardio-vascular	Unclear	Routine	Qualitative (visitor comfort, better family dynamic)		
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine		% feeling lonely	
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Visiting hours		Less boredom Not isolated
Rosbergen 2020[109]	74%	Australia	Adults, Elderly	73 patients, 1 hospital relocation	Stroke, Neurological	Emergency, Rehabilitation	Routine	p=0.02, physical activity	P=NS, social activity Cognitive activity	Less feeling of loneliness
Singh 2016[116]	70%	United Kingdom	Adults, Elderly	100 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine			$p=0.03^a$, less feeling of loneliness
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital Before	Neonates	Emergency	ICU	Space for family Accommodations for parents		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				and after relocation						
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.017, family-centred care		
Toivonen 2017[132]	63%	Finland	Neonates	20 nurses, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p<0.0001, total nurse–family interaction time p=0.001, total nurse–parent interaction time	p=NS, total nurse–infant interaction time	
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU	Qualitative support for single rooms (family involvement, family presence during care)		
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	More secure/ confident caring for baby		Contact and exchange of knowledge with other parents
Darcy Mahoney 2020[23]	59%	United States, International	Neonates	NR, 277 units	Paediatric, new-born	NR	NICU	p=0.018, parental presence following COVID-19 restrictions p=0.013, parental presence during rounds prior to COVID-19 restrictions	p=NS, parental presence prior to COVID-19 restrictions p=0.6, parental presence during rounds prior to COVID-19 restrictions	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
De Matos 2020[27]	63%	Brazil	Unclear	176 family visitors, 1 hospital, 4 ICU units	Cancer	Unclear	ICU		p=0.52, stress within 24 hrs p=0.15, stress within 7 days	
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Accommodates visitors	p=0.913, loneliness	*>50% enjoy conversation with room mate and gave help to room mate*
Erdeve 2008[36]	74%	Turkey	Infants	60 infants 1 hospital	Preterm neonates	Emergency	ICU			*Time spent with infants during non-hospitalised time*
Harris 2006,[50] Harris 2006[51]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU		Contact with other parents	
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p<0.001, visitor convenience		p<0.001, less feeling of loneliness
Liu 2019[74]	100%	Canada	Neonates	15 parents, 1 hospital	Neonates	Emergency	ICU	Qualitative (engage in parenting activities beyond basic caregiving)	Qualitative (isolation)	
Malcolm 2005[78]	80%	New Zealand	Adolescents, Adults	12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine			Qualitative (camaraderie and support)
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Staff perception of discussions with families		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine	Patients' privacy Visitor times Undisturbed sleep Personal control		Patients: Communication Company Entertainment HCPs: Interaction with other patients Company
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic	Elective	Routine		p=0.754, isolation p=0.638, loneliness	
Nash 2021[90]	63%	United Kingdom	Adults, Elderly	100 patients,	Adults >65 years, recovering from acute illness	Emergency	Routine	Company of family, not strangers		Qualitative (not isolated, social interactions)
Nassery 2019[91]	90%	Sweden	Children	13 parents, 1 hospital	Children	Unclear	Mixed	Qualitative (patient preference, privacy, stress, quieter)		Qualitative (shared experience and advice)
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine		*Mothers satisfied with visiting hours*	
Pease 2002[96]	48%	United Kingdom	Unclear	50 patients, 1 hospital	Oncologic, Terminal	Unclear	Routine			Qualitative (not isolated)
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses, 1 hospital	Orthopaedic, Surgical	Unclear	Routine			Qualitative (not isolated)
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine			Qualitative (not isolated, company, social contact)
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU	p=0.021[a], time parents spent	p=NS, time parents spent holding the infant	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								visiting the infant (week 1-2) p=0.039, time spent cuddling, visiting, and with skin-to-skin contact (week 1-2) p=0.026, p=0.017[a], time parents spent visiting the infant during weeks 3-4 p=0.062, p=0.047[a], time parents spent visiting the infant by LOS	p=0.193, time parents spent visiting the infant (week 5–term) p=0.593, interval to first time parents hold infant p=0.810, days spent cuddling infant (week 1–2) p=0.548, days spent cuddling infant (week 3–4) p=0.592, days spent cuddling infant (week 5–term) p=0.361, days spent cuddling infant by LOS p=0.496, days with skin-to-skin (week 1–2) p=0.111, days with skin-to-skin contact (week 3–4) p=0.489, days with skin-to-skin contact (week 5–term) p=0.360, days with skin-to-skin contact by LOS	
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine	Qualitative (privacy)		Qualitative (social interactions)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Schalkers 2015[114]	100%	Netherlands	Children	8 hospitals 63 patients	Children	Mixed	Routine			Qualitative (company, patient preference if they have similarities with other patients)
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Qualitative (family communication and closeness, personal control, privacy, tranquillity, comfort, practicing parenting skills)		Qualitative (not isolated, ability to distance themselves from invasive procedures)
Swanson 2013[125]	37%	United States	Neonates, Carers	55 parents, 1 hospital	Neonates	Emergency	NICU	p<0.05 advanced practitioners' satisfaction with communication		p<0.05, nurse satisfaction with communication p<0.05, nurse satisfaction with team
Tandberg 2018[126]	70%	Norway	Neonates	64 patients, 115 parents, 2 hospitals	Neonates, Premature neonates	Emergency	ICU	p<0.001, time mother and father present during first 14 days p=0.02, mother's skin-to-skin contact per 24 h p=0.05, father's skin-to-skin contact per 24 h p=0.02, guidance provided by the staff meets needs of mothers	p=0.53, guidance provided by the staff meets needs of fathers p=0.21, fathers felt their opinions were considered	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.04, mothers felt their opinions were considered p<0.001 (mothers), p=0.01 (fathers), participation in doctor visits, respectively p=0.05 (mothers), p<0.001 (fathers), emotion support received from staff		
Tandberg 2019[127]	67%	Norway	Infants	77 infants, 132 parents, 2 hospitals	Infants	Emergency	ICU	p<0.0001, mother's and father's presence in week 1 p<0.0001, mother's and father's presence per day up to week 34		
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU	p<0.001, mother's presence in week 1 p value<0.001, father's presence in week 1 p<0.001, mother's presence overall and continuous p<0.001, father's presence overall and continuous p<0.001, skin-to-skin contact per day in week 1		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, total skin-to-skin contact per day		
Van Veenendaal 2022[138]	70%	Netherlands	Neonates	182 parents, 3 hospitals	Fathers of neonates	Emergency	ICU	p<0.001, p<0.001[a], total presence p<0.001, p<0.001[a], presence >8 h p<0.001, p=0.009[a], total participation p<0.001, p=0.005[a], participation in medical care p=0.23, p=0.04[a], information gathering p<0.001, p=0.005[a], advocacy and leadership p=0.006, p=0.005[a], time spent with neonate	p=0.04, p=0.13[a], participation in daily care p=0.69, p=0.57[a], time spent comforting neonate	
Evidence synthesis										
Adamson 2003[1]	SLR 82%	United States, International	Mixed	Unclear	Mixed	Mixed	Mixed	Interaction with family members and flexibility for accommodating family members		
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Qualitative (frequency of visitors, privacy)		
OECD WHO 2019 [92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, social support Communication with family		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Quiet, private, better /easier communication		Not isolated and not lonely
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		All studies reported advantages and disadvantages	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 11. Summary of studies reporting patient's views on noise, disturbance and sleep

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Patient perceptions (comfort, noise levels, privacy)		
Before and after a hospital relocation										
Carlson 2006[17]	33%	United States	Neonates	Unclear, 1 hospital	Neonates	Emergency	ICU	Patient perceptions (noise levels)		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital	Neonates	Emergency	NICU	$p<0.001$, noise level $p<0.001$, lighting		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	*Adequate sleep reported but no comparison with shared room*		
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	Actual noise levels	Patient perceptions (noise levels) $p=0.890$, noise disturbance (short stay) $p=0.657$, noise disturbance (long stay)	
Ferri 2015[41]	100%	Canada	Adults	39 HCPs (13 nurses, 7 respiratory therapists), 5 HCPS (other),	Unclear	Unclear	ICU	Qualitative (less disruption)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				6 physicians, 4 family members 4 support staff, 1 hospital						
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine	p=0.019, noise disturbance		
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	p<0.001, physicians' perceptions of noise		
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital, Before and after relocation	Pregnant women	Maternity	Routine	p<0.001, any noise disturbance p<0.001, talking/ visiting by hospital neighbours p=0.08, staff talking at the nursing station p<0.001, crying babies	p=0.30, talking/visiting by hospital staff p=0.28, women in labour	
Maben 2015[76]	78%	United Kingdom	Unclear	24 staff, 32 patients, 1 hospital (relocated), 2 control hospitals	All patients in hospital	Mixed	Mixed	Patient perceived benefit		
Milford 2008[84]	30%	United States	Neonates	Unclear, 1 hospital	Neonates	Emergency	ICU	Higher staff satisfaction		
Pyrke 2017[103]	59%	Canada	Adults	47 patients, 1 hospital relocation	Psychiatric	Emergency	Routine		p=0.399, sleep disturbed p=0.065, time spent asleep	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	Perceived noise level		
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Restfulness		
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p<0.001, actual noise level p<0.05, lighting	Noise level adjacent to baby's ear	
Van Enk 2011[136]	44%	United States	Neonates	90 beds, 1 hospital	Neonates	Emergency	NICU	p=0.04, actual noise level (day time) *p=0.05, less illumination (day time)* *p=0.01, lower temperature (night time)* *p=0.001, lower temperature (day and night combined)* *p<0.0001, lower humidity (night time)*	p=0.35, actual noise level (night time) p=0.08, actual noise level (day or night time) p=0.49, illumination (night time) p=0.60, temperature (day time)	*p<0.0001, lower humidity (day time)* *p<0.0001, lower humidity (day and night combined)*
Walsh 2006[142]	33%	Unclear	Neonates	127 nurses, 1 hospital	Neonates	Emergency	NICU	Actual noise levels		
Contemporaneous comparison										

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU	Qualitative (privacy, fewer disturbances)		
Bevan 2016[5]	59%	United Kingdom	Adults, elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (less noise disturbance)		
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	Qualitative (fewer disturbances)		
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine			Qualitative (adequate rest and sleep due to the presence of a roommate)
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine	Fewer night-time disturbances		
Eberhard-Gran 2000[33]	59%	Norway	Adults	160 patients, Unclear (one municipality)	Adults, Pregnant women	Maternity	Routine	More sleep/ rest Enough sleep/ rest (women ≥ 30 years old) OR 8.1, 1.7-39.3 amount of sleep and rest at Akershus	Enough sleep/rest OR 2.9, 0.3-30.3 amount of sleep and rest at Kongsvinger	
Edéll-Gustafsson 2015[34]	90%	Sweden	Neonates	12 parents, 1 unit	Neonates	Emergency	ICU	Qualitative (privacy, personal control)		Qualitative (not confined)
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Qualitative (peace and quiet)		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Foo 2022[43]	74%	Australia	Adults	60 patients, 1 hospital	Cardio-respiratory, Obstetric, Sleep disorders, Other	Unclear	Routine		p>0.05, number of interruptions in 24-h p>0.05, number of disturbances at night p=0.11, other measures of discomfort	
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU	Parent satisfaction with physical environment		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, surgical	Unclear	Routine			p<0.001, better scores for sleep disorders
Meyer 1994[83]	59%	United States	Unclear	Unclear, 1 hospital	Mixed	Mixed	Mixed	p<0.05, actual noise levels (day time) p<0.05, actual noise levels (night time) lower maximum illumination (day and night time)	Maximum period of uninterrupted sleep	
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine	Qualitative (quiet sleep)		
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.003, good sleep at night	p=0.127, noise level	
Nassery 2019[91]	90%	Sweden	Children	13 interviews (9 individual parents, 4 pairs of	Children	Unclear	Mixed	Less stress sleeping alone		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				parents), 1 hospital						
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	*Mothers satisfied with room but no comparison with shared rooms*		
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses 1 hospital, 2 wards	Orthopaedic, Surgical	Unclear	Routine	Less disturbance		
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine	Sleep undisturbed		
Poncette 2021[101]	56%	Germany	Unclear	21 beds, 1 hospital	Unclear	Unclear	ICU			Less alarms raised
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine	Qualitative (less stress related to disturbing others)		
Sakr 2021[113]	74%	Lebanon	Adults	75 patients, 1 hospital	Internal medicine, Surgical	Mixed	Routine	p=0.011, fewer cases of new onset insomnia	p=0.272, patient perceived impact of room on new onset insomnia	
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital	Neonates	Emergency	ICU	Qualitative (privacy)		Qualitative (less surprise when staff appear at bedside)
Tegnestedt 2013[130]	70%	Sweden	Adults, Elderly	15 patients 1 hospital	Adults	Emergency	ICU		p=0.777 (7am to 3pm), p=0.885(3pm to 11pm), p=0.832 (11pm to 7am), actual noise	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU			p <0.001 lower light intensity
Evidence synthesis										
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Quieter (less sleep disturbance, better outcomes)		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, better sleep		
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine	Quieter (less sleep disturbance)		
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed		Mixed findings on sleep outcomes	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 12. Summary of studies reporting patients' views on satisfaction with care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Patient preference (privacy, ensuites)		Patient preference (social interaction)
Before and after a hospital relocation										
Campbell-Yeo 2021[15]	74%	Canada	Neonates	71 mothers, 2 wards	Neonates	Emergency	ICU	Postpartum depression scores Post-traumatic stress disorder scores	Parental stressor scores EQ-5D-5L self-reported health	Perceived maternal self-efficacy Intolerance of uncertainty
Carlson 2006[17]	33%	United States	Neonates	1 hospital, Patients unclear	Neonates	Emergency	ICU	Patient perception (improved lighting control)		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital Before and after relocation	Neonates	Emergency	NICU	$p<0.001$ parent perceptions of security		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine	Patient satisfaction but no comparison with shared room		
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 Before and after move	Medical and surgical, Adults	Unclear	Routine		patient preference based on previous experience inconclusive	
Janssen 2000[56]	56%	Canada	Adults	426 patients, 1 hospital	Pregnant women	Maternity	Routine	$p<0.001$, patient opinions in care considered $p<0.001$, information given to inform choices		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.001, patient choices supporter by caregivers p<0.001, assistance given to support person p<0.001, comfort measures for labour pain p<0.001, comfort measures for pain after birth		
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital	Mixed, Adults	Mixed	ICU	p=0.02, overall family satisfaction p=0.007, family satisfaction with care p=0.02, overall patient satisfaction p=0.01, patient satisfaction with care	p=0.12, family satisfaction with decision making p=0.21, patient satisfaction with decision making	
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU		Patient perceptions: (mothers and fathers, respectively) p=0.19, p=0.33, overall scores p=0.11, p=0.94, extent staff listen to mothers/fathers p=0.24, p=0.18, participation in baby's care	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									p=0.09, p=0.45, guidance provided by staff met needs p=0.71, p=0.16, opinion considered regarding care of baby p=0.51, p=0.16, mothers/fathers trust in staff caring for baby p=0.28, p=0.92, staff trust in mothers/fathers caring for baby p=0.12, p=0.89, participation in discussions during rounds p=0.51, p=0.41, information given by staff met needs p=0.70, p=0.87, staff offer emotional support	
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards	Psychiatric and Orthopaedic	Unclear	Routine	Patient perceptions (spatially, visually)		
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU	p<0.001, mother's overall satisfaction p<0.0001, mother's stress p<0.001 mother's satisfaction with family-centred care		

