



## REVIEW

# Impact of organisation and management factors on infection control in hospitals: a scoping review

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**Summary** This scoping review sought evidence about organisational and management factors affecting infection control in general hospital settings. A literature search yielded a wide range of studies, systematic reviews and reports, but high quality direct evidence was scant. The majority of studies were observational and the standard of reporting was generally inadequate. Positive leadership at ward level and above appears to be a prerequisite for effective action to control infection, although the benefits of good clinical leadership are diffused by supervision of large numbers of staff. Senior clinical leaders need a highly visible presence and clear role boundaries and responsibilities. Team stability and morale are linked to improved patient outcomes. Organisational mechanisms for supporting training, appraisal and clinical governance are important determinants of effective practice and successful change. Rates of infection have been linked to workload, in terms of nurse staffing, bed occupancy and patient turnover. The organisational characteristics identified in the review should be considered risk factors for infection. They cannot always be eliminated or avoided completely, but appropriate assessment will enable targeted action to protect patients. © 2009 The Hospital Infection Society. Published by Elsevier Ltd. All rights reserved.

## Introduction

Healthcare-associated infection (HCAI) is a global patient safety challenge. In developed health systems, estimates of infection associated with

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healthcare vary between 4% and 10%.<sup>1</sup> In the USA, HCAI prevalence among inpatients is 5–10% and causes nearly 100 000 deaths annually.<sup>2</sup> UK statistics indicate that 8–9% of patients acquire an infection,<sup>3,4</sup> and extrapolations from US data suggest that 5000 deaths occur annually in England as a direct consequence of these infections, which also contribute substantially to a further 15 000 deaths.<sup>5</sup>

There has been an increase in the proportion of difficult-to-treat organisms associated with antibiotic use and in some countries the problem is still growing. For example, meticillin-resistant *Staphylococcus aureus* (MRSA) accounted for just 2% of *S. aureus* bloodstream infections in the UK in 1990, but this rose to peak at 43% of such infections in 2002.<sup>6</sup> Similar increases have been seen in *Clostridium difficile*. For example, reports of *C. difficile* cases in Wales increased 100-fold (from 22 to >2200) between 1990 and 2006, although changes in surveillance methods and reporting practices no doubt account for some of the increase.<sup>7</sup>

Growing concern about HCAI has led to a number of high profile initiatives and a burgeoning of guidance and campaigns to prevent infections. Despite this attention and some recent evidence of success in reducing rates,<sup>3</sup> the problem remains significant. Much of the guidance focuses on specific actions that need to be taken to reduce infections. However, there is increasing recognition that the effectiveness of infection control practices is influenced by the environmental, behavioural and organisational contexts in which care is delivered.<sup>8–11</sup> In 2003, a report from England's Department of Health, *Winning Ways*, identified management and organisational factors as important,<sup>1</sup> and recent investigations into infection outbreaks in England highlighted failures of management and leadership at all levels.<sup>12</sup> Research on behavioural interventions has been reviewed,<sup>13</sup> but evidence linking wider aspects of organisation and management of care with infection control is more disparate.

The aim of this scoping review was to examine evidence for the impact of organisational and management factors on infection control practices and HCAI in general hospital settings. Factors considered included clinical management and leadership; wider organisational characteristics, such as human resource policies and clinical governance arrangements; the effects of team-working in ward nursing and relationships between ward nursing teams and others, such as infection control teams, consultant microbiologists and the wider multidisciplinary team; and the impact of

ward staffing, skill mix, workload, bed occupancy and staff morale and satisfaction.

## Methods

Searches of published research and UK policy documents were carried out in January to March 2008. Medline and CINAHL were searched for organisation and management factors, using a list of key words and synonyms, combined with general terms for infection, infection control and some common organisms. The Cochrane Library was searched for relevant reviews and the main journals were hand-searched. Each article's reference list was searched for further material. The focus was on evidence that could apply to general hospital settings; where this was scant, research from other settings was included. All research studies and systematic reviews were included; systematic reviews were given primacy and studies contained within a review were not necessarily considered individually. The primary outcomes were infection or infection control practices. Where direct evidence was lacking, secondary outcomes such as general patient outcomes (i.e. length of stay, mortality rates) or staffing outcomes such as job satisfaction were considered.

A single reviewer initially selected studies and graded evidence, using a simple categorisation system, focusing on method, sample size and reported confidence interval. A second reviewer checked all inclusions for relevance, identified further evidence from existing personal libraries and verified evidence grading.

