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# BMJ Open

## Impact of isolation on hospitalised patients who are infectious: systematic review with quantitative analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-030371
Article Type:	Research
Date Submitted by the Author:	13-Mar-2019
Complete List of Authors:	Pursell, Edward; City, University of London, School of Health Sciences Gould, Dinah; Cardiff University School of Healthcare Studies, ; Cardiff University, Healthcare Sciences Chudleigh, Jane; City, University of London, School of Health Sciences
Keywords:	Infection control < INFECTIOUS DISEASES, Anxiety disorders < PSYCHIATRY, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Manuscripts

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3 **Impact of isolation on hospitalised patients who are infectious: systematic review**  
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5 **with quantitative analysis**  
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57  
58 Word count, excluding title page, abstract, references, figures and tables: 2 289

59 Data availability statement: No additional data available

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3 **Impact of isolation on hospitalised patients who are infectious: systematic review**  
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5 **with quantitative analysis**  
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10 **Abstract**  
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14 Objective

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16 To systematically review the literature exploring impact of isolation on hospitalised  
17 patients who are infectious: psychological and non-psychological outcomes  
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23 Design

24 Systematic review with quantification  
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30 Data Sources

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32 Embase, Medline and Psychinfo were searched from inception until December 2018.  
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34 Reference lists and Google Scholar were also handsearched.  
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40 Results

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42 Twenty seven papers published from database inception until December 2018 were  
43 reviewed. A wide range of psychological and non-psychological outcomes were  
44 reported. There was a marked trend for isolated patients to exhibit higher risk of  
45 depression, anxiety and worse outcomes for a range of care-related factors but with  
46 significant variation.  
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## Conclusion

The review indicates that isolation to contain risk of infection has negative consequences for segregated patients. Although strength of the evidence is weak, comprising primarily single centre convenience samples, consistency of the effects may strengthen this conclusion. More research needs to be undertaken to examine this relationship and develop and test interventions to reduce the negative effects of isolation.

## Strengths and limitations of this study

- The isolation of those with infectious disease is common, and in the age of increased antimicrobial resistance may become more common and important.
- It is important to examine both psychological and non-psychological outcomes associated with isolation.
- This is a methodologically challenging area to examine, however consistency in the body of evidence might increase confidence in the findings.
- It is not known if any effects are temporary or how long they last.

## Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

## A competing interests statement

No authors have any competing interests to declare

## Introduction

Isolation is an established part of any infection prevention programme. Its purpose is to prevent the transmission of antibiotic-resistant pathogens, those that are highly contagious or cause serious infection.[1] The effectiveness of isolation has been questioned however [2–5] and it can be challenging to undertake, especially if patients' lack of understanding of the need for segregation, boredom or distress result in uncooperative behaviour. [6] Although single rooms are assumed to reduce infection risk, evidence of ability to contain spread is equivocal [7,8] and a recent study conducted in an all-single-room hospital was unable to demonstrate lower infection rates than in hospitals where most care takes place in open wards. [9] This study identified advantages and disadvantages of single room accommodation, whereas isolating infectious patients is generally assumed to result in adverse outcomes.[10]

A systematic review reported eight years ago indicated higher levels of anxiety, depression, perceptions of stigmatisation and a higher incidence of falls, medication errors and other incidents that detract from patient safety among patients who were isolated compared to those who were not.[11] This review reported studies undertaken before 2010 and included patients whose experiences are unlikely to be comparable: children and adults and those isolated to reduce their own risk of infection as well as infectious patients. The review was not reported according to standards currently expected for systematic reviews [12] and presents a qualitative description of patient outcomes only. A more rigorous and up-to-date systematic review is indicated in view of increasing concern about satisfaction with health care and patient safety and

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3 increasing emphasis on infection prevention as part of the global strategy to reduce  
4 risks of antimicrobial resistance.[13]  
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10 We undertook a systematic review of the literature to establish the effects of infection  
11 related isolation on psychological and non-psychological care-related outcomes in  
12 adults. This review is therefore more focussed than that previously undertaken which  
13 also included those in protective isolation, and contains a significant body of literature  
14 published since 2010.  
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### 23 **Method**

24 The eligibility criteria for inclusion was that studies should compare psychological or  
25 non-psychological outcomes in adult patients who are in infective isolation with those  
26 not isolated. Purely symptomatic/disease progression outcomes were not included,  
27 neither were those looking at those isolated due to immunosuppression. Studies not  
28 containing comparative data were also excluded. Information sources were Embase,  
29 Medline and Psychinfo, which were searched from inception until December 2018.  
30 Reference lists and Google Scholar were also handsearched. Full details of the search  
31 and PRISMA flow-chart together with excluded papers are given in the  
32 supplementary information. No protocol was published in advance.  
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49 Where available raw data were extracted and entered into a spreadsheet, and  
50 depending upon the nature of the data either the relative risk or standardised mean  
51 difference calculated. Results were then presented as forest plots. All calculations  
52 and plots were produced using the meta package in R.[14,15] Where raw data were  
53 not provided the summary results are given in the text but not the forest plots. Due to  
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3 the variety of different settings and methods it was deemed that the methodological  
4 and clinical heterogeneity was too broad to pool results; in particular outcomes were  
5 measured in a variety of different ways.  
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## 10 11 12 Patient and Public Involvement

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14 As a secondary analysis patients and public were not involved in this work  
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## 17 18 19 **Results**

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21 A total of 3 879 papers were retrieved from the three databases; 39 of which were  
22 screened and 12 excluded, leaving 26 in the final analysis. Of these 13 studies  
23 provided data suitable for the calculation of relative risks, 5 giving psychological  
24 outcomes,[16–20] and 12 non-physiological:[18,21–31] and 8 provided data for the  
25 calculation of standardised mean differences, 6 giving psychological  
26 outcomes,[20,29,32–35] and 3 non-psychological.[25,28,36] A further 6 studies did  
27 not provide raw data but are included in the results; 3 each giving psychological  
28 outcomes[37–39] and non-psychological outcomes.[16,40,41]  
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42 As it had been decided not to attempt statistical pooling of study results, the data from  
43 studies are shown as forest plots but without meta-analysis. The forest plots contain  
44 results from the studies where sufficient data were given to calculate either the  
45 relative risk or standardised mean difference. A number of studies provided data on  
46 those under contact precautions, but no comparative data and so were not  
47 included.[42–45]  
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3 Because of the large number of non-psychological outcomes for which RR could be  
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5 calculated, it was decided that a change of 20% (i.e. a RR of 0.8 or less, or 1.2 or  
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7 more) would be clinically significant, regardless of the statistical significance.  
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10 Results are shown in Figures 1 to 5. Figure 5 contains results that did not meet our  
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12 criteria for being clinically significant (see supplemental information).  
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17 The studies included were primarily single-centre and consisted of case-control,  
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19 cross-sectional and cohort studies. Although these studies have limited  
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21 generalisability, there did not appear to be significant cause for concern regarding bias  
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23 within the limitation inherent in these study designs. Full details of each study is  
24  
25 given in the supplementary information.  
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30 The data from the comparative studies suggest that although in many cases contact  
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32 precautions makes little difference to psychological outcomes, where it does make a  
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34 difference this is primarily negative. There were significant declines in mean scores  
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36 related to control and self-esteem, and in many studies increases in the mean scores  
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38 for risk of anxiety and depression. However, these findings were not consistent, and  
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40 some larger studies showed little or no difference between the groups for these  
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42 outcomes. These are shown in Figures 1 and 2 respectively.  
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49 [INSERT FIGURES 1 and 2 HERE]  
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53 Figure 1. Relative risk of psychological events in those isolated versus not isolated  
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3 Figure 2. Standardised mean difference of psychological scores in those isolated  
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5 versus those not isolated  
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10 Studies not reporting the raw data showed that contact precautions were associated  
11 with depression OR 1.4 (95% CI 1.2 to 1.5) but not anxiety OR 0.8 (95% CI 0.7 to  
12 1.1) in a non-ICU population.[40] There was also an association with delirium OR,  
13 1.40 (95% CI 1.24 to 1.51); although this was primarily among those who were newly  
14 diagnosed as needing isolation OR, 1.75 (95% CI 1.60 to 1.92,  $p<0.01$ ) rather than  
15 those who had been under contact precautions for their entire stay OR 0.97 (95% CI  
16 0.86 to 1.09,  $p=0.60$ ).[16] Another study showed no difference in the median values  
17 for the Hospital Anxiety and Depression Scale anxiety or depression scores (HADS-A  
18 and -D), or the EuroQol Visual Analogue Scale EQ VAS scores.[41]  
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33 For non-psychological outcomes, using a difference in the risk of +/- 20% of an event  
34 as being a measure of clinical significance it appears there was a trend for less  
35 attention to be given to, and for more errors to occur in those who were isolated.  
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37 However, again there was wide variation between studies. Data on these outcomes  
38 are given in Figures 3 and 4, and the non-clinically significant risks in the  
39 supplementary information (Figure 5).  
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49 [INSERT FIGURES 3 and 4 HERE]  
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54 Figure 3. Relative risk of non-psychological events in those isolated versus not  
55 isolated  
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3 Figure 4. Standardised mean difference of non-psychological scores in those isolated  
4 versus those not isolated  
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12 A study not giving raw data which looked at the rates of falls and pressure ulcers  
13 before and after a policy change that resulted in the discontinuation of contact  
14 precautions for patients with methicillin resistant *Staphylococcus aureus* (MRSA) or  
15 vancomycin resistant enterococci (VRE) found that falls and pressure ulcers were  
16 more common among those with MRSA or VRE both before the change (when they  
17 were in isolation) and afterwards (when they were not). Before the change the number  
18 of falls was 4.57 vs 2.04 per 1000 patient-days respectively ( $p < 0.0001$ ) and pressure  
19 ulcers 4.87 vs 1.22 per 1000 patient-days ( $p < 0.0001$ ). After the policy change the  
20 same numbers were falls 4.82 vs 2.10 ( $p < 0.0001$ ) and pressure ulcers 4.17 vs 1.19 per  
21 1000 patient-days ( $p < 0.0001$ ).[38] Other studies found that staff spent less time with  
22 those on contact precautions: internal medicine interns spent less time with their  
23 isolated patients compared to non-isolated patients, the median times being 5.2 and  
24 6.9 minutes respectively ( $p < 0.001$ )[37]; while the mean number of contacts per hour  
25 with healthcare workers was 2.1 compared to 4.2 in those not isolated ( $p = 0.03$ ),  
26 although the duration was longer at 4.5 minutes compared to 2.8 ( $p = 0.6$ ).[39]  
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49 **Discussion**  
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51 Current recommendations say that contact precautions should include a single room,  
52 with personal protective equipment consisting of a gown and gloves for all patient  
53 contacts or contacts with potentially contaminated environmental areas.[1] This  
54 review has shown that there are a number of apparently negative aspects to contact  
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3 precautions, in particular with regards to psychological effects and a reduction in the  
4 quality of some aspects of care. These data come from studies carried out in a variety  
5 of countries and different types of facility; although there are few data from  
6 particularly vulnerable populations such as the elderly.  
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14 Although at times there are discussions as to the necessity of contact precautions for  
15 drug resistant organisms, with some arguing that there is mixed evidence for or  
16 against their use[46] another recent review has concluded that they are of great  
17 importance in the control of epidemic and endemic multidrug-resistant  
18 microorganisms.[47] The ethics of using contact precautions and other forms of  
19 isolation rely on a positive assessment of the balance between the risks and benefits of  
20 this to the individual concerned and that of the broader population of patients and  
21 staff.[48] However, even when this assessment is positive, it is important to ensure  
22 that any harm to the individual is minimised.  
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38 One way of balancing the various priorities is to use the GRADE Evidence to  
39 Decision Framework, which provides criteria for making recommendations at the  
40 individual, group and policy-levels, and provides a number of highly patient focussed  
41 criteria for doing this. In addition to the certainty of evidence and resource  
42 requirements, it also requires consideration of: the balance of desirable and  
43 undesirable effects; the impact upon equity; and the feasibility and acceptability of the  
44 intervention.[49] The last two of these might have very different outcomes when  
45 considered at the population and individual levels; and there is certainly evidence here  
46 that for the individual patient the balance of desirable and undesirable effects might  
47 be very different to that of the broader population.  
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6 However, within the broad population of infected or potentially infected patients,  
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8 some groups might have different needs. For example a study of people isolated for  
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10 MERS found that while access to telephones reduced anxiety and anger; access to  
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12 email, text and internet increased these.[50] This was not an area investigated in any  
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14 depth in these studies. Another area where information may be lacking is that of age,  
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16 as older people in particular might feel sadness and loneliness more; and gender, as  
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18 women were more concerned about precautions and transmission while men were  
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20 more resigned, rational and tended to cope better.[51]  
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26 In some countries, such as the United States single-rooms have become the standard  
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28 for new hospitals and so one might expect fewer adverse effects if everyone is in a  
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30 single room, this being the norm. However it may be that a single room is necessary  
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32 but not sufficient for these findings, and that it is the combination of a single room  
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34 with an infection that leads to these results. Certainly it is far from clear that the long  
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36 list of advantages claimed for single rooms which include reduced stress, the ability to  
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38 deliver better care, and a lower probability of dietary or medication errors apply to  
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40 this group of patients.[52]  
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46 Caring for patients in single-rooms does have many challenges, but there is evidence  
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48 that these can be mitigated in a general population;[9] however the expanding  
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50 literature on how this can be done in a general population does not necessarily apply  
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52 here due to the necessity of isolation procedures which are, by design, 'a barrier'.  
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54 Therefore patients' needs for greater social interaction will need a solution quite  
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3 different from that which might be used for a different patient population, and the  
4 benefit of choice about this which single rooms offer does not apply here.[53]

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7 Although this review has quantified the extent of the problem, we have not been able  
8 to find solutions in the literature. Care might be improved through increased staff  
9 attention with more resources being allocated to these patients, although the extra cost  
10 of contact precautions is already considerable, one estimate being that it was an extra  
11 \$158.90 (95% CI \$124.90 to \$192.80) per patient day.[54] Alternatively new ways of  
12 working might be developed, perhaps using technology to mitigate some of these  
13 problems. What these might be is not clear however.  
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### 26 Study strengths and limitations

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28 This review suggests that infectious isolation has a number of negative effects on  
29 patients. Because this evidence is comprised of cohort and case-control studies, a  
30 claim for a causal relationship cannot be made on this evidence, although the strong  
31 and consistent effects across the studies may increase the confidence in this  
32 relationship. There are some qualitative data, although more in-depth mixed-methods  
33 data where those reporting negative effects are questioned about them would  
34 strengthen the evidence on this. In some cases large effect sizes were accompanied  
35 by very wide confidence intervals, suggesting that studies were underpowered, thus  
36 studies with larger sample sizes would be useful.  
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51 Although these data suggest that there is a problem, there is a clear gap both in what  
52 we know about improving the experience of isolation and what can be done in  
53 practical terms to make it more tolerable for patients and their families. In particular  
54 older people who may be most vulnerable to these negative effects were under-  
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3 represented in these studies; and this group are likely to represent an increasingly  
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5 large proportion of those isolated. Lastly the use of isolation may need to increase if  
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7 the current trends of antimicrobial resistance continue.  
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#### 14 Contributors

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16 EP, DG and JC conceived and conducted the review.  
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#### 21 Funding

22  
23 This research received no specific grant from any funding agency in the public,  
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25 commercial or not-for-profit sector.  
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#### 31 A competing interests statement

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33 No authors have any competing interests to declare  
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#### 38 Data availability statement

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40 No additional data available  
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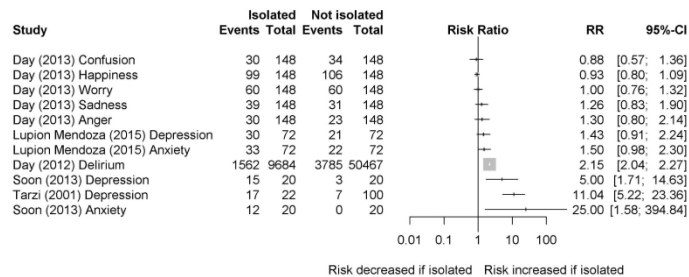


Figure 1. Relative risk of psychological events in those isolated versus not isolated

276x103mm (300 x 300 DPI)



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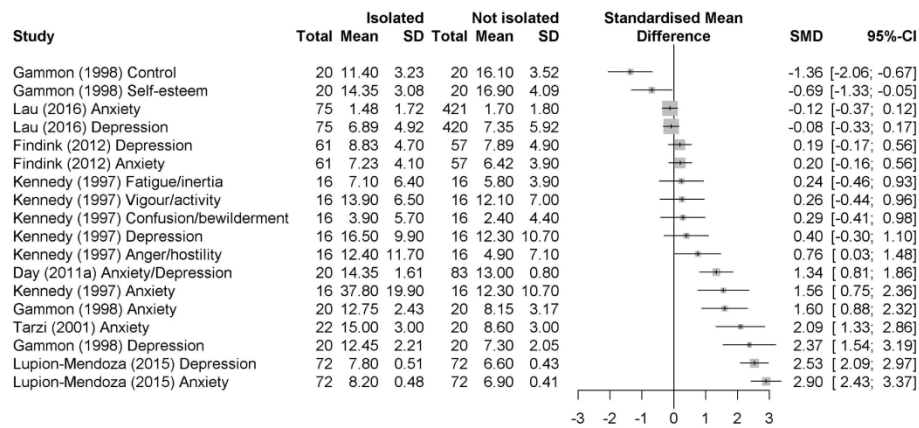


Figure 2. Standardised mean difference of psychological scores in those isolated versus those not isolated

251x114mm (300 x 300 DPI)

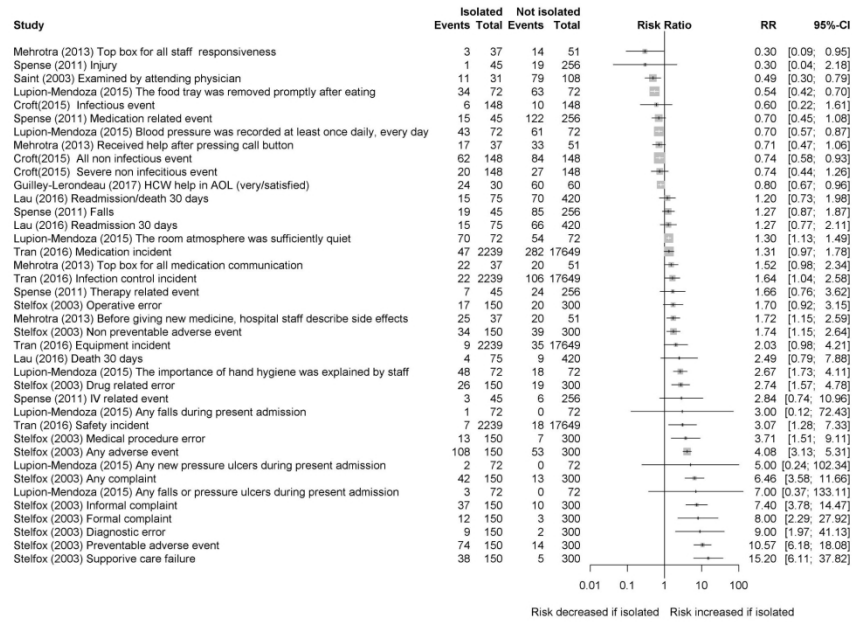


Figure 3. Relative risk of non-psychological events in those isolated versus not isolated

207x138mm (300 x 300 DPI)

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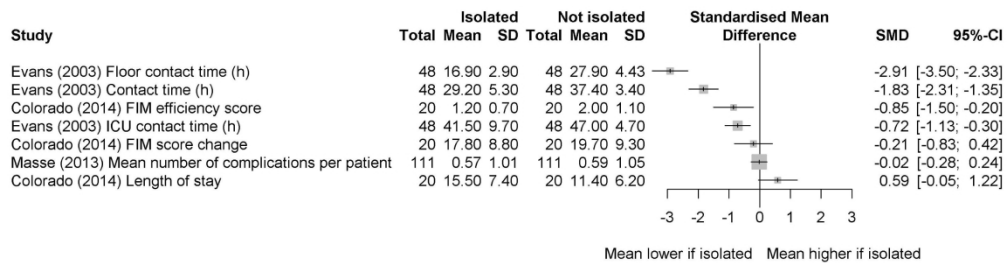


Figure 4. Standardised mean difference of non-psychological scores in those isolated versus those not isolated

251x114mm (300 x 300 DPI)

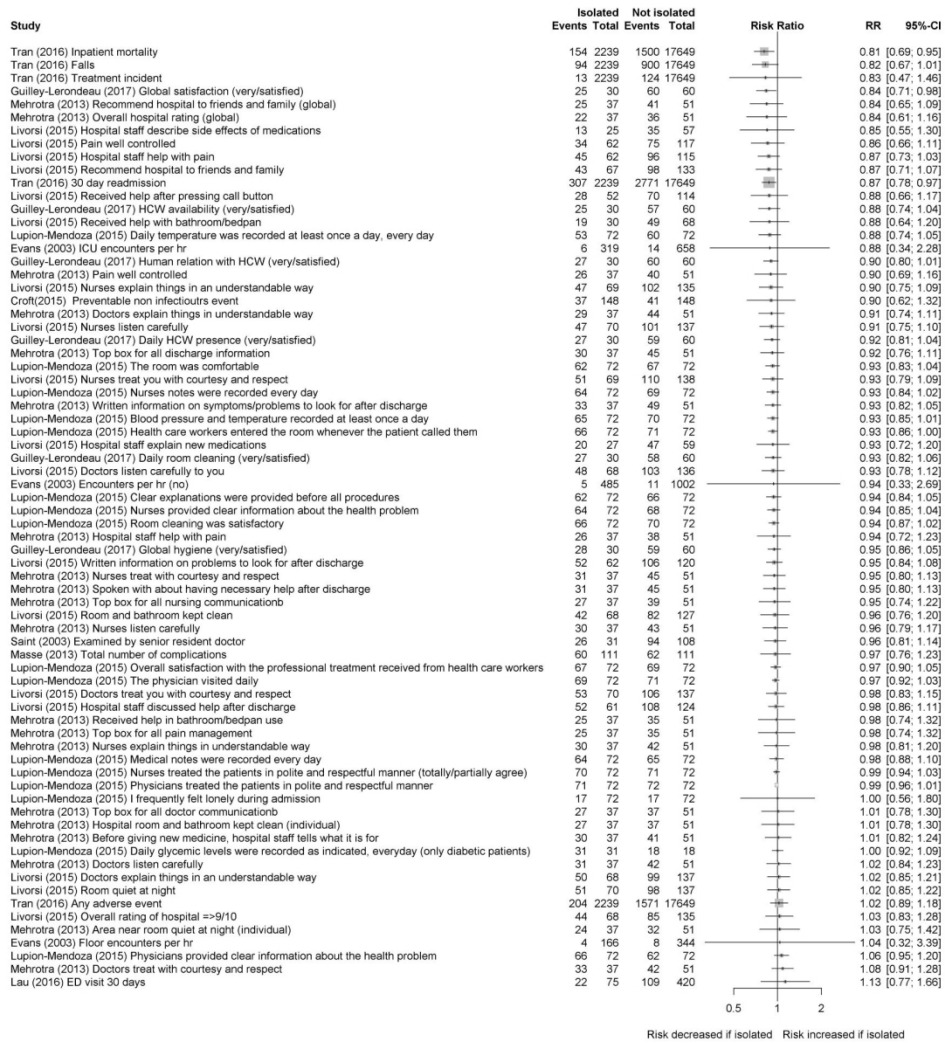
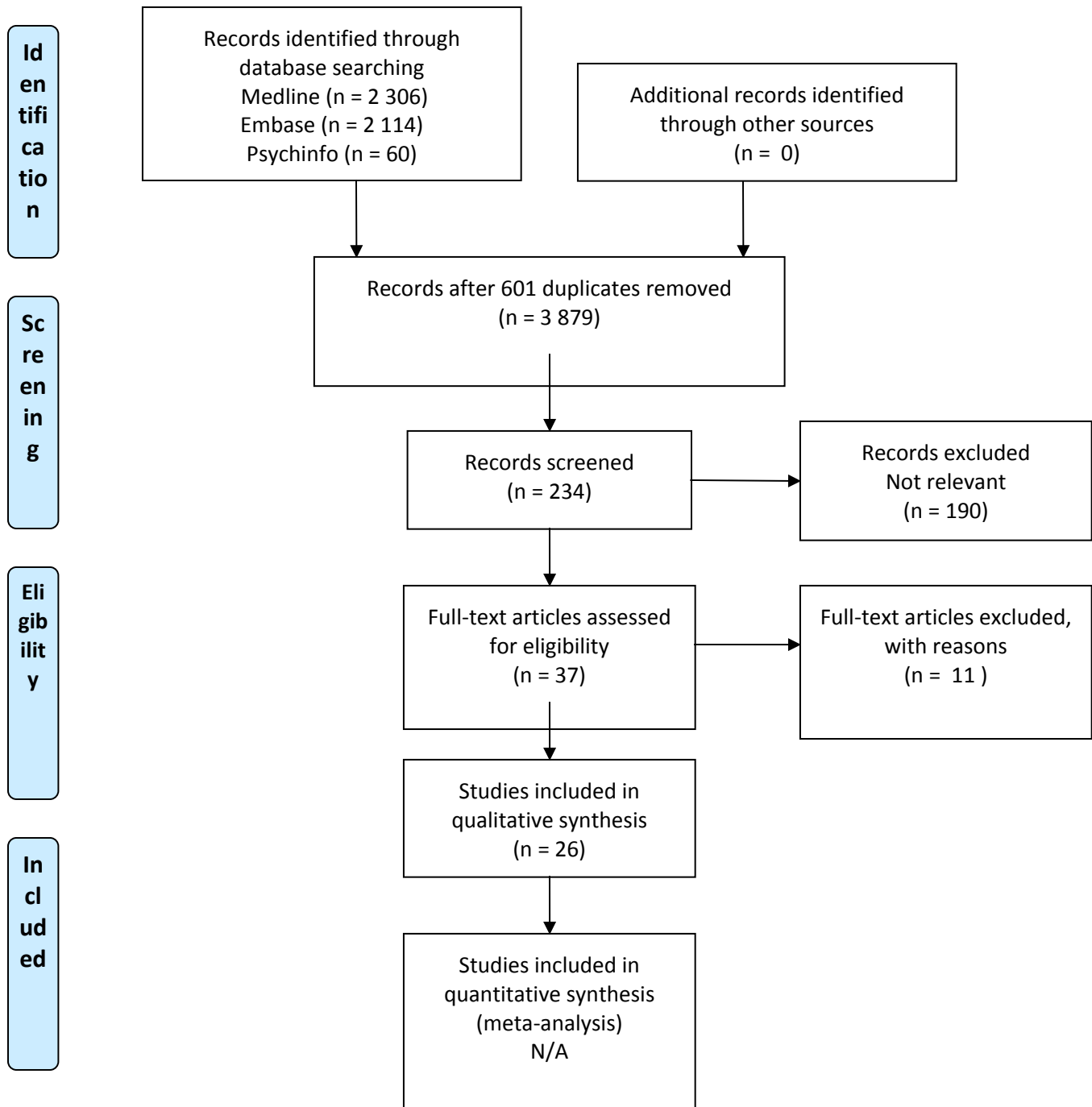


Figure 5. Relative risk of non-psychological events in those isolated versus not isolated (non clinically significant only)

153x187mm (300 x 300 DPI)



## PRISMA 2009 Flow Diagram



56 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

57 For more information, visit [www.prisma-statement.org](http://www.prisma-statement.org).

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

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**Characteristics of studies**

Reference	Study type	Isolated	Non isolated
Chittick (2016)	Cross sectional survey. Response rate 48.7%. Tertiary centre, United States January 1, 2014 to December 31, 2014	Patients in contact isolation for >48 hours Demographics not given	
Colorado (2014)	Retrospective matched case control study. Rehabilitation facility- tertiary centre United States July 2009 to December 2010	N20 Patients in contact isolation	N=20 Matched to patients not in contact isolation based on age, rehabilitation diagnosis, and type of insurance
Croft (2015)	Prospective cohort Medical or surgical inpatients admitted to non-intensive care unit hospital wards, United States. January to November 2010.	N=148 Patients on contact precautions Age: 52 (13.8) % male: 53.4	N=148 Individually matched by after an initial 3-day length of stay to patients not on contact precautions. Age 52.3 (14.6) % male: 46.6
Dashiell-Earp (2014)	Collected real-time data on the location of 15 internal medicine interns, United States. October 1, 2012 to December 31, 2012	1156 encounters	2467 encounters
Day (2011)	Patients admitted to the general acute care units, United States. June 1, 2009 to October 30, 2009	N=20 Age: 68.5 (14.7) % male: 85.0	N=83 Age: 63.9 (12.6) % male: 95.2
Day (2011)	A two-year retrospective cohort Tertiary care, United States.. All general inpatients over 18 years hospitalized for >24 h February 1, 2007 to January 31, 2009.	Contact precautions private room when possible, can be cohorted General N = 3138 Age: 51.2 (17.5) % male 58.9 ITU N=1694 Age: 54.9 (17.5) % male 61.0	General N = 25 426 Age: 49.6 (19.0) % male 46.3% ICU N = 5 854 Age: 56.0 (17.7) % male 59.7
Day (2012)	2-year retrospective cohort study of all non-psychiatric hospital admissions >18 years, United States. February 1, 2007 to January 31, 2009	N = 9 684 Contact precautions as above Mean age: 50.1 (18.8) % male 51.4	N = 50 458 Mean age: 52.3 (16.9) % males 59.1
Day (2013)	Longitudinal frequency-matched	N = 148	N = 148

	cohort study of patients admitted to general medical and surgical units, United States. Day 0, day 3 then weekly. January to November 2010	Mean age: 52.0 (13.9) % male 58.1	Mean age: 52.3 (14.6) % male 50.7
Evans (2003)	Prospective observation; survey; retrospective review, United States. Tertiary care. June and July 2001	N 48 Mean age: 47.8 (2) % male 85%	N = 48 Mean age: 58.3 (2.4) % male 75%
Findink (2012)	Non-random quasi-experiment, Turkey Age 18 to 65 Administered day 5 January 1, 2009 to December 31, 2009	N = 60 Mean age: 53.95 (18.4) % male 75%	N = 57 Mean age: 56.14 (17.1) % male 76.3%
Gammon (1998)	Quasi experiment Selected if last two numbers on their case notes even. Two large District General Hospitals and one elderly care hospital, United Kingdom	N = 20 Placed in isolation for a minimum of 7days Mean age: 61 years % male: 65	N = 20 Mean age: 52 years % male: 55
Gandra (2014)	Retrospective hospital-wide cohort study, United States. All patients admitted to medical-surgical inpatient units November 1, 2009 to October 31, 2011	Falls N=77 Mean age: 66.1 (14.3) % male: 61% Pressure ulcers N=82 Mean age: 64.5 (15.5) % male: 63	Falls N=82 Mean age: 63.7 (15.8) % male: 51 (62%) Pressure ulcers N=71 Mean age: 65.7 (15) % male: 57
Guilley-Lerondeau (2017)	Matched cohort study with prospective inclusions Interview 3 days after commencing General sample. France March to July 2012	N=30 First prescription of isolation precaution Median age (range) 69 (32 to 91) % male 47	N=60 Median age (range) 64 (24 to 91) % male 53
Kennedy (1997)	Cross-sectional matched-control study, United Kingdom. May 1994 to November 1996	N = 16 Isolated as a result of being MRSA Mean age: 31.1 All male	N = 16 Matched for age, sex, level of injury, and time since admission or injury
Kirkland (1999)	Observational study - 7 months Medical intensive-care, United States	N=14	N=21
Lau (2016)	Prospective cohort study. Adult patients discharged from	N=75 Mean age 60.35 (17.83)	N=420 Mean age 63.31 (18.69)

	internal medicine wards, Canada October 2013 to November 2014,	% male 59	% male 48%
Livorsi (2015)	Case-control study Retrospective January 1, 2012 to May 31, 2012/prospective June 1, 2012 to March 31, 2013 'safety-net facility', United States	N = 70 On contact precautions for MRSA throughout their hospital stay. Found to be MRSA positive during a previous hospitalization or as an outpatient, not current case	N = 139 No significant differences between isolated and non-isolated patients
Lupi3n- Mendoza (2015)	Matched case-control study Tertiary hospital, Spain 2011 and 2012	N = 72 Adult patients admitted in isolation for =>5 days. Median age (range) 62 (21-93) % male 73%	N = 72 Median age (range) 69 (23-89), % male 68.1%
Massee (2013)	Retrospective case-control Tertiary care, Canada	N = 111 Matched MRSA patients with an admission diagnosis of heart failure or COPD to similar non-isolated controls Median age (IQR) 80.0 (69.0-86.0) % male 60.4%	N = 111 Median age (IQR) 80.0 (68.0-86.0) % male 60.4%
Mehrotra (2013)	Prospective cohort Admission and on days 3, 7, 14 Tertiary centre, United States	N = 238 Segregation into a private or cohorted room Mean age (SD) 52.4 (13.4) % male 55.7	N = 290 Mean age (SD) 52.9 (14.8) % male 48
Saint (2003)	Prospective cohort study 2 university-affiliated medical centers, United States. October 1999 to March 2000	N=31	N=108
Soon (2013)	Cross-sectional survey of cases and matched controls Teaching hospital Singapore June and August 2011	N=20 Contact isolation in a cohort cubicle for the first time because of colonization or infection with a MDRO for at least 3 days No statistically significant differences in age or gender	N=20
Spense (2011)	Retrospective evaluation of incident reports All patients admitted to acute care facility, United States January 1, 2008 to December 31, 2008.	N=45	N=256
Stelfox	Case control study	General N = 78	General N = 156



(2003)	Consecutive adults isolated for at least 2 days with MRSA. Canada and United States Controls patients admitted before and after. January 1, 1999, to January 1, 2000	Age: 69.6 (17.1) % male: 45% CHF N = 72 Age: 66.9 (14.7) % male: 58	Age: 65.4 (18.2) % male: 51% CHF N = 144 Age: 66.0 (14.5) % male: 54
Tarzi (2001)	Cross-sectional matched case-control study Care of the elderly rehabilitation wards, UK	N = 22 Had been in isolation for at least two weeks with MRSA Mean age (SD) 80 (8.4) % male 27.3	N = 20 Mean age (SD) 81 (9.1) % male 33.3
Tran (2017)	Propensity matched cohort study. General internal medicine services, 3 hospitals, Canada January 2010 to December 2012	MRSA Age: 69 % male 57% Respiratory Age: 71.7 % male: 53 Isolated for MRSA or respiratory illness	MRSA Age: 69 % male 58% Respiratory Age: 70.6 % male: 55
Wassenburg (2010)	Cross-sectional matched cohort study Single university hospital, Netherlands November 2006 to February 2007	N = 42 Age: 52 (19) % male: 52	N = 84 Age: 55 (16) % male: 55

### Excluded papers

Reference	Reason for exclusion
Chittick et al (2016)	No comparative data
Godsell (2013)	Focussed on HCP
Jeong (2016)	MERS
MacKellaig (1986)	Qualitative
Madsden (2015)	Qualitative
Maunder (2003)	SARS
Moran (2009)	Focus on family centred care
Morgan (2011)	Focus on process measures

Rees (2000a)	No comparative data
Rees (2000a)	No comparative data
Simon (2016)	Before and after
Wilkins (1988)	No comparative data

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# PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	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.	1-2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Suppl information
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	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.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	5



# PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	None
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Suppl information
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Suppl information
Results of individual studies	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.	Figures
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	None
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	6
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	None
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9-10
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	11
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	None

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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# BMJ Open

## Impact of isolation on hospitalised patients who are infectious: systematic review with quantitative and meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-030371.R1
Article Type:	Original research
Date Submitted by the Author:	23-Aug-2019
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<b>Primary Subject Heading</b>:	Infectious diseases
Secondary Subject Heading:	Mental health, Nursing, Patient-centred medicine
Keywords:	Infection control < INFECTIOUS DISEASES, Anxiety disorders < PSYCHIATRY, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 **Impact of isolation on hospitalised patients who are infectious:**  
4 **systematic review with quantitative and meta-analysis**  
5  
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26  
27 Keywords: Contact isolation; Infection control (MeSH); Patient isolation (MeSH);  
28 Quarantine (MeSH)  
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31 Word count - excluding title page, references, figures and tables – 3 220  
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3 **Impact of isolation on hospitalised patients who are infectious: systematic review**  
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5 **with quantitative and meta-analysis**  
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10 **Abstract**  
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14 Objective

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16 To systematically review the literature exploring impact of isolation on hospitalised  
17 patients who are infectious: psychological and non-psychological outcomes  
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23 Design

24 Systematic review with meta-analysis  
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31 Data Sources

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33 Embase, Medline and Psycinfo were searched from inception until December 2018.  
34  
35 Reference lists and Google Scholar were also handsearched.  
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40 Results

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42 Twenty seven papers published from database inception until December 2018 were  
43 reviewed. A wide range of psychological and non-psychological outcomes were  
44 reported. There was a marked trend for isolated patients to exhibit higher levels of  
45 depression, the pooled standardised mean difference being 1.28 (95% CI: 0.47 to  
46 2.09) and anxiety 1.45 (95% CI: 0.56 to 2.34), although both had high levels of  
47 heterogeneity; and worse outcomes for a range of care-related factors but with  
48 significant variation.  
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## Conclusion

The review indicates that isolation to contain risk of infection has negative consequences for segregated patients. Although strength of the evidence is weak, comprising primarily single centre convenience samples, consistency of the effects may strengthen this conclusion. More research needs to be undertaken to examine this relationship and develop and test interventions to reduce the negative effects of isolation.

