British Medical Association

Tackling healthcare associated infections through effective policy action

June 2009

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Declaration of interest

Of the people involved in the research and writing of this report Dr RH George is related to Professor Sir Charles George. For further information about the editorial secretariat or Board members please contact the BMA Science and Education Department which holds a record of all declarations of interest: info.science@bma.org.uk

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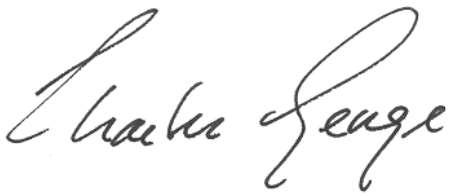
Foreword

The risk of acquiring an infection while in the care of health services is not new. Recent outbreaks of healthcare associated infections (HCAIs) have demonstrated the devastating impact that such infections can have on service delivery, patient safety and wellbeing, and public confidence. Tackling this significant cause of morbidity and mortality has therefore become a priority for the National Health Service (NHS). To date the strategy to reduce the burden of HCAIs has focused on identifying short-term solutions which have failed to address the underlying problems that adversely impact on infection control.

No single infection control policy should be viewed as a cure-all measure. Good infection control practice is the responsibility of all healthcare staff, patients and visitors. This can only be achieved with strong organisational support and commitment to implementing policies that are practicable and effective in preventing and controlling HCAIs. With the shifting emphasis to high throughput systems and increasing pressure on healthcare services, it is essential that competing priorities are managed in a way that facilitates robust infection control practices, without compromising patient safety.

At the 2008 BMA annual representative meeting (ARM) BMA members expressed their concern at the policies that have contributed to the continuing high rates of HCAIs in the UK. The aim of this report is to examine the evidence base for the range of infection control policies, and identify areas for action in tackling the problem. It builds on the 2006 BMA Board of Science publication *Healthcare associated infections – a guide for healthcare professionals*, which sets out the responsibilities healthcare professionals have in managing and reducing the incidence of HCAIs. As with other BMA Board of Science publications, this report is intended for policy makers with strategic or operational responsibility for public health in the UK, and will be of interest to healthcare professionals and patients.



Professor Sir Charles George
Chair, BMA Board of Science

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Contents

Introduction

Over the past two decades, HCAIs have become a significant challenge, both in terms of the risk to patient wellbeing, as well as the cost to the NHS. This has been accompanied by intense media and public attention, to the extent that the prevention and control of infections is now a key focus for healthcare policy in the UK. Despite this, efforts to tackle the problem have focused primarily on reducing rates of meticillin-resistant *Staphylococcus aureus* (*S. aureus*, MRSA) bacteraemia and *Clostridium difficile* (*C. difficile*) infection. Much less attention has been paid to other types of HCAIs, including infections acquired in primary and community healthcare settings.

Hospitalisation and interventions for the purposes of healthcare have always been associated with a risk of infection. Advances in medical technology and treatment, however, have meant that more patients are being treated than ever before, and many are increasingly vulnerable to infections due to a greater severity of underlying illness, the use of invasive procedures, and as a result of suppression of the immune system. This has been compounded by rising levels of resistance as pathogens adapt to exposure to antimicrobial agents, as well as organisational factors such as high bed occupancy and understaffing. The risk of acquiring an infection is therefore dependent on a complex interplay between micro-organisms, patients, healthcare workers, visitors, and the environment. Not all HCAIs can be prevented; however, high standards of infection control can minimise the risk of occurrence.

'These infections are not a new phenomenon – we need to ensure the basic principles of infection control that have been developed over many years are the cornerstone of our modern healthcare system.'
BMA member

Healthcare associated infections affect patients in a variety of ways, from increased discomfort and pain to severe illness, permanent disability and in some cases, death. Infection also leads to extended stays for affected patients, bed and ward closure, and increased diagnostic and treatment costs. The prevention and control of HCAIs is therefore essential. Reducing the burden of HCAIs requires commitment from all healthcare professionals, patients, and visitors as well as strong leadership at an organisational and national level.

This report considers the problems associated with HCAIs and examines the patterns and trends of these infections in the UK. It goes on to review the evidence base for the range of infection control policies, and identifies areas that require action in order to reduce the burden of HCAIs.

Healthcare associated infections – a guide for healthcare professionals
In 2006 the BMA Board of Science published *Healthcare associated infections: a guide for healthcare professionals* which highlights guidance on good practice in infection prevention and control, and specifically the responsibilities healthcare professionals have in managing and reducing the incidence and spread of HCAIs in all clinical settings. The 2006 report focuses on providing practical guidance on high standards of hygiene, reducing the risk of infection from the use of indwelling devices, and optimal use of antimicrobials. Further information is available at www.bma.org.uk

Healthcare associated infections

Healthcare associated infections are infections acquired as a result of contact with the healthcare system in its widest sense – from care provided in the home, to primary care, nursing home care and acute care in hospitals. A diverse range of micro-organisms can cause a wide spectrum of healthcare associated infections including MRSA and *C. difficile*, as well as other less well-known infective agents such as glycopeptide-resistant *enterococci* (GRE), norovirus, *Streptococcus pneumoniae*, *Acinetobacter* species (spp), Extended-spectrum Beta-Lactamase (ESBL) producing *Escherichia coli*, *Candida* spp, as well as various *Pseudomonas* spp. Many of these micro-organisms form part of the normal flora of patients receiving care that take advantage of breaches in the body's defences against infection to gain access to deeper tissues. In seriously ill patients the immune defences often have a diminished capacity to respond. Patients colonised by these pathogens may then act as a reservoir from which micro-organisms are transferred to other patients via hands, equipment or contact with the environment.[1] Patients receiving care are commonly exposed to antimicrobials to treat or prevent infection. Repeated exposure encourages the emergence of pathogens that are intrinsically resistant to antimicrobials.