## Results

### Quality of evidence located

The majority of literature located consisted of observational studies, which rarely followed accepted standards for reporting, e.g. STROBE.<sup>14</sup> Most studies assessing patient-level data did not report the size of the included sample. The majority reported the number of hospitals or wards included in the analysis. Only a small majority of studies gave confidence intervals and some reported no statistical analysis at all.

The evidence is presented below in two main sections, with tables providing details of the studies from acute care settings included in the review. Leadership and management factors (Table I) are considered first, followed by workforce and workload (Table II).

**Table I** Studies included in the review: leadership and management

Study	Aim	Method	Sample	Risk adjustment/ confounders controlled	Statistical results	Evidence grading <sup>a</sup>
Doran <i>et al.</i> (2004) <sup>15</sup>	Examine the influence of manager's span of control and leadership style on patient satisfaction, nurses' job satisfaction and staff turnover	Descriptive correlational survey	51 units in 7 Canadian hospitals (41 nurse managers; 680 patients; 717 nursing staff)	Demographics of nurses and managers (age, level of education, and experience); unit characteristics	Hierarchical linear regression. Findings support model in which span of control is a moderating variable between leadership and outcomes. No detailed statistics.	O
Healthcare Commission (2008) <sup>12</sup>	Summarise common themes from results of investigations into serious failings in health care in the NHS	Review of investigation reports	14 formal investigations of failings in English NHS Trusts over 3 years	N/A	N/A	Q
Healthcare Commission (2007) <sup>16</sup>	Investigate outbreaks of <i>C. difficile</i> at Maidstone and Tunbridge Wells NHS Trust	Retrospective independent expert investigation. Case study identifying factors contributing to the outbreaks	Case note review ( <i>N</i> = 50 patients who died while infected with <i>C. difficile</i> ); 200 interviews with patients and staff; observation; analysis of hospital data and documents	N/A	N/A	Q
Healthcare Commission (2006) <sup>17</sup>	Investigate outbreaks of <i>C. difficile</i> at Stoke Mandeville Hospital	Retrospective independent expert investigation. Case study identifying factors contributing to the outbreaks	Case note review ( <i>N</i> = 20 patients); >200 interviews with patients and staff; observation; analysis of hospital data and documents	N/A	N/A	Q
Houser (2003) <sup>18</sup>	Develop model of the relationship between workload, leadership, staff stability and expertise, teamwork, financial resources, and patient outcomes	Mixed method: qualitative enquiry; structural equation modelling to test hypothesis generated	Qualitative: 36 nurses in USA Quantitative: – leadership inventory: 50 nurse managers and 802 staff nurses; – work environment scale: 177 nurses	None	Structural equation model with path coefficients and fit indices	O

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Table I (continued)

Study	Aim	Method	Sample	Risk adjustment/ confounders controlled	Statistical results	Evidence grading <sup>a</sup>
Wong and Cummings (2007) <sup>19</sup>	Examine the relationship between nursing leadership and patient outcomes	Systematic review	7 studies, all rated highly in quality assessment	N/A	N/A	SR <sup>+</sup>
Dealey <i>et al.</i> (2007) <sup>20</sup>	Examine implementation of 20 modern matron posts	Audit after one year: progress against corporate objectives; questionnaire survey	1100-bed teaching hospital in England Matrons <i>N</i> = 18 (90% response rate) Trust staff <i>N</i> = 97 (51% response rate)	None reported	Reduction of 11.6% in MRSA rates	Q
Koteyko and Nerlich (2008) <sup>21</sup>	Identify problems modern matrons face in fulfilling their role and links with infection control	Qualitative study: corpus linguistics and discourse analysis	Data from 11 UK policy documents and interviews with 11 modern matrons	N/A	N/A	Q
Ashman <i>et al.</i> (2006) <sup>22</sup>	Comparison of NHS Trust nursing directors' perceived outcomes of introducing matrons with evidence for outcomes	National questionnaire survey of NHS Trust Directors of Nursing. Case studies in 10 NHS Trusts.	National survey: 414 directors (76% response rate). Case studies: Questionnaires: matrons ( <i>N</i> = 121); patients ( <i>N</i> = 120). Interviews: matrons and others ( <i>N</i> = 131).	None reported	N/A	O
West <i>et al.</i> (2002) <sup>23</sup>	Assess the relationship between human resource (HR) management practices and organisational performance	Postal/telephone questionnaire survey to gather HR information. Routinely available hospital performance data.	61 acute hospital trusts in England	Hospital size (total hospital income). Local health needs and hospital performance. Doctors per bed	HR practices and patient mortality $r = -0.77$ , $P < 0.01$ . Appraisal, training and teamwork associated with mortality rates.	O