## Strengths and limitations of this study

- This review covers a wide variety of literature from a range of different clinical areas.
- Data collected and the methods of collecting data on the impact of isolation is varied across studies.
- These data do not show if these effects are temporary, or in most cases if they are clinically significant.

## Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

## Competing interests statement

No authors have any competing interests to declare

## Introduction

Isolation is an established part of any infection prevention programme. Its purpose is to prevent the transmission of antibiotic-resistant pathogens, those that are highly contagious or cause serious infection.[1] The effectiveness of isolation has been questioned however [2–5] and it can be challenging to undertake, especially if patients' lack of understanding of the need for segregation, boredom or distress result in uncooperative behaviour. [6] A recent survey exploring the care of patients isolated for infectious conditions suggests that in clinical practice the main issues are identifying which patients need to be isolated as quickly as possible and prioritising which patients should be segregated when isolation accommodation is in short supply. Infection preventionists were aware that isolation could have negative effects on patients such as increased risk of anxiety, depression and falls and felt that more should be done to prevent these risks.[6]

Although single rooms are assumed to reduce infection risk, evidence of ability to contain spread is equivocal [7,8] and a recent study conducted in an all-single-room hospital was unable to demonstrate lower infection rates than in hospitals where most care takes place in open wards. [9] This study identified advantages and disadvantages of single room accommodation, whereas isolating infectious patients is generally assumed to result in adverse outcomes.[10]

A systematic review reported eight years ago indicated higher levels of anxiety, depression, perceptions of stigmatisation and a higher incidence of falls, medication errors and other incidents that detract from patient safety among patients who were isolated compared to those who were not.[11] This review reported studies undertaken

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3 before 2010 and included patients whose experiences are unlikely to be comparable:  
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5 children and adults and those isolated to reduce their own risk of infection as well as  
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7 infectious patients. The review was not reported according to standards currently  
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9 expected for systematic reviews [12] and presents a qualitative description of patient  
10  
11 outcomes only. A more rigorously reported and up-to-date systematic review is  
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13 indicated in view of increasing concern about satisfaction with health care and patient  
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15 safety and increasing emphasis on infection prevention as part of the global strategy  
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17 to reduce risks of antimicrobial resistance.[13]  
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24 We undertook a systematic review of the literature to establish the effects of infection  
25  
26 related isolation on psychological and non-psychological care-related outcomes in  
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28 adults. This review is therefore more focussed than that previously undertaken which  
29  
30 also included those in protective isolation, and contains a significant body of literature  
31  
32 published since 2010.  
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### 37 **Method**

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39 The eligibility criteria for inclusion was that studies should compare quantitative data  
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41 on psychological or non-psychological outcomes in adult patients who are in infective  
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43 isolation with those not isolated. Purely symptomatic/disease progression outcomes  
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45 were not included, neither were those looking at patients isolated due to  
46  
47 immunosuppression. Studies not containing comparative data between those isolated  
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49 and not isolated were also excluded. Search terms were: Patient isolation; cross  
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51 infection; contact isolation; respiratory, source or contact isolation; droplet, airborne  
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53 or contact precautions; cubicle; MRSA or methicillin resistant *Staphylococcus aureus*;  
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55 patient safety or harm; depression; anxiety; adaptation; stress; patient satisfaction;  
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3 quality of life. These were searched as free-text and index terms where these existed.  
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5 The information sources used were Embase, Medline and Psycinfo, which were  
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7 searched from inception until December 2018. Reference lists and Google Scholar  
8  
9 were also handsearched. Characteristics of included and excluded papers are shown  
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11 in Supplementary File 1. The PRISMA flow-chart together is given in Supplementary  
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13 File 2. given in with details of excluded papers are given in No protocol was  
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15 published in advance.  
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22 Studies were initially screened for relevance by one author (EP), with the final stage  
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24 being undertaken by two (EP, DG). Data were extracted and checked by two authors  
25  
26 (DG, EP); where there were disagreements data were rechecked for relevance and  
27  
28 accuracy. Where available, raw data were extracted and entered into a spreadsheet,  
29  
30 and depending upon the nature of the data either the risk ratio or standardised mean  
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32 difference calculated. Results were then presented as forest plots. Due to the variety  
33  
34 of different settings and methods it was deemed that the methodological and clinical  
35  
36 heterogeneity was too broad to pool results; apart from those related to anxiety and  
37  
38 depression, for which results were pooled using the random-effects model. All  
39  
40 calculations and plots were produced using the meta and metafor packages in R.[14–  
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42 16] Where raw data were not provided the summary results are given in the text but  
43  
44 not the forest plots. All data relevant to the study are included in the article or  
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46 uploaded as Supplementary File 3.  
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#### 54 **Patient and Public Involvement**

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56 No patient involved.  
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## Results

A total of 3 879 papers were retrieved from the three databases; of which 34 were assessed for eligibility by reading the full text. Of these 13 studies provided data suitable for the calculation of risk ratio, 5 giving psychological outcomes,[17–21] and 12 non-psychological;[19,22–32] and 8 provided data for the calculation of standardised mean differences, 6 giving psychological outcomes,[21,30,33–36] and 2 non-psychological.[29,37] A further 6 studies did not provide raw data but are included in the results; 3 each giving psychological outcomes[38–40] and non-psychological outcomes.[17,41,42] Meta-analyses were possible on two outcomes: anxiety and depression from 8 studies using standardised mean difference. [19–21,30,33–36] Where only risk ratio data were given[20,21] conversion to standardised mean difference was undertaken using the Campbell Collaboration calculator (<https://campbellcollaboration.org/research-resources/effect-size-calculator.html>).[43]

Where it was not possible to pool outcome data because of methodological and clinical heterogeneity, the data from studies are shown as forest plots but without meta-analysis. The forest plots contain results from the studies where sufficient data were given to calculate either the risk ratio or standardised mean difference. A number of studies provided data on those under contact precautions, but no comparative data and so were not included.[44–47]

Because of the large number of non-psychological outcomes for which RR could be calculated, it was decided that a change of 20% (i.e. a RR of 0.8 or less, or 1.2 or more) would be clinically significant, regardless of the statistical significance. This

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3 was a pragmatic decision, and all results are shown in Supplementary File 3. Results  
4 are shown in Figures 1 to 6. Supplementary Figure 1 contains results that did not  
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6 are shown in Figures 1 to 6. Supplementary Figure 1 contains results that did not  
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8 meet our criteria for being clinically significant. Outcomes were classified into one of  
9  
10 three categories: those to do with quality of care; satisfaction of care; and adverse  
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12 events from which median values and interquartile ranges were calculated.  
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17 The studies included were primarily single-centre and consisted of case-control,  
18  
19 cross-sectional and cohort studies. Risk of bias was assessed using the Newcastle-  
20  
21 Ottawa scale, full details of each study and its risk of bias are in the Supplementary  
22  
23 File 4.[48] Overall, although these studies have limited generalisability, there did not  
24  
25 appear to be significant cause for concern regarding bias within the limitations  
26  
27 inherent in these study designs. Most studies used established or validated tools[17–  
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29 21,23–25,27,29,30,33–37] or clinical outcomes.[22,26,28,31,32]  
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35 The data from the comparative studies suggest that although in many cases infective  
36  
37 isolation precautions make little difference to psychological outcomes, where it does  
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39 make a difference this is primarily negative. There were significant declines in mean  
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41 scores related to control and self-esteem, and in many studies increases in the mean  
42  
43 scores for risk of anxiety and depression. However, these findings were not  
44  
45 consistent, and some larger studies showed little or no difference between the groups  
46  
47 for these outcomes. These are shown in Figures 1 and 2 respectively.  
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53 [INSERT FIGURES 1 and 2 HERE]  
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58 Figure 1. Risk ratio of psychological events in those isolated versus not isolated  
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6 Figure 2. Standardised mean difference of psychological scores in those isolated  
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8 versus those not isolated  
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12 For the 8 studies reporting data on anxiety the pooled SMD was 1.45 (95% CI: 0.56 to  
13 2.34); although within this there was significant heterogeneity ( $Q = 168.11$ ,  $df = 7$ ,  $p$   
14  $< 0.0001$ ;  $I^2 = 95.84\%$ ). This was primarily caused by two studies [30,34] which  
15 showed lower levels of anxiety than the remaining studies. For depression the SMD  
16 was 1.28 (95% CI: 0.47 to 2.09); again with significant heterogeneity ( $Q = 154.5$ ,  $df =$   
17 7,  $p < 0.0001$ ;  $I^2 = 95.47\%$ ), in this case the studies falling into two categories, those  
18 with lower [30,34,35] and higher depression scores among those  
19 isolated.[19,20,33,36] The forest plots for these outcomes are shown in Figures 3 and  
20 4 respectively.  
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40 Figure 3. Meta-analysis of the standardised mean difference of anxiety in those  
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42 isolated versus those not isolated  
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47 Figure 4. Meta-analysis of the standardised mean difference of depression in those  
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49 isolated versus those not isolated  
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54 Studies not reporting the raw data showed that contact precautions were associated  
55 with depression OR 1.4 (95% CI 1.2 to 1.5) but not anxiety OR 0.8 (95% CI 0.7 to  
56 1.1) in a non-ICU population.[41] There was also an association with delirium OR  
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3 1.40 (95% CI 1.24 to 1.51); although this was primarily among those who were newly  
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5 diagnosed as needing isolation OR 1.75 (95% CI 1.60 to 1.92,  $p < 0.01$ ) rather than  
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7 those who had been under contact precautions for their entire stay OR 0.97 (95% CI  
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9 0.86 to 1.09,  $p = 0.60$ ).[17] Another study showed no difference in the median values  
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11 for the Hospital Anxiety and Depression Scale anxiety or depression scores (HADS-A  
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13 and -D), or the EuroQol Visual Analogue Scale EQ VAS scores.[42]  
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19 For non-psychological outcomes, using a difference in the risk of +/- 20% of an event  
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21 as being a measure of clinical significance it appears there was a trend for less  
22  
23 attention to be given to, and for more errors to occur in those who were isolated.  
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25 However, again there was wide variation between studies. Data on these outcomes  
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27 are given in Figures 5 and 6, and the non-clinically significant risks in the  
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29 Supplementary Figure 1. For those outcomes associated with quality, the median risk  
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31 ratio (with positive outcomes reversed so a higher risk ratio is associated with a worse  
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33 outcome) was 0.94 (IQR 0.92 to 0.98), satisfaction 0.95 (IQR 0.89 to 1.01) and  
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35 adverse events was 1.27 (0.91 to 2.5). The minimum and maximum risk ratio for  
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37 each category was 0.49 and 1.72; 0.3 and 8; and 0.3 and 18 respectively.  
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45 [INSERT FIGURES 5 and 6 HERE]  
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49 Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated  
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51 with a RR of  $\leq 0.8$  or  $\geq 1.2$   
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54 \* outcome was measured in rate per 100 admissions  
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3 Figure 6. Standardised mean difference of non-psychological scores in those isolated  
4 versus those not isolated  
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7 FIM – functional independence measure  
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12 A study not giving raw data which looked at the rates of falls and pressure ulcers  
13 before and after a policy change that resulted in the discontinuation of contact  
14 precautions for patients with methicillin resistant *Staphylococcus aureus* (MRSA) or  
15 vancomycin resistant enterococci (VRE) found that falls and pressure ulcers were  
16 more common among those with MRSA or VRE both before the change (when they  
17 were in isolation) and afterwards (when they were not). Before the change the number  
18 of falls was 4.57 vs 2.04 per 1000 patient-days respectively ( $p < 0.0001$ ) and pressure  
19 ulcers 4.87 vs 1.22 per 1000 patient-days ( $p < 0.0001$ ). After the policy change the  
20 same numbers were falls 4.82 vs 2.10 ( $p < 0.0001$ ) and pressure ulcers 4.17 vs 1.19 per  
21 1000 patient-days ( $p < 0.0001$ ).[39] Other studies found that staff spent less time with  
22 those on contact precautions: internal medicine interns spent less time with their  
23 isolated patients compared to non-isolated patients, the median times being 5.2 and  
24 6.9 minutes respectively ( $p < 0.001$ )[38]; while the mean number of contacts per hour  
25 with healthcare workers was 2.1 compared to 4.2 in those not isolated ( $p = 0.03$ ),  
26 although the duration was longer at 4.5 minutes compared to 2.8 ( $p = 0.6$ ).[40]  
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49 **Discussion**  
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51 Current recommendations say that contact precautions should include a single room,  
52 with personal protective equipment consisting of a gown and gloves for all patient  
53 contacts or contacts with potentially contaminated environmental areas.[1] This  
54 review has shown that there are a number of apparently negative aspects to contact  
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3 precautions, in particular with regards to psychological effects and a reduction in the  
4 quality of some aspects of care. These data come from studies carried out in a variety  
5 of countries and different types of facilities; although there are few data from  
6 particularly vulnerable populations such as the elderly.  
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14 Although at times there are discussions as to the necessity of contact precautions for  
15 drug resistant organisms, with some arguing that there is mixed evidence for or  
16 against their use[49] another recent review has concluded that they are of great  
17 importance in the control of epidemic and endemic multidrug-resistant  
18 microorganisms.[50] The ethics of using contact precautions and other forms of  
19 isolation rely on a positive assessment of the balance between the risks and benefits of  
20 this to the individual concerned and that of the broader population of patients and  
21 staff.[51] However, even when this assessment is positive, it is important to ensure  
22 that any harm to the individual is minimised.  
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38 One way of balancing the various priorities is to use the GRADE Evidence to  
39 Decision Framework, which provides criteria for making recommendations at the  
40 individual, group and policy-levels, and provides a number of highly patient focussed  
41 criteria for doing this. In addition to the certainty of evidence and resource  
42 requirements, it also requires consideration of: the balance of desirable and  
43 undesirable effects; the impact upon equity; and the feasibility and acceptability of the  
44 intervention.[52] The last two of these might have very different outcomes when  
45 considered at the population and individual levels; and there is certainly evidence here  
46 that for the individual patient the balance of desirable and undesirable effects might  
47 be very different to that of the broader population.  
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However, within the broad population of infected or potentially infected patients, some groups might have different needs. For example a study of people isolated for MERS found that while access to telephones reduced anxiety and anger; access to email, text and internet increased these.[53] This was not an area investigated in any depth in these studies. Another area where information may be lacking is that of age, as older people in particular might feel sadness and loneliness more; and gender, as qualitative data suggest that women in isolation were more concerned about precautions and transmission while men were more resigned, rational and tended to cope better.[54]

In some countries, such as the United States single-rooms have become the standard for new hospitals and so one might expect fewer adverse effects if everyone is in a single room, this being the norm. However it may be that a single room is necessary but not sufficient for these findings, and that it is the combination of a single room with an infection that leads to these results. Certainly it is far from clear that the long list of advantages claimed for single rooms which include reduced stress, the ability to deliver better care, and a lower probability of dietary or medication errors apply to this group of patients.[55]

Caring for patients in single-rooms does have many challenges, but there is evidence that these can be mitigated in a general population;[9] however the expanding literature on how this can be done in a general population does not necessarily apply here due to the necessity of isolation procedures which are, by design, 'a barrier'. Therefore patients' needs for greater social interaction will need a solution quite

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3 different from that which might be used for a different patient population, and the  
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5 benefit of choice about this which single rooms offer does not apply here.[56]  
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10 Although this review has quantified the extent of the problem, we have not been able  
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12 to find solutions in the literature. Care might be improved through increased staff  
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14 attention with more resources being allocated to these patients, although the extra cost  
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16 of contact precautions is already considerable, one estimate being that it was an extra  
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18 \$158.90 (95% CI \$124.90 to \$192.80) per patient day.[57] Alternatively new ways of  
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20 working might be developed, perhaps using technology to mitigate some of these  
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22 problems. Technology might be particularly useful in reducing adverse events such  
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24 as medication or clinical errors; although increasing satisfaction and some areas of  
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26 quality are more likely to be achieved by increasing the availability of staff and other  
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28 people.  
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### 35 Study strengths and limitations

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37 This review suggests that infectious isolation has a number of negative effects on  
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39 patients. Because this evidence is comprised of cohort and case-control studies, a  
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41 claim for a causal relationship can not be made on this evidence, although the strong  
42  
43 and consistent effects across the studies may increase the confidence in this  
44  
45 relationship. There are some qualitative data, although more in-depth mixed-methods  
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47 data where those reporting negative effects are questioned about them would  
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49 strengthen the evidence on this. In some cases large effect sizes were accompanied  
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51 by very wide confidence intervals, suggesting that studies were underpowered, thus  
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53 studies with larger sample sizes would be useful. It would also be useful if there were  
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55 more consistent methods of examining and reporting these data, particularly outside  
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3 of the realms of depression and anxiety where the variety of methods makes analysis  
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5 of the body of evidence difficult.  
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10 Although these data suggest that there is a problem, there is a clear gap both in what  
11  
12 we know about improving the experience of isolation and what can be done in  
13  
14 practical terms to make it more tolerable for patients and their families. In particular  
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16 older people who may be most vulnerable to these negative effects were under-  
17  
18 represented in these studies; and this group are likely to represent an increasingly  
19  
20 large proportion of those isolated. Lastly the use of isolation may need to increase if  
21  
22 the current trends of antimicrobial resistance continue.  
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### 30 Contributors

31  
32 EP, DG and JC conceived the review, EP conducted the search, EP and DG examined  
33  
34 the studies and extracted data, EP undertook the quantitative analysis, EP, DG and JC  
35  
36 undertook the qualitative analysis and wrote the discussion.  
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### 42 Funding

43  
44 This research received no specific grant from any funding agency in the public,  
45  
46 commercial or not-for-profit sector.  
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### 51 Competing interests statement

52  
53 No authors have any competing interests to declare.  
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Data Availability

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

For peer review only

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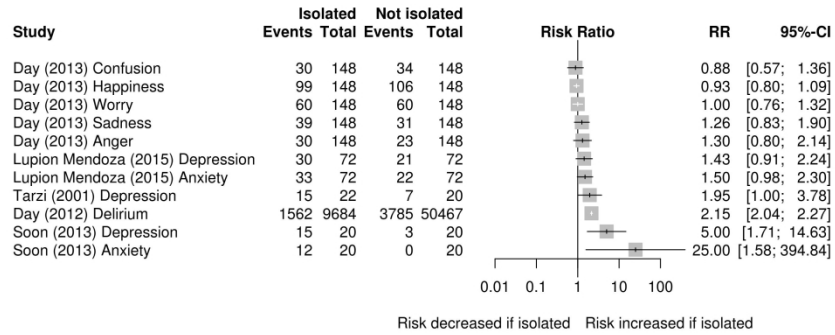


Figure 1. Risk ratio of psychological events in those isolated versus not isolated

279x127mm (300 x 300 DPI)



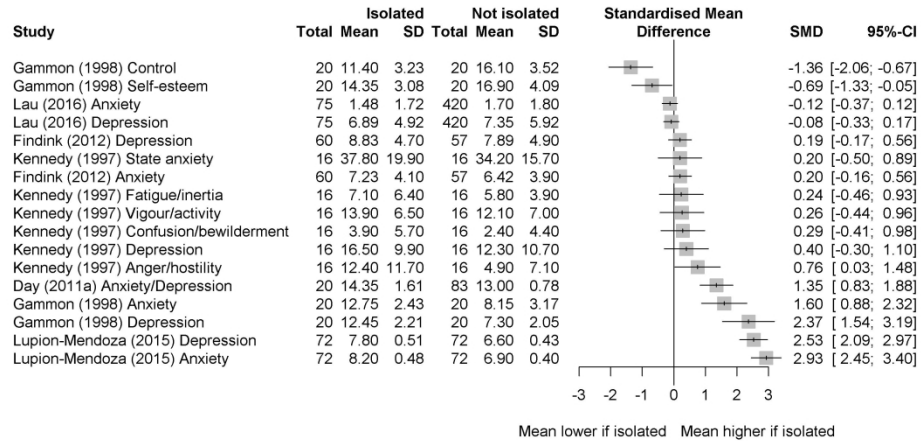


Figure 2. Standardised mean difference of psychological scores in those isolated versus those not isolated

279x152mm (300 x 300 DPI)

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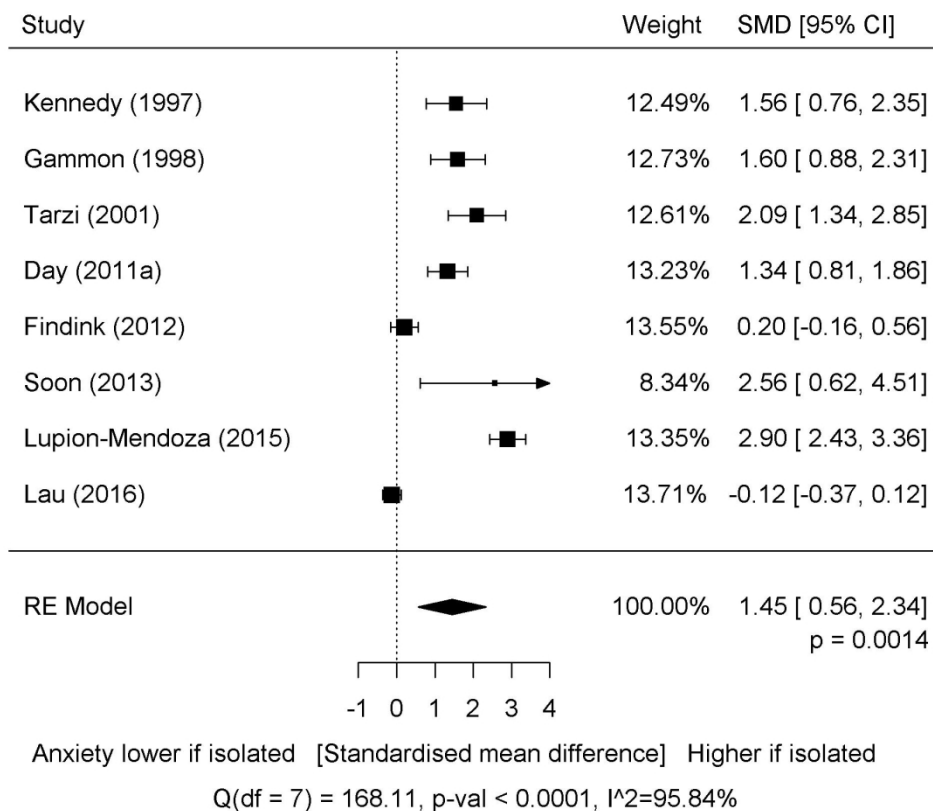


Figure 3. Meta-analysis of the standardised mean difference of anxiety in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

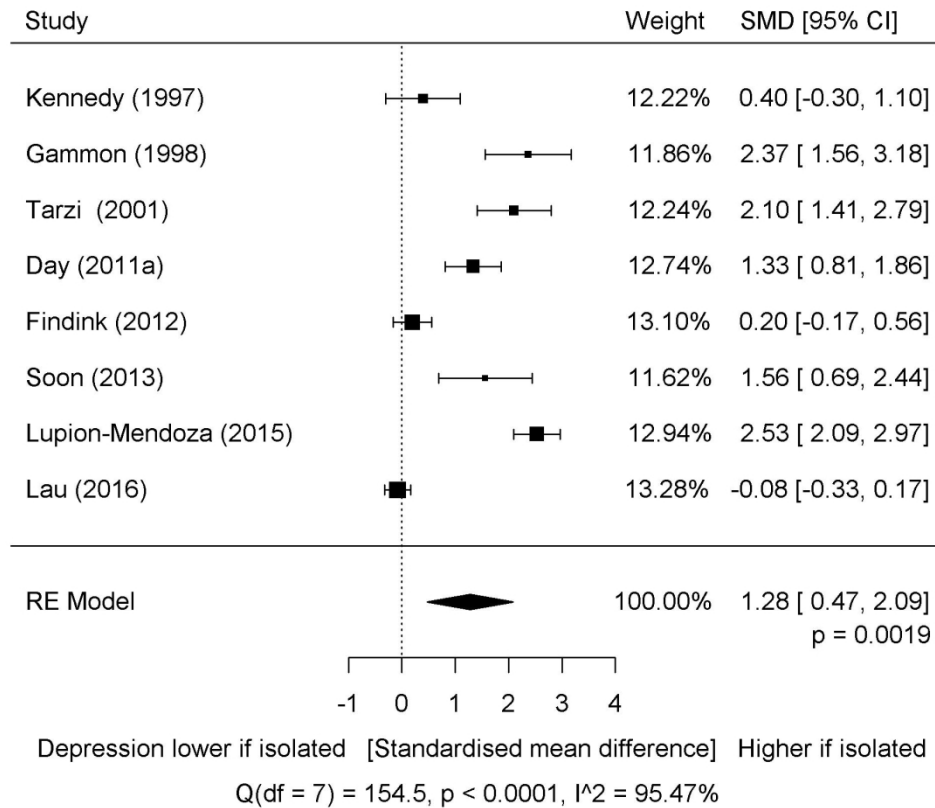


Figure 4. Meta-analysis of the standardised mean difference of depression in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

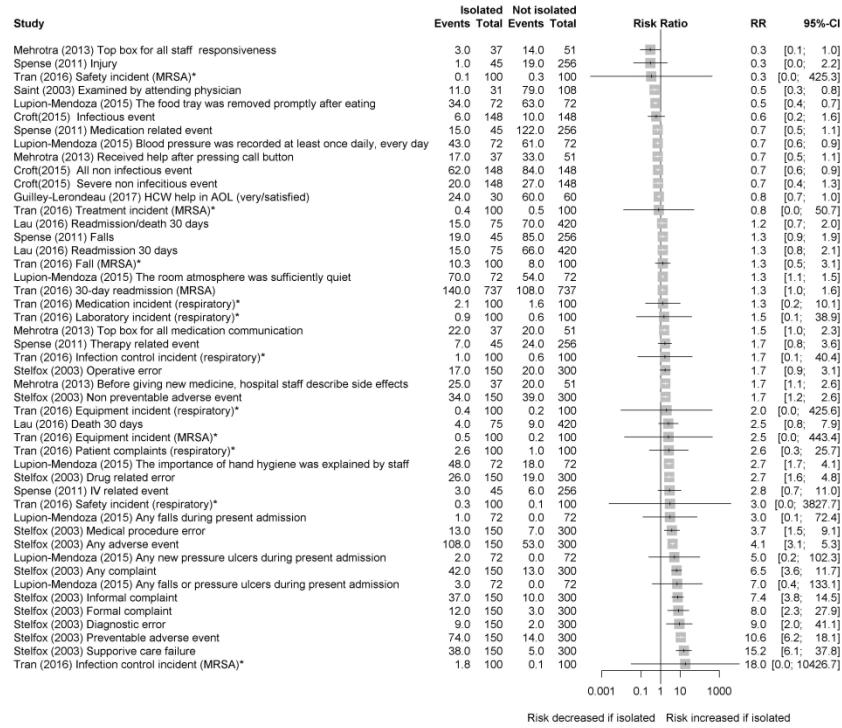


Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated with a RR of  $\leq 0.8$  or  $\geq 1.2$

381x296mm (300 x 300 DPI)

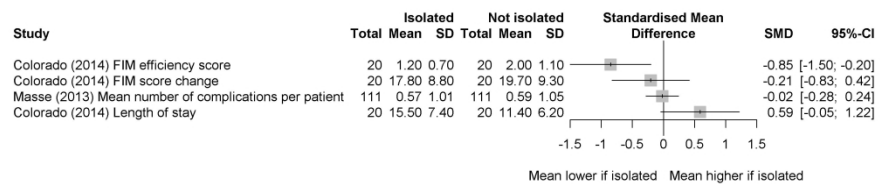


Figure 6. Standardised mean difference of non-psychological scores in those isolated versus those not isolated

321x127mm (300 x 300 DPI)