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.0001 mother's involvement in infant care		
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Positive staff perceptions		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	p<0.05, patients' satisfaction with design		
Reid 2015[107]	48%	United Kingdom	Adult, Elderly	89 patients, 1 hospital relocation	Geriatric	Rehabilitation	Routine	100% patients prefer private toilet *84.8% of patients in single rooms would prefer single rooms* *37.2% of patients in shared room would prefer single rooms*		
Stevens 2011[121]	52%	United States	Neonates	147 patients, 1 hospital	Neonates	Emergency	ICU	p<0.001, parent satisfaction with environment p=0.018, overall parent satisfaction p=0.04, total parent satisfaction score		
Swanson 2013[125]	37%	United States	Neonates, Carers	55 parents, 1 hospital	Neonates	Emergency	NICU	p<0.05, nurse perception of facilities p<0.05, practitioners' perceptions of facilities		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p<0.05, parents' perceptions of facilities		
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (privacy, personal control, private toilet) p=0.038, patients perceived a high-level of care		
Boztepe 2017[12]	63%	Turkey	Children	130 patients, 1 hospital, 1 ward	Children	Mixed	Routine		Only 15.4% expected a large or single room	
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Patient preference (privacy)		
de Matos 2020[27]	63%	Brazil	Unclear	176 family visitors, 1 hospital, 4 ICU units	Cancer	Unclear	ICU	p=0.02, patient satisfaction Satisfaction of family members		
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine	Patient satisfaction with needs met		
Eberhard-Gran 2000[33]	59%	Norway	Adults	160 patients, Unclear (one municipality)	Adults, Pregnant women	Maternity	Routine	OR[a] 18, 2.2-149.1 more likely to be satisfied with care	Satisfaction with rooms Satisfaction with sleep and rest Satisfaction with LOS	
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Adults	Unclear	Routine	Patient preference	p=0.309, fear of dying	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Erdeve 2009[37]	78%	Turkey	Adults, Neonates	60 infants, 49 mothers, 2 hospitals	Preterm neonates	Emergency	NICU		p=0.206, depression scores p=0.06, postpartum depression rate p=0.161, vulnerable child scores p=0.219, parenting stress scores	
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU	p<0.05, window view and proximity to infant during sleep Less stressful and less depressing		
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU	Less stressful and less depressing, better physical environment.		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p<0.001, patients' overall satisfaction p<0.001, patients' total satisfaction		
Janssen 2006[57]	59%	Canada	Adults	415 patients, 1 hospital, 2 wards	Pregnant women	Maternity	Routine	p<0.001, patients' overall satisfaction p<0.001, confidence in neonatal care p<0.001, provision of choice p<0.001, physical environment		
Labarère 2004[68]	70%	France	Adults	4095 patients, 1 hospital	Mixed	Mixed	Mixed	p<0.01, overall patient experience		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Miller 1998[85]	59%	United States	Adolescents, Adults	94 patients, 1 hospital	Inpatients, Outpatients	Unclear	Routine	% patients overall stating ideal rooming arrangements % inpatients stating ideal rooming arrangements % female inpatients stating ideal rooming arrangements % inpatients aged 15 to 17 and 18 to 21 stating ideal rooming arrangements % female outpatients stating ideal rooming arrangements	% outpatients aged 12 to 14 stating ideal rooming arrangements	% male inpatients and outpatients stating ideal rooming arrangements % inpatients aged 12 to 14 stating ideal rooming arrangements % outpatients stating ideal rooming arrangements % outpatients aged 15 to 17 and 18 to 21 stating ideal rooming arrangements
Morgan 2010[87]	44%	UK, US	Children	146 patients, 114 HCP, 2 hospitals	Children	Mixed	Routine			% patient preference
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine	p=0.014, feeling of safety Qualitative (privacy, security, pain management, cleanliness)	p=0.061, overall patient satisfaction	
Nash 2021[90]	63%	Australia	Adults	602 patients, 4 hospitals	Unclear	Unclear	Routine			Patient preference
Nassery 2019[91]	90%	Sweden	Children	13 interviews (9 individual parents, 4 pairs of	Children	Unclear	Mixed	Parents preference		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				parents), 1 hospital						
Olson 1992[93]	52%	United States	Adults	351 patients, 28 HCP, 1 hospital	Pregnant women	Maternity	Routine	Nurse preference *Mother satisfaction*		
Pease 2002[96]	48%	United Kingdom	Unclear	50 patients, 1 hospital	Oncologic, Terminal	Unclear	Routine	Family preference		Patient preference
Persson 2012[97]	90%	Sweden	Adults, Elderly	16 patients, 10 nurses, 1 hospital, 2 wards	Orthopaedic, Surgical	Unclear	Routine			Qualitative (security and safety)
Persson 2015[98]	90%	Sweden	Adults	16 patients, 1 hospital	Surgical	Unclear	Routine			Qualitative (security, company, not isolated)
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU		p=0.512, maternal depression p=0.152, trait anxiety p=0.830, state anxiety p=0.071, life stress p=0.603, avoidance coping p=0.967, emotion-oriented coping p=0.506, task-oriented coping p=0.951, social support	p=0.040[a], stress levels
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine			Satisfaction for older/bedridden patients

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Rowlands 2008[110]	90%	United Kingdom	Adults	12 patients, 1 hospital	Adults with advanced cancer	Unclear	Routine		Qualitative (desire for choice of room)	
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Qualitative (privacy, safety, homeliness, feelings of central engagement with child care)		
Tandberg 2019[127]	67%	Norway	Infants	77 infants, 132 parents, 2 hospitals	Infants	Emergency	ICU	Mothers: p=0.005, depression at day 14 p=0.04, anxiety at day 14 p=0.0001, role alteration at day 14 p=0.06, role alteration at discharge Fathers: p=0.06, environmental stress at day 14 p=0.003, role alteration at day 14 p=0.003, environmental stress at discharge p=0.004, role alteration at discharge	Mothers: p=0.12 Maternal distress at day 14 p=0.43 depression, and p=0.48, anxiety at discharge p=0.13, distress at discharge p=0.65, depression and p=0.54, anxiety at 4-month corrected age p=0.60, distress at 4-month corrected age p=0.62, dysfunctional interaction with child p=0.23, perceived child to be difficult p=0.42, stress p=0.51, attachment	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Fathers: p=0.17, depression and p=0.25, anxiety at day 14 p=0.57, depression and p=0.73, anxiety at discharge p=0.92, depression and p=0.11, anxiety at 4-month corrected age p=0.16, dysfunctional interaction with child p=0.77, perceived child to be difficult p=0.68, stress p=0.49, attachment	
Van Veenendaal 2022[138]	70%	Netherlands	Neonates	182 parents, 3 hospitals	Fathers of neonates	Emergency	ICU	p=0.001[a], stress overall p=0.011[a], stress related to environment p<0.001[a], stress related to role alteration	p=0.83[a], depression and anxiety p=0.26[a], self-efficacy p=0.27[a], impaired parent-newborn bonding p=0.32, satisfaction with care	
Watson 2014[144]	44%	Canada	Neonates	85 families, 1 hospital	Neonates	Emergency	NICU	p=0.008, privacy p=0.0001, comfort p=0.009, interaction with other families	p=0.05, getting to know baby p=0.05, feeling irritable, anxious, depressed or sad	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								p=0.04. confidence feeding baby p=0.04, easy to comfort baby *p=0.003, family adjusted to having the baby home*	p=0.05, satisfied with care baby received	
Economic analysis										
Boardman 2011[8]	91%	Canada	Unclear	537 beds, 1 hospital	Mixed	Mixed	Mixed	Patients and willingness to pay for single over shared rooms		
Evidence synthesis										
Bradbury-Jones 2013[14]	SLR 86%	International	Adults	NR	Mixed, Vulnerable, Learning difficulties	Unclear	Unclear		Mixed views among patients with learning disabilities	
Dowdeswell 2004[31]	SLR 36%	International	Unclear	Unclear	Mixed	Mixed	Mixed	Quicker mobility recovery Sense of self-reliance Personal control leads to happier patients.		
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	12 studies showed single rooms positively affect patient satisfaction	4 studies showed no difference	1 study showed single rooms don't positively affect patient satisfaction
Søndergaard 2022[118]	SLR 91%	International	NR	NR	Acute, Surgical, Internal medicine	Unclear	Routine			Communication and interaction with kindred spirits was appreciated

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
										Bedridden / older patients were less satisfied with single rooms.
Taylor 2018[129]	SLR 91%	International	NR	NR	Mixed	Mixed	Mixed	Patient perceptions of dignity		
Voigt 2018[141]	SLR 86%	International	NR	NR	NR	Unclear	Routine	1 study found advantages for feelings of safety 1 study found advantages for patient preference 1 study found advantage or no difference for patient preference	1 study found mixed findings for feelings of safety All studies found mixed findings regarding concern for others 1 study found mixed findings for patient preference	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 13. Summary of studies reporting data on patient monitoring and safeguarding

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed		*Qualitative (regular visits by staff to single-rooms)*	
Before and after a hospital relocation										
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine		Staffing ratio	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients 1 hospital, 2 units	Premature neonates	Maternity care	NICU		Nurse-to-patient ratio	
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU			Nurse perception (parallel patient interactions, get caught in single rooms so can't attend to other families)
Jung 2022[62]	67%	South Korea	Adults	901 patients, 1 hospital	Mixed	Unclear	ICU		Nurse-to-patient ratio	
Contemporaneous comparison										
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute medical illness	Emergency	Routine	Patient perceptions (isolation)		
Bodack 2016[10]	55%	Germany	Neonates	35 pairs of parents	Premature neonates	Maternity care	NICU	Somewhat less frequent		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
								adequate monitoring		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at admission), 1 hospital, 1 ward	Mixed, Post surgery, Medical admission	Mixed	ICU	*Standard nurse-to-patient ratio 1:2*		
Ehrlander 2009[35]	78%	United States	Adults	117 patients, 1 hospital	Mixed	Unclear	Routine	p=0.025, patient perception of nurse availability		
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	Better response to call lights. More visits to anticipate patient needs.		
Hosseini 2017[52]	63%	Iran	Adults	132 patients, 2 hospitals	Medical, Surgical	Unclear	Routine	p=0.19, access to nurses		
Julian 2015[61]	78%	United States	Neonates	1823 patients 1 hospital, 1 unit	Neonates	Mixed	NICU		Nurse-to-patient ratio	
Nahas 2016[89]	56%	United Kingdom	Adults, Elderly	60 patients, 2 hospitals	Orthopaedic (elective hip/ knee arthroplasty)	Elective	Routine		p=0.244, response to call bell	
Early vs late response to new unit design										

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff 1 hospital, 1 unit	Unclear	Unclear	ICU	75 negative comments on shared-room design		Qualitative (less safety concerns related to distance between patient and care provider)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 14. Summary of studies reporting views on patient confidentiality