Aiken <i>et al.</i> (1994) <sup>24</sup>	Compare Medicare mortality rates in magnet hospitals and hospitals with similar non-nursing organisational characteristics	Retrospective analysis of administrative data	39 magnet plus 195 control hospitals in the USA	Magnet hospitals matched controls	After adjusting for differences in predicted mortality, magnet hospitals had a 4.6% lower mortality rate ( $P = 0.026$ ; 95% CI: 0.9 to 9.4 fewer deaths per 1000)	O <sup>+</sup>
Saizy-Callaert <i>et al.</i> (2003) <sup>25</sup>	Describe the impact of multidisciplinary approach to controlling prescription of antibiotics	Observational study	600-bed hospital in France; six prescribing audits over 4 years	None	Cost of antimicrobials per patient fell from US \$13.8 to \$11 ( $P < 0.001$ ). Rates of MRSA and CRP stable; EPESB fell from 12.5% to 3.6% ( $P < 0.001$ )	O
Kaye <i>et al.</i> (2000) <sup>26</sup>	Assess the impact of multidisciplinary infection control team on ventilator-associated pneumonia (VAP) rates	Description of development of team; trends in VAP rate	Medical–surgical ICU in 583-bed hospital in USA	None reported	VAP rates fell from above the 90th percentile to below the 75th percentile	O
Salaripour <i>et al.</i> (2006) <sup>27</sup>	Describe the introduction of a multidisciplinary infection control team	Observational study over 5 years	High risk units in a Canadian hospital (no numerical values given)	Comparison with internal benchmark and rate in sentinel hospitals	Nosocomial MRSA rate fell from 0.61 to 0.21 in first year and remained significantly below benchmark and sentinel rates for 5 years.	O
Jamtvedt <i>et al.</i> (1998) <sup>28</sup>	Assess the effects of audit and feedback on clinical practice	Cochrane systematic review	118 studies	Type of intervention. Intensity of audit. Complexity of targeted behaviour. Seriousness of outcome. Baseline compliance.	N/A	SR <sup>+</sup>
Moongtui <i>et al.</i> (2000) <sup>29</sup>	Evaluate effect of a peer feedback programme (PFP) on hand washing and glove wearing	Randomised controlled trial	91 healthcare workers (HCWs) in a 1200-bed hospital in Thailand intervention group: $N = 36$ ; controls: $N = 55$	Type of HCW, attitudes to infection, demographic and experiential variables	PFP had a significant effect on compliance during intervention ( $P^2 = 0.383$ , $P < 0.00005$ ) but no significant difference between groups after 4 weeks	O <sup>+</sup>

Table 1 (continued)

Study	Aim	Method	Sample	Risk adjustment/ confounders controlled	Statistical results	Evidence grading <sup>a</sup>
Rosenthal <i>et al.</i> (2003) <sup>30</sup>	To assess the effect of education and feedback on hand washing compliance (HWC) rates	Prospective study with sequential interventions: education alone and education plus performance feedback	3 hospitals in Argentina. 15 531 patient contacts from random sampling of 30 min observation periods.	HWC characteristics. Type of unit, shift, procedure. Hospital administra- tive support for in- fection control.	HWC rate significantly increased by both interventions. Administrative support significantly increased HWC compliance (odds ratio: 5.57; 95% CI: 5.25 to 6.31, $P \leq 0.001$ ).	O <sup>+</sup>

NHS, National Health Service; N/A, not applicable; MRSA, methicillin-resistant *Staphylococcus aureus*; CRP, ceftazidime-resistant *Pseudomonas* spp.; EPESB, Enterobacteriaceae producing extended-spectrum  $\beta$ -lactamases.

<sup>a</sup> Evidence grading: SR<sup>+</sup>, systematic review of high quality trials/cohort studies (with risk adjustment) with a narrow confidence interval (CI); SR, other systematic reviews; R, non-systematic review; O<sup>+</sup>, observational study with good adjustment for risk and confounders; O, observational study without adjustment for risk/confounders and/or no report of sample size; Q, qualitative study.

