Systematic review of isolation policies in the hospital management of methicillin-resistant Staphylococcus aureus: a review of the literature with epidemiological and economic modelling


CRD summary
This review assessed the effects of isolation measures and screening practices on methicillin-resistant Staphylococcus aureus (MRSA) colonisation and infection in hospital in-patients. The authors concluded that intensive interventions that include isolation can reduce MRSA, and there is no evidence that current isolation measures recommended in the UK are not effective. The authors' conclusions are likely to be reliable.

Authors' objectives
To assess the effectiveness of isolation measures and screening practices on methicillin-resistant Staphylococcus aureus (MRSA) colonisation and infection in hospital in-patients.

Searching
MEDLINE (from 1966 to 2000), EMBASE (from 1980 to 2000), CINAHL (from 1982 to 2000), the Cochrane Library (2000) and SIGLE (from 1980 to 2000) were searched for studies in any language; details of the search strategy were given. The trials registers of the Cochrane Infectious Diseases Group and the Cochrane Wounds Group were also searched. The reference lists of identified studies and major reviews were checked, and the main hospital infection journals (Journal of Hospital Infection, and Infection Control and Hospital Epidemiology) were handsearched. Unpublished studies were not sought, owing to a lack of resources. Non-English language studies were included but, because of the large volume of these, a more stringent selection protocol was adopted than for English language studies.

Study selection
Study designs of evaluations included in the review
Prospective studies and comparative studies, where comparisons made were not suggested by any part of the outcome data, were eligible for inclusion. The review focused on those studies with a higher quality of design.

Specific interventions included in the review
Studies using an isolation strategy or policy in a hospital were eligible for inclusion. The studies had to relate to an isolation or ward unit and use nurse cohorting. Studies were excluded where details of isolation or screening policies, or their timing, remained unclear even after contacting the authors. The review focused on studies of the highest levels of patient isolation. Almost all of the studies used isolation combined with at least one other intervention. The studies were set in entire hospitals and individual hospital units (e.g. burns units, neonatal units, medical surgical or paediatric intensive care units, and a variety of other specialist medical or surgical units). The duration of the studies ranged from 1 month to 15 years.

Participants included in the review
Studies of hospital patients were eligible for inclusion.

Outcomes assessed in the review
Studies that reported MRSA transmission data for patients (including colonisation or infection with MRSA) were eligible for inclusion. The primary outcomes in the review were total MRSA colonisation and infection, bacteraemia, pneumonias and death attributable to MRSA. The secondary review outcomes were MRSA-to-MSSA (methicillin-sensitive Staphylococcus aureus) ratios, staff carriage of MRSA and outcomes related to changes in infection control measures.

How were decisions on the relevance of primary studies made?
Two or three reviewers working together selected studies.

Assessment of study quality
The studies were assessed for major threats to internal validity, threats to construct validity (e.g. Hawthorne effect and blinding of carers), appropriateness of the statistical methods used for analysis, and threats to external validity. Major threats to internal validity included: confounding factors, trends and maturation effects, seasonal effects, changes in the detection methods, attrition, patient selection, strain of MRSA, other ecological interactions, regression to the mean and reporting bias. Two independent reviewers appear to have assessed confounding and bias during the data extraction procedure.

Data extraction
Two reviewers independently extracted the data using specially designed forms. Any disagreements were resolved by discussion or through recourse to a third reviewer, if required. The data extracted included pre-existing trends, results and potential confounding factors. Authors were contacted where information on isolation or screening policies, or their timing, was unclear. The reviewers only recorded unprocessed data and did not calculate data.

Methods of synthesis
How were the studies combined?
The studies were grouped by the type of intervention, and a narrative synthesis was undertaken in which the strength of evidence was assessed using study design, quality of data, effect size and the presence of plausible alternative explanations for the effect of the intervention.

How were differences between studies investigated?
Differences between the studies were discussed with respect to study quality.

Results of the review
Forty-six studies were included: 1 prospective cohort crossover study; 2 prospective cohort studies with historical controls; 9 prospective interrupted time series (ITS); 6 prospective observational one-phase studies; 5 hybrid retrospective/prospective ITS; 1 retrospective cohort study with systematic data collection and the comparison decided on before examination of the data; 2 retrospective studies with the comparison decided on before examination of the data; 18 retrospective ITS; and 2 retrospective observational studies. The studies involved between 5 and 5,345 cases of MRSA.

Methodological flaws of the studies included: a lack of formally planned prospective studies with pre-defined pre- and post-intervention periods; a lack of systematic assessment and adjustment for potential confounders; threats to validity, including regression to the mean and reporting bias; and a lack of or inappropriate statistical analysis. It was not possible to isolate the effect of the main intervention in multi-component interventions.

It was not possible to draw conclusions about the effects of isolation from about one third (14 studies) of the included studies. Most of the other 32 studies showed results consistent with a reduction in MRSA with the intervention. Eighteen of these studies provided only weak evidence.

The strongest evidence came from 6 longer time series that adequately described the intervention, and in which there were fewer plausible alternative explanation for the decrease in MRSA. Three of these studies found conflicting evidence for isolation wards combined with other measures in hospital wide MRSA. The first found the intervention reduced infection; the second found no reduction; the third found that the intervention controlled the infection for several years until the strain of MRSA changed.

One study found that single-room isolation combined with screening, eradication and an extensive hand hygiene programme reduced MRSA infection and colonisation hospital wide.

One study found that nurse cohorting in single rooms combined with screening and eradication reduced MRSA
infection hospital wide.

One study found that single-room isolation combined with patient cohorting in bays (plus screening, feedback of infection rates and hand-hygiene education) reduced infection in a paediatric intensive care unit.

**Cost information**
The review also sought to assess economic studies. The authors stated that the poor quality of economic studies prohibited an assessment of the cost-effectiveness of the interventions.

**Authors’ conclusions**
There was evidence that intensive interventions that include isolation can reduce MRSA. There was no evidence that the current isolation measures recommended in the UK are not effective.

**CRD commentary**
The review question was clear in terms of the study design, intervention, participants and outcomes. Several relevant sources were searched, the search terms were stated, and attempts were made to limit language bias. The authors excluded unpublished studies and this might have resulted in the omission of relevant studies. Two reviewers independently extracted the data, thus reducing the potential for bias and errors. Validity was comprehensively assessed using criteria suitable for a variety of study designs. The narrative synthesis was appropriate in view of the differences among the studies, and the synthesis took study quality into consideration. The authors’ conclusions are likely to be reliable.

**Implications of the review for practice and research**
Practice: The authors stated that current isolation measures recommended in the UK should be used until further research provides evidence to the contrary.

Research: The authors stated that future research should use prospective planned comparisons with pre-defined pre- and post-intervention periods and systemic assessment and adjustment for potential confounders. Study designs could include randomised controlled trials with cluster randomisation and prospective interrupted time series. Priority should be given to research on the effect of adequately sized isolation wards in hospitals with endemic MRSA, the effects of single-room isolation with an extensive hand-hygiene programme, screening and eradication, and nurse cohorting with screening and eradication. Studies should also assess resource use. In addition, future outbreak reports and intervention studies should be written up in a standardised format with full details of the interventions, outcomes and confounders. The authors have produced guidelines to facilitate that (see Appendix 5 in the HTA report). The authors also recommended that an audit system be designed, piloted and evaluated alongside current MRSA surveillance systems, to enable infection teams to collect and use data on potential effect modifiers.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.