**Characteristics of studies**

Reference	Study type	Isolated	Non isolated
Colorado (2014)	Retrospective matched case control study. Rehabilitation facility- tertiary centre United States July 2009 to December 2010	N20 Patients in contact isolation	N=20 Matched to patients not in contact isolation based on age, rehabilitation diagnosis, and type of insurance
Croft (2015)	Prospective cohort Medical or surgical inpatients admitted to non-intensive care unit hospital wards, United States. January to November 2010.	N=148 Patients on contact precautions Age: 52 (13.8) % male: 53.4	N=148 Individually matched by after an initial 3-day length of stay to patients not on contact precautions. Age 52.3 (14.6) % male: 46.6
Dashiell-Earp (2014)	Collected real-time data on the location of 15 internal medicine interns, United States. October 1, 2012 to December 31, 2012	1156 encounters	2467 encounters
Day (2011)	Patients admitted to the general acute care units, United States. June 1, 2009 to October 30, 2009	N=20 Age: 68.5 (14.7) % male: 85.0	N=83 Age: 63.9 (12.6) % male: 95.2
Day (2011)	A two-year retrospective cohort Tertiary care, United States.. All general inpatients over 18 years hospitalized for >24 h February 1, 2007 to January 31, 2009.	Contact precautions private room when possible, can be cohorted General N = 3138 Age: 51.2 (17.5) % male 58.9 ITU N=1694 Age: 54.9 (17.5) % male 61.0	General N = 25 426 Age: 49.6 (19.0) % male 46.3% ICU N = 5 854 Age: 56.0 (17.7) % male 59.7
Day (2012)	2-year retrospective cohort study of all non-psychiatric hospital admissions >18 years, United States. February 1, 2007 to January 31, 2009	N = 9 684 Contact precautions as above Mean age: 50.1 (18.8) % male 51.4	N = 50 458 Mean age: 52.3 (16.9) % males 59.1
Day (2013)	Longitudinal frequency-matched cohort study of patients admitted to general medical and surgical units, United States. Day 0, day 3 then weekly. January to November 2010	N = 148 Mean age: 52.0 (13.9) % male 58.1	N = 148 Mean age: 52.3 (14.6) % male 50.7

1 2 3 4 5	Evans (2003)	Prospective observation; survey; retrospective review, United States. Tertiary care. June and July 2001	N 48 Mean age: 47.8 (2) % male 85%	N = 48 Mean age: 58.3 (2.4) % male 75%
6 7 8 9 10	Findink (2012)	Non-random quasi-experiment, Turkey Age 18 to 65 Administered day 5 January 1, 2009 to December 31, 2009	N = 60 Mean age: 53.95 (18.4) % male 75%	N = 57 Mean age: 56.14 (17.1) % male 76.3%
11 12 13 14 15 16 17	Gammon (1998)	Quasi experiment Selected if last two numbers on their case notes even. Two large District General Hospitals and one elderly care hospital, United Kingdom	N = 20 Placed in isolation for a minimum of 7days Mean age: 61 years % male: 65	N = 20 Mean age: 52 years % male: 55
18 19 20 21 22 23	Gandra (2014)	Retrospective hospital-wide cohort study, United States. All patients admitted to medical-surgical inpatient units November 1, 2009 to October 31, 2011	Falls N=77 Mean age: 66.1 (14.3) % male: 61% Pressure ulcers N=82 Mean age: 64.5 (15.5) % male: 63	Falls N=82 Mean age: 63.7 (15.8) % male: 51 (62%) Pressure ulcers N=71 Mean age: 65.7 (15) % male: 57
24 25 26 27 28	Guilley-Lerondeau (2017)	Matched cohort study with prospective inclusions Interview 3 days after commencing General sample. France March to July 2012	N=30 First prescription of isolation precaution Median age (range) 69 (32 to 91) % male 47	N=60 Median age (range) 64 (24 to 91) % male 53
29 30 31 32 33	Kennedy (1997)	Cross-sectional matched-control study, United Kingdom. May 1994 to November 1996	N = 16 Isolated as a result of being MRSA Mean age: 31.1 All male	N = 16 Matched for age, sex, level of injury, and time since admission or injury
34 35	Kirkland (1999)	Observational study - 7 months Medical intensive-care, United States	N=14	N=21
36 37 38 39	Lau (2016)	Prospective cohort study. Adult patients discharged from internal medicine wards, Canada October 2013 to November 2014,	N=75 Mean age 60.35 (17.83) % male 59	N=420 Mean age 63.31 (18.69) % male 48%
40 41 42 43	Livorsi (2015)	Case-control study Retrospective January 1, 2012 to	N = 70 On contact precautions for MRSA throughout	N = 139 No significant differences between isolated and

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	May 31, 2012/prospective June 1, 2012 to March 31, 2013 'safety-net facility', United States	their hospital stay. Found to be MRSA positive during a previous hospitalization or as an outpatient, not current case	non-isolated patients
Lupi3n-Mendoza (2015)	Matched case-control study Tertiary hospital, Spain 2011 and 2012	N = 72 Adult patients admitted in isolation for =>5 days. Median age (range) 62 (21-93) % male 73%	N = 72 Median age (range) 69 (23-89), % male 68.1%
Massee (2013)	Retrospective case-control Tertiary care, Canada	N = 111 Matched MRSA patients with an admission diagnosis of heart failure or COPD to similar non-isolated controls Median age (IQR) 80.0 (69.0-86.0) % male 60.4%	N = 111 Median age (IQR) 80.0 (68.0-86.0) % male 60.4%
Mehrotra (2013)	Prospective cohort Admission and on days 3, 7, 14 Tertiary centre, United States	N = 238 Segregation into a private or cohorted room Mean age (SD) 52.4 (13.4) % male 55.7	N = 290 Mean age (SD) 52.9 (14.8) % male 48
Saint (2003)	Prospective cohort study 2 university-affiliated medical centers, United States. October 1999 to March 2000	N=31	N=108
Soon (2013)	Cross-sectional survey of cases and matched controls Teaching hospital Singapore June and August 2011	N=20 Contact isolation in a cohort cubicle for the first time because of colonization or infection with a MDRO for at least 3 days No statistically significant differences in age or gender	N=20
Spense (2011)	Retrospective evaluation of incident reports All patients admitted to acute care facility, United States January 1, 2008 to December 31, 2008.	N=45	N=256
Stelfox (2003)	Case control study Consecutive adults isolated for at least 2 days with MRSA. Canada and United States Controls patients admitted before	General N = 78 Age: 69.6 (17.1) % male: 45% CHF N = 72 Age: 66.9 (14.7)	General N = 156 Age: 65.4 (18.2) % male: 51% CHF N = 144 Age: 66.0 (14.5)



	and after. January 1, 1999, to January 1, 2000	% male: 58	% male: 54
Tarzi (2001)	Cross-sectional matched case-control study Care of the elderly rehabilitation wards, UK	N = 22 Had been in isolation for at least two weeks with MRSA Mean age (SD) 80 (8.4) % male 27.3	N = 20 Mean age (SD) 81 (9.1) % male 33.3
Tran (2017)	Propensity matched cohort study. General internal medicine services, 3 hospitals, Canada January 2010 to December 2012	MRSA Age: 69 % male 57% Respiratory Age: 71.7 % male: 53 Isolated for MRSA or respiratory illness	MRSA Age: 69 % male 58% Respiratory Age: 70.6 % male: 55
Wassenburg (2010)	Cross-sectional matched cohort study Single university hospital, Netherlands November 2006 to February 2007	N = 42 Age: 52 (19) % male: 52	N = 84 Age: 55 (16) % male: 55

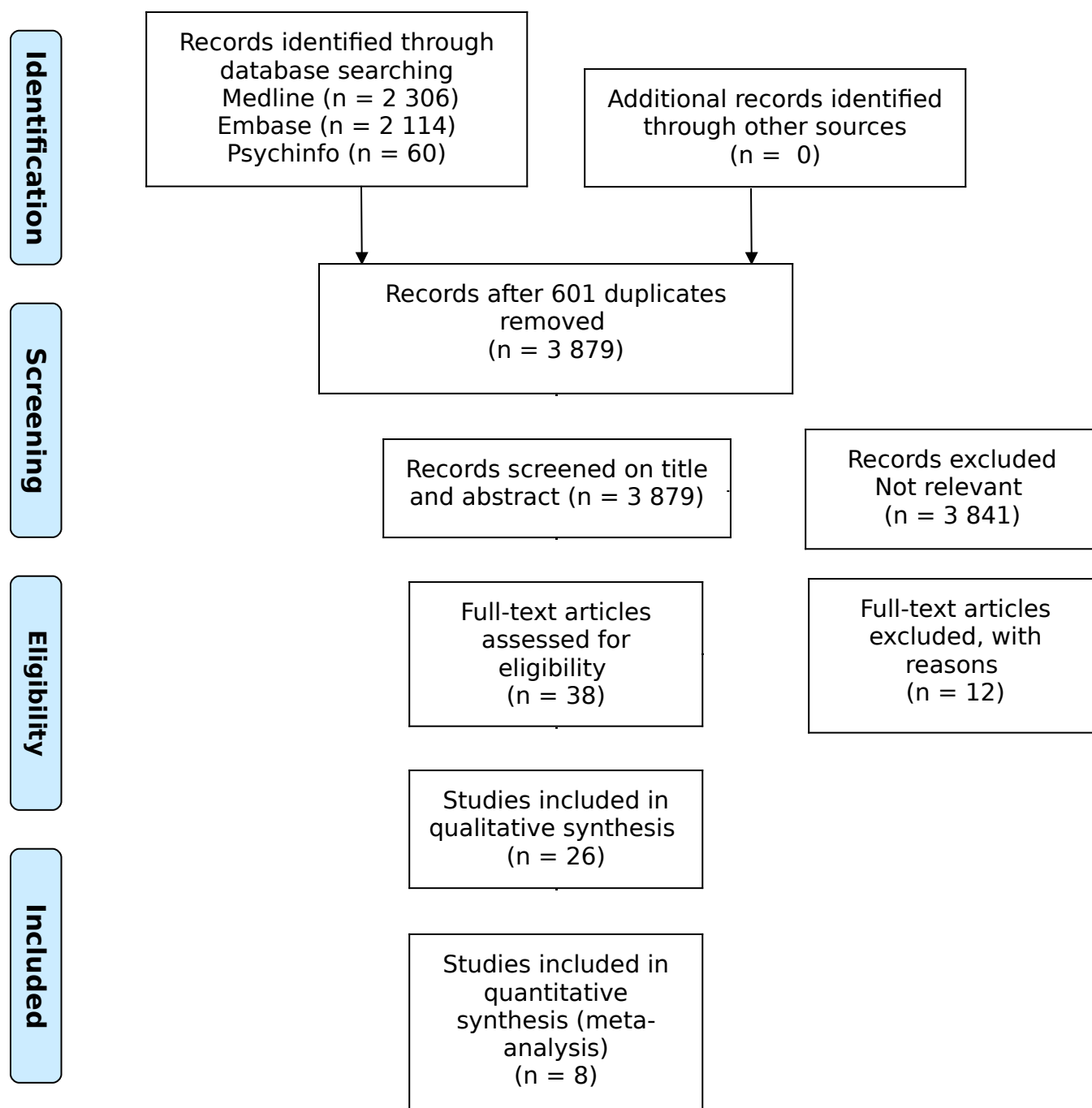
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Excluded papers

Reference	Reason for exclusion
Chittick et al (2016)	No comparative data
Godsell (2013)	Focussed on HCP
Jeong (2016)	MERS
MacKellaig (1986)	Qualitative
Madsden (2015)	Qualitative
Maunder (2003)	SARS
Moran (2009)	Focus on family centred care
Morgan (2011)	Focus on process measures
Rees (2000a)	No comparative data
Rees (2000a)	No comparative data
Simon (2016)	Before and after
Wilkins (1988)	No comparative data



## PRISMA 2009 Flow Diagram



56 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-  
57 Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

58 **For more information, visit [www.prisma-statement.org](http://www.prisma-statement.org).**

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

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## All RR data

	Reference	Year
1		
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4	1 Croft(2015)	2015
5	2 Croft(2015)	2015
6	4 Croft(2015)	2015
7	9 Guilley-Lerondeau (2017)	2017
8	15 Lau (2016)	2016
9	16 Lau (2016)	2016
10	18 Lau (2016)	2016
11	43 Lupion-Mendoza (2015)	2015
12	48 Lupion-Mendoza (2015)	2015
13	50 Lupion-Mendoza (2015)	2015
14	54 Lupion-Mendoza (2015)	2015
15	57 Lupion-Mendoza (2015)	2015
16	58 Lupion-Mendoza (2015)	2015
17	59 Lupion-Mendoza (2015)	2015
18	69 Mehrotra (2013)	2013
19	71 Mehrotra (2013)	2013
20	76 Mehrotra (2013)	2013
21	77 Mehrotra (2013)	2013
22	85 Stelfox (2003)	2003
23	86 Stelfox (2003)	2003
24	87 Stelfox (2003)	2003
25	88 Stelfox (2003)	2003
26	89 Stelfox (2003)	2003
27	90 Stelfox (2003)	2003
28	91 Stelfox (2003)	2003
29	92 Stelfox (2003)	2003
30	93 Stelfox (2003)	2003
31	94 Stelfox (2003)	2003
32	95 Stelfox (2003)	2003
33	96 Spense (2011)	2011
34	97 Spense (2011)	2011
35	98 Spense (2011)	2011
36	99 Spense (2011)	2011
37	100 Spense (2011)	2011
38	102 Saint (2003)	2003
39	103 Tran (2016)	2016
40	106 Tran (2016)	2016
41	107 Tran (2016)	2016
42	108 Tran (2016)	2016
43	109 Tran (2016)	2016
44	113 Tran (2016)	2016
45	114 Tran (2016)	2016
46	116 Tran (2016)	2016
47	117 Tran (2016)	2016
48	118 Tran (2016)	2016
49	120 Tran (2016)	2016
50	122 Tran (2016)	2016
51	3 Croft(2015)	2015
52	5 Evans (2003)	2003
53	6 Evans (2003)	2003
54	7 Evans (2003)	2003
55	8 Guilley-Lerondeau (2017)	2017
56	10 Guilley-Lerondeau (2017)	2017
57	11 Guilley-Lerondeau (2017)	2017
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## All RR data

12	Guilley-Lerondeau (2017)	2017
13	Guilley-Lerondeau (2017)	2017
14	Guilley-Lerondeau (2017)	2017
17	Lau (2016)	2016
19	Livorsi (2015)	2015
20	Livorsi (2015)	2015
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35	Livorsi (2015)	2015
36	Livorsi (2015)	2015
37	Lupion-Mendoza (2015)	2015
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56	Lupion-Mendoza (2015)	2015
60	Masse (2013)	2013
61	Mehrotra (2013)	2013
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All RR data

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81 Mehrotra (2013)	2013
82 Mehrotra (2013)	2013
83 Mehrotra (2013)	2013
84 Mehrotra (2013)	2013
101 Saint (2003)	2003
104 Tran (2016)	2016
105 Tran (2016)	2016
110 Tran (2016)	2016
111 Tran (2016)	2016
112 Tran (2016)	2016
115 Tran (2016)	2016
119 Tran (2016)	2016
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124 Tran (2016)	2016
125 Tran (2016)	2016
126 Tran (2016)	2016
127 Tran (2016)	2016
128 Tran (2016)	2016

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## All RR data

Outcome	Isolated
All non infectious event	62
Severe non infectitious event	20
Infectious event	6
HCW help in AOL (very/satisfied)	24
Readmission/death 30 days	15
Readmission 30 days	15
Death 30 days	4
The importance of hand hygiene was explained by staff	48
The food tray was removed promptly after eating	34
The room atmosphere was sufficiently quiet	70
Blood pressure was recorded at least once daily, every day	43
Any falls during present admission	1
Any new pressure ulcers during present admission	2
Any falls or pressure ulcers during present admission	3
Received help after pressing call button	17
Top box for all staff responsiveness	3
Before giving new medicine, hospital staff describe side effects	25
Top box for all medication communication	22
Any complaint	42
Informal complaint	37
Formal complaint	12
Any adverse event	108
Non preventable adverse event	34
Preventable adverse event	74
Supportive care failure	38
Diagnostic error	9
Operative error	17
Medical procedure error	13
Drug related error	26
Falls	19
Injury	1
IV related event	3
Medication related event	15
Therapy related event	7
Examined by attending physician	11
Fall (MRSA)*	10.3
Treatment incident (MRSA)*	0.4
Infection control incident (MRSA)*	1.8
Safety incident (MRSA)*	0.1
Equipment incident (MRSA)*	0.5
Medication incident (respiratory)*	2.1
Laboratory incident (respiratory)*	0.9
Infection control incident (respiratory)*	1
Safety incident (respiratory)*	0.3
Equipment incident (respiratory)*	0.4
Patient complaints (respiratory)*	2.6
30-day readmission (MRSA)	140
Preventable non infectiouts event	37
Encounters per hr (no)	5
ICU encounters per hr	6
Floor encounters per hr	4
Global hygiene (very/satisfied)	28
Daily room cleaning (very/satisfied)	27
HCW availability (very/satisfied)	25

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## All RR data

Daily HCW presence (very/satisfied)	27
Human relation with HCW (very/satisfied)	27
Global satisfaction (very/satisfied)	25
ED visit 30 days	22
Overall rating of hospital =>9/10	44
Nurses treat you with courtesy and respect	51
Nurses listen carefully	47
Nurses explain things in an understandable way	47
Received help after pressing call button	28
Doctors treat you with courtesy and respect	53
Doctors listen carefully to you	48
Doctors explain things in an understandable way	50
Room and bathroom kept clean	42
Room quiet at night	51
Received help with bathroom/bedpan	19
Pain well controlled	34
Hospital staff help with pain	45
Hospital staff explain new medications	20
Hospital staff describe side effects of medications	13
Hospital staff discussed help after discharge	52
Written information on problems to look for after discharge	52
Recommend hospital to friends and family	43
Overall satisfaction with the professional treatment received from health care workers	67
Nurses treated the patients in polite and respectful manner (totally/partially agree)	70
Physicians treated the patients in polite and respectful manner	71
Nurses provided clear information about the health problem	64
Physicians provided clear information about the health problem	66
Clear explanations were provided before all procedures	62
Health care workers entered the room whenever the patient called them	66
Blood pressure and temperature recorded at least once a day	65
The physician visited daily	69
The room was comfortable	62
Room cleaning was satisfactory	66
I frequently felt lonely during admission	17
Medical notes were recorded every day	64
Nurses notes were recorded every day	64
Daily temperature was recorded at least once a day, every day	53
Daily glycemc levels were recorded as indicated, everyday (only diabetic patients)	31
Total number of complications	60
Nurses treat with courtesy and respect	31
Nurses listen carefully	30
Nurses explain things in understandable way	30
Top box for all nursing communication	27
Doctors treat with courtesy and respect	33
Doctors listen carefully	31
Doctors explain things in understandable way	29
Top box for all doctor communication	27
Received help in bathroom/bedpan use	25
Pain well controlled	26
Hospital staff help with pain	26
Top box for all pain management	25
Before giving new medicine, hospital staff tells what it is for	30
Spoken with about having necessary help after discharge	31
Written information on symptoms/problems to look for after discharge	33
Top box for all discharge information	30



## All RR data

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4	Hospital room and bathroom kept clean (individual)	27
5	Area near room quiet at night (individual)	24
6	Recommend hospital to friends and family (global)	25
7	Overall hospital rating (global)	22
8	Examined by senior resident doctor	26
9	Medication incident (MRSA)*	2.2
10	Laboratory incident (MRSA)*	0.3
11	Any adverse event (MRSA)*	12.4
12	Patient complaints (MRSA)*	1.1
13	Fall (respiratory)*	4.2
14	Treatment incident (respiratory)*	0.6
15	Any adverse event (respiratory)*	9.1
16	Inpatient mortality (MRSA)	59
17	30-day ED visit (MRSA)	84
18	Readmission or ED visit (respiratory)	167
19	Inpatient mortality (respiratory)	104
20	30-day readmission (respiratory)	206
21	30-day ED visit (respiratory)	164
22	Readmission or ED visit (respiratory)	261
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	Isolated.N	Control	Control.N	RI	RC	RR	inout	Type
1								
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4	148	84	148	0.418918919	0.567567568	0.738095238	a	AE
5	148	27	148	0.135135135	0.182432432	0.740740741	a	AE
6	148	10	148	0.040540541	0.067567568	0.6	a	AE
7	30	60	60	0.8	1	1.25	a	Satisfaction
8	75	70	420	0.2	0.166666667	1.2	a	AE
9	75	66	420	0.2	0.157142857	1.272727273	a	AE
10	75	9	420	0.053333333	0.021428571	2.488888889	a	AE
11	72	18	72	0.666666667	0.25	0.375	a	Satisfaction
12	72	63	72	0.472222222	0.875	1.852941177	a	Satisfaction
13	72	54	72	0.972222222	0.75	0.771428572	a	Satisfaction
14	72	61	72	0.597222222	0.847222222	0.704918033	a	Quality
15	72	0	72	0.013888889	0	#DIV/0!	a	AE
16	72	0	72	0.027777778	0	#DIV/0!	a	AE
17	72	0	72	0.041666667	0	#DIV/0!	a	AE
18	37	33	51	0.459459459	0.647058824	1.408304501	a	Quality
19	37	14	51	0.081081081	0.274509804	3.385620919	a	Satisfaction
20	37	20	51	0.675675676	0.392156863	0.580392157	a	Quality
21	37	20	51	0.594594595	0.392156863	0.659536542	a	Quality
22	150	13	300	0.28	0.043333333	6.461538462	a	Satisfaction
23	150	10	300	0.246666667	0.033333333	7.4	a	Satisfaction
24	150	3	300	0.08	0.01	8	a	Satisfaction
25	150	53	300	0.72	0.176666667	4.075471698	a	Satisfaction
26	150	39	300	0.226666667	0.13	1.743589744	a	AE
27	150	14	300	0.493333333	0.046666667	10.57142857	a	AE
28	150	5	300	0.253333333	0.016666667	15.2	a	AE
29	150	2	300	0.06	0.006666667	9	a	AE
30	150	20	300	0.113333333	0.066666667	1.7	a	AE
31	150	7	300	0.086666667	0.023333333	3.714285714	a	AE
32	150	19	300	0.173333333	0.063333333	2.736842105	a	AE
33	45	85	256	0.422222222	0.33203125	1.271633987	a	AE
34	45	19	256	0.022222222	0.07421875	0.299415205	a	AE
35	45	6	256	0.066666667	0.0234375	2.844444444	a	AE
36	45	122	256	0.333333333	0.4765625	0.699453552	a	AE
37	45	24	256	0.155555556	0.09375	1.659259259	a	AE
38	31	79	108	0.35483871	0.731481481	2.061447808	a	Quality
39	100	8	100	0.103	0.08	1.2875	a	AE
40	100	0.5	100	0.004	0.005	0.8	a	AE
41	100	0.1	100	0.018	0.0011	16.36363636	a	AE
42	100	0.3	100	0.001	0.003	0.333333333	a	AE
43	100	0.2	100	0.005	0.002	2.5	a	AE
44	100	1.6	100	0.021	0.016	1.3125	a	AE
45	100	0.6	100	0.009	0.006	1.5	a	AE
46	100	0.6	100	0.01	0.006	1.666666667	a	AE
47	100	0.1	100	0.003	0.001	3	a	AE
48	100	0.2	100	0.004	0.002	2	a	AE
49	100	1	100	0.026	0.01	2.6	a	Satisfaction
50	737	108	737	0.19	0.147	1.292517007	a	AE
51	148	41	148	0.25	0.277027027	0.902439024	b	AE
52	485	11	1002	0.010309278	0.010978044	1.064870304	b	Quality
53	319	14	658	0.018808777	0.021276596	1.131205713	b	Quality
54	166	8	344	0.024096386	0.023255814	0.965116263	b	Quality
55	30	59	60	0.933333333	0.983333333	1.053571429	b	Satisfaction
56	30	58	60	0.9	0.966666667	1.074074074	b	Satisfaction
57	30	57	60	0.833333333	0.95	1.14	b	Satisfaction
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4	30	59	60	0.9	0.983333333	1.092592592	b	Satisfaction			
5	30	60	60	0.9	1	1.111111111	b	Satisfaction			
6	30	60	60	0.833333333	1	1.2	b	Satisfaction			
7	75	109	420	0.293333333	0.25952381	1.130275229	b	AE			
8	68	85	135	0.647058824	0.62962963	0.973063973	b	Satisfaction			
9	69	110	138	0.739130435	0.797101449	1.078431372	b	Satisfaction			
10	70	101	137	0.671428571	0.737226277	1.097996583	b	Satisfaction			
11	69	102	135	0.68115942	0.755555556	1.109219859	b	Satisfaction			
12	52	70	114	0.538461538	0.614035088	1.140350879	b	Satisfaction			
13	70	106	137	0.757142857	0.773722628	1.021897811	b	Satisfaction			
14	68	103	136	0.705882353	0.757352941	1.072916666	b	Satisfaction			
15	68	99	137	0.735294118	0.722627737	0.982773722	b	Satisfaction			
16	68	82	127	0.617647059	0.645669291	1.045369328	b	Satisfaction			
17	70	98	137	0.728571429	0.715328467	0.981823386	b	Satisfaction			
18	30	49	68	0.633333333	0.720588235	1.137770898	b	Satisfaction			
19	62	75	117	0.548387097	0.641025641	1.16892911	b	Satisfaction			
20	62	96	115	0.725806452	0.834782609	1.150144927	b	Satisfaction			
21	27	47	59	0.740740741	0.796610169	1.075423728	b	Satisfaction			
22	25	35	57	0.52	0.614035088	1.180836708	b	Satisfaction			
23	61	108	124	0.852459016	0.870967742	1.021712159	b	Satisfaction			
24	62	106	120	0.838709677	0.883333333	1.053205128	b	Satisfaction			
25	67	98	133	0.641791045	0.736842105	1.148102814	b	Satisfaction			
26	72	69	72	0.930555556	0.958333333	1.029850745	b	Satisfaction			
27	72	71	72	0.972222222	0.986111111	1.014285714	b	Satisfaction			
28	72	72	72	0.986111111	1	1.014084507	b	Satisfaction			
29	72	68	72	0.888888889	0.944444444	1.062499999	b	Satisfaction			
30	72	62	72	0.916666667	0.861111111	0.939393939	b	Satisfaction			
31	72	66	72	0.861111111	0.916666667	1.06451613	b	Satisfaction			
32	72	71	72	0.916666667	0.986111111	1.075757575	b	Satisfaction			
33	72	70	72	0.902777778	0.972222222	1.076923076	b	Quality			
34	72	71	72	0.958333333	0.986111111	1.028985507	b	Quality			
35	72	67	72	0.861111111	0.930555556	1.080645162	b	Satisfaction			
36	72	70	72	0.916666667	0.972222222	1.06060606	b	Quality			
37	72	17	72	0.236111111	0.236111111	1	b	Satisfaction			
38	72	65	72	0.888888889	0.902777778	1.015625	b	Quality			
39	72	69	72	0.888888889	0.958333333	1.078124999	b	Quality			
40	72	60	72	0.736111111	0.833333333	1.132075471	b	Quality			
41	31	18	18	1	1	1	b	Quality			
42	111	62	111	0.540540541	0.558558559	0.967741935	b	Satisfaction			
43	37	45	51	0.837837838	0.882352941	1.053130929	b	Satisfaction			
44	37	43	51	0.810810811	0.843137255	1.039869281	b	Satisfaction			
45	37	42	51	0.810810811	0.823529412	1.015686275	b	Satisfaction			
46	37	39	51	0.72972973	0.764705882	1.047930282	b	Satisfaction			
47	37	42	51	0.891891892	0.823529412	0.923351159	b	Satisfaction			
48	37	42	51	0.837837838	0.823529412	0.982922201	b	Satisfaction			
49	37	44	51	0.783783784	0.862745098	1.100743745	b	Satisfaction			
50	37	37	51	0.72972973	0.725490196	0.994190268	b	Satisfaction			
51	37	35	51	0.675675676	0.68627451	1.015686274	b	Quality			
52	37	40	51	0.702702703	0.784313725	1.116138762	b	Quality			
53	37	38	51	0.702702703	0.745098039	1.060331824	b	Quality			
54	37	35	51	0.675675676	0.68627451	1.015686274	b	Quality			
55	37	41	51	0.810810811	0.803921569	0.991503268	b	Quality			
56	37	45	51	0.837837838	0.882352941	1.053130929	b	Quality			
57	37	49	51	0.891891892	0.960784314	1.077243019	b	Quality			
58	37	45	51	0.810810811	0.882352941	1.088235294	b	Quality			
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## All RR data

37	37	51	0.72972973	0.725490196	0.994190268	b	Quality
37	32	51	0.648648649	0.62745098	0.96732026	b	Satisfaction
37	41	51	0.675675676	0.803921569	1.189803922	b	Satisfaction
37	36	51	0.594594595	0.705882353	1.187165775	b	Satisfaction
31	94	108	0.838709677	0.87037037	1.037749288	b	Quality
100	2.4	100	0.022	0.024	0.916666667	b	AE
100	0.3	100	0.0027	0.0033	0.818181818	b	AE
100	10.7	100	0.124	0.107	1.158878505	b	AE
100	1.3	100	0.0109	0.0125	0.872	b	Satisfaction
100	5.1	100	0.042	0.051	0.823529412	b	AE
100	0.7	100	0.006	0.007	0.857142857	b	AE
100	8.9	100	0.091	0.089	1.02247191	b	AE
737	52	737	0.08	0.07	1.142857143	b	AE
737	86	737	0.114	0.117	0.974358974	b	AE
737	142	737	0.227	0.193	1.176165803	b	AE
1502	128	1502	0.069	0.085	0.811764706	b	AE
1502	236	1502	0.137	0.157	0.872611465	b	AE
1502	168	1502	0.109	0.112	0.973214286	b	AE
1502	278	1502	0.174	0.185	0.940540541	b	AE

## All RR data

	Good/bad	exp yi	yi	vi	
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4	Good/bad	exp yi	yi	vi	
5	Bad		0.74	-0.303682414	0.014520281
6	Bad		0.74	-0.300104592	0.073523524
7	Bad		0.60	-0.510825624	0.253153153
8	Good		0.80	-0.227083588	0.008693745
9	Bad		1.20	0.182321557	0.065238095
10	Bad		1.27	0.241162057	0.066103896
11	Bad		2.49	0.911836382	0.345396825
12	Good		2.67	0.980829253	0.048611111
13	Good		0.54	-0.616774202	0.017507003
14	Good		1.30	0.259511195	0.005026455
15	Good		0.70	-0.349673748	0.011871479
16	Bad		3.00	1.098612289	2.639269406
17	Bad		5.00	1.609437912	2.37260274
18	Bad		7.00	1.945910149	2.258317025
19	Good		0.71	-0.342386497	0.04249169
20	Good		0.30	-1.219537321	0.358127035
21	Good		1.72	0.544051271	0.04336513
22	Good		1.52	0.4162179	0.048819675
23	Bad		6.46	1.865867441	0.090732601
24	Bad		7.40	2.00148	0.117027027
25	Bad		8.00	2.079441542	0.406666667
26	Bad		4.08	1.404986494	0.018127184
27	Bad		1.74	0.555946059	0.04505279
28	Bad		10.57	2.358154944	0.074942085
29	Bad		15.20	2.721295428	0.216315789
30	Bad		9.00	2.197224577	0.601111111
31	Bad		1.70	0.530628251	0.098823529
32	Bad		3.71	1.312186389	0.20978022
33	Bad		2.74	1.006804739	0.081093117
34	Bad		1.27	0.240302677	0.038267813
35	Bad		0.30	-1.205924024	1.026503107
36	Bad		2.84	1.045367774	0.473871528
37	Bad		0.70	-0.357455889	0.048734916
38	Bad		1.66	0.506371273	0.158395337
39	Good		0.49	-0.723408557	0.062049995
40	Bad		1.29	0.252702354	0.202087379
41	Bad		0.80	-0.223143551	4.48
42	Bad		18.00	2.890371758	10.53555556
43	Bad		0.33	-1.098612289	13.31333333
44	Bad		2.50	0.916290732	6.98
45	Bad		1.31	0.271933715	1.081190476
46	Bad		1.50	0.405465108	2.757777778
47	Bad		1.67	0.510825624	2.646666667
48	Bad		3.00	1.098612289	13.31333333
49	Bad		2.00	0.693147181	7.48
50	Bad		2.60	0.955511445	1.364615385
51	Bad		1.30	0.259511195	0.013688412
52	Bad		0.90	-0.102654154	0.037903757
53	Good		0.94	-0.06285297	0.287849231
54	Good		0.88	-0.123284032	0.233440685
55	Good		1.04	0.035506688	0.366068927
56	Good		0.95	-0.052185753	0.002663438
57	Good		0.93	-0.071458964	0.004278416
58	Good		0.88	-0.131028262	0.00754386
59	Good				
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## All RR data