## Leadership and management

### Leadership styles

Leadership describes the ability to influence, motivate and enable members of an organisation to contribute to the effectiveness and success of the organisation. Positive, proactive leadership styles, based on shared visions and interaction with staff, have been demonstrated to increase staff and patient satisfaction, whereas laissez-faire or responsive styles, with intervention only when problems occur, result in negative experiences.<sup>15</sup> Investigations by the Healthcare Commission into failings in healthcare systems, including outbreaks of *C. difficile*, identified the negative impacts of poor leadership, ineffective management, inadequate teamwork and communication between staff, lack of clarity about responsibilities, and staff feeling undermined and unable to raise concerns.<sup>12,16,17</sup>

The relationship between nursing leadership and patient outcomes was assessed in a recent systematic review including seven studies, one of which examined the impact of leadership factors on HCAI. Houser used a mixed method design to develop a structural equation model of nursing demands at ward level, and explored factors such as leadership, staff expertise, staff stability, teamwork, financial resources and workload.<sup>18</sup> Positive leadership was associated with a reduced incidence of pneumonia and urinary tract infection (UTI). The overall findings of the review suggested that leadership style has a strong impact on patient outcomes, supporting Houser's results, although evidence for the relationship between leadership style and patient mortality was inconclusive.<sup>19</sup> However, all the studies included used non-experimental, cross-sectional or descriptive designs which do not allow determination of causality.

Contingency theories of leadership recognise that effective leadership is not simply a product of the leader's approach, but also of the wider context. Doran *et al.* examined the impact of the manager's span of control (defined as the number of people supervised by an individual manager) on nurse, patient and unit outcomes.<sup>15</sup> They found that a wide span of control decreased the beneficial effects on nurses' job satisfaction of positive leadership styles, and increased the negative effects of responsive styles. A wider span of control was correlated with lower patient satisfaction, and it diminished the enhancing effect of positive leadership on patient satisfaction. It was also linked to increased staff turnover. In Houser's model, the relationship between positive leadership and reduced incidence of pneumonia and UTI was mediated by staff expertise and stability.<sup>18</sup>

**Table II** Studies included in the review: workforce and workload

Study	Aim	Method	Sample	Risk adjustment/ confounders controlled	Statistical results	Evidence grading <sup>a</sup>
Hugonnet <i>et al.</i> (2004) <sup>31</sup>	Review evidence for association between nurse staffing, skill mix and HCAI	Review	29 studies	None reported	N/A	R
McCutcheon <i>et al.</i> (2005) <sup>32</sup>	Synthesise evidence on nurse staffing and patient safety	Systematic review	Nurse staffing and mortality: 7 studies; nurse staffing and adverse patient outcomes: 18 studies	N/A	N/A	SR
Lang <i>et al.</i> (2004) <sup>33</sup>	Review evidence for association between nurse staffing and patient, nurse employee and hospital outcomes	Review	43 studies	N/A	N/A	R
Kane <i>et al.</i> (2007) <sup>34</sup>	Examine the association between registered nurse (RN) staffing and patient outcomes in acute hospitals	Systematic review	28 studies	Adjusted for patient acuity at the individual and hospital level. Separate analyses for intensive care units and medical and surgical patients.	An increase of 1 RN per patient-day associated with a decreased OR of hospital-acquired pneumonia (OR: 0.70; 95% CI: 0.56–0.88)	SR <sup>+</sup>
Hugonnet <i>et al.</i> (2007) <sup>35</sup>	Determine whether low staffing levels increase infection risks in critical care	Observational, prospective cohort study over 4 years	Medical ICU in one hospital in Switzerland (N = 1883 patients)	Demographics. Admission diagnosis. APACHE II score. Daily invasive device and antibiotic use. Length of stay.	Higher staffing level was associated with a >30% infection risk reduction (incidence rate ratio: 0.69; 95% CI: 0.50–0.95)	O <sup>+</sup>

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Table II (continued)

Study	Aim	Method	Sample	Risk adjustment/ confounders controlled	Statistical results	Evidence grading <sup>a</sup>
Aiken <i>et al.</i> (2003) <sup>36</sup>	Assess the association between educational preparation of nurses and patient outcomes	Retrospective analysis of administrative data and survey data	168 adult acute care general hospitals in the USA: 232 342 patients aged 20–86	Hospital characteristics (including size, technology, status); patient characteristics (including a total of 133 variables, e.g. age, sex, type of admission); surgeon characteristics	10% increase in proportion of nurses with a bachelors degree associated with a 5% decrease in the likelihood of patients dying within 30 days and the odds of failure to rescue (OR: 0.95; 95% CI: 0.91–0.99 in both cases)	O <sup>+</sup>
Department of Health (2007) <sup>39</sup>	Investigate organisational factors associated with trust level differences in MRSA	Retrospective analysis of routinely collected data	All acute NHS trusts in England 2001/02 to 2005/06	Hospital characteristics, including size, location, type, case mix, bed occupancy rates, cleanliness and use of temp staff	Regression analysis: bed occupancy and use of temporary nursing staff significantly correlated with MRSA rates 2001/2 to 2003/4, but not for 2004/5 and 2005/6	O
Aiken <i>et al.</i> (2002) <sup>40</sup>	Determine the association between staffing levels and surgical patient mortality; and factors related to nurse retention	Retrospective analysis of administrative data and survey data	168 adult acute care general hospitals in the USA: 232 342 patients aged 20–86; 10 184 staff nurses	As Aiken <i>et al.</i> (2003) (above)	Each additional patient per nurse associated with a 7% increase in the likelihood of dying within 30 days of admission (OR: 1.07; 95% CI: 1.03–1.12); a 7% increase in the odds of failure to rescue (OR: 1.07; 95% CI: 1.02–1.11); and an increase in the odds of nurse burnout and job dissatisfaction.	O <sup>+</sup>
Rafferty <i>et al.</i> (2007) <sup>41</sup>	Assess the relationship between nurse staffing levels and patient mortality and nurse dissatisfaction and burnout	Cross-sectional study combining nurse survey data, discharge abstracts and administrative data	30 English hospital trusts; 118 752 patients; 3984 nurses.	Hospital characteristics, demographics, consultant, specialised diagnosis and procedures	Hospitals with the highest patient:nurse ratios had 26% higher mortality (95% CI: 12–49%) and greater nurse dissatisfaction	O <sup>+</sup>