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus Contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	Qualitative (confidentiality)		
Before and after a hospital relocation										
Ferri 2015[41]	100%	Canada	Adults	39 HCPs, of which 13 nurses, 7 respiratory therapists, 5 HCPS (other), 6 physicians, 4 family members 4 support staff, 1 hospital	Unclear	Unclear	ICU	Qualitative (patient perceptions of confidentiality)		
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Qualitative (nurse perceptions of confidentiality, facilitating care)		
Florey 2009[42]	44%	United Kingdom	Adults	80 patients, 2 hospitals, 1 move	Medical and surgical, Adults	Unclear	Routine	p<0.001 ability to have confidential discussions		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine		Patient satisfaction with confidentiality	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Roos 2020[108]	90%	Norway	Adults	39 patients, 1 hospital relocation	Internal medicine, Surgical, Maternity	Maternity, Unclear	Routine	Qualitative (patient perceptions of confidentiality)		
Contemporaneous comparison										
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	Qualitative (easier to guarantee confidentiality)		
Bevan 2016[5]	59%	United Kingdom	Adults, Elderly	50 patients, 2 hospitals	Acute illness	Emergency	Routine	Qualitative (patient perceptions of confidentiality)		
Hosseini 2017[52]	63%	Iran	Adults	2 hospitals 132 patients	Adults, Medical or surgical	Unclear	Routine	p<0.001 comfortable discussing personal problems		
Malcolm 2005[78]	80%	New Zealand	Adolescents, Adults	12 former patients	Mixed surgery, orthopaedic, medical, obstetric, ENT	Mixed	Routine	Qualitative (patients in shared rooms felt a lack of privacy and confidentiality which affected relationships with other patients)		
Evidence synthesis										
OECD WHO 2019[92]	Report 14%	Europe	NR	NR	Mixed	Mixed	Mixed	p<0.05, improved patient confidentiality		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 2. Summary of studies reporting data on availability of beds, space requirements, and capital costs

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Higher space requirement for single-bed wards Building costs per bed
Before and after a hospital relocation										
Darley 2018[24]	56%	United Kingdom	Unclear	1 hospital relocation	Unclear	Unclear	Routine	Ward closures per year Bed days lost per 100,000		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150, PEMRs 4=12), 1 hospital, 2 units	Paediatric	NR	NICU	Number of patients accommodated; Total space		
Jones 2016[58]	100%	Australia	Neonates	66 mothers, 51 nurses, 1 hospital relocation	Adults, Mothers of premature neonates, Nurses	Maternity	NICU	Capacity		Room space
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital Before and after relocation	Mixed, Adults	Mixed	ICU	Number of beds Space per bed		
Jung 2022[62]	67%	Korea	Adults	901 patients, 1 hospital Before and after renovation	Adult, mixed	Unclear	ICU		Number of isolated rooms	Number of beds
Kosuge 2013[67]	41%	Japan	Unclear	555 beds, 1 hospital	Surgical, Internal medicine	Unclear	Routine	Number of beds (working, general, per nursing unit) Wards in total	Number of beds (tuberculosis)	Number of beds (mental, cases of floor transfer)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
									Total number of people / day and the wards	
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards (pre-/post-relocation)	Orthopaedic	Unclear	Routine	Number of beds		
Real 2018[105]	56%	United States	Unclear	111 patients, 77 nurses, 1 hospital, 1 ward	Cardio-vascular	Unclear	ICU, Routine	Qualitative (larger rooms promote more space for family)		
Rosbergen 2020[109]	74%	Australia	Adults, Elderly	73 patients, 1 hospital relocation	Stroke, Neurological	Emergency, Rehabilitation	Routine	p=0.007, number of single bedrooms in acute stroke unit/ neurology p<0.001, number of single bedrooms in inpatient rehab unit Ward length Total communal floor space	Number of any bedrooms, acute stroke unit/ neurology	Number of any bedrooms, inpatient rehabilitation unit
Contemporaneous comparison										
Julian 2015[61]	78%	United States	Neonates	1823 patients, 1 hospital, 1 unit	Neonates	Mixed	NICU			Bed capacity
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine	Single rooms usage (approx. 90%)	Number of rooms	
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine			Bed capacity
Pineda 2012[100]	70%	United States	Neonates	81 patients, 1 hospital	Premature neonates	Emergency	NICU			Number of beds; Room/ward area

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Quach 2018[104]	59%	Canada, United States	Children	83,334 patient-days, 2 hospitals	Children	Mixed	Mixed			Bed capacity
Stelwagen 2021[120]	100%	Netherlands	Neonates	36 parents, 1 hospital	Neonates	Emergency	ICU	Capacity; Room/ward area		

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 16. Summary of studies reporting data on length of stay

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed	LOS (per 1,000 patient-days): new hospital older people's ward, control new-build hospital older people's ward, steady-state control hospital medical assessment unit		LOS (per 1,000 patient-days): new hospital assessment unit, control new-build hospital medical assessment unit, steady-state control hospital older people's ward
Before and after a hospital relocation										
Blandfort 2019[6]	67%	Denmark	Elderly	964 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	p=0.35, median LOS		
Blandfort 2019[7]	67%	Denmark	Elderly	1014 patients, 2 hospitals	Geriatric, Dementia	Elective	Routine	Fewer cases with LOS ≥ 14 days	Minimum LOS	Maximum LOS
Cantoni 2009[16]	67%	Switzerland	Adults	227 patients, 1 hospital	Stem cell transplant	Elective	Routine	LOS Duration of catheterisation Number of patients catheterised		
Carter 2008[18]	33%	United States	Neonates	53 parents, 1 hospital Before and after relocation	Neonates	Emergency	NICU	LOS		
Davis 2019[25]	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.698, ward LOS p=0.226, hospital LOS	
Domanico 2010[28]	63%	United States	Neonates	161 caregivers, 1 hospital, 2 units	Paediatric	NR	NICU	LOS		
Domanico 2011[29]	63%	United States	Neonates	162 patients (PEMRs 2/3=150,	Paediatric	NR	NICU		p=0.340, LOS for PEMR 2 and 3 patients	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				PEMRs 4=12), 1 hospital, 2 units					p=0.890, LOS for PEMR 4 patients	
Erickson 2011[38]	67%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Preterm neonates	Emergency	NICU		*p*=0.73, LOS	
Gregersen 2021[46]	70%	Denmark	Elderly	446 patients, 1 hospital relocation	Geriatric	Unclear	Routine		*p*=0.50, hospital LOS	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	p<0.001, total LOS p<0.001, postpartum LOS		p=0.01, length of first stage labour p=0.002, length of second stage labour p=0.002, intrapartum LOS
Hourigan 2018[53]	63%	United States	Neonates	32 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU		p=0.52, LOS	
Jansen 2021[55]	63%	Netherlands	Neonates	712 patients, 1 hospital, 2 units relocation	Premature neonates	Maternity	NICU		p=0.36, hospital LOS	
Jongerden 2013[59]	67%	Netherlands	Adults	387 patients, 323 completed surveys, 1 hospital Before and after relocation	Mixed, Adults	Mixed	ICU		p=0.25, ICU LOS: family p=0.11, ICU LOS: patients p=0.25, hospital LOS: family p=0.60, hospital LOS: patients	
Jung 2022[62]	67%	Korea	Adults	901 patients, 1 hospital Before and after renovation	Adult, mixed	Unclear	ICU		p=0.575, ICU LOS	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kainiemi 2021[63]	59%	Finland	Neonates	61 families, 1 hospital, 1 unit (pre-post-restructuring)	Pre-term infants (<35 weeks)	Unclear	NICU		p=0.1784, hospital LOS	
Kosuge 2013[67]	41%	Japan	Unclear	555 beds, 1 hospital	Surgical, Internal medicine	Unclear	Routine	Average hospital LOS (surgery, internal medicine)		
Lawson 2000[69]	41%	United Kingdom	Adults	424 patients, 2 hospitals, 4 wards (pre-/post-relocation)	Psychiatric and Orthopaedic	Unclear	Routine	p<0.05, hospital LOS (orthopaedic patients not undergoing operation) Hospital LOS overall (psychiatric patients) ICU LOS (psychiatric patients)	Hospital LOS (orthopaedic patients undergoing operation)	
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Average LOS		
Monson 2018[86]	78%	United States	Neonates	90 preterm infants, 15 term-born control infants, 1 hospital	Preterm neonates	Emergency	NICU		p=0.81, LOS	
Puumala 2020[102]	67%	United States	Neonates	9995 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.02, LOS for extremely preterm infants p<0.0001, LOS for very preterm infants	p=0.71, LOS for moderately pre-term	p<0.0001, overall median hospital LOS p<0.0001, LOS for term/post term infants
Pyrke 2017[103]	59%	Canada	Adults	47 patients, 1 hospital relocation	Psychiatric	Emergency	Routine		*p*=0.832, LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Sadatsafavi 2019[112]	100%	United States	Neonates	NR, 1 hospital (theoretical)	Neonates	NR	ICU	Mean benefit–cost ratio 1.298 (95% CI: 1.282–1.315) when reduced LOS considered		
Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine	p<0.01, LOS		
Stevens 2014[123]	44%	United States	Neonates	73 patients, 1 hospital	Neonates	Emergency	ICU			p=0.0052, hospital LOS
Teltsch 2011[131]	67%	Canada	Adults	19343 patients, 2 hospitals, Before and after relocation or control	Adults	Unclear	ICU			Average ICU LOS (year 2000, 2001, 2002, 2003, 2004, 2005, and total)
van der Hoeven 2022[135]	63%	Netherlands	Infants	1293 infants, 1 hospital Before and after relocation	Infants	Unclear	ICU		p=0.49, hospital LOS	
van Veenendaal 2020[137]	70%	Netherlands	Neonates	1152 infants, 1 hospital Before and after relocation	Neonates	Emergency	ICU	p=0.016, LOS		
Vietri 2004[139]	59%	United States	Adults	261 Adults, 1 hospital Before and after relocation	Mixed	Unclear	ICU		p=NS, ICU LOS	
Contemporaneous comparison										
Bodack 2016[10]	56%	Germany	Neonates	35 pairs of parents of 40 neonates, 1 hospital	Neonates	Emergency	ICU	LOS		
Bracco 2007[13]	74%	Canada	Adults	2522 patients (of whom 207 known MRS carriers at	Mixed, Post surgery, Medical admission	Mixed	ICU	*LOS in the same bed*	LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
				admission), 1 hospital, 1 ward						
Caruso 2014[19]	74%	Brazil	Adults	1253 patients, 1 hospital	Adults	Mixed	ICU		p=0.44, ICU LOS	
Deitrick 2010[26]	90%	United States	Adults	24 patients, 29 HCP, 2 hospitals, 2 wards	Orthopaedic, Neurological, Surgical	Unclear	Routine	LOS		
Douglas 2005[30]	90%	United Kingdom	Unclear	785 patients (post discharge), 1 hospital	Surgical, Acute care, Maternity, Geriatric	Unclear	Routine		LOS	
Erdeve 2008,[36] Erdeve 2009[37]	74%	Turkey	Adults, Neonates	60 infants, 49 mothers, 1 hospital	Preterm neonates	Emergency	NICU		p=0.929, NICU LOS	
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine		p=0.36, overall LOS p=0.73, LOS for total hip arthroplasty p=0.55, LOS for knee arthroplasty	
Grundt 2021[47]	67%	Norway	Neonates	77 patients, 66 mothers, 2 hospitals, 2 units	Premature neonates	Maternity	NICU		p=0.16, LOS	
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU	Patient transfers		Average LOS Average discharges
Harris 2006[51]	52%	United States	Neonates	21 parents, 75 HCPs	Neonates	Maternity	ICU			Average LOS
Hyun 2021[54]	78%	South Korea	Adults	666 patients, 1 hospital	Respiratory, COVID-19	Emergency	ICU	p=0.001, hospital LOS		
Kinnula 2008[64]	63%	Finland	Children	1927 patients, 1 hospital	Children, infectious disease	Mixed	Routine		hospital LOS	

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Kinnula 2012[65]	67%	Finland, Switzerland	Children	5119 patients, 3 hospitals, 4 wards	Children, mixed	Mixed	Routine			Mean hospital LOS
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine			p=0.001, overall LOS p=0.01, LOS (patients who experienced an inpatient fall)
Labarère 2004[68]	70%	France	Adults	4095 patients, 1 hospital	Mixed	Mixed	Mixed		hospital LOS	
Lehtonen 2020[71]	74%	International	Neonates	4662 patients, 331 units	Preterm neonates	Emergency	ICU	Overall LOS OR[a] −3.4 (−4.7 to −3.1)		
Mattner 2007[79]	74%	Germany	Adults	336 patients, 1 hospital	Cardiovascular Adults	Mixed	ICU	p=0.004, LOS		
Vohr 2017[140]	67%	United States	Neonates	651 patients, 1 hospital Before and after relocation	Neonates	Emergency	NICU			p=0.07, hospital LOS
Tandberg 2019[128]	67%	Norway	Neonates	77 patients, 2 hospitals	Neonates	Emergency	ICU		p=0.16, LOS	
Lester 2014[72]	63%	United States	Neonates	403 patients, 1 hospital	Neonates	Emergency	ICU		p=0.382, LOS	
Lester 2016[73]	59%	United States	Neonates	216 patients, 1 hospital	Premature neonates	Maternity	ICU		p=0.06, LOS	
Zaal 2013[145]	67%	Netherlands	Older Adults	156 patients 1 hospital	Older Adults with dementia	Mixed	ICU		p=0.56, LOS	
Evidence synthesis										
OECD WHO 2019[92]	14%	Europe	NR	NR	Mixed	Mixed	Mixed		p=NS. LOS	
Voigt 2018[141]	86%	International	NR	NR	NR	Unclear	Routine		LOS	