The most common HCAIs are gastrointestinal (20.6%), urinary tract (19.9%), surgical site (14.5%), pneumonias (14.1%), skin and soft tissue (10.4%), and primary bloodstream (7.0%).[2] Specific HCAIs are commonly linked with invasive procedures; for example, urinary tract infections are frequently associated with catheterisation, bloodstream infections are often associated with intravenous devices, and respiratory infections commonly occur following artificial ventilation. Antimicrobial-resistant micro-organisms do not generally cause different infections to non-resistant strains but may have particular characteristics that enable them to spread more easily between patients. The infections caused by resistant micro-organisms can therefore be more difficult to treat, complicating prevention and control of HCAIs, and exacerbating the associated problems of infection.[3] The use of antimicrobials to treat one infection can also enable other micro-organisms to colonise patients and then cause harm (eg *C. difficile* and *Candida* spp).

The burden of healthcare associated infections

For patients affected by a HCAI the consequences may be severe as they can cause considerable distress; extend stays in hospital; reduce quality of life, and result in prolonged discomfort, permanent disability and in some cases contribute to, or cause, death. Healthcare staff are also at risk of acquiring HCAIs as a result of attending to infected patients (eg *C. difficile*).

In addition to the unnecessary pain and suffering that these infections can cause patients and their families, treating HCAIs impacts adversely on NHS resources and the wider economy (see **Box 1**). These include opportunity costs to healthcare services (eg prolonged inpatient stay, outpatient consultations, GP consultations, community care), costs to patients and informal carers (eg travel expenditure, medicines), and other costs to society (eg production losses due to morbidity/mortality and caring activities).

Box 1: Summary data on the cost of HCAIs

England

- A 1999 research study from the London School of Hygiene and Tropical Medicine (LSHTM) and Public Health Laboratory Service (PHLS) estimated that the national costs of HCAIs to the health sector amounted to at least £1 billion annually.[4]
- The 1999 study also found that on average infected patients stayed in hospital 2.5 times longer than uninfected patients, corresponding to 11 extra days in hospital, at a cost equivalent to an extra £3,000 per case.[4]
- In a 2001 study, patients affected by a HCAI were found to take an average of six extra days to return to work – which constitutes an average cost of £800 per patient – and an average of 17 extra days to return to normal daily activities.[5]

Scotland

- A Scottish survey conducted in 2005/06 found that the additional length of stay associated with HCAIs in acute hospitals ranged from 3.2 days in obstetrics to 13.7 days in care of the elderly, and that patients with a HCAI have a length of stay 70 per cent greater than patients without.[6]
- The survey also estimated the costs of HCAIs in Scotland to be £183 million per year, ranging from £2 million per year in obstetrics and urology, to £49 million in general medicine.

A 2006 review concluded that the costs of HCAIs have been underestimated and that MRSA alone results in annual costs to the UK economy of between £3-11 billion.[7]

While not all HCAIs are avoidable, a significant proportion can be prevented.[8] The Department of Health (DH) in England, has estimated that approximately 15 to 30 per cent of HCAIs are preventable.[9] There is increasing evidence that, even when infection is endemic, control efforts can be successful and highly cost-effective, particularly in the context of the societal costs, as well as in long-term risks that HCAIs pose.[7] It has previously been estimated that a 10 per cent reduction in the rate of HCAIs would afford a saving of approximately £93 million, with 364,000 bed days released for alternative use; equivalent to an estimated 48,000 finished consultant episodes.[4] In 2000, the National Audit Office (NAO) estimated that a reduction in the incidence of HCAIs by 15 per cent would free up £150 million a year.[10] The 2005/06 survey of HCAIs in Scotland estimated that prevention of a third of all HCAIs would save approximately £55 million.[6]

Data on healthcare associated infections

It has been estimated that eight to nine per cent of patients acquire an infection while in UK health services' care;[a] equivalent to at least 300,000 HCAIs per year.[11, 12] The prevalence of HCAIs in patients in primary and community care settings in the UK is unknown. From an international perspective, a prevalence survey conducted under the auspices of the World Health Organization (WHO) of 55 hospitals in 14 countries found that on average 8.7 per cent of hospital patients suffer HCAIs.[13] Prevalence surveys of HCAIs in industrialised European countries have found that the proportion of patients in acute care hospitals with a HCAI is on average 7.1 per cent, ranging from 3.5 per cent to 9.5 per cent (see **Table 1**).