Cunningham <i>et al.</i> (2005) <sup>42</sup>	Examine the relationship between bed occupancy (PO) and turnover interval (TI) and MRSA rates in acute beds	Retrospective analysis hospital surveillance data from Northern Ireland CDSC and hospital statistics 2001/2 and 2002/3	12 acute trusts in Northern Ireland	None stated	TI and MRSA: 2001/2, $r = -0.62$ , $P < 0.05$ ; 2002/3, $r = -0.85$ , $P < 0.01$ PO and MRSA: 2001/2, $r = 0.38$ , NS; 2002/3, $r = 0.68$ , $P < 0.05$	O
Cunningham <i>et al.</i> (2006) <sup>43</sup>	Examine the relationship between bed occupancy (PO) and turnover interval (TI) and MRSA rates acute beds of specialist trusts	Retrospective analysis of Department of Health hospital episode statistics and hospital activity data for one year 2004/5	Specialist NHS Trusts in England ( $N = 40$ for PO; $N = 38$ for TI)	None stated	TI and MRSA: $r = -0.27$ , $P = 0.1$ ; PO and MRSA: $r = 0.31$ , $P = 0.05$	O
Borg (2003) <sup>44</sup>	Assess the relationship between rates of MRSA and level of bed occupancy in general hospital wards	Retrospective analysis of surveillance data over 24 months	900-bed hospital in Malta. Number of patients not stated.	Length of stay. Site of infection.	Bed occupancy and MRSA: $r = 0.463$ , $P < 0.05$ . No statistically significant relationship between length of stay and MRSA.	O
National Nursing Research Unit (2007) <sup>45</sup>	Examine evidence on cohort nursing	Rapid scoping review	5 studies	N/A	N/A	R
Cooper <i>et al.</i> (2004) <sup>46</sup>	Evaluate evidence for the effectiveness of isolation measures in reducing MRSA infection	Systematic review	46 studies	N/A	N/A	SR

HCAI, healthcare-associated infection; N/A, not applicable; NS, not significant; OR, odds ratio; CI, confidence interval; ICU, intensive care unit; APACHE II, Acute Physiological Assessment and Chronic Health Evaluation II; NHS, National Health Service; MRSA, methicillin-resistant *Staphylococcus aureus*; CDSC, Communicable Disease Surveillance Centre.

<sup>a</sup> Evidence grading: SR<sup>+</sup>, systematic review of high quality trials/cohort studies (with risk adjustment) with a narrow confidence interval; SR, other systematic review; R, non-systematic review; RCT, randomised controlled trial; O<sup>+</sup>, observational study with good adjustment for risk and confounders; O, observational study without adjustment for risk/confounders and/or no report of sample size; Q, qualitative study.

### Management structures and roles

Infection control was an explicit goal of appointing modern matrons (senior clinical nurses in a middle management and leadership role) in UK hospitals. An implementation study in an acute trust compared benchmarking data before and after matrons were introduced and explored stakeholders' views: matrons were perceived as visible, accessible and having improved patient care, and there was a reduction of 11.6% in MRSA bacteraemia.<sup>20</sup> The statistical significance of the observed change is unclear, and it is impossible to attribute it to the matrons, since there were no control settings and because other initiatives to reduce infection were introduced during the period studied.