Good	0.92	-0.088553397	0.00398619
Good	0.89	-0.111570701	0.004241055
Good	0.83	-0.187078253	0.007093105
Bad	1.13	0.122461169	0.038914572
Good	1.03	0.027305451	0.012378689
Good	0.93	-0.075507553	0.006959622
Good	0.91	-0.093487231	0.009592601
Good	0.90	-0.103656938	0.009180356
Good	0.88	-0.131336002	0.021997301
Good	0.98	-0.021661497	0.006716902
Good	0.93	-0.070380797	0.008483248
Good	1.02	0.017376376	0.008095858
Good	0.96	-0.044370248	0.013424748
Good	1.02	0.018343838	0.00822694
Good	0.88	-0.129070995	0.025000527
Good	0.86	-0.156088039	0.018069057
Good	0.87	-0.139887958	0.007814204
Good	0.93	-0.07271475	0.017290406
Good	0.85	-0.166223261	0.047950646
Good	0.98	-0.021479807	0.00403207
Good	0.95	-0.051838018	0.004202366
Good	0.87	-0.138110854	0.011015725
Good	0.97	-0.029413885	0.001640349
Good	0.99	-0.014184635	0.000592444
Good	0.99	-0.013889112	0.000381857
Good	0.94	-0.060624622	0.002553105
Good	1.06	0.062520357	0.00350277
Good	0.94	-0.062520357	0.00350277
Good	0.93	-0.073025135	0.001458244
Good	0.93	-0.074107972	0.001892552
Good	0.97	-0.028573372	0.000799483
Good	0.93	-0.077558234	0.003276628
Good	0.94	-0.0588405	0.001659452
Bad	1.00	0	0.089869281
Good	0.98	-0.015504187	0.003231838
Good	0.93	-0.075223421	0.002339976
Good	0.88	-0.124052649	0.007756813
Good	1.01	0.01091989	0.001918507
Bad	0.97	-0.032789823	0.014777681
Good	0.95	-0.051767565	0.007845417
Good	0.96	-0.039095014	0.009954277
Good	0.98	-0.015564517	0.010507987
Good	0.95	-0.04681706	0.016043193
Good	1.08	0.079745663	0.007477684
Good	1.02	0.017225306	0.009432718
Good	0.91	-0.095986084	0.010575161
Good	1.01	0.005826673	0.017429194
Good	0.98	-0.015564517	0.021936558
Good	0.90	-0.109875196	0.016826668
Good	0.94	-0.058581902	0.018142458
Good	0.98	-0.015564517	0.021936558
Good	1.01	0.008533035	0.011088707
Good	0.95	-0.051767565	0.007845417
Good	0.93	-0.074405017	0.004076323
Good	0.92	-0.084557388	0.008920685

## All RR data

3	Good	1.01	0.005826673	0.017429194
4	Good	1.03	0.033225648	0.026281797
5	Good	0.84	-0.173788522	0.017755374
6	Good	0.84	-0.171568765	0.026597453
7	Good	0.96	-0.037054222	0.007582513
8	Bad	0.92	-0.087011377	0.851212121
9	Bad	1.00	0	6.646666667
10	Bad	1.16	0.147452731	0.154103105
11	Bad	0.85	-0.167054085	1.658321678
12	Bad	0.82	-0.194156014	0.414173669
13	Bad	0.86	-0.15415068	3.075238095
14	Bad	1.02	0.022223137	0.20224966
15	Bad	1.13	0.126293725	0.033466218
16	Bad	0.98	-0.023530497	0.020818965
17	Bad	1.18	0.162166755	0.010316573
18	Bad	0.81	-0.207639365	0.016096327
19	Bad	0.87	-0.135955636	0.007760099
20	Bad	0.98	-0.024097552	0.010718384
21	Bad	0.94	-0.063100706	0.006096982

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Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
2 Kennedy (1	1997	Anxiety	37.8	19.9	16	12.3	10.7
9 Gammon ('	1998	Anxiety	12.75	2.43	20	8.15	3.17
15 Tarzi (2001	2001	Anxiety	15	3	22	8.6	3
16 Day (2011a	2011	Anxiety/Dep	14.35	1.61	20	13	0.8
13 Findink (20	2012	Anxiety	7.23	4.1	61	6.42	3.9
Soon (2013	2013	Anxiety					
17 Lupion-Mer	2015	Anxiety	8.2	0.48	72	6.9	0.41
8 Lau (2016)	2016	Anxiety	1.48	1.72	75	1.7	1.8

For peer review only



Control.N	yi	vi
16	1.5558	0.1628
20	1.5963	0.1319
20	2.093	0.1476
83	1.3351	0.0707
57	0.201	0.0341
	2.5649	0.986
72	2.8969	0.0569
421	-0.1228	0.0157

For peer review only

Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
1 Kennedy (1	1997	Depression	16.5	9.9	16	12.3	10.7
10 Gammon (	1998	Depression	12.45	2.21	20	7.3	2.05
Tarzi (200	2001	Depression					
16 Day (2011	2011	Anxiety/De	14.3	1.61	20	13	0.8
14 Findink (20	2012	Depression	8.83	4.7	61	7.89	4.9
Soon (2013	2013	Depression					
18 Lupion-Mer	2015	Depression	7.8	0.51	72	6.6	0.43
7 Lau (2016)	2016	Depression	6.89	4.92	75	7.35	5.92

For peer review only

Control.N	yi	vi
16	0.397	0.127
20	2.368	0.17
	2.101	0.125
83	1.335	0.071
57	0.195	0.034
	1.562	0.2
72	2.531	0.05
420	-0.079	0.016

For peer review only

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**Case-control studies**

	Colorado (2014)	Kennedy (1997)	Livorsi (2015)	Lupion (2015)	Masse (2013)	Soon (2013)	Tarzi (2001)
1) <u>Is the case definition adequate?</u> a) yes, with independent validation * b) yes, eg record linkage or based on self reports c) no description	*	*	*	*	*	*	*
2) <u>Representativeness of the cases</u> a) consecutive or obviously representative series of cases * b) potential for selection biases or not stated	b	b	*	b	b	*	*
3) <u>Selection of Controls</u> a) community controls (studies of hospital patients) * b) hospital controls c) no description	*	*	*	*	*	*	*
4) <u>Definition of Controls</u> a) no history of disease (endpoint) * b) no description of source	*			*			
<b>Comparability</b>							
1) <u>Comparability of cases and controls on the basis of the design or analysis</u> a) study controls for diagnosis * b) study controls for any additional factor *	* * (l)	* * (l, g)		* * (g)	* * (g)	* * (l, g)	* * (l, g)
<b>Outcome</b>							
1) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview where blind to case/control status * c) interview not blinded to case/control status d) written self report or medical record only e) no description	*	*	*	*	*	*	*
2) <u>Same method of ascertainment for cases and controls</u> a) yes * b) no	Functional Independence Measure ## *	Functional Independence Measure; Beck Inventory Depression; State Anxiety Inventory; Profile Mood States ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Charlston Comorbidity Index ## *	Hospital Anxiety and Depression Scale ## *	Geriatric Depression Scale; Profile of Mood States; Abbreviated Mental Test Score; Barthel Index ## *
3) <u>Non-Response rate</u> a) same rate for both groups * b) non respondents described c) rate different and no designation	*	*	*	*			*

**Cohort studies (1)**

Selection	Croft (2015)	Day (2011) a	Day (2011) b	Day (2012)	Day (2013)	Evans (2003)	Findink (2012)	Guilley (2017)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*	*	*	*	* b	c	*b	*b
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*	*	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	b	b	*	*	*		*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *	* * (l,g)		* * (l,g)	* * (l,g)	* * (l,g)			* (g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	Global Trigger Tool ### *	Hospital Anxiety and Depression Scale ## *	*	Clinical diagnosis of delirium *	Hospital Anxiety and Depression Scale ### *	Clinical encounters per hour *	Hospital Anxiety and Depression Scale ## *	State-Trait Anxiety Inventory ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*	*	*	*	* 3 days	*	*	
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*	*	*	*	*	*	*	*

Community – was hospital population  
Time to outcome of interest – question is regarding outcome during isolation

a – age  
g- gender  
l – LOS

# own scale  
## validated scale/s used appropriately

## Cohort studies (2)

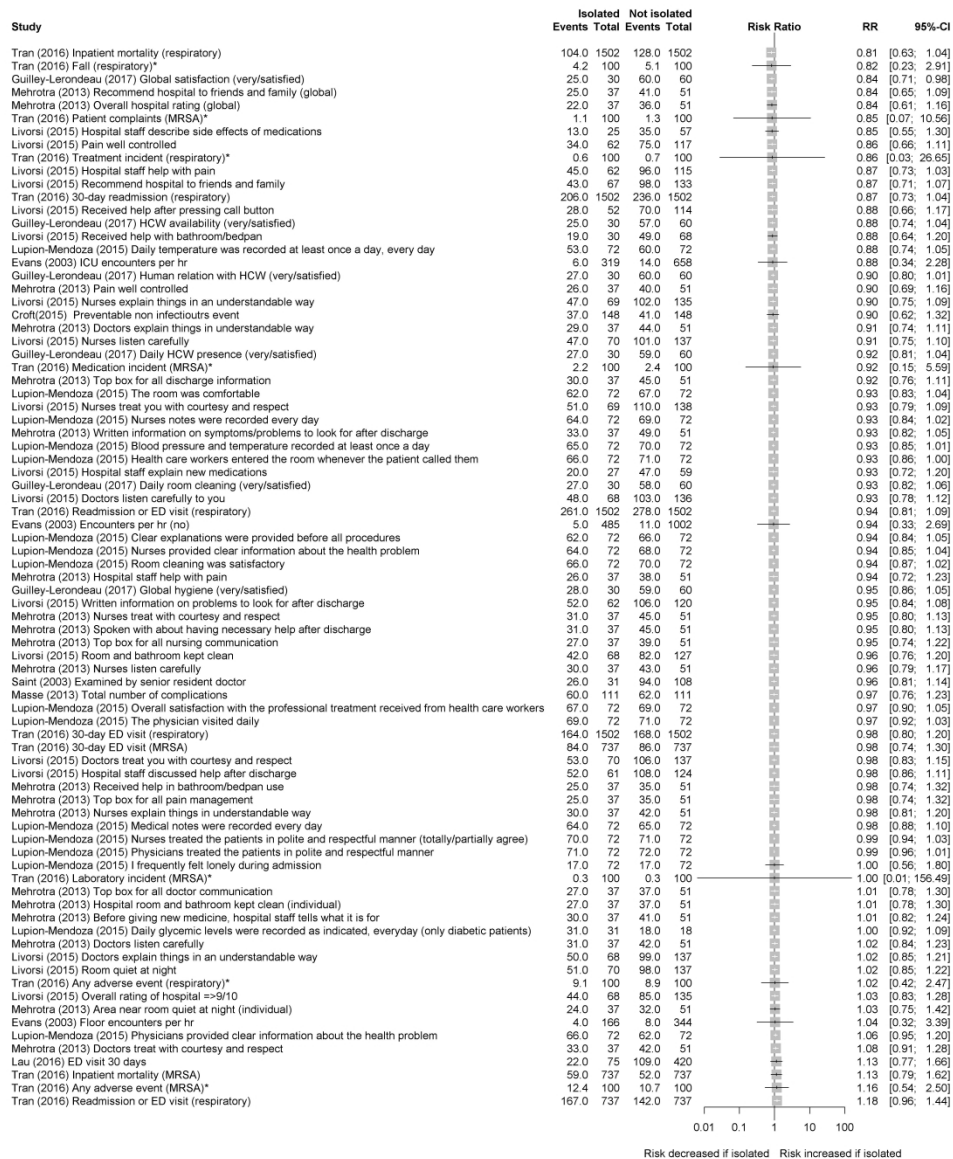
Selection	Kirkland (1999)	Lau (2016)	Mehotra (2013)	Stelfox (2003)	Spense (2011)	Saint (2003)	Tran (2016)	Wassenberg (2010)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*b	*	*	*	b	*	*	*
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*b	*b	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	*	*	*	*	*	*	*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *		* (g)	* * (l,g)	* * (l,g)		*	* * (l,g)	(l,g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	* #	Patient Health Questionnaire-9; CQ-5D c telephone /health records ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Clinical satisfaction # *	Clinical outcomes *	Observation of doctors *	Clinical outcomes *	EQ5-D; Hospital Anxiety and Depression Scale ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*		*	*	*	*	*	*
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*		37/278 contact; 51/290 non	*	*		*	*

## General notes

Community – the population of interest was a hospital population

Time to outcome of interest – question is regarding outcome during isolation or shortly afterwards

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# BMJ Open

## Impact of isolation on hospitalised patients who are infectious: systematic review with meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-030371.R2
Article Type:	Original research
Date Submitted by the Author:	20-Nov-2019
Complete List of Authors:	Purssell, Edward; City, University of London, School of Health Sciences Gould, Dinah; City, University of London, School of Health Sciences Chudleigh, Jane; City, University of London, School of Health Sciences
<b>Primary Subject Heading</b>:	Infectious diseases
Secondary Subject Heading:	Mental health, Nursing, Patient-centred medicine
Keywords:	Infection control < INFECTIOUS DISEASES, Anxiety disorders < PSYCHIATRY, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 **Impact of isolation on hospitalised patients who are infectious:**  
4 **systematic review with meta-analysis**  
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6

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26  
27 Keywords: Contact isolation; Infection control (MeSH); Patient isolation (MeSH);  
28 Quarantine (MeSH)  
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30  
31 Word count - excluding title page, references, figures and tables – 3 301  
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3 **Impact of isolation on hospitalised patients who are infectious: systematic review**  
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5 **with quantitative and meta-analysis**  
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10 **Abstract**  
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15 Objective

16  
17 To systematically review the literature exploring impact of isolation on hospitalised  
18 patients who are infectious: psychological and non-psychological outcomes  
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24 Design

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26 Systematic review with meta-analysis  
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31 Data Sources

32  
33 Embase, Medline and Psychinfo were searched from inception until December 2018.  
34  
35 Reference lists and Google Scholar were also handsearched.  
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40  
41 Results

42  
43 Twenty six papers published from database inception until December 2018 were  
44 reviewed. A wide range of psychological and non-psychological outcomes were  
45 reported. There was a marked trend for isolated patients to exhibit higher levels of  
46 depression, the pooled standardised mean difference being 1.28 (95% CI: 0.47 to  
47 2.09) and anxiety 1.45 (95% CI: 0.56 to 2.34), although both had high levels of  
48 heterogeneity; and worse outcomes for a range of care-related factors but with  
49 significant variation.  
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## Conclusion

The review indicates that isolation to contain risk of infection has negative consequences for segregated patients. Although strength of the evidence is weak, comprising primarily single centre convenience samples, consistency of the effects may strengthen this conclusion. More research needs to be undertaken to examine this relationship and develop and test interventions to reduce the negative effects of isolation.

## Strengths and limitations of this study

- This review covers a wide variety of literature from a range of different clinical areas.
- Data collected and the methods of collecting data on the impact of isolation is varied across studies.
- These data do not show if these effects are temporary, or in most cases if they are clinically significant.

## Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

## Competing interests statement

No authors have any competing interests to declare

## Introduction

Isolation is an established part of any infection prevention programme. Its purpose is to prevent the transmission of antibiotic-resistant pathogens, those that are highly contagious or cause serious infection.[1] The effectiveness of isolation has been questioned however [2–5] and it can be challenging to undertake, especially if patients' lack of understanding of the need for segregation, boredom or distress result in uncooperative behaviour. [6] A recent survey exploring the care of patients isolated for infectious conditions suggests that in clinical practice the main issues are identifying which patients need to be isolated as quickly as possible and prioritising which patients should be segregated when isolation accommodation is in short supply. Infection preventionists were aware that isolation could have negative effects on patients such as increased risk of anxiety, depression and falls and felt that more should be done to prevent these risks.[6]

Although single rooms are assumed to reduce infection risk, evidence of ability to contain spread is equivocal [7,8] and a recent study conducted in an all-single-room hospital was unable to demonstrate lower infection rates than in hospitals where most care takes place in open wards. [9] This study identified advantages and disadvantages of single room accommodation, whereas isolating infectious patients is generally assumed to result in adverse outcomes.[10]

A systematic review reported eight years ago indicated higher levels of anxiety, depression, perceptions of stigmatisation and a higher incidence of falls, medication errors and other incidents that detract from patient safety among patients who were isolated compared to those who were not.[11] This review reported studies undertaken

1  
2  
3 before 2010 and included patients whose experiences are unlikely to be comparable:  
4  
5 children and adults and those isolated to reduce their own risk of infection as well as  
6  
7 infectious patients. The review was not reported according to standards currently  
8  
9 expected for systematic reviews [12] and presents a qualitative description of patient  
10  
11 outcomes only. A more rigorously reported and up-to-date systematic review is  
12  
13 indicated in view of increasing concern about satisfaction with health care and patient  
14  
15 safety and increasing emphasis on infection prevention as part of the global strategy  
16  
17 to reduce risks of antimicrobial resistance.[13]  
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24 We undertook a systematic review of the literature to establish the effects of infection  
25  
26 related isolation on psychological and non-psychological care-related outcomes in  
27  
28 adults. This review is therefore more focussed than that previously undertaken which  
29  
30 also included those in protective isolation, and contains a significant body of literature  
31  
32 published since 2010.  
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### 37 **Method**

38  
39 The eligibility criteria for inclusion was that studies should compare quantitative data  
40  
41 on psychological or non-psychological outcomes in adult patients who are in infective  
42  
43 isolation with those not isolated. Purely symptomatic/disease progression outcomes  
44  
45 were not included, neither were those looking at patients isolated due to  
46  
47 immunosuppression. Studies not containing comparative data between those isolated  
48  
49 and not isolated were also excluded. Search terms were: Patient isolation; cross  
50  
51 infection; contact isolation; respiratory, source or contact isolation; droplet, airborne  
52  
53 or contact precautions; cubicle; MRSA or methicillin resistant *Staphylococcus aureus*;  
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55 patient safety or harm; depression; anxiety; adaptation; stress; patient satisfaction;  
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3 quality of life. These were searched as free-text and index terms where these existed.  
4  
5 The information sources used were Embase, Medline and Psycinfo, which were  
6  
7 searched from inception until December 2018. Reference lists and Google Scholar  
8  
9 were also handsearched. Characteristics of included and excluded papers are shown  
10  
11 in Supplementary File 1. The PRISMA flow-chart is given in Supplementary File 2.  
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14 No protocol was published in advance.  
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19 Studies were initially screened for relevance by one author (EP), with the final stage  
20  
21 being undertaken by two (EP, DG). Data were extracted and checked by two authors  
22  
23 (DG, EP); where there were disagreements data were rechecked for relevance and  
24  
25 accuracy. Where available, raw data were extracted and entered into a spreadsheet,  
26  
27 and depending upon the nature of the data either the risk ratio (where numbers of  
28  
29 patients were given) or standardised mean difference (where other statistics were  
30  
31 given) calculated. Results were then presented as forest plots.  
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38 Due to the variety of different settings and methods it was deemed that the  
39  
40 methodological and clinical heterogeneity was too broad to pool results; apart from  
41  
42 those related to anxiety and depression, for which results were pooled using the  
43  
44 random-effects model. This model assumes that the observed effect from each study  
45  
46 is estimating a related but different true effect, allowing for between-study variation  
47  
48 to be calculated in the form of heterogeneity statistics. All calculations and plots were  
49  
50 produced using the meta and metafor packages in R.[14–16] Where raw data were  
51  
52 not provided the summary results are given in the text but not the forest plots. All data  
53  
54 relevant to the study are included in the article or uploaded as Supplementary File 3.  
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## Patient and Public Involvement

No patient involved.

## Results

A total of 3 879 papers were retrieved from the three databases; of which 34 were assessed for eligibility by reading the full text. Of these 13 studies provided data suitable for the calculation of risk ratio, 5 giving psychological outcomes,[17–21] and 12 non-psychological;[19,22–32] and 8 provided data for the calculation of standardised mean differences, 6 giving psychological outcomes,[21,30,33–36] and 2 non-psychological.[29,37] A further 6 studies did not provide raw data but are included in the results; 3 each giving psychological outcomes[38–40] and non-psychological outcomes.[17,41,42] Meta-analyses were possible on two outcomes: anxiety and depression from 8 studies using standardised mean difference. [19–21,30,33–36] Where only risk ratio data were given[20,21] conversion to standardised mean difference was undertaken using the Campbell Collaboration calculator (<https://campbellcollaboration.org/research-resources/effect-size-calculator.html>).[43]

Where it was not possible to pool outcome data because of methodological and clinical heterogeneity, the data from studies are shown as forest plots but without meta-analysis. The forest plots contain results from the studies where sufficient data were given to calculate either the risk ratio or standardised mean difference. A number of studies provided data on those under contact precautions, but no comparative data and so were not included.[44–47]



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3 Because of the large number of non-psychological outcomes for which RR could be  
4 calculated, it was decided that a change of 20% (i.e. a RR of 0.8 or less, or 1.2 or  
5 more) would be clinically significant, regardless of the statistical significance. This  
6 was a pragmatic decision, and all results are shown in Supplementary File 3. Results  
7 are shown in Figures 1 to 6. Supplementary Figure 1 contains results that did not  
8 meet our criteria for being clinically significant. Outcomes were classified into one of  
9 three categories: those to do with quality of care; satisfaction of care; and adverse  
10 events from which median values and interquartile ranges were calculated.  
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24 The studies included were primarily single-centre and consisted of case-control,  
25 cross-sectional and cohort studies. Risk of bias was assessed using the Newcastle-  
26 Ottawa scale, full details of each study and its risk of bias are in the Supplementary  
27 File 4.[48] Overall, although these studies have limited generalisability, there did not  
28 appear to be significant cause for concern regarding bias within the limitations  
29 inherent in these study designs. Most studies used established or validated tools[17–  
30 21,23–25,27,29,30,33–37] or clinical outcomes.[22,26,28,31,32]  
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43 The data from the comparative studies suggest that although in many cases infective  
44 isolation precautions make little difference to psychological outcomes, where it does  
45 make a difference this is primarily negative. There were significant declines in mean  
46 scores related to control and self-esteem, and in many studies increases in the mean  
47 scores for risk of anxiety and depression. However, these findings were not  
48 consistent, and some larger studies showed little or no difference between the groups  
49 for these outcomes. These are shown in Figures 1 and 2 respectively.  
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3 [INSERT FIGURES 1 and 2 HERE]  
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8 Figure 1. Risk ratio of psychological events in those isolated versus not isolated  
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12 Figure 2. Standardised mean difference of psychological scores in those isolated  
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15 versus those not isolated  
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19 For the 8 studies reporting data on anxiety the pooled SMD was 1.45 (95% CI: 0.56 to  
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21 2.34); although within this there was significant heterogeneity ( $Q = 168.11$ ,  $df = 7$ ,  $p$   
22  
23  $< 0.0001$ ;  $I^2 = 95.84\%$ ). This was primarily caused by two studies [30,34] which  
24  
25 showed lower levels of anxiety than the remaining studies. For depression the SMD  
26  
27 was 1.28 (95% CI: 0.47 to 2.09); again with significant heterogeneity ( $Q = 154.5$ ,  $df =$   
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29  $7$ ,  $p < 0.0001$ ;  $I^2 = 95.47\%$ ), in this case the studies falling into two categories, those  
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31 with lower [30,34,35] and higher depression scores among those  
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33 isolated.[19,20,33,36] The forest plots for these outcomes are shown in Figures 3 and  
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42 [INSERT FIGURES 3 and 4 HERE]  
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47 Figure 3. Meta-analysis of the standardised mean difference of anxiety in those  
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49 isolated versus those not isolated  
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54 Figure 4. Meta-analysis of the standardised mean difference of depression in those  
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56 isolated versus those not isolated  
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3 Studies not reporting the raw data showed that contact precautions were associated  
4 with depression OR 1.4 (95% CI 1.2 to 1.5) but not anxiety OR 0.8 (95% CI 0.7 to  
5 1.1) in a non-ICU population.[41] There was also an association with delirium OR  
6 1.40 (95% CI 1.24 to 1.51); although this was primarily among those who were newly  
7 diagnosed as needing isolation OR 1.75 (95% CI 1.60 to 1.92,  $p < 0.01$ ) rather than  
8 those who had been under contact precautions for their entire stay OR 0.97 (95% CI  
9 0.86 to 1.09,  $p = 0.60$ ).[17] Another study showed no difference in the median values  
10 for the Hospital Anxiety and Depression Scale anxiety or depression scores (HADS-A  
11 and -D), or the EuroQol Visual Analogue Scale EQ VAS scores.[42]

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26 For non-psychological outcomes, using a difference in the risk of +/- 20% of an event  
27 as being a measure of clinical significance it appears there was a trend for less  
28 attention to be given to, and for more errors to occur in those who were isolated.  
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33 However, again there was wide variation between studies. Data on these outcomes  
34 are given in Figures 5 and 6, and the non-clinically significant risks in the  
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Supplementary Figure 1. For those outcomes associated with quality, the median risk  
ratio (with positive outcomes reversed so a higher risk ratio is associated with a worse  
outcome) was 0.94 (IQR 0.92 to 0.98), satisfaction 0.95 (IQR 0.89 to 1.01) and  
adverse events was 1.27 (0.91 to 2.5). The minimum and maximum risk ratio for  
each category was 0.49 and 1.72; 0.3 and 8; and 0.3 and 18 respectively.

[INSERT FIGURES 5 and 6 HERE]

Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated  
with a RR of  $\leq 0.8$  or  $\geq 1.2$

\* outcome was measured in rate per 100 admissions

Figure 6. Standardised mean difference of non-psychological scores in those isolated versus those not isolated

FIM – functional independence measure

A study not giving raw data which looked at the rates of falls and pressure ulcers before and after a policy change that resulted in the discontinuation of contact precautions for patients with methicillin resistant *Staphylococcus aureus* (MRSA) or vancomycin resistant enterococci (VRE) found that falls and pressure ulcers were more common among those with MRSA or VRE both before the change (when they were in isolation) and afterwards (when they were not). Before the change the number of falls was 4.57 vs 2.04 per 1000 patient-days respectively ( $p < 0.0001$ ) and pressure ulcers 4.87 vs 1.22 per 1000 patient-days ( $p < 0.0001$ ). After the policy change the same numbers were falls 4.82 vs 2.10 ( $p < 0.0001$ ) and pressure ulcers 4.17 vs 1.19 per 1000 patient-days ( $p < 0.0001$ ). [39] Other studies found that staff spent less time with those on contact precautions: internal medicine interns spent less time with their isolated patients compared to non-isolated patients, the median times being 5.2 and 6.9 minutes respectively ( $p < 0.001$ ) [38]; while the mean number of contacts per hour with healthcare workers was 2.1 compared to 4.2 in those not isolated ( $p = 0.03$ ), although the duration was longer at 4.5 minutes compared to 2.8 ( $p = 0.6$ ). [40]

## Discussion

Current recommendations say that contact precautions should include a single room, with personal protective equipment consisting of a gown and gloves for all patient

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3 contacts or contacts with potentially contaminated environmental areas.[1] This  
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5 review has shown that there are a number of apparently negative aspects to contact  
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7 precautions, in particular with regards to psychological effects and a reduction in the  
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9 quality of some aspects of care. These data come from studies carried out in a variety  
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11 of countries and different types of facilities; although there are few data from  
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13 particularly vulnerable populations such as the elderly.  
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19 Although at times there are discussions as to the necessity of contact precautions for  
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21 drug resistant organisms, with some arguing that there is mixed evidence for or  
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23 against their use[49] another recent review has concluded that they are of great  
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25 importance in the control of epidemic and endemic multidrug-resistant  
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27 microorganisms.[50] The ethics of using contact precautions and other forms of  
28  
29 isolation rely on a positive assessment of the balance between the risks and benefits of  
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31 this to the individual concerned and that of the broader population of patients and  
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33 staff.[51] However, even when this assessment is positive, it is important to ensure  
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35 that any harm to the individual is minimised.  
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42 One way of balancing the various priorities is to use the GRADE Evidence to  
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44 Decision Framework, which provides criteria for making recommendations at the  
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46 individual, group and policy-levels, and provides a number of highly patient focussed  
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48 criteria for doing this. In addition to the certainty of evidence and resource  
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50 requirements, it also requires consideration of: the balance of desirable and  
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52 undesirable effects; the impact upon equity; and the feasibility and acceptability of the  
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54 intervention.[52] The last two of these might have very different outcomes when  
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56 considered at the population and individual levels; and there is certainly evidence here  
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3 that for the individual patient the balance of desirable and undesirable effects might  
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5 be very different to that of the broader population.  
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10 However, within the broad population of infected or potentially infected patients,  
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12 some groups might have different needs. For example a study of people isolated for  
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14 MERS found that while access to telephones reduced anxiety and anger; access to  
15  
16 email, text and internet increased these.[53] This was not an area investigated in any  
17  
18 depth in these studies. Another area where information may be lacking is that of age,  
19  
20 as older people in particular might feel sadness and loneliness more; and gender, as  
21  
22 as older people in particular might feel sadness and loneliness more; and gender, as  
23  
24 qualitative data suggest that women in isolation were more concerned about  
25  
26 precautions and transmission while men were more resigned, rational and tended to  
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28 cope better.[54]  
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33 In some countries, such as the United States single-rooms have become the standard  
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35 for new hospitals and so one might expect fewer adverse effects if everyone is in a  
36  
37 single room, this being the norm. However it may be that a single room is necessary  
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39 but not sufficient for these findings, and that it is the combination of a single room  
40  
41 with an infection that leads to these results. Certainly it is far from clear that the long  
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43 list of advantages claimed for single rooms which include reduced stress, the ability to  
44  
45 deliver better care, and a lower probability of dietary or medication errors apply to  
46  
47 this group of patients.[55]  
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53 Caring for patients in single-rooms does have many challenges, but there is evidence  
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55 that these can be mitigated in a general population;[9] however the expanding  
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57 literature on how this can be done in a general population does not necessarily apply  
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3 here due to the necessity of isolation procedures which are, by design, ‘a barrier’.  
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5 Therefore patients’ needs for greater social interaction will need a solution quite  
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7 different from that which might be used for a different patient population, and the  
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9 benefit of choice about this which single rooms offer does not apply here.[56]  
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14 Although this review has quantified the extent of the problem, we have not been able  
15  
16 to find solutions in the literature. Care might be improved through increased staff  
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18 attention with more resources being allocated to these patients, although the extra cost  
19  
20 of contact precautions is already considerable, one estimate being that it was an extra  
21  
22 \$158.90 (95% CI \$124.90 to \$192.80) per patient day.[57] Alternatively new ways of  
23  
24 working might be developed, perhaps using technology to mitigate some of these  
25  
26 problems. Technology might be particularly useful in reducing adverse events such  
27  
28 as medication or clinical errors; although increasing satisfaction and some areas of  
29  
30 quality are more likely to be achieved by increasing the availability of staff and other  
31  
32 people. The extent to which scarce resources are allocated to this may be driven in  
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34 part by the longevity of any negative effects; which current literature is not really able  
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36 to clarify. To understand this longitudinal studies are needed.  
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#### 45 Study strengths and limitations

46 This review suggests that infectious isolation has a number of negative effects on  
47  
48 patients. Because this evidence is comprised of cohort and case-control studies, a  
49  
50 claim for a causal relationship can not be made on this evidence, although the strong  
51  
52 and consistent effects across the studies may increase the confidence in this  
53  
54 relationship. There are some qualitative data, although more in-depth mixed-methods  
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56 data where those reporting negative effects are questioned about them would  
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3 strengthen the evidence on this. In some cases large effect sizes were accompanied  
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5 by very wide confidence intervals, suggesting that studies were underpowered, thus  
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7 studies with larger sample sizes would be useful. It would also be useful if there were  
8  
9 more consistent methods of examining and reporting these data, particularly outside  
10  
11 of the realms of depression and anxiety where the variety of methods makes analysis  
12  
13 of the body of evidence difficult. We were also unable to assess whether these effects  
14  
15 varied according to reason for isolation; or to understand if they are likely to be long-  
16  
17 term or simply temporary phenomena.  
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24 Although these data suggest that there is a problem, there is a clear gap both in what  
25  
26 we know about improving the experience of isolation and what can be done in  
27  
28 practical terms to make it more tolerable for patients and their families. In particular  
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30 older people who may be most vulnerable to these negative effects were under-  
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32 represented in these studies; and this group are likely to represent an increasingly  
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34 large proportion of those isolated.  
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#### 42 Contributors

43  
44 EP, DG and JC conceived the review, EP conducted the search, EP and DG examined  
45  
46 the studies and extracted data, EP undertook the quantitative analysis, EP, DG and JC  
47  
48 wrote the discussion.  
49  
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51