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

Table 17. Summary of studies reporting data on costs of care

Citation	QA	Location	Population	Number of patients/ hospitals	Patient type	Type of admission	Level of care	Data that favour single room	Data showing no difference	Data that favour shared room
Before and after a hospital relocation plus contemporaneous comparison										
Maben 2015[76]	78%	United Kingdom	Unclear	24 staff, 32 patients, 1 hospital (relocated), 2 control hospitals	All patients in hospital	Mixed	Mixed		Cost impact (changes in falls, LOS, medication errors, hospital-acquired infections)	
Maben 2016[77]	67%	United Kingdom	Unclear	32 patients, 21 HCP, 1 hospital relocation, 2 control hospitals	Mixed	Unclear	Mixed			Cleaning costs per bed Nursing staff full-time equivalent Nursing staff costs
Before and after a hospital relocation										
Davis [25]2019	67%	Australia	Adults	1569 patients, 1 hospital relocation	Orthopaedic	Elective	Routine		p=0.311, discharge to home p=0.406, transfer to other facility	
Harris 2004[49]	74%	Canada	Adults	976 patients, 1 hospital, Before and after new unit established	Pregnancy	Maternity	Routine	Reduction in overall staffing costs after opening single-room maternity care		
Milford 2008[84]	30%	United States	Neonates	No. of patients unclear, 1 hospital	Neonates	Emergency	ICU	Cost savings due to reduced LOS		
Reed 1986[106]	10%	United States	Adults	No. of patients unclear, 1 hospital	Pregnant women	Maternity care	Routine	Number of staff required		
Sadatsafavi 2019[112]	100%	United States	Neonates	1 hospital (theoretical)	Neonates	NR	ICU	Investment justifiable when direct costs considered, mean benefit–cost ratio 1.794 (1.783–1.804) Investment justifiable when LOS considered		Investment not justifiable when nosocomial infections considered, mean benefit–cost ratio 0.730 (0.724-0.735)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Singh 2015[116]	70%	United Kingdom	Adults, Elderly	1749 patients, 1 hospital relocation	Internal medicine, Geriatric	Mixed	Routine		p=0.74, discharge to home p =0.21, discharge to new care home	
Stevens 2012[122]	44%	United States	Neonates	73 patients, 1 hospital Before and after relocation	Neonates	Emergency	ICU	Direct cost (infants with equal comorbidities, duration of hospitalisation)	Costs per square foot	p^a=statistically significant, need for nursing and all unit staff
Stevens 2014[123]	44%	United States	Neonates	73 patients, 1 hospital	Neonates	Emergency	ICU	p<0.0001, lower costs for supplies p<0.0001, lower depreciation in costs Full adjustment of the model shows a cost advantage for SFR	p=0.2316, total direct costs p=0.1551, other costs General linear model: p=0.2854, admission p=0.2485, severity p=0.2806, duration of respiratory support	p=0.0373, direct costs for NICU labour p=0.0002, direct costs for other labour costs (therapies, radiology, pharmacy)
Contemporaneous comparison										
Apple 2014[4]	52%	Sweden	Unclear	81 HCP, 3 ICUs	Mixed	Unclear	ICU			Number of staff equired
Boardman 2011[8]	91%	Canada	Unclear	537 beds, 1 hospital	Mixed	Mixed	Mixed	Reduced transfers and waiting time Net social benefits taking into account upfront and ongoing costs and annual benefits		Cost of a bed per day Up-front land and construction costs On-going annual maintenance, housekeeping, operating, additional nursing and phsycian costs
Felice Tong 2018[40]	78%	Australia	Adults	185 patients, 1 hospital	Orthopaedic	Elective	Routine	$p=0.002^u$, $p=0.002^m$ discharge to rehabilitation		
Harris 2006[50]	63%	United States	Neonates	75 HCP, 21 parents, 5 NICU units (SFR=2, open bay=3)	Neonates	Unclear	Level 3, NICU			Construction costs per square foot
Harris 2006[51]	63%	Canada	Adults	976 patients, 1 hospital, Before and	Pregnancy	Maternity	Routine			Average costs per square foot[a]

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

For peer review only

Health Economics Unit

				after new unit established						
Knight 2016[66]	59%	United Kingdom	Elderly	100 patients, 2 hospitals	Geriatric, Dementia	Mixed	Routine		p=0.17, discharged to home p=0.19, discharged to new care home	
Sadatsafavi 2016[111]	100%	Canada	Unclear	8811 patient-days, 1 hospital	Medical and surgical	Unclear	ICU	Costs due to hospital acquired infection		Construction and operating costs
Evidence synthesis										
Adamson 2003[1]	82%	United States, International	Mixed	Unclear	Mixed	Mixed	Mixed			Costs per patient by floor plan type
Voigt 2018[141]	86%	International	NR	NR	NR	Unclear	Routine	Operational efficiencies		

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

References

1. Adamson D. The Use of Single Patient Rooms vs. Multiple Occupancy Rooms in Acute Care Environments | Semantic Scholar [Internet]. 2003 [cited 2022 May 4]. Available from: https://www.semanticscholar.org/paper/The-Use-of-Single-Patient-Rooms-vs.-Multiple-Rooms-Chaudhury-Mahmood/252452e8fa872a517c15d6ecf70c74f82a363271
2. Anåker A, Von Koch L, Sjöstrand C, Bernhardt J, Elf M. A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction—The significance of the built environment. PLOS ONE. 2017 Jul 1;12(7):e0177477.
3. Anåker A, Von Koch L, Heylighen A, Elf M. 'It's Lonely': Patients' Experiences of the Physical Environment at a Newly Built Stroke Unit. Health Environments Research & Design Journal. 2019;12(3):141–52.
4. Apple M. A Comparative Evaluation of Swedish Intensive Care Patient Rooms. HERD. 2014 Apr;7(3):78–93.
5. Bevan V, Edwards C, Woodhouse K, Singh I. Dignified care for older people: Mixed methods evaluation of the impact of the hospital environment - single rooms or multi-bedded wards: Healthy Aging Research. 2016;5(13):1–8.
6. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Analgesic and psychoactive medications and the risk of falls in relation to delirium in single-bed rooms compared to multiple-bed rooms in geriatric inpatients. Aging Clinical and Experimental Research 2019 32:8. 2019 Aug 28;32(8):1493–9.
7. Blandfort S, Gregersen M, Rahbek K, Juul S, Damsgaard EM. Single-bed rooms in a geriatric ward prevent delirium in older patients. Aging Clinical and Experimental Research 2019 32:1. 2019 Mar 21;32(1):141–7.
8. Boardman AE, Forbes D. A Benefit-Cost Analysis of Private and Semi-Private Hospital Rooms. J Benefit Cost Anal. 2011 Jan 3;2(1):1–27.
9. Bocquet A, Wintenberger C, Lupo J, Morand P, Pavese P, Gallouche M, et al. Description of an influenza outbreak in a French university hospital and risk factors of nosocomial influenza. Eur J Clin Microbiol Infect Dis. 2021 Apr;40(4):879–84.
10. Bodack E, Schenk O, Karutz H. Die Einrichtung von Einzelzimmern auf neonatologischen Intensivstationen – Auswirkungen auf die Betreuung aus Sicht der Eltern. Z Geburtshilfe Neonatol. 2016 Jun;220(3):124–9.
11. Bonizzoli M, Bigazzi E, Peduto C, Tucci V, Zagli G, Pecile P, et al. Microbiological survey following the conversion from a bay-room to single-room intensive care unit design. Journal of Hospital Infection. 2011 Jan;77(1):84–6.
12. Boztepe H, Çınar S, Ay A. School-age children's perception of the hospital experience. J Child Health Care. 2017 Jun;21(2):162–70.
13. Bracco D, Dubois MJ, Bouali R, Eggimann P. Single rooms may help to prevent nosocomial bloodstream infection and cross-transmission of methicillin-resistant Staphylococcus aureus in intensive care units. Intensive Care Med. 2007 May 1;33(5):836–40.
14. Bradbury-Jones C, Rattray J, Jones M, MacGillivray S. Promoting the health, safety and welfare of adults with learning disabilities in acute care settings: a structured literature review. Journal of Clinical Nursing. 2013;22(11–12):1497–509.
15. Campbell-Yeo M, Kim T, Disher T, Richardson B, Dol J, Bishop T, et al. Do Single-Family Rooms Increase Parental Presence, Involvement, and Maternal Well-Being in Neonatal Intensive Care? Journal of Perinatal & Neonatal Nursing. 2021 Oct;35(4):350–61.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

16. Cantoni N, Weisser M, Buser A, Arber C, Stern M, Heim D, et al. Infection prevention strategies in a stem cell transplant unit: impact of change of care in isolation practice and routine use of high dose intravenous immunoglobulins on infectious complications and transplant related mortality - Cantoni - 2009 - European Journal of Haematology - Wiley Online Library [Internet]. [cited 2022 Jul 11]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0609.2009.01249.x
17. Carlson B, Walsh S, Wergin T, Schwarzkopf K, Ecklund S. Challenges in design and transition to a private room model in the neonatal intensive care unit. Adv Neonatal Care. 2006 Oct;6(5):271–80.
18. Carter BS, Carter A, Bennett S. Families' views upon experiencing change in the neonatal intensive care unit environment: from the 'baby barn' to the private room. J Perinatol. 2008 Dec;28(12):827–9.
19. Caruso P, Guardian L, Tiengo T, dos Santos LS, Junior PM. ICU Architectural Design Affects the Delirium Prevalence: A Comparison Between Single-Bed and Multibed Rooms*. Critical Care Medicine. 2014 Oct;42(10):2204–10.
20. Cobo J, Asensio Á, Moreno S, Navas E, Pintado V, Oliva J, et al. Risk factors for nosocomial transmission of multidrug-resistant tuberculosis due to Mycobacterium bovis among HIV-infected patients. :6.
21. Curtis P, Northcott A. The impact of single and shared rooms on family-centred care in children's hospitals. Journal of Clinical Nursing. 2017 Jun;26(11–12):1584–96.
22. Cusack L, Wiechula R, Schultz T, Dollard J, Maben J. Anticipated advantages and disadvantages of a move to 100% single-room hospital in Australia: A case study. J Nurs Manag. 2019 Jul;27(5):963–70.
23. Darcy Mahoney A, White RD, Velasquez A, Barrett TS, Clark RH, Ahmad KA. Impact of restrictions on parental presence in neonatal intensive care units related to coronavirus disease 2019. J Perinatol. 2020 Sep;40(S1):36–46.
24. Darley ESR, Vasant J, Leeming J, Hammond F, Matthews S, Albur M, et al. Impact of moving to a new hospital build, with a high proportion of single rooms, on healthcare-associated infections and outbreaks. J Hosp Infect. 2018 Feb;98(2):191–3.
25. Davis M, Elliott R, Hills R, Fry M. Single-Room Ward Design and Its Impact on Service and Patient Outcomes: An Evaluation Study. Orthopaedic Nursing. 2019 Oct;38(5):317–25.
26. Deitrick LM, Bokovoy J, Panik A. The "Dance" Continues ... Evaluating Differences in Call Bell Use Between Patients in Private Rooms and Patients in Double Rooms Using Ethnography. Journal of Nursing Care Quality. 2010 Oct;25(4):279–87.
27. de Matos LBN, Fumis RRL, Nassar Junior AP, Lacerda FH, Caruso P. Single-Bed or Multibed Room Designs Influence ICU Staff Stress and Family Satisfaction, But Do Not Influence ICU Staff Burnout. HERD. 2020 Apr;13(2):234–42.
28. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units. Journal of perinatology : official journal of the California Perinatal Association. 2010 May;30(5):343–51.
29. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: comparative patient progress in open-ward and single family room units. Journal of Perinatology 2010 31:4. 2011 Nov 11;31(4):281–8.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