Interviews with modern matrons identified challenges to their effective functioning.<sup>21</sup> They reported time constraints, organisational barriers, administrative duties and multiple responsibilities; consequently they felt unable to spend sufficient time on the wards to fulfil their mandate as people of visibility and authority. A national survey of directors of nursing, combined with local case studies, found that matrons had a positive effect on leadership and workforce issues (such as skill mix management, staffing levels and performance management), although a range of difficulties, such as role conflicts, a fragile sense of authority, competing priorities and role overload, could limit their success.<sup>22</sup> Matrons were generally considered to have improved clinical leadership by setting an example, challenging poor practice, encouraging reflection and empowering staff. The study found positive impacts on patient environment (e.g. cleanliness), care standards, staff morale, communication, staff training, service development and infection control.

### Teamwork

Houser's model demonstrated that teamwork and expertise had effects on nurse-sensitive outcomes, including hospital-acquired pneumonia and UTI.<sup>18</sup> At an organisational level, the Healthcare Commission's investigations implicated inadequate teamwork in failure to control infection outbreaks.<sup>12</sup> The proportion of staff working in teams was related to adjusted mortality rates in a survey of 61 UK acute hospital trusts by West *et al.*, which echoes the findings of studies of 'magnet' hospitals in the US.<sup>23,24</sup> A multidisciplinary approach to improving antibiotic prescribing in one hospital significantly reduced inappropriate prescriptions (from 6% to 3%); infections with Enterobacteriaceae producing extended-spectrum  $\beta$ -lactamases also fell, although the prevalence of MRSA and resistant strains of pseudomonas were unchanged.<sup>25</sup>

Two studies considered the impact of multidisciplinary infection control teams. Kaye *et al.* evaluated the effectiveness of a multidisciplinary clinical team created to reduce rates of hospital-acquired pneumonia in an intensive care unit.<sup>26</sup> The team revised policy and procedures, changed supplies and ordered new equipment, and developed educational tools. Rates of ventilator-associated pneumonia dropped from the 90th percentile to below the 75th percentile. Salaripour *et al.* assessed the success of a broad multidisciplinary initiative, led by a team consisting of a wide range of medical, nursing, management and site service staff, in reducing MRSA rates in high incidence units.<sup>27</sup> The team identified causes of high rates of infection and implemented a wide range of measures; over a period of five years infection rates dropped by 60% hospital-wide. These studies suggest that a multidisciplinary approach to infection control is associated with success, although the evidence primarily supports the effectiveness of multifaceted interventions, rather than the effectiveness of a multidisciplinary team per se. In both studies, very little was in place in terms of infection control before teams were created.

### Human resource management

No studies were located that specifically addressed the impact of human resource factors on infection, although the survey by West *et al.* provides some tentative evidence for this relationship, indicating that staff appraisal and robust training policies were strongly associated with lower mortality rates, even after adjustment for patient and hospital characteristics.<sup>23</sup>

### Clinical governance

Clinical governance is the system through which National Health Service organisations are accountable for continuously improving the quality of their services and safeguarding high standards of care; key mechanisms being audit, feedback and clear accountability for clinical performance. The Healthcare Commission's report on investigations into serious failures by healthcare providers identified inadequate information about clinical care and poor use of data in decision making as a recurring theme.<sup>12</sup> One of the investigations, undertaken following two outbreaks of *Clostridium difficile*, revealed a dysfunctional governance system and insufficient focus on risk management.<sup>17</sup>

A Cochrane systematic review has shown that audit and feedback can improve professional practice (including antibiotic prescribing, hand washing and glove use), although the effects are generally small to moderate.<sup>28</sup> One of the largest

effects was shown by the single study on hand washing and glove use included in the review, although behaviour change was transitory.<sup>29</sup> A large observational study of hand washing found that the impact of interventions was influenced by organisational context: hospitals providing managerial support for infection control activities, including audit, showing greater improvements.<sup>30</sup>

## Workforce and workload

### Staffing and skill mix

Between 2004 and 2008 several reviews assessed the relationship between staffing levels and patient outcomes. Although they focused on different staffing issues and outcome measures, they all found an inverse relationship between nurse staffing [total numbers and registered nurse (RN) numbers] and general patient outcomes, and provided some tentative support for an association between staffing levels and HCAI.

A narrative review by Hugonnet *et al.* found evidence for a relationship between understaffing and an increase in nosocomial infections, although they were unable to determine optimal staffing levels.<sup>31</sup> A systematic review by McCutcheon *et al.* showed that in hospitals with registered nurse staffing levels above the 75th percentile, rates of hospital-acquired pneumonia and UTI in medical patients were reduced by 6.4% and 3.6% respectively compared to hospitals with low numbers of registered nurses (25th percentile).<sup>32</sup> For surgical patients, higher staffing was associated with a reduction of 4.9% in UTI rates.