#### 52 Funding

53  
54 This research received no specific grant from any funding agency in the public,  
55  
56 commercial or not-for-profit sector.  
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6 Competing interests statement  
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8 No authors have any competing interests to declare.  
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14 Data Availability  
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16 All data relevant to the study are included in the article or uploaded as supplementary  
17 information.  
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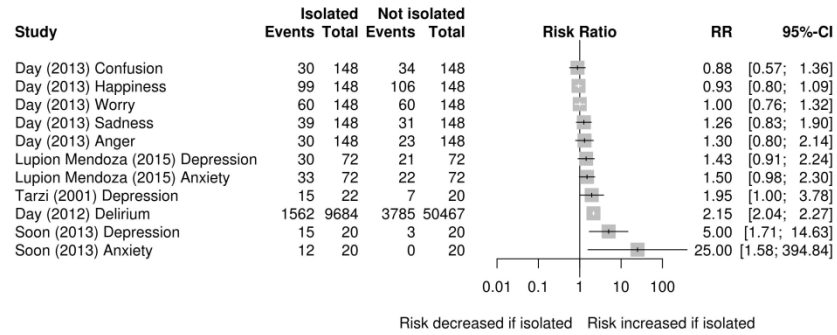


Figure 1. Risk ratio of psychological events in those isolated versus not isolated

279x127mm (300 x 300 DPI)

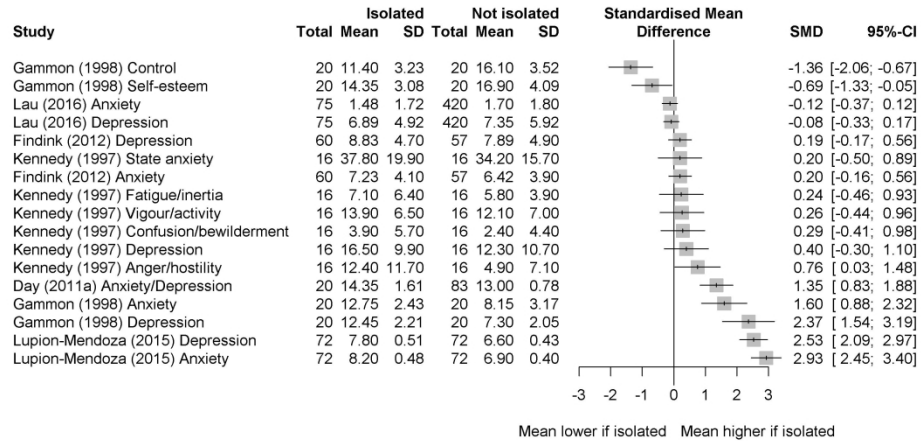


Figure 2. Standardised mean difference of psychological scores in those isolated versus those not isolated

279x152mm (300 x 300 DPI)

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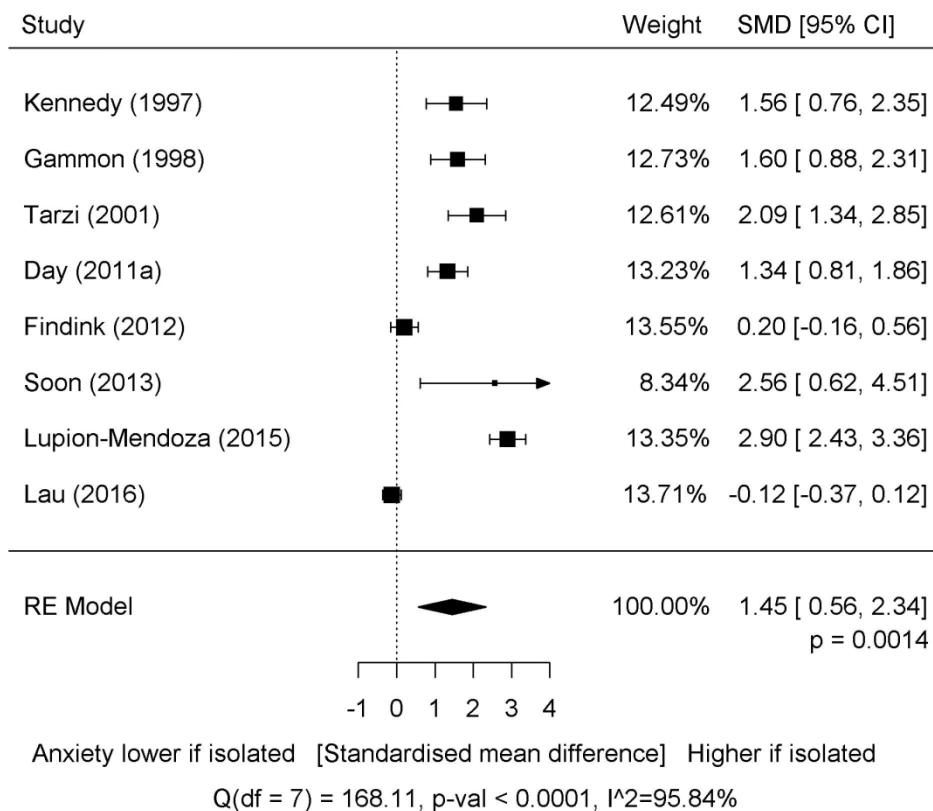


Figure 3. Meta-analysis of the standardised mean difference of anxiety in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

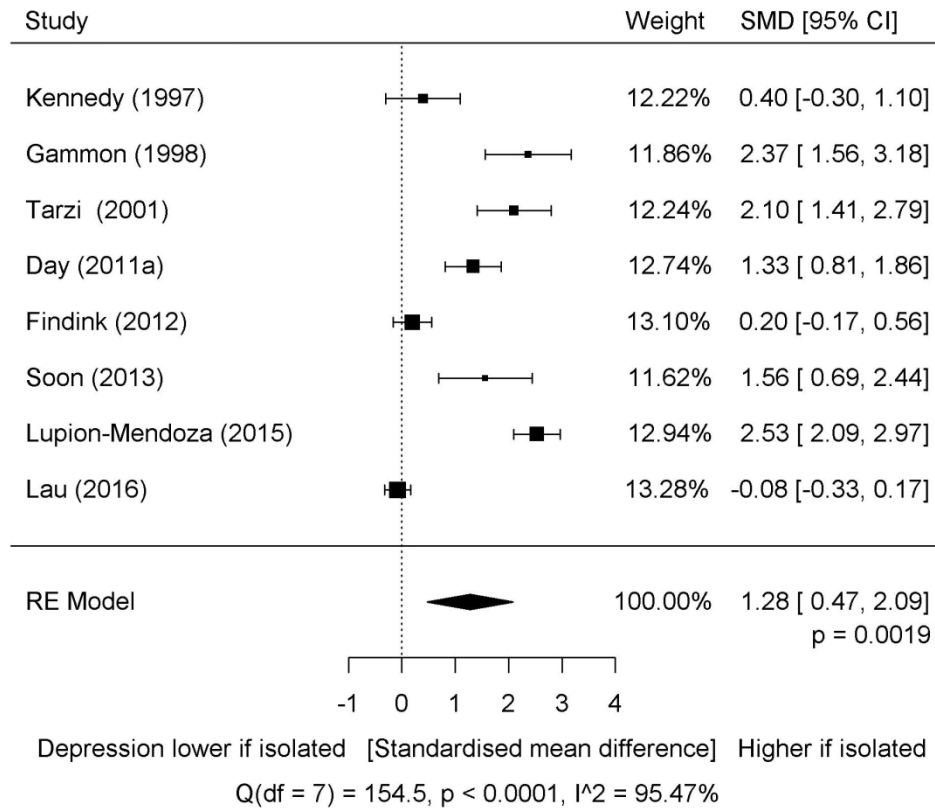


Figure 4. Meta-analysis of the standardised mean difference of depression in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

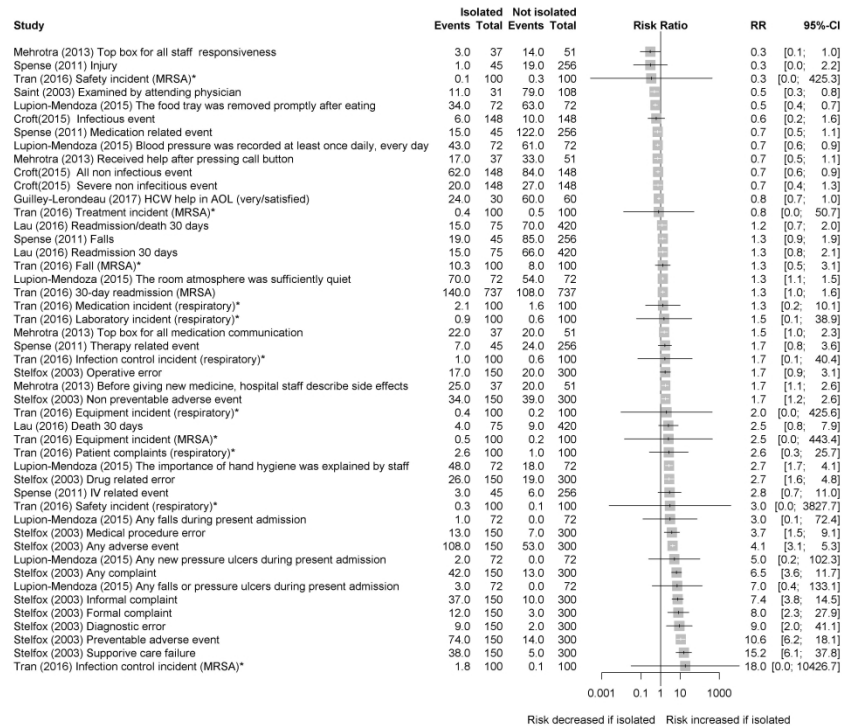


Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated with a RR of  $\leq 0.8$  or  $\geq 1.2$

381x296mm (300 x 300 DPI)

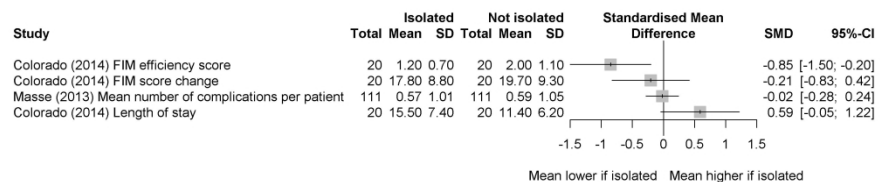


Figure 6. Standardised mean difference of non-psychological scores in those isolated versus those not isolated

321x127mm (300 x 300 DPI)



**Characteristics of studies**

Reference	Study type	Isolated	Non isolated
Colorado (2014)	Retrospective matched case control study. Rehabilitation facility- tertiary centre United States July 2009 to December 2010	N20 Patients in contact isolation	N=20 Matched to patients not in contact isolation based on age, rehabilitation diagnosis, and type of insurance
Croft (2015)	Prospective cohort Medical or surgical inpatients admitted to non-intensive care unit hospital wards, United States. January to November 2010.	N=148 Patients on contact precautions Age: 52 (13.8) % male: 53.4	N=148 Individually matched by after an initial 3-day length of stay to patients not on contact precautions. Age 52.3 (14.6) % male: 46.6
Dashiell-Earp (2014)	Collected real-time data on the location of 15 internal medicine interns, United States. October 1, 2012 to December 31, 2012	1156 encounters	2467 encounters
Day (2011)	Patients admitted to the general acute care units, United States. June 1, 2009 to October 30, 2009	N=20 Age: 68.5 (14.7) % male: 85.0	N=83 Age: 63.9 (12.6) % male: 95.2
Day (2011)	A two-year retrospective cohort Tertiary care, United States.. All general inpatients over 18 years hospitalized for >24 h February 1, 2007 to January 31, 2009.	Contact precautions private room when possible, can be cohorted General N = 3138 Age: 51.2 (17.5) % male 58.9 ITU N=1694 Age: 54.9 (17.5) % male 61.0	General N = 25 426 Age: 49.6 (19.0) % male 46.3% ICU N = 5 854 Age: 56.0 (17.7) % male 59.7
Day (2012)	2-year retrospective cohort study of all non-psychiatric hospital admissions >18 years, United States. February 1, 2007 to January 31, 2009	N = 9 684 Contact precautions as above Mean age: 50.1 (18.8) % male 51.4	N = 50 458 Mean age: 52.3 (16.9) % males 59.1
Day (2013)	Longitudinal frequency-matched cohort study of patients admitted to general medical and surgical units, United States. Day 0, day 3 then weekly. January to November 2010	N = 148 Mean age: 52.0 (13.9) % male 58.1	N = 148 Mean age: 52.3 (14.6) % male 50.7

1 2 3 4 5	Evans (2003)	Prospective observation; survey; retrospective review, United States. Tertiary care. June and July 2001	N 48 Mean age: 47.8 (2) % male 85%	N = 48 Mean age: 58.3 (2.4) % male 75%
6 7 8 9 10	Findink (2012)	Non-random quasi-experiment, Turkey Age 18 to 65 Administered day 5 January 1, 2009 to December 31, 2009	N = 60 Mean age: 53.95 (18.4) % male 75%	N = 57 Mean age: 56.14 (17.1) % male 76.3%
11 12 13 14 15 16 17	Gammon (1998)	Quasi experiment Selected if last two numbers on their case notes even. Two large District General Hospitals and one elderly care hospital, United Kingdom	N = 20 Placed in isolation for a minimum of 7days Mean age: 61 years % male: 65	N = 20 Mean age: 52 years % male: 55
18 19 20 21 22 23	Gandra (2014)	Retrospective hospital-wide cohort study, United States. All patients admitted to medical-surgical inpatient units November 1, 2009 to October 31, 2011	Falls N=77 Mean age: 66.1 (14.3) % male: 61% Pressure ulcers N=82 Mean age: 64.5 (15.5) % male: 63	Falls N=82 Mean age: 63.7 (15.8) % male: 51 (62%) Pressure ulcers N=71 Mean age: 65.7 (15) % male: 57
24 25 26 27 28	Guilley-Lerondeau (2017)	Matched cohort study with prospective inclusions Interview 3 days after commencing General sample. France March to July 2012	N=30 First prescription of isolation precaution Median age (range) 69 (32 to 91) % male 47	N=60 Median age (range) 64 (24 to 91) % male 53
29 30 31 32 33	Kennedy (1997)	Cross-sectional matched-control study, United Kingdom. May 1994 to November 1996	N = 16 Isolated as a result of being MRSA Mean age: 31.1 All male	N = 16 Matched for age, sex, level of injury, and time since admission or injury
34 35	Kirkland (1999)	Observational study - 7 months Medical intensive-care, United States	N=14	N=21
36 37 38 39	Lau (2016)	Prospective cohort study. Adult patients discharged from internal medicine wards, Canada October 2013 to November 2014,	N=75 Mean age 60.35 (17.83) % male 59	N=420 Mean age 63.31 (18.69) % male 48%
40 41 42 43 44 45 46 47	Livorsi (2015)	Case-control study Retrospective January 1, 2012 to	N = 70 On contact precautions for MRSA throughout	N = 139 No significant differences between isolated and

	May 31, 2012/prospective June 1, 2012 to March 31, 2013 'safety-net facility', United States	their hospital stay. Found to be MRSA positive during a previous hospitalization or as an outpatient, not current case	non-isolated patients
Lupi3n-Mendoza (2015)	Matched case-control study Tertiary hospital, Spain 2011 and 2012	N = 72 Adult patients admitted in isolation for =>5 days. Median age (range) 62 (21-93) % male 73%	N = 72 Median age (range) 69 (23-89), % male 68.1%
Massee (2013)	Retrospective case-control Tertiary care, Canada	N = 111 Matched MRSA patients with an admission diagnosis of heart failure or COPD to similar non-isolated controls Median age (IQR) 80.0 (69.0-86.0) % male 60.4%	N = 111 Median age (IQR) 80.0 (68.0-86.0) % male 60.4%
Mehrotra (2013)	Prospective cohort Admission and on days 3, 7, 14 Tertiary centre, United States	N = 238 Segregation into a private or cohorted room Mean age (SD) 52.4 (13.4) % male 55.7	N = 290 Mean age (SD) 52.9 (14.8) % male 48
Saint (2003)	Prospective cohort study 2 university-affiliated medical centers, United States. October 1999 to March 2000	N=31	N=108
Soon (2013)	Cross-sectional survey of cases and matched controls Teaching hospital Singapore June and August 2011	N=20 Contact isolation in a cohort cubicle for the first time because of colonization or infection with a MDRO for at least 3 days No statistically significant differences in age or gender	N=20
Spense (2011)	Retrospective evaluation of incident reports All patients admitted to acute care facility, United States January 1, 2008 to December 31, 2008.	N=45	N=256
Stelfox (2003)	Case control study Consecutive adults isolated for at least 2 days with MRSA. Canada and United States Controls patients admitted before	General N = 78 Age: 69.6 (17.1) % male: 45% CHF N = 72 Age: 66.9 (14.7)	General N = 156 Age: 65.4 (18.2) % male: 51% CHF N = 144 Age: 66.0 (14.5)

	and after. January 1, 1999, to January 1, 2000	% male: 58	% male: 54
Tarzi (2001)	Cross-sectional matched case-control study Care of the elderly rehabilitation wards, UK	N = 22 Had been in isolation for at least two weeks with MRSA Mean age (SD) 80 (8.4) % male 27.3	N = 20 Mean age (SD) 81 (9.1) % male 33.3
Tran (2017)	Propensity matched cohort study. General internal medicine services, 3 hospitals, Canada January 2010 to December 2012	MRSA Age: 69 % male 57% Respiratory Age: 71.7 % male: 53 Isolated for MRSA or respiratory illness	MRSA Age: 69 % male 58% Respiratory Age: 70.6 % male: 55
Wassenburg (2010)	Cross-sectional matched cohort study Single university hospital, Netherlands November 2006 to February 2007	N = 42 Age: 52 (19) % male: 52	N = 84 Age: 55 (16) % male: 55

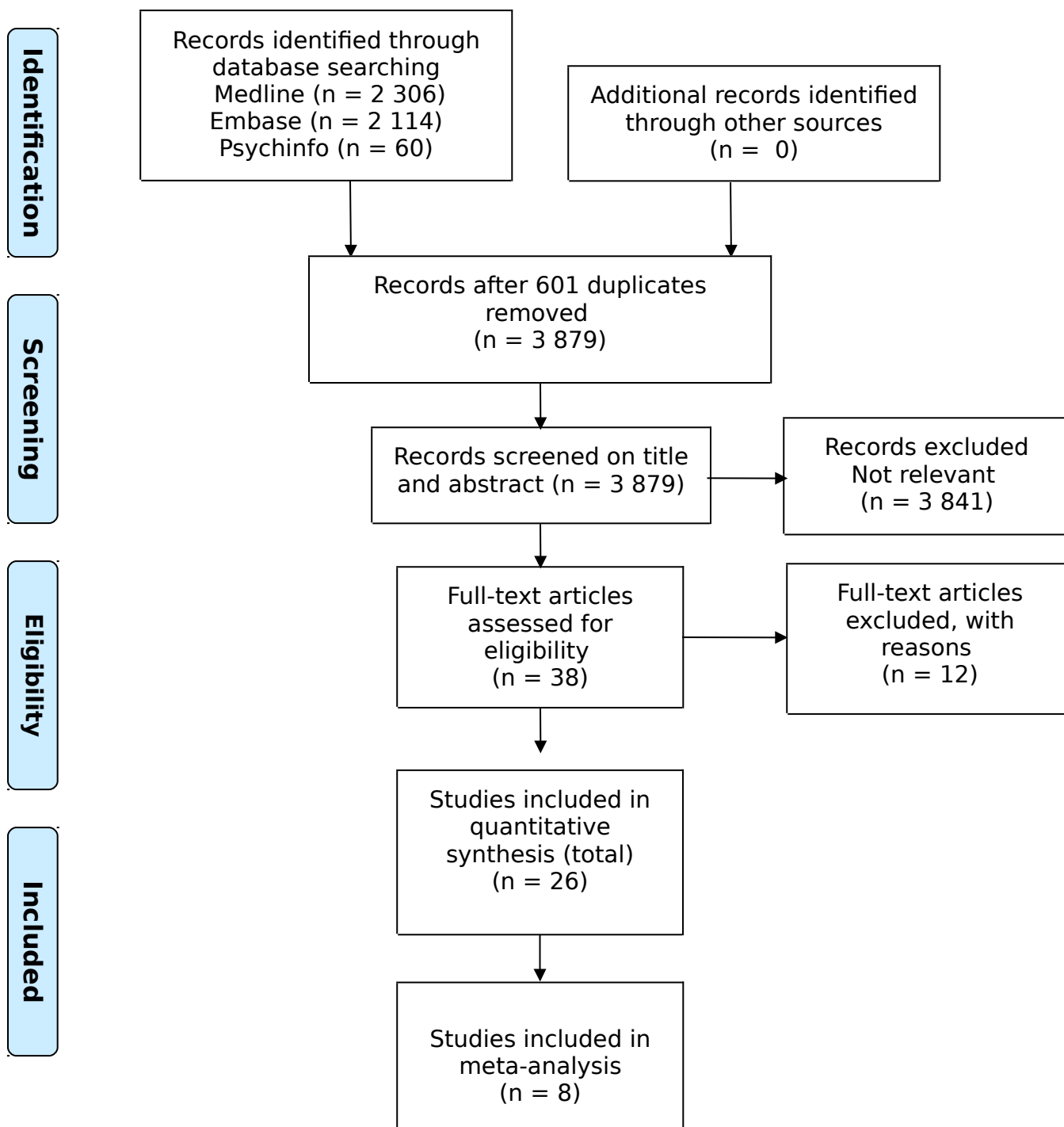
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Excluded papers

Reference	Reason for exclusion
Chittick et al (2016)	No comparative data
Godsell (2013)	Focussed on HCP
Jeong (2016)	MERS
MacKellaig (1986)	Qualitative
Madsden (2015)	Qualitative
Maunder (2003)	SARS
Moran (2009)	Focus on family centred care
Morgan (2011)	Focus on process measures
Rees (2000a)	No comparative data
Rees (2000a)	No comparative data
Simon (2016)	Before and after
Wilkins (1988)	No comparative data



# PRISMA 2009 Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit [www.prisma-statement.org](http://www.prisma-statement.org).

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## All RR data

	Reference	Year
1		
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4	1 Croft(2015)	2015
5	2 Croft(2015)	2015
6	4 Croft(2015)	2015
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8	9 Guilley-Lerondeau (2017)	2017
9	15 Lau (2016)	2016
10	16 Lau (2016)	2016
11	18 Lau (2016)	2016
12	43 Lupion-Mendoza (2015)	2015
13	48 Lupion-Mendoza (2015)	2015
14	50 Lupion-Mendoza (2015)	2015
15	54 Lupion-Mendoza (2015)	2015
16	57 Lupion-Mendoza (2015)	2015
17	58 Lupion-Mendoza (2015)	2015
18	59 Lupion-Mendoza (2015)	2015
19	69 Mehrotra (2013)	2013
20	71 Mehrotra (2013)	2013
21	76 Mehrotra (2013)	2013
22	77 Mehrotra (2013)	2013
23	85 Stelfox (2003)	2003
24	86 Stelfox (2003)	2003
25	87 Stelfox (2003)	2003
26	88 Stelfox (2003)	2003
27	89 Stelfox (2003)	2003
28	90 Stelfox (2003)	2003
29	91 Stelfox (2003)	2003
30	92 Stelfox (2003)	2003
31	93 Stelfox (2003)	2003
32	94 Stelfox (2003)	2003
33	95 Stelfox (2003)	2003
34	96 Spense (2011)	2011
35	97 Spense (2011)	2011
36	98 Spense (2011)	2011
37	99 Spense (2011)	2011
38	100 Spense (2011)	2011
39	102 Saint (2003)	2003
40	103 Tran (2016)	2016
41	106 Tran (2016)	2016
42	107 Tran (2016)	2016
43	108 Tran (2016)	2016
44	109 Tran (2016)	2016
45	113 Tran (2016)	2016
46	114 Tran (2016)	2016
47	116 Tran (2016)	2016
48	117 Tran (2016)	2016
49	118 Tran (2016)	2016
50	120 Tran (2016)	2016
51	122 Tran (2016)	2016
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53	3 Croft(2015)	2015
54	5 Evans (2003)	2003
55	6 Evans (2003)	2003
56	7 Evans (2003)	2003
57	8 Guilley-Lerondeau (2017)	2017
58	10 Guilley-Lerondeau (2017)	2017
59	11 Guilley-Lerondeau (2017)	2017
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## All RR data

12	Guilley-Lerondeau (2017)	2017
13	Guilley-Lerondeau (2017)	2017
14	Guilley-Lerondeau (2017)	2017
17	Lau (2016)	2016
19	Livorsi (2015)	2015
20	Livorsi (2015)	2015
21	Livorsi (2015)	2015
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31	Livorsi (2015)	2015
32	Livorsi (2015)	2015
33	Livorsi (2015)	2015
34	Livorsi (2015)	2015
35	Livorsi (2015)	2015
36	Livorsi (2015)	2015
37	Lupion-Mendoza (2015)	2015
38	Lupion-Mendoza (2015)	2015
39	Lupion-Mendoza (2015)	2015
40	Lupion-Mendoza (2015)	2015
41	Lupion-Mendoza (2015)	2015
42	Lupion-Mendoza (2015)	2015
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55	Lupion-Mendoza (2015)	2015
56	Lupion-Mendoza (2015)	2015
60	Masse (2013)	2013
61	Mehrotra (2013)	2013
62	Mehrotra (2013)	2013
63	Mehrotra (2013)	2013
64	Mehrotra (2013)	2013
65	Mehrotra (2013)	2013
66	Mehrotra (2013)	2013
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73	Mehrotra (2013)	2013
74	Mehrotra (2013)	2013
75	Mehrotra (2013)	2013
78	Mehrotra (2013)	2013
79	Mehrotra (2013)	2013
80	Mehrotra (2013)	2013



All RR data

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4	81 Mehrotra (2013)	2013
5	82 Mehrotra (2013)	2013
6	83 Mehrotra (2013)	2013
7	84 Mehrotra (2013)	2013
8	101 Saint (2003)	2003
9	104 Tran (2016)	2016
10	105 Tran (2016)	2016
11	110 Tran (2016)	2016
12	111 Tran (2016)	2016
13	112 Tran (2016)	2016
14	115 Tran (2016)	2016
15	119 Tran (2016)	2016
16	121 Tran (2016)	2016
17	123 Tran (2016)	2016
18	124 Tran (2016)	2016
19	125 Tran (2016)	2016
20	126 Tran (2016)	2016
21	127 Tran (2016)	2016
22	128 Tran (2016)	2016
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## All RR data

Outcome	Isolated
All non infectious event	62
Severe non infectitious event	20
Infectious event	6
HCW help in AOL (very/satisfied)	24
Readmission/death 30 days	15
Readmission 30 days	15
Death 30 days	4
The importance of hand hygiene was explained by staff	48
The food tray was removed promptly after eating	34
The room atmosphere was sufficiently quiet	70
Blood pressure was recorded at least once daily, every day	43
Any falls during present admission	1
Any new pressure ulcers during present admission	2
Any falls or pressure ulcers during present admission	3
Received help after pressing call button	17
Top box for all staff responsiveness	3
Before giving new medicine, hospital staff describe side effects	25
Top box for all medication communication	22
Any complaint	42
Informal complaint	37
Formal complaint	12
Any adverse event	108
Non preventable adverse event	34
Preventable adverse event	74
Supportive care failure	38
Diagnostic error	9
Operative error	17
Medical procedure error	13
Drug related error	26
Falls	19
Injury	1
IV related event	3
Medication related event	15
Therapy related event	7
Examined by attending physician	11
Fall (MRSA)*	10.3
Treatment incident (MRSA)*	0.4
Infection control incident (MRSA)*	1.8
Safety incident (MRSA)*	0.1
Equipment incident (MRSA)*	0.5
Medication incident (respiratory)*	2.1
Laboratory incident (respiratory)*	0.9
Infection control incident (respiratory)*	1
Safety incident (respiratory)*	0.3
Equipment incident (respiratory)*	0.4
Patient complaints (respiratory)*	2.6
30-day readmission (MRSA)	140
Preventable non infectiouts event	37
Encounters per hr (no)	5
ICU encounters per hr	6
Floor encounters per hr	4
Global hygiene (very/satisfied)	28
Daily room cleaning (very/satisfied)	27
HCW availability (very/satisfied)	25

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## All RR data

Daily HCW presence (very/satisfied)	27
Human relation with HCW (very/satisfied)	27
Global satisfaction (very/satisfied)	25
ED visit 30 days	22
Overall rating of hospital =>9/10	44
Nurses treat you with courtesy and respect	51
Nurses listen carefully	47
Nurses explain things in an understandable way	47
Received help after pressing call button	28
Doctors treat you with courtesy and respect	53
Doctors listen carefully to you	48
Doctors explain things in an understandable way	50
Room and bathroom kept clean	42
Room quiet at night	51
Received help with bathroom/bedpan	19
Pain well controlled	34
Hospital staff help with pain	45
Hospital staff explain new medications	20
Hospital staff describe side effects of medications	13
Hospital staff discussed help after discharge	52
Written information on problems to look for after discharge	52
Recommend hospital to friends and family	43
Overall satisfaction with the professional treatment received from health care workers	67
Nurses treated the patients in polite and respectful manner (totally/partially agree)	70
Physicians treated the patients in polite and respectful manner	71
Nurses provided clear information about the health problem	64
Physicians provided clear information about the health problem	66
Clear explanations were provided before all procedures	62
Health care workers entered the room whenever the patient called them	66
Blood pressure and temperature recorded at least once a day	65
The physician visited daily	69
The room was comfortable	62
Room cleaning was satisfactory	66
I frequently felt lonely during admission	17
Medical notes were recorded every day	64
Nurses notes were recorded every day	64
Daily temperature was recorded at least once a day, every day	53
Daily glycemc levels were recorded as indicated, everyday (only diabetic patients)	31
Total number of complications	60
Nurses treat with courtesy and respect	31
Nurses listen carefully	30
Nurses explain things in understandable way	30
Top box for all nursing communication	27
Doctors treat with courtesy and respect	33
Doctors listen carefully	31
Doctors explain things in understandable way	29
Top box for all doctor communication	27
Received help in bathroom/bedpan use	25
Pain well controlled	26
Hospital staff help with pain	26
Top box for all pain management	25
Before giving new medicine, hospital staff tells what it is for	30
Spoken with about having necessary help after discharge	31
Written information on symptoms/problems to look for after discharge	33
Top box for all discharge information	30

## All RR data

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4	Hospital room and bathroom kept clean (individual)	27
5	Area near room quiet at night (individual)	24
6	Recommend hospital to friends and family (global)	25
7	Overall hospital rating (global)	22
8	Examined by senior resident doctor	26
9	Medication incident (MRSA)*	2.2
10	Laboratory incident (MRSA)*	0.3
11	Any adverse event (MRSA)*	12.4
12	Patient complaints (MRSA)*	1.1
13	Fall (respiratory)*	4.2
14	Treatment incident (respiratory)*	0.6
15	Any adverse event (respiratory)*	9.1
16	Inpatient mortality (MRSA)	59
17	30-day ED visit (MRSA)	84
18	Readmission or ED visit (respiratory)	167
19	Inpatient mortality (respiratory)	104
20	30-day readmission (respiratory)	206
21	30-day ED visit (respiratory)	164
22	Readmission or ED visit (respiratory)	261
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## All RR data