30. Douglas CH, Douglas MR. Patient-centred improvements in health-care built environments: perspectives and design indicators. Health Expect. 2005 Sep;8(3):264–76.
31. Dowdeswell B, Erskine J, Heasman M. A Report for NHS Estates, England by the EU Health Property Network. :40.
32. Dowling DA, Blatz MA, Graham G. Mothers' Experiences Expressing Breast Milk for Their Preterm Infants: Does NICU Design Make a Difference? Advances in Neonatal Care. 2012 Dec;12(6):377–84.
33. Eberhard-Gran M, Eskild A, Opjordsmoen S, Schei B. Maternity care - sleep, rest and satisfaction. :10.
34. Edéll-Gustafsson U, Angelhoff C, Johnsson E, Karlsson J, Mörelius E. Hindering and buffering factors for parental sleep in neonatal care. A phenomenographic study. J Clin Nurs. 2015 Mar;24(5–6):717–27.
35. Ehrlander W, Ali F, Chretien KC. Multioccupancy hospital rooms: Veterans' experiences and preferences. Journal of Hospital Medicine. 2009;4(8):E22–7.
36. Erdeve O, Arsan S, Yigit S, Armangil D, Atasay B, Korkmaz A. The impact of individual room on rehospitalization and health service utilization in preterms after discharge. Acta paediatrica (Oslo, Norway : 1992). 2008 Oct;97(10):1351–7.
37. Erdeve O, Arsan S, Canpolat FE, Ertem IO, Karagol BS, Atasay B, et al. Does individual room implemented family- centered care contribute to mother-infant interaction in preterm deliveries necessitating neonatal intensive care unit hospitalization? American Journal of Perinatology. 2009 Feb 19;26(2):159–64.
38. Erickson C, Kattelmann K, Remington J, Cuirong Ren, Carol Helseth, Stevens D. Traditional open-bay versus single-family room neonatal intensive care unit: a comparison of selected nutrition outcomes. Research and Reports in Neonatology. 2011 Mar;15.
39. Everts RJ, Hanger HC, Jennings LC, Hawkins A, Sainsbury R. Outbreaks of influenza A among elderly hospital inpatients. The New Zealand Medical Journal. 1996 Jul 1;109(1026):272–4.
40. Felice Tong YY, Karunaratne S, Youlden D, Gupta S. The Impact of Room-Sharing on Length of Stay After Total Hip or Knee Arthroplasty: A Retrospective Study. Arthroplasty Today. 2021 Apr;8:289-294.e2.
41. Ferri M, Zygun DA, Harrison A, Stelfox HT. Evidence-based design in an intensive care unit: End-user perceptions. BMC Anesthesiology. 2015 Apr 25;15(1):1–9.
42. Florey L, Flynn R, Isles C. Patient Preferences for Single Rooms or Shared Accommodation in a District General Hospital. Scott Med J. 2009 May;54(2):5–8.
43. Foo CT, O'Driscoll DM, Ogeil RP, Lubman D, Young AC. Barriers to sleep in acute hospital settings. Sleep Breath. 2022 Jun;26(2):855–63.
44. Ford-Jones EL, Mindorff CM, Gold R, Petric M. THE INCIDENCE OF VIRAL-ASSOCIATED DIARRHEA AFTER ADMISSION TO A PEDIATRIC HOSPITAL. American Journal of Epidemiology. 1990 Apr;131(4):711–8.
45. Fraenkel Cj, Inghammar M, Söderlund-Strand A, Johansson PJH, Böttiger B. Risk factors for hospital norovirus outbreaks: impact of vomiting, genotype, and multi-occupancy rooms. Journal of Hospital Infection. 2018 Apr;98(4):398–403.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

46. Gregersen M, Mellemkjær A, Foss CH, Blandfort S. Use of single-bed rooms may decrease the incidence of hospital-acquired infections in geriatric patients: A retrospective cohort study in Central Denmark region. J Health Serv Res Policy. 2021 Oct;26(4):282–8.
47. Grundt H, Tandberg BS, Flacking R, Drageset J, Moen A. Associations Between Single-Family Room Care and Breastfeeding Rates in Preterm Infants. J Hum Lact. 2021 Aug;37(3):593–602.
48. Halaby T, al Naiemi N, Beishuizen B, Verkooijen R, Ferreira JA, Klont R, et al. Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. Antimicrob Resist Infect Control. 2017 Dec;6(1):117.
49. Harris SJ, Farren MD, Janssen PA, Klein MC, Lee SK. Single room maternity care: perinatal outcomes, economic costs,and physician preferences. Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du Canada : JOGC. 2004;26(7):633–40.
50. Harris DD, Shepley MM, White RD, Kolberg KJS, Harrell JW. The impact of single family room design on patients and caregivers: executive summary. Journal of Perinatology 2006 26:3. 2006 Sep 28;26(3):S38–48.
51. Harris D, Shepley M, White R. Impact of Single Family NICU Rooms | The Center for Health Design [Internet]. 2006 [cited 2022 May 4]. Available from: https://www.healthdesign.org/chd/knowledge-repository/impact-single-family-nicu-rooms
52. Hosseini SB, Bagheri M. Comparison of Patient Satisfaction with Single Patient Rooms Versus Shared Patient Rooms. Ann Mil Health Sci Res [Internet]. 2018 Jul 8 [cited 2022 Jul 20];15(4). Available from: https://brief.land/amhsr/articles/80199.html
53. Hourigan SK, Subramanian P, Hasan NA, Ta A, Klein E, Chettout N, et al. Comparison of Infant Gut and Skin Microbiota, Resistome and Virulome Between Neonatal Intensive Care Unit (NICU) Environments. Front Microbiol. 2018 Jun 25;9:1361.
54. Hyun M, Lee JY, Kwon YS, Kim JY, Park JS, Park S, et al. COVID-19: Comparing the applicability of shared room and single room occupancy. Transbound Emerg Dis. 2021 Jul;68(4):2059–65.
55. Jansen SJ, Lopriore E, Berkhout RJM, van der Hoeven A, Saccoccia B, de Boer JM, et al. The Effect of Single-Room Care Versus Open-Bay Care on the Incidence of Bacterial Nosocomial Infections in Pre-Term Neonates: A Retrospective Cohort Study. Infectious Diseases and Therapy. 2021 Mar 1;10(1):373–86.
56. Janssen PA, Klein MC, Harris SJ, Soolsma J, Seymour LC. Single room maternity care and client satisfaction. Birth (Berkeley, Calif). 2000;27(4):235–43.
57. Janssen PA, Dennis CL, Reime B. Development and psychometric testing of the care in obstetrics: Measure for testing satisfaction (COMFORTS) scale. Research in Nursing & Health. 2006 Feb 1;29(1):51–60.
58. Jones L, Peters K, Rowe J, Sheeran N. The Influence of Neonatal Nursery Design on Mothers' Interactions in the Nursery. J Pediatr Nurs. 2016 Oct;31(5):e301-312.
59. Jongerden IP, Slooter AJ, Peelen LM, Wessels H, Ram CM, Kesecioglu J, et al. Effect of intensive care environment on family and patient satisfaction: a before–after study. Intensive Care Med. 2013 Sep 1;39(9):1626–34.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

60. Jou J, Ebrahim J, Shofer FS, Hamilton KW, Stern J, Han JH. Environmental Transmission of *Clostridium difficile* : Association Between Hospital Room Size and *C. difficile* Infection. Infect Control Hosp Epidemiol. 2015 May;36(5):564–8.
61. Julian S, Burnham CAD, Sellenriek P, Shannon WD, Hamvas A, Tarr PI, et al. Impact of Neonatal Intensive Care Bed Configuration on Rates of Late-Onset Bacterial Sepsis and Methicillin-Resistant Staphylococcus aureus Colonization. Infection Control & Hospital Epidemiology. 2015 Oct;36(10):1173–82.
62. Jung J, Choe PG, Choi S, Kim E, Lee HY, Kang CK, et al. Reduction in the acquisition rate of carbapenem-resistant Acinetobacter baumannii (CRAB) after room privatization in an intensive care unit. Journal of Hospital Infection. 2022 Mar 1;121:14–21.
63. Kainiemi E, Hongisto P, Lehtonen L, Pape B, Axelin A. Effects of single family room architecture on parent–infant closeness and family centered care in neonatal environments—a single-center pre–post study. J Perinatol. 2021 Sep;41(9):2244–51.
64. Kinnula SE, Renko M, Tapiainen T, Knuutinen M, Uhari M. Hospital-associated infections during and after care in a paediatric infectious disease ward. J Hosp Infect. 2008 Apr;68(4):334–40.
65. Kinnula S, Buettcher M, Tapiainen T, Renko M, Vepsäläinen K, Lantto R, et al. Hospital-associated infections in children: a prospective post-discharge follow-up survey in three different paediatric hospitals. The Journal of hospital infection. 2012 Jan;80(1):17–24.
66. Knight S, Singh I. Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards. Journal of Clinical Gerontology and Geriatrics. 2016 Sep;7(3):87–92.
67. KOSUGE R, KOBAYASHI K, KAKEHI A. COMPARATIVE STUDIES ON HOSPITAL-BED MANAGEMENT BETWEEN ALL SINGLE-ROOM WARDS AND MIXED MULTI-BED ROOM WARDS. Journal of Architecture and Planning (Transactions of AIJ). 2013;78(686):765–73.
68. Labarère J, Fourny M, Jean-Phillippe V, Marin-Pache S, Patrice F. Refinement and validation of a French in-patient experience questionnaire. International Journal of Health Care Quality Assurance. 2004 Jan 1;17(1):17–25.
69. Lawson B, Phiri M. Hospital design. Room for improvement. The Health Service Journal. 2000 Jan 1;110(5688):24–6.
70. Lazar I, Abukaf H, Sofer S, Peled N, Leibovitz E. Impact of Conversion from an Open Ward Design Paediatric Intensive Care Unit Environment to All Isolated Rooms Environment on Incidence of Bloodstream Infections and Antibiotic Resistance in Southern Israel (2000 to 2008) [Internet]. [cited 2022 Jul 11]. Available from: https://journals.sagepub.com/doi/10.1177/0310057X1504300106?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed
71. Lehtonen L, Lee SK, Kusuda S, Lui K, Norman M, Bassler D, et al. Family Rooms in Neonatal Intensive Care Units and Neonatal Outcomes: An International Survey and Linked Cohort Study. The Journal of Pediatrics. 2020 Nov;226:112-117.e4.
72. Lester BM, Hawes K, Abar B, Sullivan M, Miller R, Bigsby R, et al. Single-family room care and neurobehavioral and medical outcomes in preterm infants. Pediatrics. 2014;134(4):754–60.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

73. Lester BM, Salisbury AL, Hawes K, Dansereau LM, Bigsby R, Laptook A, et al. 18-Month Follow-Up of Infants Cared for in a Single-Family Room Neonatal Intensive Care Unit. The Journal of pediatrics. 2016;177:84–9.
74. Liu LX, Mozafarinia M, Axelin A, Feeley N. Parents' Experiences of Support in NICU Single-Family Rooms. Neonatal Netw. 2019 Mar 1;38(2):88–97.
75. Lorenz SG, Dreher HM. Hospital Room Design and Health Outcomes of the Aging Adult. PA P E R S. 2011;4(2):14.
76. Maben J, Griffiths P, Penfold C, Simon M, Pizzo E, Anderson J, et al. Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation. Health Services and Delivery Research. 2015 Feb;3(3):1–304.
77. Maben J, Griffiths P, Penfold C, Simon M, Anderson JE, Robert G, et al. One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. BMJ quality & safety. 2016 Apr 1;25(4):241–56.
78. Malcolm HA. Does privacy matter? Former patients discuss their perceptions of privacy in shared hospital rooms. Nurs Ethics. 2005 Mar;12(2):156–66.
79. Mattner F, Rüden AS, Mattner L, Chaberny IF, Ziesing S, Strueber M, et al. Thoracic organ transplantation may not increase the risk of bacterial transmission in intensive care units. International Journal of Hygiene and Environmental Health. 2007 Mar;210(2):139–45.
80. McDonald EG, Dendukuri N, Frenette C, Lee TC. Time-Series Analysis of Health Care–Associated Infections in a New Hospital With All Private Rooms. JAMA Intern Med. 2019 Nov 1;179(11):1501.
81. McKeown K, Haase T, Pratschke J, Twomey S, Donovan H, Engling F. Determinants of care outcomes for patients who die in hospital in Ireland: a retrospective study. BMC Palliat Care. 2015 Dec;14(1):11.
82. Mental Welfare Commission for Scotland. Psychiatr bull. 1991 Apr;15(4):254–5.
83. Meyer TJ, Eveloff SE, Bauer MS, Schwartz WA, Hill NS, Millman RP. Adverse Environmental Conditions in the Respiratory and Medical ICU Settings. Chest. 1994 Apr;105(4):1211–6.
84. Milford C, Zapalo B, Davis G. Transition to an Individual-Room NICU Design: Process and Outcome Measures. Neonatal Network. 2008 Sep;27(5):299–305.
85. Miller NO, Friedman SB, Coupey SM. Adolescent preferences for rooming during hospitalization. Journal of Adolescent Health. 1998 Aug;23(2):89–93.
86. Monson BB, Eaton-Rosen Z, Kapur K, Liebenthal E, Brownell A, Smyser CD, et al. Differential Rates of Perinatal Maturation of Human Primary and Nonprimary Auditory Cortex. eNeuro. 2018 Jan;5(1):ENEURO.0380-17.2017.
87. Morgan H. Single and shared accommodation for young patients in hospital [Internet]. 2010 [cited 2022 Jul 20]. Available from: https://journals.rcni.com/doi/abs/10.7748/paed2010.10.22.8.20.c7997