Other research produced more equivocal findings. Lang *et al.*'s systematic review of the impact of nurse staffing on patients, nurse employees and hospital outcomes, found that nursing hours and skill mix influenced patient outcomes such as failure to rescue rates (generally defined as death among patients with treatable serious complications), inpatient mortality and length of hospital stay.<sup>33</sup> However, the evidence for a link between staffing and UTI/sepsis was less clear and generally insufficient to determine nurse:patient ratios for acute hospitals. A more recent review also found inconsistent evidence for the relationship between nurse staffing and infection control outcomes, demonstrating a link with healthcare-associated bloodstream infection but not UTI.<sup>34</sup> A prospective study carried out by Hugonnet *et al.* over a four-year period in a medical intensive care unit found that, on average, an increase in the nurse:patient ratio of one unit was associated with a 30% reduction of risk of infection in a univariate analysis.<sup>35</sup> This remained unchanged in a multivariate model

(controlling for risk factors). A major strength of this study is that it established a temporal link between staffing and infections, showing that staffing levels were consistently lower 2–4 days before cases of infection.

There is scant evidence for a link between infections and the nursing team's skill mix in acute care settings. However, a relationship has been demonstrated between a richer skill mix (in terms of bachelors-qualified nurses) and mortality and failure to rescue.<sup>36</sup> Large scale studies using routine data from US nursing homes have shown that a higher proportion of registered nurses is associated with lower rates of UTI,<sup>37</sup> whereas high use of licensed practical nurses is associated with higher rates of infection.<sup>38</sup>

### Temporary nursing staff and team stability

Houser's model linked staff turnover and vacancies with poorer outcomes, including infections.<sup>18</sup> Analysis of five years' data on hospital organisation and rates of MRSA by the Department of Health found that a proportion of temporary nursing staff 10% above the national average was associated with a rise of 1% in rates of MRSA, all else being equal.<sup>39</sup> Possible mechanisms were not addressed. The correlation was weaker in the most recent years studied (2004/5 and 2005/6), suggesting that the adverse effect of temporary staffing had been reduced by widespread implementation of infection control measures.

### Job satisfaction and morale

No studies were located that tested empirically a causal link between staff morale or job satisfaction and infection control in hospitals. In US nursing homes, lack of management emphasis on staff satisfaction was associated with higher rates of hospital admission for infection.<sup>38</sup> Research in hospitals has shown a consistent relationship between low staff satisfaction/burnout and adverse outcomes such as mortality and failure to rescue,<sup>40,41</sup> although the mechanism and, indeed, direction of causality is unclear.

### Bed occupancy

Four retrospective surveys of administrative data suggest an association between bed occupancy and HCAI, particularly MRSA. However, none of these studies provide guidance on safe levels of bed occupancy, nor do they assess mechanisms by which bed occupancy affects patient outcomes.

Three studies examined the relationship between bed occupancy and rates of MRSA in Northern Ireland, England and Malta using published administrative data.<sup>42–44</sup> Two found a significant and

positive relationship between the two variables.<sup>43,44</sup> The third study examined rates over two years, finding a significant relationship for 2002/03, but not for 2001/02.<sup>42</sup> In contrast, Houser's model found no association between bed occupancy and adverse outcomes.<sup>18</sup> Although the scale of this study was relatively small, it controlled for possible intervening variables such as leadership, team stability and skill.

The Department of Health investigation found that hospitals with higher bed occupancy levels had higher rates of MRSA.<sup>39</sup> Hospitals with bed occupancy of  $\geq 90\%$  had a 10.3% higher MRSA rate compared to those with an occupancy of  $\leq 85\%$ . However, the relationship weakened over the course of the five years studied, possibly because of the success of initiatives to combat HCAI. Moreover, average bed occupancy in acute wards has fallen and it may be that more acute wards are now operating at optimal levels of bed occupancy; hence there is too little variation to detect an effect.

A further factor relating to hospital bed management is turnover interval (that is the time between a bed being vacated and another patient being put into it). Two studies by Cunningham *et al.* found a significantly negative correlation between turnover interval and rates of MRSA.<sup>42,43</sup> The results of a partial correlation indicated that the influence of turnover interval on rates of MRSA was greater than that of bed occupancy.<sup>42</sup>

None of these studies explored mechanisms by which high bed occupancy and rapid turnover might affect rates of MRSA. Cunningham *et al.* offer the plausible explanation that these factors increase workload for nursing staff and reduce the time available for bed and environmental cleaning between patients.<sup>43</sup> High bed occupancy and, to some extent, turnover interval can also affect the availability of isolation and cohort areas. A recent review found that evidence for the effectiveness of cohort nursing was weak,<sup>45</sup> whereas a systematic review found consistent benefits from interventions that included some degree of isolation, including cohorting, although evidence on isolation wards was more mixed.<sup>46</sup>

## Discussion

This review has identified direct and circumstantial evidence for the impact of a number of organisational, management and leadership factors on infection control and rates of infection in hospitals. The quality of the evidence was generally inadequate and direct evidence was limited, but there is a degree of consistency in the findings.