	Isolated.N	Control	Control.N	RI	RC	RR	inout	Type
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2								
3								
4	148	84	148	0.418918919	0.567567568	0.738095238	a	AE
5	148	27	148	0.135135135	0.182432432	0.740740741	a	AE
6	148	10	148	0.040540541	0.067567568	0.6	a	AE
7	30	60	60	0.8	1	1.25	a	Satisfaction
8	75	70	420	0.2	0.166666667	1.2	a	AE
9	75	66	420	0.2	0.157142857	1.272727273	a	AE
10	75	9	420	0.053333333	0.021428571	2.488888889	a	AE
11	72	18	72	0.666666667	0.25	0.375	a	Satisfaction
12	72	63	72	0.472222222	0.875	1.852941177	a	Satisfaction
13	72	54	72	0.972222222	0.75	0.771428572	a	Satisfaction
14	72	61	72	0.597222222	0.847222222	0.704918033	a	Quality
15	72	0	72	0.013888889	0	#DIV/0!	a	AE
16	72	0	72	0.027777778	0	#DIV/0!	a	AE
17	72	0	72	0.041666667	0	#DIV/0!	a	AE
18	37	33	51	0.459459459	0.647058824	1.408304501	a	Quality
19	37	14	51	0.081081081	0.274509804	3.385620919	a	Satisfaction
20	37	20	51	0.675675676	0.392156863	0.580392157	a	Quality
21	37	20	51	0.594594595	0.392156863	0.659536542	a	Quality
22	150	13	300	0.28	0.043333333	6.461538462	a	Satisfaction
23	150	10	300	0.246666667	0.033333333	7.4	a	Satisfaction
24	150	3	300	0.08	0.01	8	a	Satisfaction
25	150	53	300	0.72	0.176666667	4.075471698	a	Satisfaction
26	150	39	300	0.226666667	0.13	1.743589744	a	AE
27	150	14	300	0.493333333	0.046666667	10.57142857	a	AE
28	150	5	300	0.253333333	0.016666667	15.2	a	AE
29	150	2	300	0.06	0.006666667	9	a	AE
30	150	20	300	0.113333333	0.066666667	1.7	a	AE
31	150	7	300	0.086666667	0.023333333	3.714285714	a	AE
32	150	19	300	0.173333333	0.063333333	2.736842105	a	AE
33	45	85	256	0.422222222	0.33203125	1.271633987	a	AE
34	45	19	256	0.022222222	0.07421875	0.299415205	a	AE
35	45	6	256	0.066666667	0.0234375	2.844444444	a	AE
36	45	122	256	0.333333333	0.4765625	0.699453552	a	AE
37	45	24	256	0.155555556	0.09375	1.659259259	a	AE
38	31	79	108	0.35483871	0.731481481	2.061447808	a	Quality
39	100	8	100	0.103	0.08	1.2875	a	AE
40	100	0.5	100	0.004	0.005	0.8	a	AE
41	100	0.1	100	0.018	0.0011	16.36363636	a	AE
42	100	0.3	100	0.001	0.003	0.333333333	a	AE
43	100	0.2	100	0.005	0.002	2.5	a	AE
44	100	1.6	100	0.021	0.016	1.3125	a	AE
45	100	0.6	100	0.009	0.006	1.5	a	AE
46	100	0.6	100	0.01	0.006	1.666666667	a	AE
47	100	0.1	100	0.003	0.001	3	a	AE
48	100	0.2	100	0.004	0.002	2	a	AE
49	100	1	100	0.026	0.01	2.6	a	Satisfaction
50	737	108	737	0.19	0.147	1.292517007	a	AE
51	148	41	148	0.25	0.277027027	0.902439024	b	AE
52	485	11	1002	0.010309278	0.010978044	1.064870304	b	Quality
53	319	14	658	0.018808777	0.021276596	1.131205713	b	Quality
54	166	8	344	0.024096386	0.023255814	0.965116263	b	Quality
55	30	59	60	0.933333333	0.983333333	1.053571429	b	Satisfaction
56	30	58	60	0.9	0.966666667	1.074074074	b	Satisfaction
57	30	57	60	0.833333333	0.95	1.14	b	Satisfaction
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## All RR data

37	37	51	0.72972973	0.725490196	0.994190268	b	Quality
37	32	51	0.648648649	0.62745098	0.96732026	b	Satisfaction
37	41	51	0.675675676	0.803921569	1.189803922	b	Satisfaction
37	36	51	0.594594595	0.705882353	1.187165775	b	Satisfaction
31	94	108	0.838709677	0.87037037	1.037749288	b	Quality
100	2.4	100	0.022	0.024	0.916666667	b	AE
100	0.3	100	0.0027	0.0033	0.818181818	b	AE
100	10.7	100	0.124	0.107	1.158878505	b	AE
100	1.3	100	0.0109	0.0125	0.872	b	Satisfaction
100	5.1	100	0.042	0.051	0.823529412	b	AE
100	0.7	100	0.006	0.007	0.857142857	b	AE
100	8.9	100	0.091	0.089	1.02247191	b	AE
737	52	737	0.08	0.07	1.142857143	b	AE
737	86	737	0.114	0.117	0.974358974	b	AE
737	142	737	0.227	0.193	1.176165803	b	AE
1502	128	1502	0.069	0.085	0.811764706	b	AE
1502	236	1502	0.137	0.157	0.872611465	b	AE
1502	168	1502	0.109	0.112	0.973214286	b	AE
1502	278	1502	0.174	0.185	0.940540541	b	AE



## All RR data

	Good/bad	exp yi	yi	vi	
1					
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4	Good/bad	exp yi	yi	vi	
5	Bad		0.74	-0.303682414	0.014520281
6	Bad		0.74	-0.300104592	0.073523524
7	Bad		0.60	-0.510825624	0.253153153
8	Good		0.80	-0.227083588	0.008693745
9	Bad		1.20	0.182321557	0.065238095
10	Bad		1.27	0.241162057	0.066103896
11	Bad		2.49	0.911836382	0.345396825
12	Good		2.67	0.980829253	0.048611111
13	Good		0.54	-0.616774202	0.017507003
14	Good		1.30	0.259511195	0.005026455
15	Good		0.70	-0.349673748	0.011871479
16	Bad		3.00	1.098612289	2.639269406
17	Bad		5.00	1.609437912	2.37260274
18	Bad		7.00	1.945910149	2.258317025
19	Good		0.71	-0.342386497	0.04249169
20	Good		0.30	-1.219537321	0.358127035
21	Good		1.72	0.544051271	0.04336513
22	Good		1.52	0.4162179	0.048819675
23	Bad		6.46	1.865867441	0.090732601
24	Bad		7.40	2.00148	0.117027027
25	Bad		8.00	2.079441542	0.406666667
26	Bad		4.08	1.404986494	0.018127184
27	Bad		1.74	0.555946059	0.04505279
28	Bad		10.57	2.358154944	0.074942085
29	Bad		15.20	2.721295428	0.216315789
30	Bad		9.00	2.197224577	0.601111111
31	Bad		1.70	0.530628251	0.098823529
32	Bad		3.71	1.312186389	0.20978022
33	Bad		2.74	1.006804739	0.081093117
34	Bad		1.27	0.240302677	0.038267813
35	Bad		0.30	-1.205924024	1.026503107
36	Bad		2.84	1.045367774	0.473871528
37	Bad		0.70	-0.357455889	0.048734916
38	Bad		1.66	0.506371273	0.158395337
39	Good		0.49	-0.723408557	0.062049995
40	Bad		1.29	0.252702354	0.202087379
41	Bad		0.80	-0.223143551	4.48
42	Bad		18.00	2.890371758	10.53555556
43	Bad		0.33	-1.098612289	13.31333333
44	Bad		2.50	0.916290732	6.98
45	Bad		1.31	0.271933715	1.081190476
46	Bad		1.50	0.405465108	2.757777778
47	Bad		1.67	0.510825624	2.646666667
48	Bad		3.00	1.098612289	13.31333333
49	Bad		2.00	0.693147181	7.48
50	Bad		2.60	0.955511445	1.364615385
51	Bad		1.30	0.259511195	0.013688412
52	Bad		0.90	-0.102654154	0.037903757
53	Good		0.94	-0.06285297	0.287849231
54	Good		0.88	-0.123284032	0.233440685
55	Good		1.04	0.035506688	0.366068927
56	Good		0.95	-0.052185753	0.002663438
57	Good		0.93	-0.071458964	0.004278416
58	Good		0.88	-0.131028262	0.00754386
59	Good				
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## All RR data

Good	0.92	-0.088553397	0.00398619
Good	0.89	-0.111570701	0.004241055
Good	0.83	-0.187078253	0.007093105
Bad	1.13	0.122461169	0.038914572
Good	1.03	0.027305451	0.012378689
Good	0.93	-0.075507553	0.006959622
Good	0.91	-0.093487231	0.009592601
Good	0.90	-0.103656938	0.009180356
Good	0.88	-0.131336002	0.021997301
Good	0.98	-0.021661497	0.006716902
Good	0.93	-0.070380797	0.008483248
Good	1.02	0.017376376	0.008095858
Good	0.96	-0.044370248	0.013424748
Good	1.02	0.018343838	0.00822694
Good	0.88	-0.129070995	0.025000527
Good	0.86	-0.156088039	0.018069057
Good	0.87	-0.139887958	0.007814204
Good	0.93	-0.07271475	0.017290406
Good	0.85	-0.166223261	0.047950646
Good	0.98	-0.021479807	0.00403207
Good	0.95	-0.051838018	0.004202366
Good	0.87	-0.138110854	0.011015725
Good	0.97	-0.029413885	0.001640349
Good	0.99	-0.014184635	0.000592444
Good	0.99	-0.013889112	0.000381857
Good	0.94	-0.060624622	0.002553105
Good	1.06	0.062520357	0.00350277
Good	0.94	-0.062520357	0.00350277
Good	0.93	-0.073025135	0.001458244
Good	0.93	-0.074107972	0.001892552
Good	0.97	-0.028573372	0.000799483
Good	0.93	-0.077558234	0.003276628
Good	0.94	-0.0588405	0.001659452
Bad	1.00	0	0.089869281
Good	0.98	-0.015504187	0.003231838
Good	0.93	-0.075223421	0.002339976
Good	0.88	-0.124052649	0.007756813
Good	1.01	0.01091989	0.001918507
Bad	0.97	-0.032789823	0.014777681
Good	0.95	-0.051767565	0.007845417
Good	0.96	-0.039095014	0.009954277
Good	0.98	-0.015564517	0.010507987
Good	0.95	-0.04681706	0.016043193
Good	1.08	0.079745663	0.007477684
Good	1.02	0.017225306	0.009432718
Good	0.91	-0.095986084	0.010575161
Good	1.01	0.005826673	0.017429194
Good	0.98	-0.015564517	0.021936558
Good	0.90	-0.109875196	0.016826668
Good	0.94	-0.058581902	0.018142458
Good	0.98	-0.015564517	0.021936558
Good	1.01	0.008533035	0.011088707
Good	0.95	-0.051767565	0.007845417
Good	0.93	-0.074405017	0.004076323
Good	0.92	-0.084557388	0.008920685

## All RR data

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4	Good	1.01	0.005826673	0.017429194
5	Good	1.03	0.033225648	0.026281797
6	Good	0.84	-0.173788522	0.017755374
7	Good	0.84	-0.171568765	0.026597453
8	Good	0.96	-0.037054222	0.007582513
9	Bad	0.92	-0.087011377	0.851212121
10	Bad	1.00	0	6.646666667
11	Bad	1.16	0.147452731	0.154103105
12	Bad	0.85	-0.167054085	1.658321678
13	Bad	0.82	-0.194156014	0.414173669
14	Bad	0.86	-0.15415068	3.075238095
15	Bad	1.02	0.022223137	0.20224966
16	Bad	1.13	0.126293725	0.033466218
17	Bad	0.98	-0.023530497	0.020818965
18	Bad	1.18	0.162166755	0.010316573
19	Bad	0.81	-0.207639365	0.016096327
20	Bad	0.87	-0.135955636	0.007760099
21	Bad	0.98	-0.024097552	0.010718384
22	Bad	0.94	-0.063100706	0.006096982
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Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
2 Kennedy (1	1997	Anxiety	37.8	19.9	16	12.3	10.7
9 Gammon (	1998	Anxiety	12.75	2.43	20	8.15	3.17
15 Tarzi (2001	2001	Anxiety	15	3	22	8.6	3
16 Day (2011a	2011	Anxiety/Dep	14.35	1.61	20	13	0.8
13 Findink (20	2012	Anxiety	7.23	4.1	61	6.42	3.9
Soon (2013	2013	Anxiety					
17 Lupion-Mer	2015	Anxiety	8.2	0.48	72	6.9	0.41
8 Lau (2016)	2016	Anxiety	1.48	1.72	75	1.7	1.8

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Control.N	yi	vi
16	1.5558	0.1628
20	1.5963	0.1319
20	2.093	0.1476
83	1.3351	0.0707
57	0.201	0.0341
	2.5649	0.986
72	2.8969	0.0569
421	-0.1228	0.0157

For peer review only

Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
1 Kennedy (1	1997	Depression	16.5	9.9	16	12.3	10.7
10 Gammon (	1998	Depression	12.45	2.21	20	7.3	2.05
Tarzi (200	2001	Depression					
16 Day (2011	2011	Anxiety/De	14.3	1.61	20	13	0.8
14 Findink (20	2012	Depression	8.83	4.7	61	7.89	4.9
Soon (2013	2013	Depression					
18 Lupion-Mer	2015	Depression	7.8	0.51	72	6.6	0.43
7 Lau (2016)	2016	Depression	6.89	4.92	75	7.35	5.92

For peer review only

Control.N	yi	vi
16	0.397	0.127
20	2.368	0.17
	2.101	0.125
83	1.335	0.071
57	0.195	0.034
	1.562	0.2
72	2.531	0.05
420	-0.079	0.016

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**Case-control studies**

	Colorado (2014)	Kennedy (1997)	Livorsi (2015)	Lupion (2015)	Masse (2013)	Soon (2013)	Tarzi (2001)
1) <u>Is the case definition adequate?</u> a) yes, with independent validation * b) yes, eg record linkage or based on self reports c) no description	*	*	*	*	*	*	*
2) <u>Representativeness of the cases</u> a) consecutive or obviously representative series of cases * b) potential for selection biases or not stated	b	b	*	b	b	*	*
3) <u>Selection of Controls</u> a) community controls (studies of hospital patients) * b) hospital controls c) no description	*	*	*	*	*	*	*
4) <u>Definition of Controls</u> a) no history of disease (endpoint) * b) no description of source	*			*			
<b>Comparability</b>							
1) <u>Comparability of cases and controls on the basis of the design or analysis</u> a) study controls for diagnosis * b) study controls for any additional factor *	* * (l)	* * (l, g)		* * (g)	* * (g)	* * (l, g)	* * (l, g)
<b>Outcome</b>							
1) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview where blind to case/control status * c) interview not blinded to case/control status d) written self report or medical record only e) no description	*	*	*	*	*	*	*
2) <u>Same method of ascertainment for cases and controls</u> a) yes * b) no	Functional Independence Measure ## *	Functional Independence Measure; Beck Inventory Depression; State Anxiety Inventory; Profile Mood States ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Charlston Comorbidity Index ## *	Hospital Anxiety and Depression Scale ## *	Geriatric Depression Scale; Profile of Mood States; Abbreviated Mental Test Score; Barthel Index ## *
3) <u>Non-Response rate</u> a) same rate for both groups * b) non respondents described c) rate different and no designation	*	*	*	*			*

**Cohort studies (1)**

Selection	Croft (2015)	Day (2011) a	Day (2011) b	Day (2012)	Day (2013)	Evans (2003)	Findink (2012)	Guilley (2017)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*	*	*	*	* b	c	*b	*b
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*	*	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	b	b	*	*	*		*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *	* * (l,g)		* * (l,g)	* * (l,g)	* * (l,g)			* (g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	Global Trigger Tool ### *	Hospital Anxiety and Depression Scale ## *	*	Clinical diagnosis of delirium *	Hospital Anxiety and Depression Scale ### *	Clinical encounters per hour *	Hospital Anxiety and Depression Scale ## *	State-Trait Anxiety Inventory ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*	*	*	*	* 3 days	*	*	
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*	*	*	*	*	*	*	*

Community – was hospital population  
Time to outcome of interest – question is regarding outcome during isolation

a – age  
g- gender  
l – LOS

# own scale  
## validated scale/s used appropriately



## Cohort studies (2)

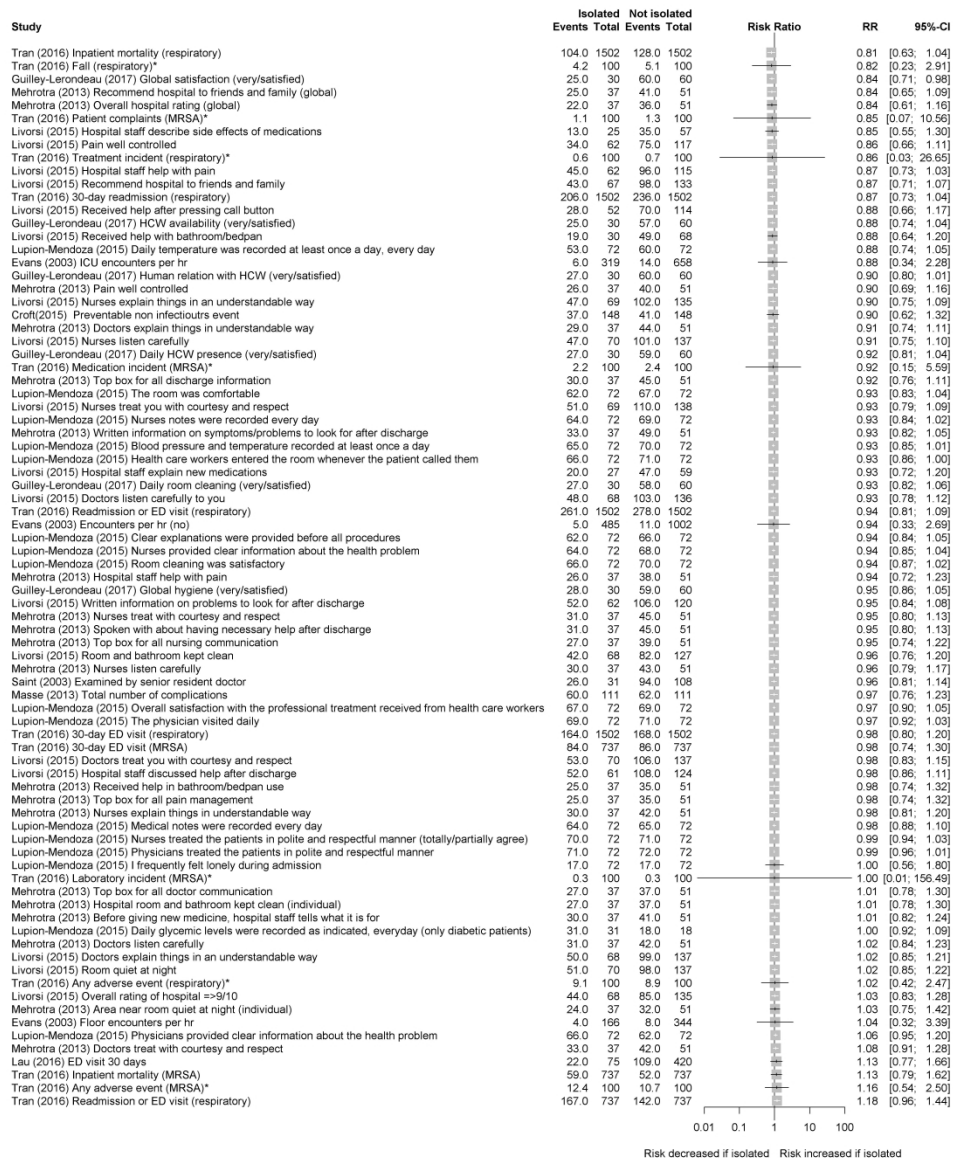
Selection	Kirkland (1999)	Lau (2016)	Mehotra (2013)	Stelfox (2003)	Spense (2011)	Saint (2003)	Tran (2016)	Wassenberg (2010)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*b	*	*	*	b	*	*	*
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*b	*b	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	*	*	*	*	*	*	*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *		* (g)	* * (l,g)	* * (l,g)		*	* * (l,g)	(l,g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	* #	Patient Health Questionnaire-9; CQ-5D c telephone /health records ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Clinical satisfaction # *	Clinical outcomes *	Observation of doctors *	Clinical outcomes *	EQ5-D; Hospital Anxiety and Depression Scale ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*		*	*	*	*	*	*
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*		37/278 contact; 51/290 non	*	*		*	*

## General notes

Community – the population of interest was a hospital population

Time to outcome of interest – question is regarding outcome during isolation or shortly afterwards

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# PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	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.	1-2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Suppl information
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	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.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	6-7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	6-7



# PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7-8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	None
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Suppl information
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Suppl information
Results of individual studies	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.	Figures
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	None
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8-9
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	None
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	8-11
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	14
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	None

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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# BMJ Open

## Impact of isolation on hospitalised patients who are infectious: systematic review with meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-030371.R3
Article Type:	Original research
Date Submitted by the Author:	03-Dec-2019
Complete List of Authors:	Purssell, Edward; City, University of London, School of Health Sciences Gould, Dinah; City, University of London, School of Health Sciences Chudleigh, Jane; City, University of London, School of Health Sciences
<b>Primary Subject Heading</b>:	Infectious diseases
Secondary Subject Heading:	Mental health, Nursing, Patient-centred medicine
Keywords:	Infection control < INFECTIOUS DISEASES, Anxiety disorders < PSYCHIATRY, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 **Impact of isolation on hospitalised patients who are infectious:**  
4 **systematic review with meta-analysis**  
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27 Keywords: Contact isolation; Infection control (MeSH); Patient isolation (MeSH);  
28 Quarantine (MeSH)  
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31 Word count - excluding title page, references, figures and tables – 3 301  
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3 **Impact of isolation on hospitalised patients who are infectious: systematic review**  
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5 **with quantitative and meta-analysis**  
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10 **Abstract**  
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15 Objective

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17 To systematically review the literature exploring impact of isolation on hospitalised  
18 patients who are infectious: psychological and non-psychological outcomes  
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24 Design

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26 Systematic review with meta-analysis  
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31 Data Sources

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33 Embase, Medline and Psycinfo were searched from inception until December 2018.  
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35 Reference lists and Google Scholar were also handsearched.  
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41 Results

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43 Twenty six papers published from database inception until December 2018 were  
44 reviewed. A wide range of psychological and non-psychological outcomes were  
45 reported. There was a marked trend for isolated patients to exhibit higher levels of  
46 depression, the pooled standardised mean difference being 1.28 (95% CI: 0.47 to  
47 2.09) and anxiety 1.45 (95% CI: 0.56 to 2.34), although both had high levels of  
48 heterogeneity; and worse outcomes for a range of care-related factors but with  
49 significant variation.  
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## Conclusion

The review indicates that isolation to contain risk of infection has negative consequences for segregated patients. Although strength of the evidence is weak, comprising primarily single centre convenience samples, consistency of the effects may strengthen this conclusion. More research needs to be undertaken to examine this relationship and develop and test interventions to reduce the negative effects of isolation.

## Strengths and limitations of this study

- This review covers a wide variety of literature from a range of different clinical areas.
- Data collected and the methods of collecting data on the impact of isolation is varied across studies.
- These data do not show if these effects are temporary, or in most cases if they are clinically significant.

## Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

## Competing interests statement

No authors have any competing interests to declare

## Introduction

Isolation is an established part of any infection prevention programme. Its purpose is to prevent the transmission of antibiotic-resistant pathogens, those that are highly contagious or cause serious infection.[1] The effectiveness of isolation has been questioned however [2–5] and it can be challenging to undertake, especially if patients' lack of understanding of the need for segregation, boredom or distress result in uncooperative behaviour. [6] A recent survey exploring the care of patients isolated for infectious conditions suggests that in clinical practice the main issues are identifying which patients need to be isolated as quickly as possible and prioritising which patients should be segregated when isolation accommodation is in short supply. Infection preventionists were aware that isolation could have negative effects on patients such as increased risk of anxiety, depression and falls and felt that more should be done to prevent these risks.[6]

Although single rooms are assumed to reduce infection risk, evidence of ability to contain spread is equivocal [7,8] and a recent study conducted in an all-single-room hospital was unable to demonstrate lower infection rates than in hospitals where most care takes place in open wards. [9] This study identified advantages and disadvantages of single room accommodation, whereas isolating infectious patients is generally assumed to result in adverse outcomes.[10]

A systematic review reported eight years ago indicated higher levels of anxiety, depression, perceptions of stigmatisation and a higher incidence of falls, medication errors and other incidents that detract from patient safety among patients who were isolated compared to those who were not.[11] This review reported studies undertaken

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3 before 2010 and included patients whose experiences are unlikely to be comparable:  
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5 children and adults and those isolated to reduce their own risk of infection as well as  
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7 infectious patients. The review was not reported according to standards currently  
8  
9 expected for systematic reviews [12] and presents a qualitative description of patient  
10  
11 outcomes only. A more rigorously reported and up-to-date systematic review is  
12  
13 indicated in view of increasing concern about satisfaction with health care and patient  
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15 safety and increasing emphasis on infection prevention as part of the global strategy  
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17 to reduce risks of antimicrobial resistance.[13]  
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24 We undertook a systematic review of the literature to establish the effects of infection  
25  
26 related isolation on psychological and non-psychological care-related outcomes in  
27  
28 adults. This review is therefore more focussed than that previously undertaken which  
29  
30 also included those in protective isolation, and contains a significant body of literature  
31  
32 published since 2010.  
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### 37 **Method**

38  
39 The eligibility criteria for inclusion was that studies should compare quantitative data  
40  
41 on psychological or non-psychological outcomes in adult patients who are in infective  
42  
43 isolation with those not isolated. Purely symptomatic/disease progression outcomes  
44  
45 were not included, neither were those looking at patients isolated due to  
46  
47 immunosuppression. Studies not containing comparative data between those isolated  
48  
49 and not isolated were also excluded. Search terms were: Patient isolation; cross  
50  
51 infection; contact isolation; respiratory, source or contact isolation; droplet, airborne  
52  
53 or contact precautions; cubicle; MRSA or methicillin resistant *Staphylococcus aureus*;  
54  
55 patient safety or harm; depression; anxiety; adaptation; stress; patient satisfaction;  
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3 quality of life. These were searched as free-text and index terms where these existed.  
4  
5 The information sources used were Embase, Medline and Psycinfo, which were  
6  
7 searched from inception until December 2018. The full Medline search is shown in  
8  
9 Supplementary File 1. Reference lists and Google Scholar were also handsearched.  
10  
11 Characteristics of included and excluded papers are shown in Supplementary File 2.  
12  
13 The PRISMA flow-chart is given in Supplementary File 3. No protocol was  
14  
15 published in advance.  
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21 Studies were initially screened for relevance by one author (EP), with the final stage  
22  
23 being undertaken by two (EP, DG). Data were extracted and checked by two authors  
24  
25 (DG, EP); where there were disagreements data were rechecked for relevance and  
26  
27 accuracy. Where available, raw data were extracted and entered into a spreadsheet,  
28  
29 and depending upon the nature of the data either the risk ratio (where numbers of  
30  
31 patients were given) or standardised mean difference (where other statistics were  
32  
33 given) calculated. Results were then presented as forest plots.  
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40 Due to the variety of different settings and methods it was deemed that the  
41  
42 methodological and clinical heterogeneity was too broad to pool results; apart from  
43  
44 those related to anxiety and depression, for which results were pooled using the  
45  
46 random-effects model. This model assumes that the observed effect from each study  
47  
48 is estimating a related but different true effect, allowing for between-study variation  
49  
50 to be calculated in the form of heterogeneity statistics. All calculations and plots were  
51  
52 produced using the meta and metafor packages in R.[14–16] Where raw data were  
53  
54 not provided the summary results are given in the text but not the forest plots. All data  
55  
56 relevant to the study are included in the article or uploaded as Supplementary File 3.  
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## Patient and Public Involvement

No patient involved.

## Results

A total of 3 879 papers were retrieved from the three databases; of which 38 were assessed for eligibility by reading the full text. Of these 13 studies provided data suitable for the calculation of risk ratio, 5 giving psychological outcomes,[17–21] and 12 non-psychological;[19,22–32] and 8 provided data for the calculation of standardised mean differences, 6 giving psychological outcomes,[21,30,33–36] and 2 non-psychological.[29,37] A further 6 studies did not provide raw data but are included in the results; 3 each giving psychological outcomes[38–40] and non-psychological outcomes.[17,41,42] Meta-analyses were possible on two outcomes: anxiety and depression from 8 studies using standardised mean difference. [19–21,30,33–36] Where only risk ratio data were given[20,21] conversion to standardised mean difference was undertaken using the Campbell Collaboration calculator (<https://campbellcollaboration.org/research-resources/effect-size-calculator.html>).[43]

Where it was not possible to pool outcome data because of methodological and clinical heterogeneity, the data from studies are shown as forest plots but without meta-analysis. The forest plots contain results from the studies where sufficient data were given to calculate either the risk ratio or standardised mean difference. A number of studies provided data on those under contact precautions, but no comparative data and so were not included.[44–47]

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5 Because of the large number of non-psychological outcomes for which RR could be  
6 calculated, it was decided that a change of 20% (i.e. a RR of 0.8 or less, or 1.2 or  
7 more) would be clinically significant, regardless of the statistical significance. This  
8 was a pragmatic decision, and all results are shown in Supplementary File 4. Results  
9 are shown in Figures 1 to 6. Supplementary Figure 1 contains results that did not  
10 meet our criteria for being clinically significant. Outcomes were classified into one of  
11 three categories: those to do with quality of care; satisfaction of care; and adverse  
12 events from which median values and interquartile ranges were calculated.  
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26 The studies included were primarily single-centre and consisted of case-control,  
27 cross-sectional and cohort studies. Risk of bias was assessed using the Newcastle-  
28 Ottawa scale, full details of each study and its risk of bias are in the Supplementary  
29 File 5.[48] Overall, although these studies have limited generalisability, there did not  
30 appear to be significant cause for concern regarding bias within the limitations  
31 inherent in these study designs. Most studies used established or validated tools[17–  
32 21,23–25,27,29,30,33–37] or clinical outcomes.[22,26,28,31,32]  
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45 The data from the comparative studies suggest that although in many cases infective  
46 isolation precautions make little difference to psychological outcomes, where it does  
47 make a difference this is primarily negative. There were significant declines in mean  
48 scores related to control and self-esteem, and in many studies increases in the mean  
49 scores for risk of anxiety and depression. However, these findings were not  
50 consistent, and some larger studies showed little or no difference between the groups  
51 for these outcomes. These are shown in Figures 1 and 2 respectively.  
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6 [INSERT FIGURES 1 and 2 HERE]  
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10 Figure 1. Risk ratio of psychological events in those isolated versus not isolated  
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15 Figure 2. Standardised mean difference of psychological scores in those isolated  
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17 versus those not isolated  
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21 For the 8 studies reporting data on anxiety the pooled SMD was 1.45 (95% CI: 0.56 to  
22 2.34); although within this there was significant heterogeneity ( $Q = 168.11$ ,  $df = 7$ ,  $p$   
23  $< 0.0001$ ;  $I^2 = 95.84\%$ ). This was primarily caused by two studies [30,34] which  
24 showed lower levels of anxiety than the remaining studies. For depression the SMD  
25 was 1.28 (95% CI: 0.47 to 2.09); again with significant heterogeneity ( $Q = 154.5$ ,  $df =$   
26 7,  $p < 0.0001$ ;  $I^2 = 95.47\%$ ), in this case the studies falling into two categories, those  
27 with lower [30,34,35] and higher depression scores among those  
28 isolated.[19,20,33,36] The forest plots for these outcomes are shown in Figures 3 and  
29 4 respectively.  
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[INSERT FIGURES 3 and 4 HERE]

Figure 3. Meta-analysis of the standardised mean difference of anxiety in those  
isolated versus those not isolated

Figure 4. Meta-analysis of the standardised mean difference of depression in those  
isolated versus those not isolated

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6 Studies not reporting the raw data showed that contact precautions were associated  
7  
8 with depression OR 1.4 (95% CI 1.2 to 1.5) but not anxiety OR 0.8 (95% CI 0.7 to  
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10 1.1) in a non-ICU population.[41] There was also an association with delirium OR  
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12 1.40 (95% CI 1.24 to 1.51); although this was primarily among those who were newly  
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14 diagnosed as needing isolation OR 1.75 (95% CI 1.60 to 1.92,  $p<0.01$ ) rather than  
15  
16 those who had been under contact precautions for their entire stay OR 0.97 (95% CI  
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18 0.86 to 1.09,  $p=0.60$ ).[17] Another study showed no difference in the median values  
19  
20 for the Hospital Anxiety and Depression Scale anxiety or depression scores (HADS-A  
21  
22 and -D), or the EuroQol Visual Analogue Scale EQ VAS scores.[42]  
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28 For non-psychological outcomes, using a difference in the risk of +/- 20% of an event  
29  
30 as being a measure of clinical significance it appears there was a trend for less  
31  
32 attention to be given to, and for more errors to occur in those who were isolated.  
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34 However, again there was wide variation between studies. Data on these outcomes  
35  
36 are given in Figures 5 and 6, and the non-clinically significant risks in the  
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38 Supplementary Figure 1. For those outcomes associated with quality, the median risk  
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40 ratio (with positive outcomes reversed so a higher risk ratio is associated with a worse  
41  
42 outcome) was 0.94 (IQR 0.92 to 0.98), satisfaction 0.95 (IQR 0.89 to 1.01) and  
43  
44 adverse events was 1.27 (0.91 to 2.5). The minimum and maximum risk ratio for  
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46 each category was 0.49 and 1.72; 0.3 and 8; and 0.3 and 18 respectively.  
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54 [INSERT FIGURES 5 and 6 HERE]  
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3 Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated  
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5 with a RR of  $\leq 0.8$  or  $\geq 1.2$

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8 \* outcome was measured in rate per 100 admissions  
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12 Figure 6. Standardised mean difference of non-psychological scores in those isolated  
13  
14 versus those not isolated