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

88. Munier-Marion E, Bénet T, Régis C, Lina B, Morfin F, Vanhems P. Hospitalization in double-occupancy rooms and the risk of hospital-acquired influenza: a prospective cohort study. Clinical Microbiology and Infection. 2016 May;22(5):461.e7-461.e9.
89. Nahas S, Patel A, Duncan J, Nicholl J, Nathwani D. Patient Experience in Single Rooms Compared with the Open Ward for Elective Orthopaedic Admissions. Musculoskeletal Care. 2016 Mar;14(1):57–61.
90. Nash D, O'Rourke T, Memmott P, Haynes M. Indigenous Preferences for Inpatient Rooms in Australian Hospitals: A Mixed-Methods Study in Cross-Cultural Design. HERD. 2021 Jan;14(1):174–89.
91. Nassery W, Landgren K. Parents' Experience of Their Sleep and Rest When Admitted to Hospital with Their Ill Child: A Qualitative Study. Comprehensive Child and Adolescent Nursing. 2019 Oct 2;42(4):265–79.
92. OECD, World Health Organization. Improving Healthcare Quality in Europe: Characteristics, Effectiveness and Implementation of Different Strategies [Internet]. OECD; 2019 [cited 2022 Jul 11]. Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/improving-healthcare-quality-in-europe_b11a6e8f-en
93. Olson ME, Smith MJ. An evaluation of single-room maternity care. The Health Care Manager. 1992 Sep;11(1):43–9.
94. O'Neill L, Park SH, Rosinia F. The role of the built environment and private rooms for reducing central line-associated bloodstream infections. Kamolz LP, editor. PLoS ONE. 2018 Jul 27;13(7):e0201002.
95. Park SH, Stockbridge EL, Miller TL, O'Neill L. Private patient rooms and hospital-acquired methicillin-resistant Staphylococcus aureus: A hospital-level analysis of administrative data from the United States. PLOS ONE. 2020 Jul 9;15(7):e0235754.
96. Pease NJ, Finlay IG. Do patients and their relatives prefer single cubicles or shared wards? Palliat Med. 2002 Jul;16(5):445–6.
97. Persson E, Määttä S. To provide care and be cared for in a multiple-bed hospital room. Scandinavian Journal of Caring Sciences. 2012 Dec 1;26(4):663–70.
98. Persson E, Anderberg P, Kristensson Ekwall A. A room of one's own--Being cared for in a hospital with a single-bed room design. Scandinavian journal of caring sciences. 2015 Jun 1;29(2):340–6.
99. Pilmis B, Billard-Pomares T, Martin M, Clarempuy C, Lemezo C, Saint-Marc C, et al. Can environmental contamination be explained by particular traits associated with patients? Journal of Hospital Infection. 2020 Mar;104(3):293–7.
100. Pineda RG, Stransky KE, Rogers C, Duncan MH, Smith GC, Neil J, et al. The single-patient room in the NICU: maternal and family effects. Journal of perinatology : official journal of the California Perinatal Association. 2012 Jul;32(7):545–51.
101. Poncette AS, Wunderlich MM, Spies C, Heeren P, Vorderwülbecke G, Salgado E, et al. Patient Monitoring Alarms in an Intensive Care Unit: Observational Study With Do-It-Yourself Instructions. J Med Internet Res. 2021 May 28;23(5):e26494.
102. Puumala SE, Rich RK, Roy L, Reynolds R, Jimenez FE, Opollo JG, et al. Single-family room neonatal intensive care unit design: do patient outcomes actually change? | Journal of Perinatology [Internet]. [cited 2022 Jul 11]. Available from: https://www.nature.com/articles/s41372-019-0584-6

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

103. Pyrke RJL, McKinnon MC, McNeely HE, Ahern C, Langstaff KL, Bieling PJ. Evidence-Based Design Features Improve Sleep Quality Among Psychiatric Inpatients. HERD. 2017 Oct;10(5):52–63.
104. Quach C, Shah R, Rubin LG. Burden of Healthcare-Associated Viral Respiratory Infections in Children's Hospitals. Journal of the Pediatric Infectious Diseases Society. 2018 Feb 19;7(1):18–24.
105. Real K, Fay L. Using Systems Theory to Examine Patient and Nurse Structures, Processes, and Outcomes in Centralized and Decentralized Units. :16.
106. Reed G, Schmid M. Nursing Implementation of Single-Room Maternity Care. Journal of Obstetric, Gynecologic & Neonatal Nursing. 1986 Sep;15(5):386–9.
107. Reid J, Wilson K, Anderson KE, Maguire CPJ. Older inpatients' room preference: single versus shared accommodation. Age and Ageing. 2015 Mar;44(2):331–3.
108. Roos AKØ, Skaug EA, Grøndahl VA, Helgesen AK. Trading company for privacy: A study of patients' experiences. Nurs Ethics. 2020 Jun;27(4):1089–102.
109. Rosbergen ICM, Tonello I, Clark RA, Grimley RS. Does hospital design impact on patient activity levels and time spent alone? Disability and Rehabilitation. 2022 Jun 19;44(13):3173–80.
110. Rowlands J, Noble S. How does the environment impact on the quality of life of advanced cancer patients? A qualitative study with implications for ward design. Palliat Med. 2008 Sep;22(6):768–74.
111. Sadatsafavi H, Niknejad B, Zadeh R, Sadatsafavi M. Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. J Crit Care. 2016 Feb;31(1):194–200.
112. Sadatsafavi H, Niknejad B, Shepley M, Sadatsafavi M. Probabilistic Return-on-Investment Analysis of Single-Family Versus Open-Bay Rooms in Neonatal Intensive Care Units—Synthesis and Evaluation of Early Evidence on Nosocomial Infections, Length of Stay, and Direct Cost of Care. Journal of Intensive Care Medicine. 2019 Feb 1;34(2):115–25.
113. Sakr N, Hallit S, Mattar H. Incidence of and Factors Associated with New-Onset Insomnia Among Lebanese Hospitalised Patients: A single-centre study. Sultan Qaboos Univ Med J. 2021 Jun 21;21(2):e210-220.
114. Schalkers I, Dedding CWM, Bunders JFG. '[I would like] a place to be alone, other than the toilet' - Children's perspectives on paediatric hospital care in the Netherlands. Health Expect. 2015 Dec;18(6):2066–78.
115. Scottish Intercollegiate Guidelines Network. Sign 50: a guideline developer's handbook. Healthcare Improvement Scotland; 2014.
116. Singh I, Okeke J, Edwards C. Outcome of in-patient falls in hospitals with 100% single rooms and multi-bedded wards. Age and Ageing. 2015;44(6):1032–5.
117. Singh I. (PDF) Loneliness among Older People in Hospitals: A Comparative Study between Single Rooms and Multi- Bedded Wards to Evaluate Current Health Service within the Same Organisation [Internet]. 2016 [cited 2022 May 4]. Available from:

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

https://www.researchgate.net/publication/304495269_Loneliness_among_Older_People_in_Hospitals_A_Comparative_Study_between_Single_Rooms_and_Multi-_Bedded_Wards_to_Evaluate_Current_Health_Service_within_the_Same_Organisation
118. Søndergaard SF, Beedholm K, Kolbæk R, Frederiksen K. Patients' and Nurses' Experiences of All Single-Room Hospital Accommodation: A Scoping Review. HERD. 2022 Jan;15(1):292–314.
119. Song X, Soghier L, Floyd TT, Harris TR, Short BL, DeBiasi RL. Reassessing the need for active surveillance of extended-spectrum beta-lactamase–producing Enterobacteriaceae in the neonatal intensive care population. Infect Control Hosp Epidemiol. 2018 Dec;39(12):1436–41.
120. Stelwagen M, van Kempen A, Westmaas A, Vet E, Scheele F. Parents' Experiences With a Model of Integrated Maternity and Neonatal Care Designed to Empower Parents. Journal of Obstetric, Gynecologic & Neonatal Nursing. 2021 Mar;50(2):181–92.
121. Stevens DC, Helseth CC, Khan MA, Munson DP, Reid EJ. A Comparison of Parent Satisfaction in an Open-Bay and Single-Family Room Neonatal Intensive Care Unit. HERD. 2011 Apr;4(3):110–23.
122. Stevens DC, Helseth CC, Thompson PA, Pottala JV, Khan MA, Munson DP. A Comprehensive Comparison of Open-Bay and Single-Family-Room Neonatal Intensive Care Units at Sanford Children's Hospital. HERD. 2012 Jul;5(4):23–39.
123. Stevens DC, Thompson PA, Helseth CC, Hsu B, Khan MA, Munson DP. A comparison of the direct cost of care in an open-bay and single-family room NICU. Journal of Perinatology 2014 34:11. 2014 Sep 25;34(11):830–5.
124. Stiller A, Schröder C, Gropmann A, Schwab F, Behnke M, Geffers C, et al. ICU ward design and nosocomial infection rates: a cross-sectional study in Germany. Journal of Hospital Infection. 2017 Jan;95(1):71–5.
125. Swanson JR, Peters C, Lee BH. NICU redesign from open ward to private room: a longitudinal study of parent and staff perceptions. J Perinatol. 2013 Jun;33(6):466–9.
126. Tandberg BS, Frøslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. J Perinat Neonatal Nurs. 2018 Dec;32(4):E22–32.
127. Tandberg BS, Flacking R, Markestad T, Grundt H, Moen A. Parent psychological wellbeing in a single-family room versus an open bay neonatal intensive care unit. PLOS ONE. 2019 Nov 1;14(11):e0224488.
128. Tandberg BS, Frøslie KF, Markestad T, Flacking R, Grundt H, Moen A. Single-family room design in the neonatal intensive care unit did not improve growth. Acta Paediatrica. 2019 Jun 1;108(6):1028–35.
129. Taylor E, Card AJ, Piatkowski M. Single-Occupancy Patient Rooms: A Systematic Review of the Literature Since 2006. HERD. 2018 Jan;11(1):85–100.
130. Tegnestedt C, Günther A, Reichard A, Bjurström R, Alvarsson J, Martling CR, et al. Levels and sources of sound in the intensive care unit - an observational study of three room types: Levels and sources of sound in a multidisciplinary ICU. Acta Anaesthesiol Scand. 2013 Sep;57(8):1041–50.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

131. Teltsch DY, Hanley J, Loo V, Goldberg P, Gursahaney A, Buckeridge DL. Infection Acquisition Following Intensive Care Unit Room Privatization. Arch Intern Med [Internet]. 2011 Jan 10 [cited 2022 Jul 14];171(1). Available from: http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinternmed.2010.469
132. Toivonen M, Lehtonen L, Löyttyniemi E, Axelin A. Effects of single-family rooms on nurse-parent and nurse-infant interaction in neonatal intensive care unit. Early Human Development. 2017 Mar 1;106–107:59–62.
133. Vaisman A, Jula M, Wagner J, Winston LG. Examining the association between hospital-onset Clostridium difficile infection and multiple-bed room exposure: a case-control study. Infect Control Hosp Epidemiol. 2018 Sep;39(9):1068–73.
134. van de Glind I, van Dulmen S, Goossensen A. Physician–patient communication in single-bedded versus four-bedded hospital rooms. Patient Education and Counseling. 2008 Nov 1;73(2):215–9.
135. van der Hoeven A, Bekker V, Jansen SJ, Saccoccia B, Berkhout RJM, Lopriore E, et al. Impact of transition from open bay to single room design neonatal intensive care unit on multidrug-resistant organism colonization rates. Journal of Hospital Infection. 2022 Feb;120:90–7.
136. Van Enk RA, Steinberg F. Comparison of Private Room with Multiple-Bed Ward Neonatal Intensive Care Unit Environments. HERD. 2011 Oct;5(1):52–63.
137. van Veenendaal NR, van der Schoor SRD, Heideman WH, Rijnhart JJM, Heymans MW, Twisk JWR, et al. Family integrated care in single family rooms for preterm infants and late-onset sepsis: a retrospective study and mediation analysis. Pediatr Res. 2020 Oct;88(4):593–600.
138. van Veenendaal NR, van der Schoor SRD, Broekman BFP, de Groof F, van Laerhoven H, van den Heuvel MEN, et al. Association of a Family Integrated Care Model With Paternal Mental Health Outcomes During Neonatal Hospitalization. JAMA Netw Open. 2022 Jan 24;5(1):e2144720.
139. Vietri NJ, Dooley DP, Davis CE, Longfield JN, Meier PA, Whelen AC. The effect of moving to a new hospital facility on the prevalence of methicillin-resistant Staphylococcus aureus. Am J Infect Control. 2004 Aug;32(5):262–7.
140. Vohr B, McGowan E, McKinley L, Tucker R, Keszler L, Alksninis B. Differential Effects of the Single-Family Room Neonatal Intensive Care Unit on 18- to 24-Month Bayley Scores of Preterm Infants. J Pediatr. 2017 Jun;185:42-48.e1.
141. Voigt J, Mosier M, Darouiche R. Private Rooms in Low Acuity Settings: A Systematic Review of the Literature. HERD. 2018 Jan;11(1):57–74.
142. Walsh WF, McCullough KL, White RD. Room for improvement: nurses' perceptions of providing care in a single room newborn intensive care setting. Adv Neonatal Care. 2006 Oct;6(5):261–70.
143. Washam MC, Ankrum A, Haberman BE, Staat MA, Haslam DB. Risk Factors for *Staphylococcus aureus* Acquisition in the Neonatal Intensive Care Unit: A Matched Case-Case-Control Study. Infect Control Hosp Epidemiol. 2018 Jan;39(1):46–52.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Health Economics Unit

144. Watson J, DeLand M, Gibbins S, MacMillan York E, Robson K. Improvements in Staff Quality of Work Life and Family Satisfaction Following the Move to Single-Family Room NICU Design. Advances in Neonatal Care. 2014 Apr;14(2):129–36.
145. Zaal IJ, Spruyt CF, Peelen LM, van Eijk MMJ, Wientjes R, Schneider MME, et al. Intensive care unit environment may affect the course of delirium. Intensive Care Med. 2013 Mar;39(3):481–8.