Positive leadership at ward level and above seems a necessary prerequisite for effective action to control infection.<sup>15</sup> The recent Healthcare Commission reports into infection outbreaks provide powerful examples of leadership failures relating to infection control.<sup>16,17</sup> The effects of positive leadership are diffused when managers supervise large numbers of staff;<sup>15</sup> hence it is important to allocate responsibility for direct supervision of staff to the appropriate managerial level. Introduction of modern matrons (senior nurses) as middle-level clinical managers has been associated with decreased rates of MRSA, although other initiatives may have been directly responsible for improvements. Implementation studies suggest that modern matrons' role boundaries and responsibilities must be clear and that clinical leadership must be visible for them to be effective.<sup>20–22</sup>

Successful infection control has been associated with multiprofessional involvement, and although the evidence is tangential, the need for action across a range of professions and practitioners is largely self-evident. However, effective leadership of multiprofessional endeavours in complex organisations is particularly challenging, raising issues of authority and accountability, and investigations into infection outbreaks illustrate the difficulties faced by infection control teams working across disciplinary boundaries, operational units and management levels.<sup>16,17</sup> Organisational mechanisms to support training, staff appraisal and clinical governance are important determinants of effective practice and change.<sup>23</sup>

Much evidence supports a relationship between nurse staffing levels and patient outcomes.<sup>34</sup> Infection rates have been studied less and the evidence is more equivocal, but generally an inverse relationship with staffing levels has been shown. Fixed nurse:patient ratios have been implemented in a number of health systems, although evidence of direct benefit is largely lacking,<sup>47–49</sup> and the evidence reviewed here does not indicate optimum staffing levels. It seems clear that increases in workload on a ward potentially reduce care quality and contribute to increased infection; therefore low staffing and high workload should be considered risk factors. Rather than setting a fixed staffing ratio, a better approach is to monitor and match staffing to workload at a unit level.

Associations have been shown between infections and the use of temporary nursing staff.<sup>39</sup> However, it is not clear if this is an independent association: it may be that use of temporary nursing staff is a marker for workforce problems that have been shown to impede quality of care (vacancies, high turnover, low morale).<sup>18,24,38</sup> Thus it would

be wrong to conclude that infections can be avoided simply by decreasing the use of bank or agency staff. Since not employing temporary staff would reduce the workforce and potentially increase workload, the priority must be to address underlying problems and stabilise the workforce.

High bed occupancy and rapid patient turnover have been linked with increased rates of MRSA,<sup>42,43</sup> although the strength of the relationship has diminished as initiatives to combat HCAI have become more widespread.<sup>39</sup> The reason for the association is unclear, although both workload and the limited ability to isolate patients have been cited.<sup>43</sup> It seems safest to conclude that while there may be no correlation with infection at bed occupancy levels currently observed in the UK, high bed occupancy represents a strain, albeit one that may not necessarily result in adverse consequences provided other conditions (e.g. staffing levels, leadership) are favourable.

This review has identified the following risks for infection and infection control problems:

- weak or negative clinical leadership at ward level;
- weak or negative clinical leadership above ward level;
- absence of clear lines of clinical management and responsibility;
- excessive span of control among clinical leaders;
- unclear roles and responsibilities for infection control;
- lack of clear policies and active support for training;
- absence of an effective multidisciplinary infection control team perceived as exercising positive leadership at ward or unit level;
- high staff turnover;
- high use of bank or agency staff;
- low staff morale;
- high patient turnover;
- workload not matched to available staffing;
- high bed occupancy.

Individually, these risks may not be sufficient to create problems with infection control, and rectifying them may not be sufficient to resolve problems. Indeed, in some cases (e.g. high staff turnover) there may be no direct remedial action. However, awareness of the risks offers the opportunity to analyse and appraise the wider organisational environment of care, in addition to the usual assessments focusing on patients' physical environment, clinical procedures and interactions, and identify action to increase the effectiveness of infection control. The

problem of HCAI cannot be solved simply by identifying best infection control practices and issuing guidelines; practices must be implemented and embedded within supportive systems.

### Conflict of interest statement

The views expressed are those of the authors and not necessarily those of the Royal College of Nursing.

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