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17 FIM – functional independence measure  
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21 A study not giving raw data which looked at the rates of falls and pressure ulcers  
22  
23 before and after a policy change that resulted in the discontinuation of contact  
24  
25 precautions for patients with methicillin resistant *Staphylococcus aureus* (MRSA) or  
26  
27 vancomycin resistant enterococci (VRE) found that falls and pressure ulcers were  
28  
29 more common among those with MRSA or VRE both before the change (when they  
30  
31 were in isolation) and afterwards (when they were not). Before the change the number  
32  
33 of falls was 4.57 vs 2.04 per 1000 patient-days respectively ( $p < 0.0001$ ) and pressure  
34  
35 ulcers 4.87 vs 1.22 per 1000 patient-days ( $p < 0.0001$ ). After the policy change the  
36  
37 same numbers were falls 4.82 vs 2.10 ( $p < 0.0001$ ) and pressure ulcers 4.17 vs 1.19 per  
38  
39 1000 patient-days ( $p < 0.0001$ ).[39] Other studies found that staff spent less time with  
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41 those on contact precautions: internal medicine interns spent less time with their  
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43 isolated patients compared to non-isolated patients, the median times being 5.2 and  
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45 6.9 minutes respectively ( $p < 0.001$ )[38]; while the mean number of contacts per hour  
46  
47 with healthcare workers was 2.1 compared to 4.2 in those not isolated ( $p = 0.03$ ),  
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49 although the duration was longer at 4.5 minutes compared to 2.8 ( $p = 0.6$ ).[40]  
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## 58 **Discussion**

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3 Current recommendations say that contact precautions should include a single room,  
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5 with personal protective equipment consisting of a gown and gloves for all patient  
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7 contacts or contacts with potentially contaminated environmental areas.[1] This  
8  
9 review has shown that there are a number of apparently negative aspects to contact  
10  
11 precautions, in particular with regards to psychological effects and a reduction in the  
12  
13 quality of some aspects of care. These data come from studies carried out in a variety  
14  
15 of countries and different types of facilities; although there are few data from  
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17 particularly vulnerable populations such as the elderly.  
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24 Although at times there are discussions as to the necessity of contact precautions for  
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26 drug resistant organisms, with some arguing that that there is mixed evidence for or  
27  
28 against their use[49] another recent review has concluded that they are of great  
29  
30 importance in the control of epidemic and endemic multidrug-resistant  
31  
32 microorganisms.[50] The ethics of using contact precautions and other forms of  
33  
34 isolation rely on a positive assessment of the balance between the risks and benefits of  
35  
36 this to the individual concerned and that of the broader population of patients and  
37  
38 staff.[51] However, even when this assessment is positive, it is important to ensure  
39  
40 that any harm to the individual is minimised.  
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47 One way of balancing the various priorities is to use the GRADE Evidence to  
48  
49 Decision Framework, which provides criteria for making recommendations at the  
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51 individual, group and policy-levels, and provides a number of highly patient focussed  
52  
53 criteria for doing this. In addition to the certainty of evidence and resource  
54  
55 requirements, it also requires consideration of: the balance of desirable and  
56  
57 undesirable effects; the impact upon equity; and the feasibility and acceptability of the  
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3 intervention.[52] The last two of these might have very different outcomes when  
4  
5 considered at the population and individual levels; and there is certainly evidence here  
6  
7 that for the individual patient the balance of desirable and undesirable effects might  
8  
9 be very different to that of the broader population.  
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14  
15 However, within the broad population of infected or potentially infected patients,  
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17 some groups might have different needs. For example a study of people isolated for  
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19 MERS found that while access to telephones reduced anxiety and anger; access to  
20  
21 email, text and internet increased these.[53] This was not an area investigated in any  
22  
23 depth in these studies. Another area where information may be lacking is that of age,  
24  
25 as older people in particular might feel sadness and loneliness more; and gender, as  
26  
27 qualitative data suggest that women in isolation were more concerned about  
28  
29 precautions and transmission while men were more resigned, rational and tended to  
30  
31 cope better.[54]  
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38 In some countries, such as the United States single-rooms have become the standard  
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40 for new hospitals and so one might expect fewer adverse effects if everyone is in a  
41  
42 single room, this being the norm. However it may be that a single room is necessary  
43  
44 but not sufficient for these findings, and that it is the combination of a single room  
45  
46 with an infection that leads to these results. Certainly it is far from clear that the long  
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48 list of advantages claimed for single rooms which include reduced stress, the ability to  
49  
50 deliver better care, and a lower probability of dietary or medication errors apply to  
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52 this group of patients.[55]  
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3 Caring for patients in single-rooms does have many challenges, but there is evidence  
4 that these can be mitigated in a general population;[9] however the expanding  
5 literature on how this can be done in a general population does not necessarily apply  
6 here due to the necessity of isolation procedures which are, by design, ‘a barrier’.  
7  
8 Therefore patients’ needs for greater social interaction will need a solution quite  
9 different from that which might be used for a different patient population, and the  
10 benefit of choice about this which single rooms offer does not apply here.[56]  
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21 Although this review has quantified the extent of the problem, we have not been able  
22 to find solutions in the literature. Care might be improved through increased staff  
23 attention with more resources being allocated to these patients, although the extra cost  
24 of contact precautions is already considerable, one estimate being that it was an extra  
25 \$158.90 (95% CI \$124.90 to \$192.80) per patient day.[57] Alternatively new ways of  
26 working might be developed, perhaps using technology to mitigate some of these  
27 problems. Technology might be particularly useful in reducing adverse events such  
28 as medication or clinical errors; although increasing satisfaction and some areas of  
29 quality are more likely to be achieved by increasing the availability of staff and other  
30 people. The extent to which scarce resources are allocated to this may be driven in  
31 part by the longevity of any negative effects; which current literature is not really able  
32 to clarify. To understand this longitudinal studies are needed.  
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### 51 Study strengths and limitations

52  
53 This review suggests that infectious isolation has a number of negative effects on  
54 patients. Because this evidence is comprised of cohort and case-control studies, a  
55 claim for a causal relationship can not be made on this evidence, although the strong  
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3 and consistent effects across the studies may increase the confidence in this  
4  
5 relationship. There are some qualitative data, although more in-depth mixed-methods  
6  
7 data where those reporting negative effects are questioned about them would  
8  
9 strengthen the evidence on this. In some cases large effect sizes were accompanied  
10  
11 by very wide confidence intervals, suggesting that studies were underpowered, thus  
12  
13 studies with larger sample sizes would be useful. It would also be useful if there were  
14  
15 more consistent methods of examining and reporting these data, particularly outside  
16  
17 of the realms of depression and anxiety where the variety of methods makes analysis  
18  
19 of the body of evidence difficult. We were also unable to assess whether these effects  
20  
21 varied according to reason for isolation; or to understand if they are likely to be long-  
22  
23 term or simply temporary phenomena.  
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30 Although these data suggest that there is a problem, there is a clear gap both in what  
31  
32 we know about improving the experience of isolation and what can be done in  
33  
34 practical terms to make it more tolerable for patients and their families. In particular  
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36 older people who may be most vulnerable to these negative effects were under-  
37  
38 represented in these studies; and this group are likely to represent an increasingly  
39  
40 large proportion of those isolated.  
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#### 49 Contributors

50  
51 EP, DG and JC conceived the review, EP conducted the search, EP and DG examined  
52  
53 the studies and extracted data, EP undertook the quantitative analysis, EP, DG and JC  
54  
55 wrote the discussion.  
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3 Funding  
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5 This research received no specific grant from any funding agency in the public,  
6 commercial or not-for-profit sector.  
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12 Competing interests statement  
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14 No authors have any competing interests to declare.  
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21 Data Availability  
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23 All data relevant to the study are included in the article or uploaded as supplementary  
24 information.  
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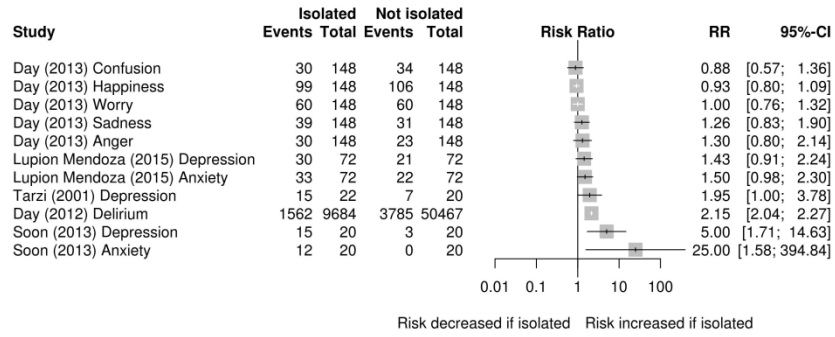


Figure 1. Risk ratio of psychological events in those isolated versus not isolated

279x127mm (300 x 300 DPI)



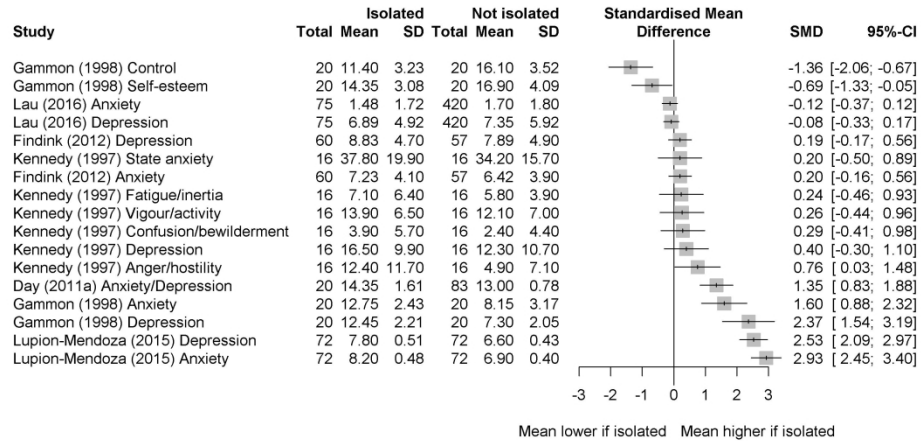


Figure 2. Standardised mean difference of psychological scores in those isolated versus those not isolated

279x152mm (300 x 300 DPI)

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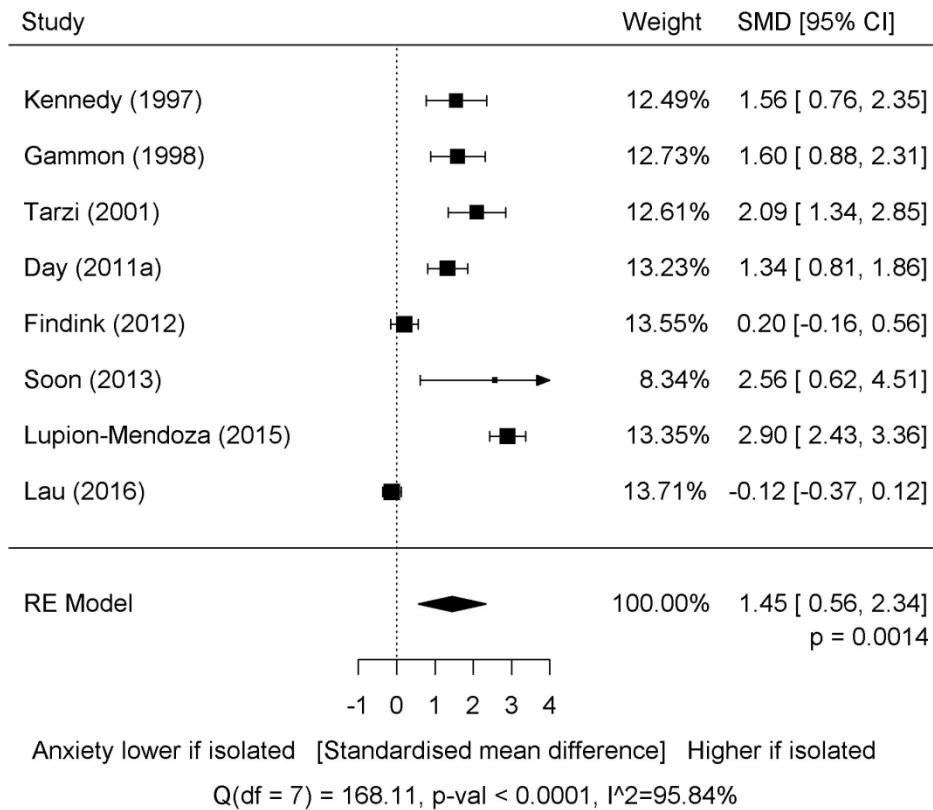


Figure 3. Meta-analysis of the standardised mean difference of anxiety in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

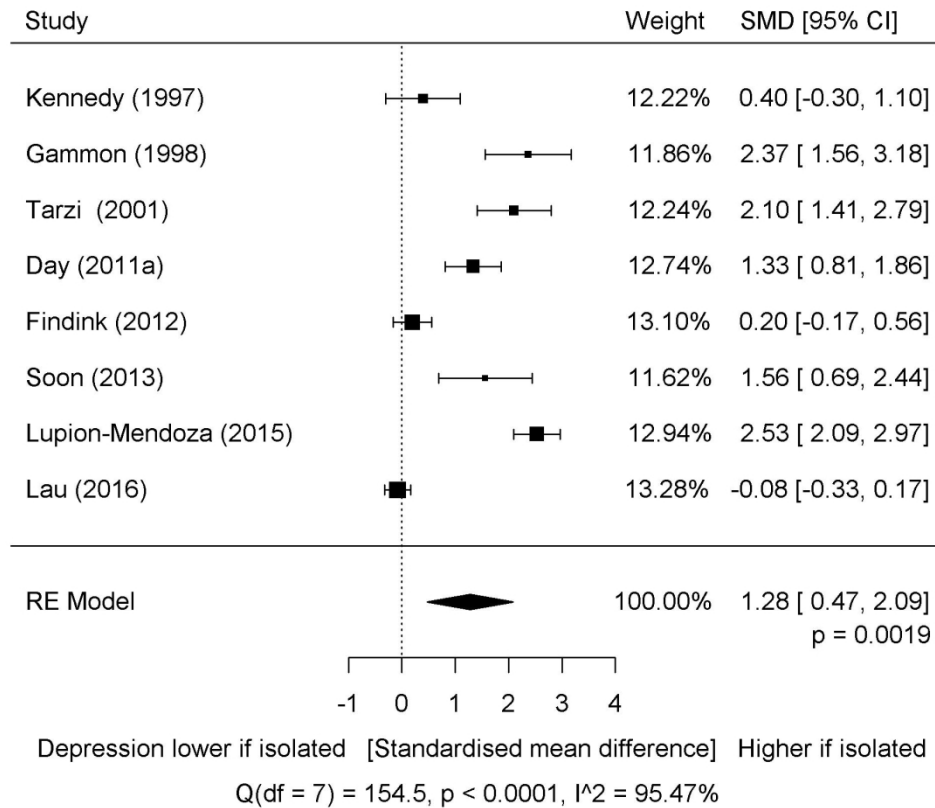


Figure 4. Meta-analysis of the standardised mean difference of depression in those isolated versus those not isolated

169x169mm (300 x 300 DPI)

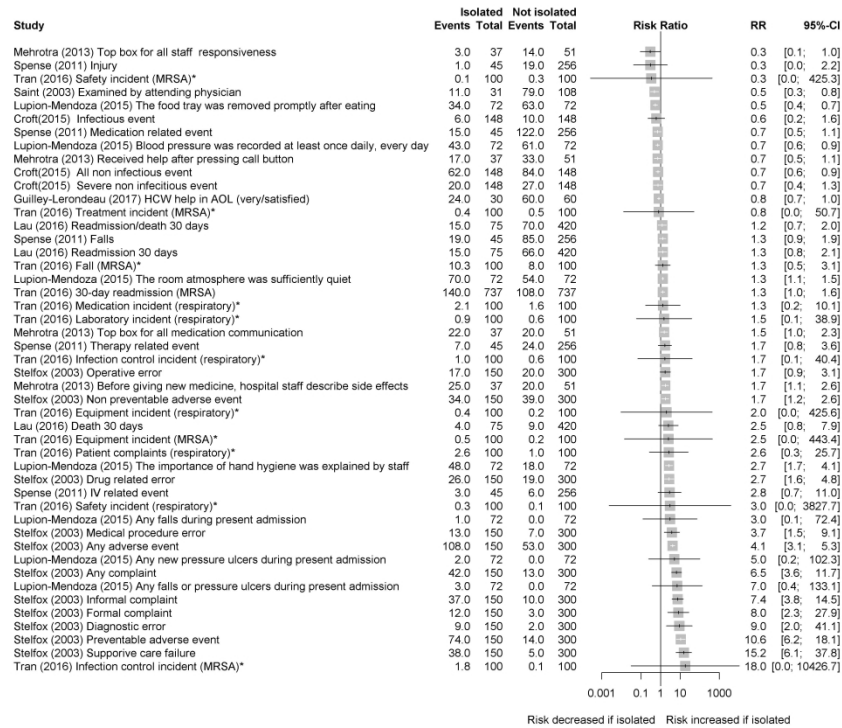


Figure 5. Risk ratio of non-psychological events in those isolated versus not isolated with a RR of  $\leq 0.8$  or  $> 1.2$

381x296mm (300 x 300 DPI)

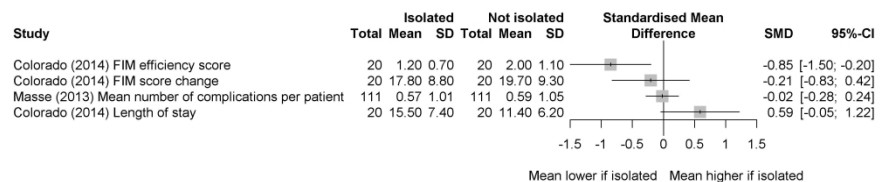
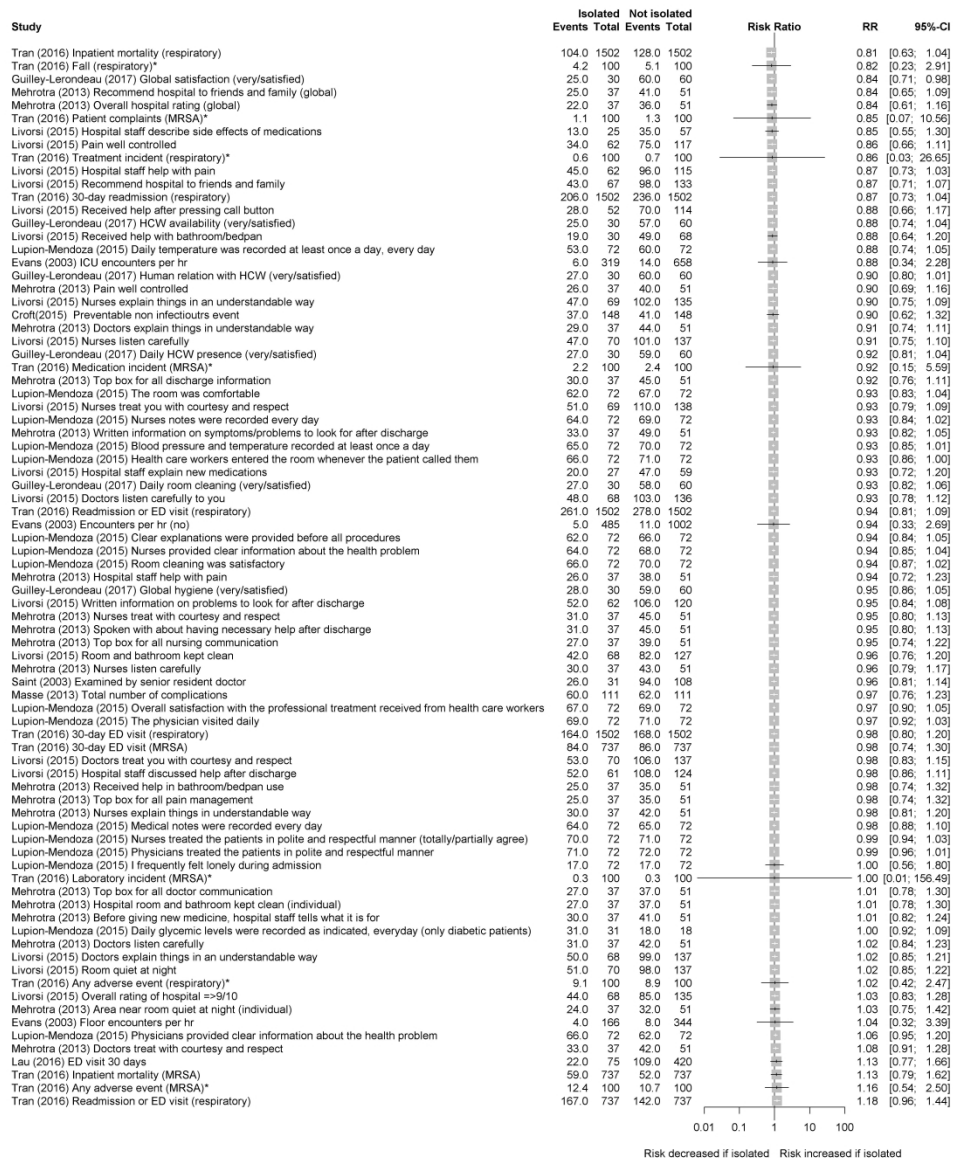


Figure 6. Standardised mean difference of non-psychological scores in those isolated versus those not isolated

321x127mm (300 x 300 DPI)

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381x465mm (300 x 300 DPI)

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25 10. mrsa.mp. or exp Methicillin-Resistant Staphylococcus aureus/  
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33 14. depression.mp. or exp DEPRESSION/  
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37 16. adaptation.mp. or exp ADAPTATION, PSYCHOLOGICAL/  
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**Characteristics of studies**

Reference	Study type	Isolated	Non isolated
Colorado (2014)	Retrospective matched case control study. Rehabilitation facility- tertiary centre United States July 2009 to December 2010	N20 Patients in contact isolation	N=20 Matched to patients not in contact isolation based on age, rehabilitation diagnosis, and type of insurance
Croft (2015)	Prospective cohort Medical or surgical inpatients admitted to non-intensive care unit hospital wards, United States. January to November 2010.	N=148 Patients on contact precautions Age: 52 (13.8) % male: 53.4	N=148 Individually matched by after an initial 3-day length of stay to patients not on contact precautions. Age 52.3 (14.6) % male: 46.6
Dashiell-Earp (2014)	Collected real-time data on the location of 15 internal medicine interns, United States. October 1, 2012 to December 31, 2012	1156 encounters	2467 encounters
Day (2011)	Patients admitted to the general acute care units, United States. June 1, 2009 to October 30, 2009	N=20 Age: 68.5 (14.7) % male: 85.0	N=83 Age: 63.9 (12.6) % male: 95.2
Day (2011)	A two-year retrospective cohort Tertiary care, United States.. All general inpatients over 18 years hospitalized for >24 h February 1, 2007 to January 31, 2009.	Contact precautions private room when possible, can be cohorted General N = 3138 Age: 51.2 (17.5) % male 58.9 ITU N=1694 Age: 54.9 (17.5) % male 61.0	General N = 25 426 Age: 49.6 (19.0) % male 46.3% ICU N = 5 854 Age: 56.0 (17.7) % male 59.7
Day (2012)	2-year retrospective cohort study of all non-psychiatric hospital admissions >18 years, United States. February 1, 2007 to January 31, 2009	N = 9 684 Contact precautions as above Mean age: 50.1 (18.8) % male 51.4	N = 50 458 Mean age: 52.3 (16.9) % males 59.1
Day (2013)	Longitudinal frequency-matched cohort study of patients admitted to general medical and surgical units, United States. Day 0, day 3 then weekly. January to November 2010	N = 148 Mean age: 52.0 (13.9) % male 58.1	N = 148 Mean age: 52.3 (14.6) % male 50.7



1 2 3 4 5	Evans (2003)	Prospective observation; survey; retrospective review, United States. Tertiary care. June and July 2001	N 48 Mean age: 47.8 (2) % male 85%	N = 48 Mean age: 58.3 (2.4) % male 75%
6 7 8 9 10	Findink (2012)	Non-random quasi-experiment, Turkey Age 18 to 65 Administered day 5 January 1, 2009 to December 31, 2009	N = 60 Mean age: 53.95 (18.4) % male 75%	N = 57 Mean age: 56.14 (17.1) % male 76.3%
11 12 13 14 15 16 17	Gammon (1998)	Quasi experiment Selected if last two numbers on their case notes even. Two large District General Hospitals and one elderly care hospital, United Kingdom	N = 20 Placed in isolation for a minimum of 7days Mean age: 61 years % male: 65	N = 20 Mean age: 52 years % male: 55
18 19 20 21 22 23	Gandra (2014)	Retrospective hospital-wide cohort study, United States. All patients admitted to medical-surgical inpatient units November 1, 2009 to October 31, 2011	Falls N=77 Mean age: 66.1 (14.3) % male: 61% Pressure ulcers N=82 Mean age: 64.5 (15.5) % male: 63	Falls N=82 Mean age: 63.7 (15.8) % male: 51 (62%) Pressure ulcers N=71 Mean age: 65.7 (15) % male: 57
24 25 26 27 28	Guilley-Lerondeau (2017)	Matched cohort study with prospective inclusions Interview 3 days after commencing General sample. France March to July 2012	N=30 First prescription of isolation precaution Median age (range) 69 (32 to 91) % male 47	N=60 Median age (range) 64 (24 to 91) % male 53
29 30 31 32 33	Kennedy (1997)	Cross-sectional matched-control study, United Kingdom. May 1994 to November 1996	N = 16 Isolated as a result of being MRSA Mean age: 31.1 All male	N = 16 Matched for age, sex, level of injury, and time since admission or injury
34 35	Kirkland (1999)	Observational study - 7 months Medical intensive-care, United States	N=14	N=21
36 37 38 39	Lau (2016)	Prospective cohort study. Adult patients discharged from internal medicine wards, Canada October 2013 to November 2014,	N=75 Mean age 60.35 (17.83) % male 59	N=420 Mean age 63.31 (18.69) % male 48%
40 41 42 43	Livorsi (2015)	Case-control study Retrospective January 1, 2012 to	N = 70 On contact precautions for MRSA throughout	N = 139 No significant differences between isolated and

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	May 31, 2012/prospective June 1, 2012 to March 31, 2013 'safety-net facility', United States	their hospital stay. Found to be MRSA positive during a previous hospitalization or as an outpatient, not current case	non-isolated patients
Lupi3n-Mendoza (2015)	Matched case-control study Tertiary hospital, Spain 2011 and 2012	N = 72 Adult patients admitted in isolation for =>5 days. Median age (range) 62 (21-93) % male 73%	N = 72 Median age (range) 69 (23-89), % male 68.1%
Massee (2013)	Retrospective case-control Tertiary care, Canada	N = 111 Matched MRSA patients with an admission diagnosis of heart failure or COPD to similar non-isolated controls Median age (IQR) 80.0 (69.0-86.0) % male 60.4%	N = 111 Median age (IQR) 80.0 (68.0-86.0) % male 60.4%
Mehrotra (2013)	Prospective cohort Admission and on days 3, 7, 14 Tertiary centre, United States	N = 238 Segregation into a private or cohorted room Mean age (SD) 52.4 (13.4) % male 55.7	N = 290 Mean age (SD) 52.9 (14.8) % male 48
Saint (2003)	Prospective cohort study 2 university-affiliated medical centers, United States. October 1999 to March 2000	N=31	N=108
Soon (2013)	Cross-sectional survey of cases and matched controls Teaching hospital Singapore June and August 2011	N=20 Contact isolation in a cohort cubicle for the first time because of colonization or infection with a MDRO for at least 3 days No statistically significant differences in age or gender	N=20
Spense (2011)	Retrospective evaluation of incident reports All patients admitted to acute care facility, United States January 1, 2008 to December 31, 2008.	N=45	N=256
Stelfox (2003)	Case control study Consecutive adults isolated for at least 2 days with MRSA. Canada and United States Controls patients admitted before	General N = 78 Age: 69.6 (17.1) % male: 45% CHF N = 72 Age: 66.9 (14.7)	General N = 156 Age: 65.4 (18.2) % male: 51% CHF N = 144 Age: 66.0 (14.5)

	and after. January 1, 1999, to January 1, 2000	% male: 58	% male: 54
Tarzi (2001)	Cross-sectional matched case-control study Care of the elderly rehabilitation wards, UK	N = 22 Had been in isolation for at least two weeks with MRSA Mean age (SD) 80 (8.4) % male 27.3	N = 20 Mean age (SD) 81 (9.1) % male 33.3
Tran (2017)	Propensity matched cohort study. General internal medicine services, 3 hospitals, Canada January 2010 to December 2012	MRSA Age: 69 % male 57% Respiratory Age: 71.7 % male: 53 Isolated for MRSA or respiratory illness	MRSA Age: 69 % male 58% Respiratory Age: 70.6 % male: 55
Wassenburg (2010)	Cross-sectional matched cohort study Single university hospital, Netherlands November 2006 to February 2007	N = 42 Age: 52 (19) % male: 52	N = 84 Age: 55 (16) % male: 55

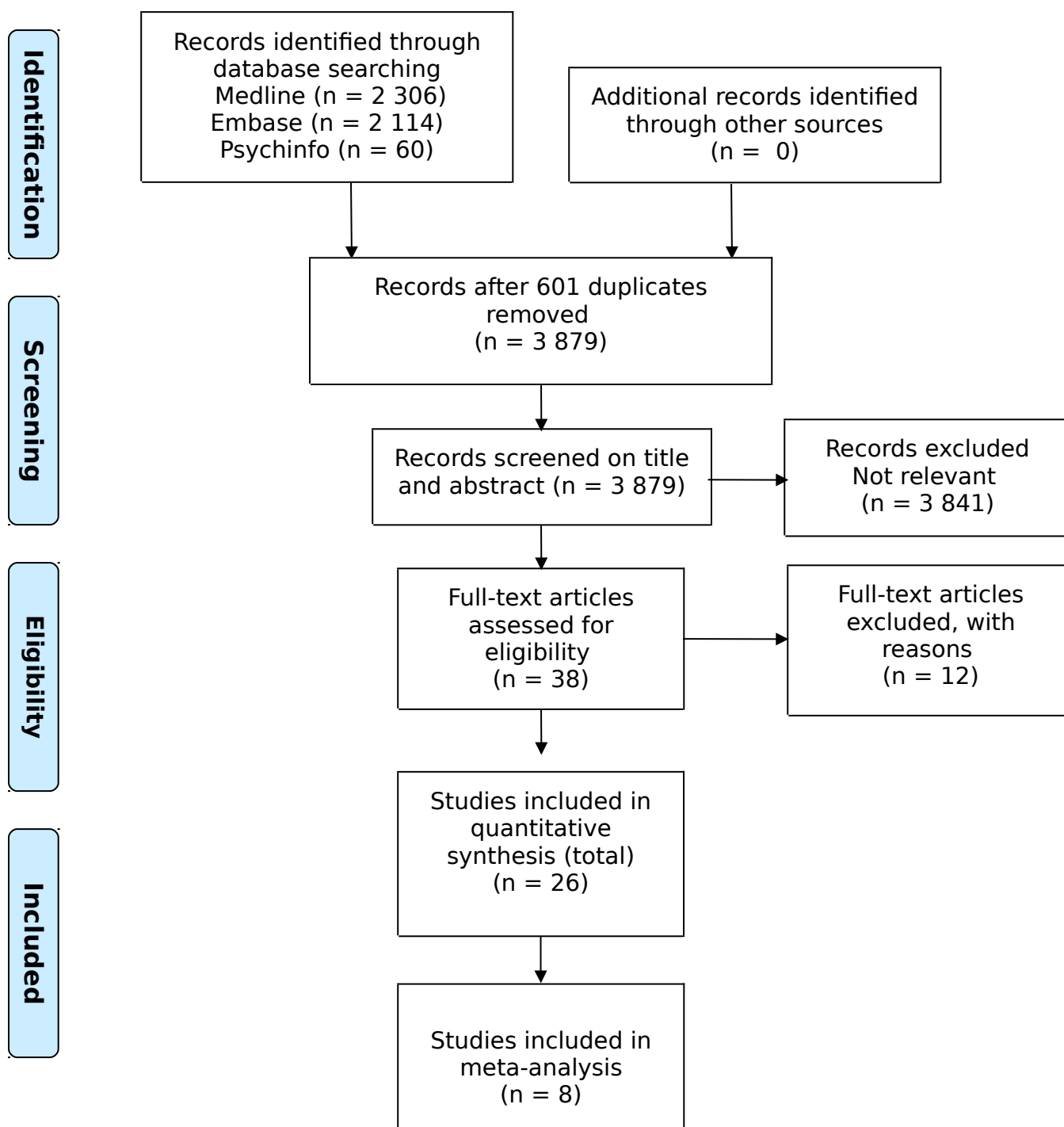
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Excluded papers

Reference	Reason for exclusion
Chittick et al (2016)	No comparative data
Godsell (2013)	Focussed on HCP
Jeong (2016)	MERS
MacKellaig (1986)	Qualitative
Madsden (2015)	Qualitative
Maunder (2003)	SARS
Moran (2009)	Focus on family centred care
Morgan (2011)	Focus on process measures
Rees (2000a)	No comparative data
Rees (2000a)	No comparative data
Simon (2016)	Before and after
Wilkins (1988)	No comparative data