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Appendix: Search Strategy

1. Searches

We ran systematic searches of Medline via PubMed and Embase via embase.com and supplemented these databases with additional searches of Google Scholar and the National Institute for Health and Care Excellence website using the search strategy below.

Embase search strategy

	Search terms	Number of hits (17 Feb 2022)
1	'hospital design'/exp OR 'hospital design' OR 'hospital management'/exp OR 'hospital management' OR 'health care facility'/exp OR 'health care facility'	2,538,404
2	(single OR multi*) NEAR/2 (room* OR bay* OR bed* OR accommodation)	6,553
3	1 AND 2	2,005

PubMed search strategy

	Search terms	Number of hits (17 Feb 2022)
1	"Hospital Design and Construction"[Mesh] OR "Hospital Administration"[Mesh] OR "Health Facility Environment"[Mesh]	289,082
2	((single OR multiple) AND (room OR room* OR bay OR bays OR bed OR beds OR accommodation))	70,205
3	1 AND 2	2,599

Google scholar search strategy

	Search terms	Number of hits (14 Feb 2022)
1	Hospital AND ("single room" OR "multiple room" OR "single bed" OR "multiple bay")	42

NICE website

	Search terms	Number of hits (14 Feb 2022)
1	"single room"	215

We have used NICE's online Evidence Search tool (https://www.evidence.nhs.uk).

This search strategy yields ***4,563 abstracts for screening*** after deduplication, once the additional sources have been included.

2. Inclusion criteria

The inclusion criteria for the review are set out below.

Criterion	Inclusion criterion	Exclusion criterion
Population	Adults, adolescents or children who are inpatients in an acute hospital for more than 24 hours Includes: Those requiring level 0 or 1 care Neonates, children and young adults (everyone under age 18) Pregnant/labouring women Vulnerable adults (those requiring assistance while living in the community) Those with dementia or delirium Those requiring level 2 or 3 care Those primarily receiving rehabilitation Those admitted for elective care Those admitted for emergency care	Patients admitted to long-stay, community or other non-acute hospitals Patients admitted as day cases to an acute hospital Patients attending Accident and Emergency or medical assessment units but not admitted to an acute hospital
Interventions	Staying in a single room for the whole admission	Patients who are relocated to a single room during their admission (e.g. for isolation due to contracting infectious disease or for terminal care)
Comparison	Staying in a multi-bed bay or room	No direct comparison
Outcomes	In-hospital mortality 30-day, or longer, mortality Morbidity such as falls, deterioration, new pressure ulcers and additional diagnoses Experience of patient safety incidents Hospital-acquired infection Quantitative, qualitative and patient-reported measures of experience Length of stay Cost of stay Experience of accommodation change during admission, or number of bed moves during admission Impact on caregivers and family of dependent patient	Non-clinically relevant outcomes Impact on healthcare professionals and support staff
Study methodology	Comparative clinical trials and observational studies Systematic reviews of relevant studies Study protocols: index separately	Non-comparative observational studies Narrative reviews, opinion pieces, letters, editorials Conference abstracts with no relevant data
Study size	Any	
Language and location	Any	

3. Studies excluded at full text screening

Citation	Reason for exclusion
Adabi, G. *et al.* (2019). Barriers to sleep in patients hospitalised with an acute exacerbation of chronic obstructive pulmonary disease. *J Sleep Res.* 28(SUPPL 1).	Outcome: No relevant data reported
Alzheimer's Disease International (2020) World Alzheimer Report 2020 Design Dignity Dementia: dementia-related design and the built environment, Volume 1 https://www.alzint.org/u/WorldAlzheimerReport2020Vol1.pdf	Outcome: No relevant data reported
Baillie, J. (2015). Hospitals single-room design evaluated. *Health Estate* 69(1): 27-30.	Irretrievable
Bernhardt, J. and Cumming, T. (2013). The elephant in the single room debate: keeping patients active. *BMJ Clin Res Ed.* 347.	Outcome: No relevant data reported
Dean, E. (2010). Patient opinion divided on the introduction of single rooms. *Nurs Stand.* 24(40): 12-13.	Outcome: No relevant data reported
Dean, E. (2015). Study finds ideal ward has a mix of single rooms and multi-bed bays. *Nurs Stand.* 29(28): 11.	Outcome: No relevant data reported
Dulny, G. *et al.* (2013). An analysis of risk factors of *Clostridium difficile* infection in patients hospitalized in the teaching hospital in 2008. *Przeglad epidemiologiczny* 67(3): 445-50, 547-51.	Intervention: No data on single room
Kelly, R. *et al.* (2019). The experience of person-centred practice in a 100% single-room environment in acute care settings-A narrative literature review. *J Clin Nurs.* 28(13-14): 2369-2385.	Outcome: No relevant data reported
Lerner, A. O. *et al.* (2019). Environmental contamination by carbapenem-resistant Acinetobacter baumannii: The effects of room type and cleaning methods. *Infect Control Hosp Epidemiol.* 41(2): 166-171.	Outcome: No relevant data reported
LI, M. *et al.* (2020). Construction and application of three-dimensional evaluation model of single bed efficiency in hospital. *Chin J Hosp Admin*: 127-130.	Irretrievable
Linqvist Leonardsen, AC *et al.* (2016). A qualitative study of patient experiences of decentralized acute healthcare services. *Scand J Prim Health Care* 34(3): 317-324.	Population: not acute hospital
Mental Welfare Commission for Scotland (2015) Making progress: older functional assessment wards. https://www.mwcscot.org.uk/sites/default/files/2019-06/making_progress_older_adult_functional_assessment_wards.pdf	Outcome: No relevant data reported
NIHR Evidence (2015) NIHR Alert: One size does not fit all – evaluating the move to a hospital with 100% single rooms. https://evidence.nihr.ac.uk/alert/one-size-does-not-fit-all-evaluating-the-move-to-a-hospital-with-100-single-rooms/	Secondary to Maben 2016 #1802
NIHR Journals Library Health Services and Delivery Research (2015) Evaluating a major innovation in hospital design: workforce implications and impact on patient and staff experiences of all single room hospital accommodation. https://www.journalslibrary.nihr.ac.uk/hsdr/hsdr03030/#/abstract	Duplicate of Maben 2015 #1804
Oliver, D. (2021). David Oliver: Should single rooms be the default for NHS inpatients? *BMJ* 375:n2612.	Outcome: No relevant data reported
Pennington, H. and Isles, C. (2013). Should hospitals provide all patients with single rooms? *BMJ* 347: f5695.	Outcome: No relevant data reported

Citation	Reason for exclusion
Ali, E. (2020) Single-room maternity care: Systematic review and narrative synthesis. *Nurs Open.* 7(6):1661-1670. https://pubmed.ncbi.nlm.nih.gov/33072349	SLR: citation chase
Royal College of Psychiatrists (2020) Next steps for funding mental healthcare in England: Infrastructure. Version 2 https://www.rcpsych.ac.uk/docs/default-source/improving-care/better-mh-policy/policy/next-steps-for-funding-mental-healthcare---infrastructure-royal-college-of-psychiatrists-august-2020.pdf	Outcome: No relevant data reported
Russo, PL *et al.* (2018). Establishing the prevalence of healthcare-associated infections in Australian hospitals: Protocol for the Comprehensive Healthcare Associated Infection National Surveillance (CHAINS) study. *BMJ Open* 8(11).	Outcome: No relevant data reported
Semret, M. *et al.* (2016). Cleaning the grey zones of hospitals: A prospective, crossover, interventional study. *Am J Infect Control* 44(12): 1582-1588.	Intervention: No data on single room
Sengupta, S. *et al.* (2021). Not All Multi.drug Resistant Organism (MDRO)S are Alike-Lessons from Candida Auris in Singapore. *Antimicrobial Resistance and Infection Control* 10(SUPPL 2).	Outcome: No relevant data reported
Shannon, MM. *et al.* (2019). Can the physical environment itself influence neurological patient activity? *Disabil Rehabil*. 41(10): 1177-1189.	Intervention: No data on single room
Simon, M. *et al.* (2016). Is single room hospital accommodation associated with differences in healthcare-associated infection, falls, pressure ulcers or medication errors? A natural experiment with non-equivalent controls. *J Health Serv Res Policy* 21(3): 147-155.	Secondary publication to Maben 2016, no additional data
Teo, R. *et al.* (2015). Patients' preference: Single rooms or shared wards? *Scottish Med J* 59(4): e40.	Outcome: No relevant data reported
Welsh Government (2020) National care review of NHS learning disability hospitals provision https://gov.wales/sites/default/files/publications/2020-03/national-care-review-of-learning-disabilities-hospital-inpatient-provision.pdf	Outcome: No relevant data reported
Fairhall, K. *et al.* (2009). Single-bed versus multi-bed hospital rooms: The case for patient safety. *World Health Design* 7: 57-61.	Irretrievable
BaHammam, A. (2006). Sleep quality of patients with acute myocardial infarction outside the ccu environment: A preliminary study. *Med Sci Monit* 12(4): CR168-CR172.	Outcome: No relevant data reported
Harris, S., Farren, M., Janssen, P., Klein, M., & Lee, S. (2004). Single room maternity care offers an efficient and physician friendly environment, without compromising perinatal outcomes. *J Obstetr Gynecol Canada* 26, 633–640.	Irretrievable
Ishii, H. *et al.* (2007). Advantages of silent and air-conditioned environment on polysomnography. *Respir Circul* 55(2): 233-236.	Irretrievable
Isles, LF., Flynn, R., & Isles, C. (2009). Patient preferences for single rooms or shared accommodation in a district general hospital. *Scottish Med J*. 54, 5–8.	DUPLICATE
Jones, R. *et al.* (2016). The effects of single-family rooms on parenting behavior and maternal psychological factors. *J Obstet Gynecol Neonatal Nurs* 45(3): 359-370.	Irretrievable
Feeley, N. *et al.* (2020). A comparative study of mothers of infants hospitalized in an open ward neonatal intensive care unit and a combined pod and single-family room design. *BMC Pediatrics* 20(1).	Outcome: No relevant data reported
Herr, CE. *et al.* (2003). Additional costs for preventing the spread of methicillin-resistant *Staphylococcus aureus* and a strategy for reducing these costs on a surgical ward. *Infect Control Hosp Epidemiol* 24(9): 673-678.	Intervention: No data on single room

Citation	Reason for exclusion
Hurst, K. (2009). Do single rooms require more staff than other wards? *Nurs Stand* 24(4): 16.	Population: only data is on staff workload
Jobe, AH. (2017). The single-family room neonatal intensive care unit – critical for improving outcomes? *J Pediatr* 185: 10-12.	Outcome: No relevant data reported
Joshi, R. *et al.* (2018). Does the architectural layout of a NICU affect alarm pressure? A comparative clinical audit of a single-family room and an open bay area NICU using a retrospective study design. *BMJ Open* 8(6): e022813.	Outcome: No relevant data reported
Langley, JM. and Hanakowski, M. (2000). Variation in risk for nosocomial chickenpox after inadvertent exposure. *J Hosp Infect* 44(3): 224-226.	Outcome: No relevant data reported
McKinley, LT. *et al.* (2022). Implementation of a nutrition care bundle and improved weight gain of extremely preterm infants to 36 weeks postmenstrual age. *J Pediatr* 241: 42-47.e42.	Outcome: No relevant data reported
Mental Welfare Commission for Scotland (2018) Young person monitoring report 2017-2018 https://www.mwcscot.org.uk/sites/default/files/2019-06/young_person_monitoring_report_2017-18.pdf	Outcome: No relevant data reported
National Nursing Research Unit (2009) Policy + Issue 17: Splendid Isolation? The pros and cons of single occupancy rooms for the NHS https://www.kcl.ac.uk/nmpc/research/nnru/policy/policy-plus-issues-by-theme/hownursingcareisdelivered/policyissue17.pdf	METHOD
Pellikka, HK. *et al.* (2020). Finnish parents' responsibilities for their infant's care when they stayed in a single family room in a neonatal intensive care unit. *J Pediatr Nurs* 53: e28-e34.	Outcome: No relevant data reported
Rose, P. and Blythe, S. (2008). Use of single rooms on the children's ward: Part 1. *Paediatr Nurs* 20(10): 13-17.	SLR
Rose, P. and Blythe, S. (2009). Use of single rooms on the children's ward, Part 2: Guideline for practice. *Paediatr Nurs* 21(1): 31-35.	Outcome: No relevant data reported
Saha, S. *et al.* (2022). Mapping the impact of ICU design on patients, families and the ICU team: A scoping review. *J Crit Care* 67: 3-13.	SLR
Servel, AC. and Rideau Batista Novais, A. (2016). [Single-family rooms for neonatal intensive care units impacts on preterm newborns, families, and health-care staff. A systematic literature review]. *Arch Pediatr* 23(9): 921-926.	SLR
Shahheidari, M. and Homer, C. (2012). Impact of the design of neonatal intensive care units on neonates, staff, and families: a systematic literature review. *J Perinat Neonat Nurs* 26(3): 260-266.	SLR
Shin, JH. *et al*. (2000). Nosocomial cluster of Candida lipolytica fungemia in pediatric patients. Eur J Clin Microbiol Infect Dis 19(5): 344-349.	Intervention: No data on single room
Soleimani, F. *et al.* (2020). Impacts of the design of a neonatal intensive care unit (single-family room care and open-ward care) on clinical and environmental outcomes. *Crescent J Med Biol Sci* 7(1): 1-6.	SLR
Stolker, JJ. *et al.* (2006). Are patients' views on seclusion associated with lack of privacy in the ward? Arch Psychiatr Nurs 20(6): 282-7.	Outcome: No relevant data reported
Tse, Y. (2013). Children thrive on companionship, not single rooms. *BMJ Clin. Res. Ed.* 347: f6335.	METHOD
van de Glind, I. *et al.* (2007). Do patients in hospitals benefit from single rooms? A literature review. *Health Policy* 84(2-3): 153-161.	SLR
Van Eijk, M. *et al.* (2010). Quality and quantity of sleep in multiple versus single	Outcome: No relevant data