## PRISMA 2009 Flow Diagram



56 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

58 **For more information, visit [www.prisma-statement.org](http://www.prisma-statement.org).**

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

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## All RR data

	Reference	Year
1		
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4	1 Croft(2015)	2015
5	2 Croft(2015)	2015
6	4 Croft(2015)	2015
7	9 Guilley-Lerondeau (2017)	2017
8	15 Lau (2016)	2016
9	16 Lau (2016)	2016
10	18 Lau (2016)	2016
11	43 Lupion-Mendoza (2015)	2015
12	48 Lupion-Mendoza (2015)	2015
13	50 Lupion-Mendoza (2015)	2015
14	54 Lupion-Mendoza (2015)	2015
15	57 Lupion-Mendoza (2015)	2015
16	58 Lupion-Mendoza (2015)	2015
17	59 Lupion-Mendoza (2015)	2015
18	69 Mehrotra (2013)	2013
19	71 Mehrotra (2013)	2013
20	76 Mehrotra (2013)	2013
21	77 Mehrotra (2013)	2013
22	85 Stelfox (2003)	2003
23	86 Stelfox (2003)	2003
24	87 Stelfox (2003)	2003
25	88 Stelfox (2003)	2003
26	89 Stelfox (2003)	2003
27	90 Stelfox (2003)	2003
28	91 Stelfox (2003)	2003
29	92 Stelfox (2003)	2003
30	93 Stelfox (2003)	2003
31	94 Stelfox (2003)	2003
32	95 Stelfox (2003)	2003
33	96 Spense (2011)	2011
34	97 Spense (2011)	2011
35	98 Spense (2011)	2011
36	99 Spense (2011)	2011
37	100 Spense (2011)	2011
38	102 Saint (2003)	2003
39	103 Tran (2016)	2016
40	106 Tran (2016)	2016
41	107 Tran (2016)	2016
42	108 Tran (2016)	2016
43	109 Tran (2016)	2016
44	113 Tran (2016)	2016
45	114 Tran (2016)	2016
46	116 Tran (2016)	2016
47	117 Tran (2016)	2016
48	118 Tran (2016)	2016
49	120 Tran (2016)	2016
50	122 Tran (2016)	2016
51	3 Croft(2015)	2015
52	5 Evans (2003)	2003
53	6 Evans (2003)	2003
54	7 Evans (2003)	2003
55	8 Guilley-Lerondeau (2017)	2017
56	10 Guilley-Lerondeau (2017)	2017
57	11 Guilley-Lerondeau (2017)	2017
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## All RR data

12	Guilley-Lerondeau (2017)	2017
13	Guilley-Lerondeau (2017)	2017
14	Guilley-Lerondeau (2017)	2017
17	Lau (2016)	2016
19	Livorsi (2015)	2015
20	Livorsi (2015)	2015
21	Livorsi (2015)	2015
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30	Livorsi (2015)	2015
31	Livorsi (2015)	2015
32	Livorsi (2015)	2015
33	Livorsi (2015)	2015
34	Livorsi (2015)	2015
35	Livorsi (2015)	2015
36	Livorsi (2015)	2015
37	Lupion-Mendoza (2015)	2015
38	Lupion-Mendoza (2015)	2015
39	Lupion-Mendoza (2015)	2015
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53	Lupion-Mendoza (2015)	2015
55	Lupion-Mendoza (2015)	2015
56	Lupion-Mendoza (2015)	2015
60	Masse (2013)	2013
61	Mehrotra (2013)	2013
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68	Mehrotra (2013)	2013
70	Mehrotra (2013)	2013
72	Mehrotra (2013)	2013
73	Mehrotra (2013)	2013
74	Mehrotra (2013)	2013
75	Mehrotra (2013)	2013
78	Mehrotra (2013)	2013
79	Mehrotra (2013)	2013
80	Mehrotra (2013)	2013

All RR data

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4	81 Mehrotra (2013)	2013
5	82 Mehrotra (2013)	2013
6	83 Mehrotra (2013)	2013
7	84 Mehrotra (2013)	2013
8	101 Saint (2003)	2003
9	104 Tran (2016)	2016
10	105 Tran (2016)	2016
11	110 Tran (2016)	2016
12	111 Tran (2016)	2016
13	112 Tran (2016)	2016
14	115 Tran (2016)	2016
15	119 Tran (2016)	2016
16	121 Tran (2016)	2016
17	123 Tran (2016)	2016
18	124 Tran (2016)	2016
19	125 Tran (2016)	2016
20	126 Tran (2016)	2016
21	127 Tran (2016)	2016
22	128 Tran (2016)	2016
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## All RR data

Outcome	Isolated
All non infectious event	62
Severe non infectitious event	20
Infectious event	6
HCW help in AOL (very/satisfied)	24
Readmission/death 30 days	15
Readmission 30 days	15
Death 30 days	4
The importance of hand hygiene was explained by staff	48
The food tray was removed promptly after eating	34
The room atmosphere was sufficiently quiet	70
Blood pressure was recorded at least once daily, every day	43
Any falls during present admission	1
Any new pressure ulcers during present admission	2
Any falls or pressure ulcers during present admission	3
Received help after pressing call button	17
Top box for all staff responsiveness	3
Before giving new medicine, hospital staff describe side effects	25
Top box for all medication communication	22
Any complaint	42
Informal complaint	37
Formal complaint	12
Any adverse event	108
Non preventable adverse event	34
Preventable adverse event	74
Supportive care failure	38
Diagnostic error	9
Operative error	17
Medical procedure error	13
Drug related error	26
Falls	19
Injury	1
IV related event	3
Medication related event	15
Therapy related event	7
Examined by attending physician	11
Fall (MRSA)*	10.3
Treatment incident (MRSA)*	0.4
Infection control incident (MRSA)*	1.8
Safety incident (MRSA)*	0.1
Equipment incident (MRSA)*	0.5
Medication incident (respiratory)*	2.1
Laboratory incident (respiratory)*	0.9
Infection control incident (respiratory)*	1
Safety incident (respiratory)*	0.3
Equipment incident (respiratory)*	0.4
Patient complaints (respiratory)*	2.6
30-day readmission (MRSA)	140
Preventable non infectiouts event	37
Encounters per hr (no)	5
ICU encounters per hr	6
Floor encounters per hr	4
Global hygiene (very/satisfied)	28
Daily room cleaning (very/satisfied)	27
HCW availability (very/satisfied)	25

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## All RR data

Daily HCW presence (very/satisfied)	27
Human relation with HCW (very/satisfied)	27
Global satisfaction (very/satisfied)	25
ED visit 30 days	22
Overall rating of hospital =>9/10	44
Nurses treat you with courtesy and respect	51
Nurses listen carefully	47
Nurses explain things in an understandable way	47
Received help after pressing call button	28
Doctors treat you with courtesy and respect	53
Doctors listen carefully to you	48
Doctors explain things in an understandable way	50
Room and bathroom kept clean	42
Room quiet at night	51
Received help with bathroom/bedpan	19
Pain well controlled	34
Hospital staff help with pain	45
Hospital staff explain new medications	20
Hospital staff describe side effects of medications	13
Hospital staff discussed help after discharge	52
Written information on problems to look for after discharge	52
Recommend hospital to friends and family	43
Overall satisfaction with the professional treatment received from health care workers	67
Nurses treated the patients in polite and respectful manner (totally/partially agree)	70
Physicians treated the patients in polite and respectful manner	71
Nurses provided clear information about the health problem	64
Physicians provided clear information about the health problem	66
Clear explanations were provided before all procedures	62
Health care workers entered the room whenever the patient called them	66
Blood pressure and temperature recorded at least once a day	65
The physician visited daily	69
The room was comfortable	62
Room cleaning was satisfactory	66
I frequently felt lonely during admission	17
Medical notes were recorded every day	64
Nurses notes were recorded every day	64
Daily temperature was recorded at least once a day, every day	53
Daily glycemc levels were recorded as indicated, everyday (only diabetic patients)	31
Total number of complications	60
Nurses treat with courtesy and respect	31
Nurses listen carefully	30
Nurses explain things in understandable way	30
Top box for all nursing communication	27
Doctors treat with courtesy and respect	33
Doctors listen carefully	31
Doctors explain things in understandable way	29
Top box for all doctor communication	27
Received help in bathroom/bedpan use	25
Pain well controlled	26
Hospital staff help with pain	26
Top box for all pain management	25
Before giving new medicine, hospital staff tells what it is for	30
Spoken with about having necessary help after discharge	31
Written information on symptoms/problems to look for after discharge	33
Top box for all discharge information	30

## All RR data

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4	Hospital room and bathroom kept clean (individual)	27
5	Area near room quiet at night (individual)	24
6	Recommend hospital to friends and family (global)	25
7	Overall hospital rating (global)	22
8	Examined by senior resident doctor	26
9	Medication incident (MRSA)*	2.2
10	Laboratory incident (MRSA)*	0.3
11	Any adverse event (MRSA)*	12.4
12	Patient complaints (MRSA)*	1.1
13	Fall (respiratory)*	4.2
14	Treatment incident (respiratory)*	0.6
15	Any adverse event (respiratory)*	9.1
16	Inpatient mortality (MRSA)	59
17	30-day ED visit (MRSA)	84
18	Readmission or ED visit (respiratory)	167
19	Inpatient mortality (respiratory)	104
20	30-day readmission (respiratory)	206
21	30-day ED visit (respiratory)	164
22	Readmission or ED visit (respiratory)	261
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	Isolated.N	Control	Control.N	RI	RC	RR	inout	Type
1								
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4	148	84	148	0.418918919	0.567567568	0.738095238	a	AE
5	148	27	148	0.135135135	0.182432432	0.740740741	a	AE
6	148	10	148	0.040540541	0.067567568	0.6	a	AE
7	30	60	60	0.8	1	1.25	a	Satisfaction
8	75	70	420	0.2	0.166666667	1.2	a	AE
9	75	66	420	0.2	0.157142857	1.272727273	a	AE
10	75	9	420	0.053333333	0.021428571	2.488888889	a	AE
11	72	18	72	0.666666667	0.25	0.375	a	Satisfaction
12	72	63	72	0.472222222	0.875	1.852941177	a	Satisfaction
13	72	54	72	0.972222222	0.75	0.771428572	a	Satisfaction
14	72	61	72	0.597222222	0.847222222	0.704918033	a	Quality
15	72	0	72	0.013888889	0	#DIV/0!	a	AE
16	72	0	72	0.027777778	0	#DIV/0!	a	AE
17	72	0	72	0.041666667	0	#DIV/0!	a	AE
18	37	33	51	0.459459459	0.647058824	1.408304501	a	Quality
19	37	14	51	0.081081081	0.274509804	3.385620919	a	Satisfaction
20	37	20	51	0.675675676	0.392156863	0.580392157	a	Quality
21	37	20	51	0.594594595	0.392156863	0.659536542	a	Quality
22	150	13	300	0.28	0.043333333	6.461538462	a	Satisfaction
23	150	10	300	0.246666667	0.033333333	7.4	a	Satisfaction
24	150	3	300	0.08	0.01	8	a	Satisfaction
25	150	53	300	0.72	0.176666667	4.075471698	a	Satisfaction
26	150	39	300	0.226666667	0.13	1.743589744	a	AE
27	150	14	300	0.493333333	0.046666667	10.57142857	a	AE
28	150	5	300	0.253333333	0.016666667	15.2	a	AE
29	150	2	300	0.06	0.006666667	9	a	AE
30	150	20	300	0.113333333	0.066666667	1.7	a	AE
31	150	7	300	0.086666667	0.023333333	3.714285714	a	AE
32	150	19	300	0.173333333	0.063333333	2.736842105	a	AE
33	45	85	256	0.422222222	0.33203125	1.271633987	a	AE
34	45	19	256	0.022222222	0.07421875	0.299415205	a	AE
35	45	6	256	0.066666667	0.0234375	2.844444444	a	AE
36	45	122	256	0.333333333	0.4765625	0.699453552	a	AE
37	45	24	256	0.155555556	0.09375	1.659259259	a	AE
38	31	79	108	0.35483871	0.731481481	2.061447808	a	Quality
39	100	8	100	0.103	0.08	1.2875	a	AE
40	100	0.5	100	0.004	0.005	0.8	a	AE
41	100	0.1	100	0.018	0.0011	16.36363636	a	AE
42	100	0.3	100	0.001	0.003	0.333333333	a	AE
43	100	0.2	100	0.005	0.002	2.5	a	AE
44	100	1.6	100	0.021	0.016	1.3125	a	AE
45	100	0.6	100	0.009	0.006	1.5	a	AE
46	100	0.6	100	0.01	0.006	1.666666667	a	AE
47	100	0.1	100	0.003	0.001	3	a	AE
48	100	0.2	100	0.004	0.002	2	a	AE
49	100	1	100	0.026	0.01	2.6	a	Satisfaction
50	737	108	737	0.19	0.147	1.292517007	a	AE
51	148	41	148	0.25	0.277027027	0.902439024	b	AE
52	485	11	1002	0.010309278	0.010978044	1.064870304	b	Quality
53	319	14	658	0.018808777	0.021276596	1.131205713	b	Quality
54	166	8	344	0.024096386	0.023255814	0.965116263	b	Quality
55	30	59	60	0.933333333	0.983333333	1.053571429	b	Satisfaction
56	30	58	60	0.9	0.966666667	1.074074074	b	Satisfaction
57	30	57	60	0.833333333	0.95	1.14	b	Satisfaction
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All RR data

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4	30	59	60	0.9	0.983333333	1.092592592	b	Satisfaction	
5	30	60	60	0.9	1	1.111111111	b	Satisfaction	
6	30	60	60	0.833333333	1	1.2	b	Satisfaction	
7	75	109	420	0.293333333	0.25952381	1.130275229	b	AE	
8	68	85	135	0.647058824	0.62962963	0.973063973	b	Satisfaction	
9	69	110	138	0.739130435	0.797101449	1.078431372	b	Satisfaction	
10	70	101	137	0.671428571	0.737226277	1.097996583	b	Satisfaction	
11	69	102	135	0.68115942	0.755555556	1.109219859	b	Satisfaction	
12	52	70	114	0.538461538	0.614035088	1.140350879	b	Satisfaction	
13	70	106	137	0.757142857	0.773722628	1.021897811	b	Satisfaction	
14	68	103	136	0.705882353	0.757352941	1.072916666	b	Satisfaction	
15	68	99	137	0.735294118	0.722627737	0.982773722	b	Satisfaction	
16	68	82	127	0.617647059	0.645669291	1.045369328	b	Satisfaction	
17	70	98	137	0.728571429	0.715328467	0.981823386	b	Satisfaction	
18	30	49	68	0.633333333	0.720588235	1.137770898	b	Satisfaction	
19	62	75	117	0.548387097	0.641025641	1.16892911	b	Satisfaction	
20	62	96	115	0.725806452	0.834782609	1.150144927	b	Satisfaction	
21	27	47	59	0.740740741	0.796610169	1.075423728	b	Satisfaction	
22	25	35	57	0.52	0.614035088	1.180836708	b	Satisfaction	
23	61	108	124	0.852459016	0.870967742	1.021712159	b	Satisfaction	
24	62	106	120	0.838709677	0.883333333	1.053205128	b	Satisfaction	
25	67	98	133	0.641791045	0.736842105	1.148102814	b	Satisfaction	
26	72	69	72	0.930555556	0.958333333	1.029850745	b	Satisfaction	
27	72	71	72	0.972222222	0.986111111	1.014285714	b	Satisfaction	
28	72	72	72	0.986111111	1	1.014084507	b	Satisfaction	
29	72	68	72	0.888888889	0.944444444	1.062499999	b	Satisfaction	
30	72	62	72	0.916666667	0.861111111	0.939393939	b	Satisfaction	
31	72	66	72	0.861111111	0.916666667	1.06451613	b	Satisfaction	
32	72	71	72	0.916666667	0.986111111	1.075757575	b	Satisfaction	
33	72	70	72	0.902777778	0.972222222	1.076923076	b	Quality	
34	72	71	72	0.958333333	0.986111111	1.028985507	b	Quality	
35	72	67	72	0.861111111	0.930555556	1.080645162	b	Satisfaction	
36	72	70	72	0.916666667	0.972222222	1.06060606	b	Quality	
37	72	17	72	0.236111111	0.236111111	1	b	Satisfaction	
38	72	65	72	0.888888889	0.902777778	1.015625	b	Quality	
39	72	69	72	0.888888889	0.958333333	1.078124999	b	Quality	
40	72	60	72	0.736111111	0.833333333	1.132075471	b	Quality	
41	31	18	18	1	1	1	b	Quality	
42	111	62	111	0.540540541	0.558558559	0.967741935	b	Satisfaction	
43	37	45	51	0.837837838	0.882352941	1.053130929	b	Satisfaction	
44	37	43	51	0.810810811	0.843137255	1.039869281	b	Satisfaction	
45	37	42	51	0.810810811	0.823529412	1.015686275	b	Satisfaction	
46	37	39	51	0.72972973	0.764705882	1.047930282	b	Satisfaction	
47	37	42	51	0.891891892	0.823529412	0.923351159	b	Satisfaction	
48	37	42	51	0.837837838	0.823529412	0.982922201	b	Satisfaction	
49	37	44	51	0.783783784	0.862745098	1.100743745	b	Satisfaction	
50	37	37	51	0.72972973	0.725490196	0.994190268	b	Satisfaction	
51	37	35	51	0.675675676	0.68627451	1.015686274	b	Quality	
52	37	40	51	0.702702703	0.784313725	1.116138762	b	Quality	
53	37	38	51	0.702702703	0.745098039	1.060331824	b	Quality	
54	37	35	51	0.675675676	0.68627451	1.015686274	b	Quality	
55	37	41	51	0.810810811	0.803921569	0.991503268	b	Quality	
56	37	45	51	0.837837838	0.882352941	1.053130929	b	Quality	
57	37	49	51	0.891891892	0.960784314	1.077243019	b	Quality	
58	37	45	51	0.810810811	0.882352941	1.088235294	b	Quality	
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## All RR data

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4	37	37	51	0.72972973	0.725490196	0.994190268	b	Quality
5	37	32	51	0.648648649	0.62745098	0.96732026	b	Satisfaction
6	37	41	51	0.675675676	0.803921569	1.189803922	b	Satisfaction
7	37	36	51	0.594594595	0.705882353	1.187165775	b	Satisfaction
8	31	94	108	0.838709677	0.87037037	1.037749288	b	Quality
9	100	2.4	100	0.022	0.024	0.916666667	b	AE
10	100	0.3	100	0.0027	0.0033	0.818181818	b	AE
11	100	10.7	100	0.124	0.107	1.158878505	b	AE
12	100	1.3	100	0.0109	0.0125	0.872	b	Satisfaction
13	100	5.1	100	0.042	0.051	0.823529412	b	AE
14	100	0.7	100	0.006	0.007	0.857142857	b	AE
15	100	8.9	100	0.091	0.089	1.02247191	b	AE
16	737	52	737	0.08	0.07	1.142857143	b	AE
17	737	86	737	0.114	0.117	0.974358974	b	AE
18	737	142	737	0.227	0.193	1.176165803	b	AE
19	1502	128	1502	0.069	0.085	0.811764706	b	AE
20	1502	236	1502	0.137	0.157	0.872611465	b	AE
21	1502	168	1502	0.109	0.112	0.973214286	b	AE
22	1502	278	1502	0.174	0.185	0.940540541	b	AE
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	Good/bad	exp yi	yi	vi	
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4	Good/bad	exp yi	yi	vi	
5	Bad		0.74	-0.303682414	0.014520281
6	Bad		0.74	-0.300104592	0.073523524
7	Bad		0.60	-0.510825624	0.253153153
8	Good		0.80	-0.227083588	0.008693745
9	Bad		1.20	0.182321557	0.065238095
10	Bad		1.27	0.241162057	0.066103896
11	Bad		2.49	0.911836382	0.345396825
12	Good		2.67	0.980829253	0.048611111
13	Good		0.54	-0.616774202	0.017507003
14	Good		1.30	0.259511195	0.005026455
15	Good		0.70	-0.349673748	0.011871479
16	Bad		3.00	1.098612289	2.639269406
17	Bad		5.00	1.609437912	2.37260274
18	Bad		7.00	1.945910149	2.258317025
19	Good		0.71	-0.342386497	0.04249169
20	Good		0.30	-1.219537321	0.358127035
21	Good		1.72	0.544051271	0.04336513
22	Good		1.52	0.4162179	0.048819675
23	Bad		6.46	1.865867441	0.090732601
24	Bad		7.40	2.00148	0.117027027
25	Bad		8.00	2.079441542	0.406666667
26	Bad		4.08	1.404986494	0.018127184
27	Bad		1.74	0.555946059	0.04505279
28	Bad		10.57	2.358154944	0.074942085
29	Bad		15.20	2.721295428	0.216315789
30	Bad		9.00	2.197224577	0.601111111
31	Bad		1.70	0.530628251	0.098823529
32	Bad		3.71	1.312186389	0.20978022
33	Bad		2.74	1.006804739	0.081093117
34	Bad		1.27	0.240302677	0.038267813
35	Bad		0.30	-1.205924024	1.026503107
36	Bad		2.84	1.045367774	0.473871528
37	Bad		0.70	-0.357455889	0.048734916
38	Bad		1.66	0.506371273	0.158395337
39	Good		0.49	-0.723408557	0.062049995
40	Bad		1.29	0.252702354	0.202087379
41	Bad		0.80	-0.223143551	4.48
42	Bad		18.00	2.890371758	10.53555556
43	Bad		0.33	-1.098612289	13.31333333
44	Bad		2.50	0.916290732	6.98
45	Bad		1.31	0.271933715	1.081190476
46	Bad		1.50	0.405465108	2.757777778
47	Bad		1.67	0.510825624	2.646666667
48	Bad		3.00	1.098612289	13.31333333
49	Bad		2.00	0.693147181	7.48
50	Bad		2.60	0.955511445	1.364615385
51	Bad		1.30	0.259511195	0.013688412
52	Bad		0.90	-0.102654154	0.037903757
53	Good		0.94	-0.06285297	0.287849231
54	Good		0.88	-0.123284032	0.233440685
55	Good		1.04	0.035506688	0.366068927
56	Good		0.95	-0.052185753	0.002663438
57	Good		0.93	-0.071458964	0.004278416
58	Good		0.88	-0.131028262	0.00754386
59	Good				
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Good	0.92	-0.088553397	0.00398619
Good	0.89	-0.111570701	0.004241055
Good	0.83	-0.187078253	0.007093105
Bad	1.13	0.122461169	0.038914572
Good	1.03	0.027305451	0.012378689
Good	0.93	-0.075507553	0.006959622
Good	0.91	-0.093487231	0.009592601
Good	0.90	-0.103656938	0.009180356
Good	0.88	-0.131336002	0.021997301
Good	0.98	-0.021661497	0.006716902
Good	0.93	-0.070380797	0.008483248
Good	1.02	0.017376376	0.008095858
Good	0.96	-0.044370248	0.013424748
Good	1.02	0.018343838	0.00822694
Good	0.88	-0.129070995	0.025000527
Good	0.86	-0.156088039	0.018069057
Good	0.87	-0.139887958	0.007814204
Good	0.93	-0.07271475	0.017290406
Good	0.85	-0.166223261	0.047950646
Good	0.98	-0.021479807	0.00403207
Good	0.95	-0.051838018	0.004202366
Good	0.87	-0.138110854	0.011015725
Good	0.97	-0.029413885	0.001640349
Good	0.99	-0.014184635	0.000592444
Good	0.99	-0.013889112	0.000381857
Good	0.94	-0.060624622	0.002553105
Good	1.06	0.062520357	0.00350277
Good	0.94	-0.062520357	0.00350277
Good	0.93	-0.073025135	0.001458244
Good	0.93	-0.074107972	0.001892552
Good	0.97	-0.028573372	0.000799483
Good	0.93	-0.077558234	0.003276628
Good	0.94	-0.0588405	0.001659452
Bad	1.00	0	0.089869281
Good	0.98	-0.015504187	0.003231838
Good	0.93	-0.075223421	0.002339976
Good	0.88	-0.124052649	0.007756813
Good	1.01	0.01091989	0.001918507
Bad	0.97	-0.032789823	0.014777681
Good	0.95	-0.051767565	0.007845417
Good	0.96	-0.039095014	0.009954277
Good	0.98	-0.015564517	0.010507987
Good	0.95	-0.04681706	0.016043193
Good	1.08	0.079745663	0.007477684
Good	1.02	0.017225306	0.009432718
Good	0.91	-0.095986084	0.010575161
Good	1.01	0.005826673	0.017429194
Good	0.98	-0.015564517	0.021936558
Good	0.90	-0.109875196	0.016826668
Good	0.94	-0.058581902	0.018142458
Good	0.98	-0.015564517	0.021936558
Good	1.01	0.008533035	0.011088707
Good	0.95	-0.051767565	0.007845417
Good	0.93	-0.074405017	0.004076323
Good	0.92	-0.084557388	0.008920685



## All RR data

3	Good	1.01	0.005826673	0.017429194
4	Good	1.03	0.033225648	0.026281797
5	Good	0.84	-0.173788522	0.017755374
6	Good	0.84	-0.171568765	0.026597453
7	Good	0.96	-0.037054222	0.007582513
8	Bad	0.92	-0.087011377	0.851212121
9	Bad	1.00	0	6.646666667
10	Bad	1.16	0.147452731	0.154103105
11	Bad	0.85	-0.167054085	1.658321678
12	Bad	0.82	-0.194156014	0.414173669
13	Bad	0.86	-0.15415068	3.075238095
14	Bad	1.02	0.022223137	0.20224966
15	Bad	1.13	0.126293725	0.033466218
16	Bad	0.98	-0.023530497	0.020818965
17	Bad	1.18	0.162166755	0.010316573
18	Bad	0.81	-0.207639365	0.016096327
19	Bad	0.87	-0.135955636	0.007760099
20	Bad	0.98	-0.024097552	0.010718384
21	Bad	0.94	-0.063100706	0.006096982

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Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
2 Kennedy (1	1997	Anxiety	37.8	19.9	16	12.3	10.7
9 Gammon ('	1998	Anxiety	12.75	2.43	20	8.15	3.17
15 Tarzi (2001	2001	Anxiety	15	3	22	8.6	3
16 Day (2011a	2011	Anxiety/Dep	14.35	1.61	20	13	0.8
13 Findink (20	2012	Anxiety	7.23	4.1	61	6.42	3.9
Soon (2013	2013	Anxiety					
17 Lupion-Mer	2015	Anxiety	8.2	0.48	72	6.9	0.41
8 Lau (2016)	2016	Anxiety	1.48	1.72	75	1.7	1.8

For peer review only

Control.N	yi	vi
16	1.5558	0.1628
20	1.5963	0.1319
20	2.093	0.1476
83	1.3351	0.0707
57	0.201	0.0341
	2.5649	0.986
72	2.8969	0.0569
421	-0.1228	0.0157

For peer review only

Reference	Year	Outcome	Isolated	IsolatedSD	Isolated.N	Control	ControlSD
1 Kennedy (1	1997	Depression	16.5	9.9	16	12.3	10.7
10 Gammon (	1998	Depression	12.45	2.21	20	7.3	2.05
Tarzi (200	2001	Depression					
16 Day (2011	2011	Anxiety/De	14.3	1.61	20	13	0.8
14 Findink (20	2012	Depression	8.83	4.7	61	7.89	4.9
Soon (2013	2013	Depression					
18 Lupion-Mer	2015	Depression	7.8	0.51	72	6.6	0.43
7 Lau (2016)	2016	Depression	6.89	4.92	75	7.35	5.92

For peer review only

Control.N	yi	vi
16	0.397	0.127
20	2.368	0.17
	2.101	0.125
83	1.335	0.071
57	0.195	0.034
	1.562	0.2
72	2.531	0.05
420	-0.079	0.016

For peer review only

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**Case-control studies**

	Colorado (2014)	Kennedy (1997)	Livorsi (2015)	Lupion (2015)	Masse (2013)	Soon (2013)	Tarzi (2001)
1) <u>Is the case definition adequate?</u> a) yes, with independent validation * b) yes, eg record linkage or based on self reports c) no description	*	*	*	*	*	*	*
2) <u>Representativeness of the cases</u> a) consecutive or obviously representative series of cases * b) potential for selection biases or not stated	b	b	*	b	b	*	*
3) <u>Selection of Controls</u> a) community controls (studies of hospital patients) * b) hospital controls c) no description	*	*	*	*	*	*	*
4) <u>Definition of Controls</u> a) no history of disease (endpoint) * b) no description of source	*			*			
<b>Comparability</b>							
1) <u>Comparability of cases and controls on the basis of the design or analysis</u> a) study controls for diagnosis * b) study controls for any additional factor *	* * (l)	* * (l, g)		* * (g)	* * (g)	* * (l, g)	* * (l, g)
<b>Outcome</b>							
1) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview where blind to case/control status * c) interview not blinded to case/control status d) written self report or medical record only e) no description	*	*	*	*	*	*	*
2) <u>Same method of ascertainment for cases and controls</u> a) yes * b) no	Functional Independence Measure ## *	Functional Independence Measure; Beck Inventory Depression; State Anxiety Inventory; Profile Mood States ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Charlston Comorbidity Index ## *	Hospital Anxiety and Depression Scale ## *	Geriatric Depression Scale; Profile of Mood States; Abbreviated Mental Test Score; Barthel Index ## *
3) <u>Non-Response rate</u> a) same rate for both groups * b) non respondents described c) rate different and no designation	*	*	*	*			*

**Cohort studies (1)**

Selection	Croft (2015)	Day (2011) a	Day (2011) b	Day (2012)	Day (2013)	Evans (2003)	Findink (2012)	Guilley (2017)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*	*	*	*	* b	c	*b	*b
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*	*	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	b	b	*	*	*		*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *	* * (l,g)		* * (l,g)	* * (l,g)	* * (l,g)			* (g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	Global Trigger Tool ### *	Hospital Anxiety and Depression Scale ## *	*	Clinical diagnosis of delirium *	Hospital Anxiety and Depression Scale ### *	Clinical encounters per hour *	Hospital Anxiety and Depression Scale ## *	State-Trait Anxiety Inventory ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*	*	*	*	* 3 days	*	*	
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*	*	*	*	*	*	*	*

Community – was hospital population  
Time to outcome of interest – question is regarding outcome during isolation

a – age  
g- gender  
l – LOS

# own scale  
## validated scale/s used appropriately

## Cohort studies (2)

Selection	Kirkland (1999)	Lau (2016)	Mehotra (2013)	Stelfox (2003)	Spense (2011)	Saint (2003)	Tran (2016)	Wassenberg (2010)
1) <u>Representativeness of the exposed cohort</u> a) truly representative of the average patient in the community * b) somewhat representative of the average patient in the community * c) selected group of users eg nurses, volunteers d) no description of the derivation of the cohort	*b	*	*	*	b	*	*	*
2) <u>Selection of the non exposed cohort</u> a) drawn from the same community as the exposed cohort * b) drawn from a different source c) no description of the derivation of the non exposed cohort	*	*	*	*	*	*	*	*
3) <u>Ascertainment of exposure</u> a) secure record (eg surgical records) * b) structured interview * c) written self report d) no description	*	*b	*b	*	*	*	*	*
4) <u>Demonstration that outcome of interest was not present at start of study</u> a) yes * b) no	*	*	*	*	*	*	*	*
<b>Comparability</b>								
1) Comparability of cohorts on the basis of the design or analysis a) study controls for diagnosis * b) study controls for any additional factor *		* (g)	* * (l,g)	* * (l,g)		*	* * (l,g)	(l,g)
<b>Outcome</b>								
1) <u>Assessment of outcome</u> a) independent blind assessment * b) record linkage * c) self report d) no description	* #	Patient Health Questionnaire-9; CQ-5D c telephone /health records ## *	Hospital Consumer Assessment of Healthcare Providers and Systems ## *	Clinical satisfaction # *	Clinical outcomes *	Observation of doctors *	Clinical outcomes *	EQ5-D; Hospital Anxiety and Depression Scale ## *
2) <u>Was follow-up long enough for outcomes to occur</u> a) yes (during hospitalisation or immediately afterwards) * b) no	*		*	*	*	*	*	*
3) <u>Adequacy of follow up of cohorts</u> a) complete follow up - all subjects accounted for * b) subjects lost to follow up unlikely to introduce bias - small number lost - > 90 % follow up, or description provided of those lost) * c) follow up rate < 90% and no description of those lost d) no statement	*		37/278 contact; 51/290 non	*	*		*	*

## General notes

Community – the population of interest was a hospital population

Time to outcome of interest – question is regarding outcome during isolation or shortly afterwards





# PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	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.	1-2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Suppl information
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	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.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	6-7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I <sup>2</sup> ) for each meta-analysis.	6-7



# PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7-8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	None
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Suppl information
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Suppl information
Results of individual studies	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.	Figures
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	None
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8-9
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	None
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	8-11
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	14
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	None

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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