Citation	Reason for exclusion
patient room intensive care units. *Intensive Care Med* 36: S189.	reported
van Veenendaal, NR. *et al.* (2019). Hospitalising preterm infants in single family rooms versus open bay units: a systematic review and meta-analysis. *Lancet Child Adolesc Health* 3(3): 147-157.	SLR
van Veenendaal, NR. *et al.* (2020). Hospitalising preterm infants in single family rooms versus open bay units: A systematic review and meta-analysis of impact on parents. *EClinicalMedicine* 23.	SLR
Vohr, BR. (2019). The importance of parent presence and involvement in the single-family room and open-bay NICU. *Acta Paediatr* 108(6): 986-988.	METHOD
WHO Regional Office for Europe – WHO Europe (2009) Capital investment for health. Case studies from Europe (2009) https://www.euro.who.int/__data/assets/pdf_file/0014/43322/E92798.pdf	METHOD
Yamaguchi, K. *et al.* (2019). A Study on Operation Architectural Design and Planning of Single-Room PICU in JAPAN Children's Hospital. Sustainable Urban Environments: Research, Design and Planning for the Next 50 Years, EDRA.	Outcome: No relevant data reported
Bigazzi, E., Turrisi, L.,Zagli, G.,Pecile, P.,Bonizzoli, M.,Peris, A. (2010). Bay rooms vs single-bed rooms in intensive care unit nosocomial infections: a case-control study. *CritCare* 14(Suppl.1):P458-P.http://dx.doi.org/10.1186/cc8690[PubMedPMID: PMC2934264].	Outcome: No relevant data reported
Stevens, D., Thompson, P., Helseth, C., Pottala, J., Khan, M., Munson, D. (2011). A comparison of outcomes of care in an open bay and single family room neonatal intensive care facility. *J Neonat Perinat Med* 4: 189–200.	Irretrievable
Gotlieb, JB. (2000). Understanding the effects of nurses, patients' hospital rooms and patients' perception of control on the perceived quality of a hospital. *Health Mark Q* 18:1–14.	Outcome: No relevant data reported
Hamel, M., Zoutman, D., O'Callaghan, C. (2010). Exposure to hospital roommates as a risk factor for health care–associated infection. *Am J Infect Control* 38:173–81.	Intervention: No data on single room
Heddema, ER. & van Benthem, BHB. (2011). Decline in incidence of *Clostridium difficile* infection after relocation to a new hospital building with single rooms. *J Hosp Infect* 79, 93–98.	METHOD
Okeke, J., Daniel, J., Naseem, A. *et al.* (2013). Impact of all single rooms with ensuite facility in an acute care hospital in Wales (UK). *Age Ageing* 42(Suppl 3):iii1–11.	Outcome: No relevant data reported
Okeke, J., Aithal, S., Edwards, C., Ramakrishna, S., & Singh, I. (2014). Outcome of inpatient falls in single bedded and multi-bedded bays. *Age Ageing* 43, ii1–ii11. https://doi.org/10.1093/ageing/afu124.	Outcome: No relevant data reported
Shaughnessy, MK., Micielli, RL., DePestel, DD. *et al.* (2011) Evaluation of hospital room assignment and acquisition of Clostridium difficile infection. *Infect Control Hosp Epidemiol* 32(3):201–6. [PubMed: 21460503]	Intervention: No data on single room
Shepley, MM., Harris, DD., White, R. (2008). Open-bay and single family room neonatal intensive care units – caregiver satisfaction and stress. *Environ Behav* 40(2):249–268.	Population: Impact on staff only
Singh, I., Edwards, C., Okeke, J. (2015). Impact of cognitive impairment on inpatient falls in single room setting and its adverse outcomes. *J Gerontol Geriatr Res* S4. S4eS001.	Secondary publication of Singh 2015, no additional relevant data about single rooms

Citation	Reason for exclusion
Ulrich, RS. (2006). Effects of single versus multi-bed accommodation and outcomes. Presented at the Symposium on Single-Bed Ward Accommodation, Cardiff, Wales.	METHOD
van Oel, CJ., Mlihi, M., & Freeke, A. (2021). Design models for single patient rooms tested for patient preferences. *HERD*, 14(1), 31-46. https://doi.org/10.1177/1937586720937995	Outcome: No relevant data reported
Williams, C., & Gardiner, C. (2015). Preference for a single or shared room in a UK inpatient hospice: Patient, family and staff perspectives. *BMJ Support Palliat Care* 5, 169–174. doi: 10.1136/bmjspcare-2013-000514	Population: hospice – not acute hospital

For peer review only

Section/topic (page no)	Item	PRISMA checklist item	PRISMA harms (minimum)	Recommendations for reporting harms in systematic reviews (desirable)	Check if done
Title					
Title (3)	1	Identify the report as a systematic review, meta-analysis, or both.	Specifically mention "harms" or other related terms, or the harm of interest in the review.	—	X
Abstract					
Structured summary (4)	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	—	Abstracts should report any analysis of harms undertaken in the review, if harms are a primary or secondary outcome.	X
Introduction					
Rationale (5)	3	Describe the rationale for the review in the context of what is already known.	—	It should clearly describe in introduction or in methods section which events are considered harms and provide a clear rationale for the specific harm(s), condition(s), and patient group(s) included in the review.	X
Objectives (5)	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	—	PICOS format should be specified, although in systematic reviews of harms the selection criteria for P, C, and O may be very broad (same intervention may have been used for heterogeneous indications in a diverse range of patients)	X
Methods					
Protocol and registration (6)	5	Indicate if a review protocol exists, if and where it can be accessed (eg, web address), and, if available, provide registration information including registration number.	—	No specific additional information is required for systematic reviews of harms.	X
Eligibility criteria (6)	6	Specify study characteristics (eg, PICOS, length of follow-up) and report characteristics (eg, years considered, language, publication status) used as criteria for eligibility, giving rationale.	—	Report how handled relevant studies (based on population and intervention) when the outcomes of interest were not reported. Report choices for specific study designs and length of follow-up.	X
Information sources (7)	7	Describe all information sources (eg, databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	—	Report if only searched for published data, or also sought data from unpublished sources, from authors, drug manufacturers and regulatory agencies. If includes unpublished data, provide the source and the process of obtaining it.	X
Search (7)	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	—	If additional searches were used specifically to identify adverse events, authors should present the full search process so it can be replicated.	X

For peer review only

Study selection (8)	9	State the process for selecting studies (ie, screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	—	If only included studies reporting on adverse events of interest, defined if screening was based on adverse event reporting in title/abstract or full text. If no harms reported in the text, report if any attempt was made to retrieve relevant data from authors.	x
Data collection process (9)	10	Describe method of data extraction from reports (eg, piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	—	No specific additional information is required for systematic reviews of harms.	x
Data items (9)	11	List and define all variables for which data were sought (eg, PICOS, funding sources) and any assumptions and simplifications made.	—	Report the definition of the harm and seriousness used by each included study (if applicable). Report if multiple events occurred in the same individuals, if this information is available. Consider if the harm may be related to factors associated with participants (eg, age, sex, use of medications) or provider (eg, years of practice, level of training). Specify if information was extracted and how it was used in subsequent results. Specify if extracted details regarding the specific methods used to capture harms (active/passive and timing of adverse event).	x
Risk of bias in individual studies (10)	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	—	The risk of bias assessment should be considered separately for outcomes of benefit and harms.	x
Summary measures (11)	13	State the principal summary measures (eg, risk ratio, difference in means).	—	No specific additional information is required for systematic reviews of harms.	x
Synthesis of results (11)	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (eg, I^2) for each meta-analysis.	Specify how zero events were handled, if relevant.		
Risk of bias across studies (11)	15	Specify any assessment of risk of bias that may affect the cumulative evidence (eg, publication bias, selective reporting within studies).	—	Present the extent of missing information (studies without harms outcomes), any factors that may account for their absence, and whether these reasons may be related to the results.	x
Additional analyses (12)	16	Describe methods of additional analyses (eg, sensitivity or subgroup analyses, meta-regression), if done, indicating which were prespecified.	—	Sensitivity analyses may be affected by different definitions, grading, and attribution of adverse events, as adverse events are typically infrequent or reported using heterogeneous classifications. Report the number of participants and studies included in each subgroup.	
Results					
Study selection (13)	17	Give numbers of studies screened, assessed for eligibility, and included in the	—	If a review addresses both efficacy and harms, display a flow diagram specific for each (efficacy and harm).	x

For peer review only

		review, with reasons for exclusions at each stage, ideally with a flow diagram.			
Study characteristics (14)	18	For each study, present characteristics for which data were extracted (eg, study size, PICOS, follow-up period) and provide the citations.	Define each harm addressed, how it was ascertained (eg, patient report, active search), and over what time period.	Add additional characteristics to: "P" (population) patient risk factors that were considered as possibly affecting the risk of the harm outcome. "I" (intervention) professional expertise/skills if relevant (for example if the intervention is a procedure). "T" (time) timing of all harms assessments and the length of follow-up.	x
Risk of bias within studies (15)	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	—	Consider the possible sources of biases that could affect the specific harm under consideration within the review. Sample selection, dropouts and measurement of adverse events should be evaluated separately from the outcomes of benefit as described in item 12, above.	x
Results of individual studies (16)	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	—	Report the actual numbers of adverse events in each study, separately for each intervention.	x
Synthesis of results (17)	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Describe any assessment of possible causality.	If included data from unpublished sources, report clearly the data source and the impact of these studies to the final systematic review.	N/A
Risk of bias across studies (18)	22	Present results of any assessment of risk of bias across studies (see item 15).	—	No specific additional information is required for systematic reviews of harms. See item 15 above.	x
Additional analysis (18)	23	Give results of additional analyses, if done (eg, sensitivity or subgroup analyses, meta-regression (see item 16)).	—	No specific additional information is required for systematic reviews of harms.	N/A
Discussion					
Summary of evidence (18)	24	Summarise the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (eg, healthcare providers, users, and policy makers).	—	No specific additional information is required for systematic reviews of harms.	x
Limitations (18)	25	Discuss limitations at study and outcome level (eg, risk of bias), and at review level (eg, incomplete retrieval of identified research, reporting bias).	—	Recognise possible limitations of meta-analysis for rare adverse events (ie, quality and quantity of data), issues noted previously related to collection and reporting.	x
Conclusions (19)	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	—	State conclusions in coherence with the review findings. When adverse events were not identified we caution against the conclusion that the intervention is "safe," when, in reality, its safety remains unknown.	x
Funding					
Funding (19)	27	Describe sources of funding for the systematic review and other support (eg, supply of data); role of funders for the systematic review.	—	No specific additional information is required for systematic reviews of harms.	x

For peer review only

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title page
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract page
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p.4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p.4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p.4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p.4 and suppl mat.
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	p.4 and appendix 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p.5 and appendix 2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p.5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	p.5
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p.5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p.5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p.5
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p.5
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p.5
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p.5
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p.5
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	p.5
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p.5

For peer review only

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	p.5
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	p.6 and fig.1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Fig.1 and appendix
Study characteristics	17	Cite each included study and present its characteristics.	p.6, fig.1, suppl tables
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Suppl. tab.1
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Suppl. Tab 2-17
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Suppl. Tab 2-17
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p.17
	23b	Discuss any limitations of the evidence included in the review.	p.18
	23c	Discuss any limitations of the review processes used.	p.18
	23d	Discuss implications of the results for practice, policy, and future research.	p.18
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p.19 - registration
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p.19
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p.19 - funding
Competing interests	26	Declare any competing interests of review authors.	p.19 competing interests

For peer review only

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	p.19

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

For peer review only