Table 1: Overview of recent prevalence surveys of HCAI in industrialised European countries

Country	Prevalence (%)
UK, 1996	9.0
Germany, 1997	3.5
France, 2001 (1996)	6.6
Switzerland, 2002	8.1
Greece, 2000	9.3
Italy, Lombardy, 2000	4.9
Slovenia, 2001	4.6
Italy, 2002	7.5
Portugal, 2003	8.4
Denmark, 2003	8.7
Latvia, 2003	3.9
Finland, 2005	8.5
Sweden, 2004-2006[b]	9.5
France, 2006[c]	5.0
Norway, 2002-2007[b]	6.8
Scotland, 2007[c]	9.5
Spain, 2004-2007[b]	6.8
Lithuania 2003, 2005, 2007[b]	3.7
Netherlands, 2007	6.9

Source: The European Centre for Disease Prevention and Control (2008) *Annual epidemiological report on communicable diseases in Europe 2008 – report on the state of communicable diseases in the EU and EEA/EFTA countries.* Stockholm: European Centre for Disease Prevention and Control.

a In the absence of comparable data, it is not known what proportion of infections are acquired following contact with the healthcare system compared to the total number of infections

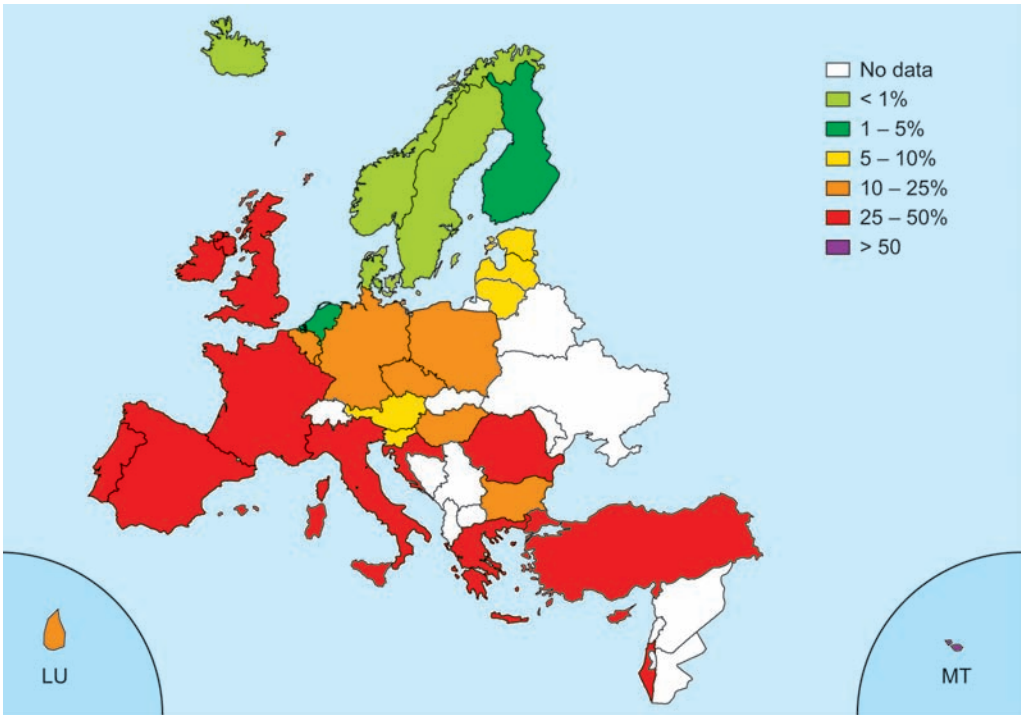
b Average numbers from repeated point prevalence surveys over several years

c This figure includes acute facilities only

Limited data are available for international comparison for specific HCAIs. With regard to MRSA, the UK has one of the highest recorded prevalence rates in Europe (see **Figure 1**).

Figure 1: Proportion of *S. aureus* isolates resistant to meticillin, Europe, 2007

Reproduced with the permission of the European Antimicrobial Resistance Surveillance System.



Trends

In the UK, the prevalence of HCAIs has remained relatively static over the last 30 years and the available evidence suggests that there has been no increase in overall infection rates; however, significant changes have occurred in the proportion of micro-organisms resistant to antimicrobial treatment. The first two national prevalence surveys in UK hospitals (1980 and 1994) showed consistent prevalence rates at just over nine per cent.[14] Data on trends in the prevalence of specific infections are limited as there is no mandatory surveillance for all HCAIs, and methods for data collection differ between nations.[d] Surveillance data and data on deaths linked to HCAIs provide some information on trends for specific bloodstream infections (MRSA and GRE), gastrointestinal infections (*C. difficile* and Norovirus), and surgical site infections (SSIs). Data on the prevalence of these infections in community settings, and on other types of HCAI, are not readily available.

d In England, mandatory surveillance of *S. aureus* bloodstream infections was introduced in 2001, followed by GRE bloodstream infections in 2003, and *C. difficile* infection and orthopaedic surgical site infections in 2004. In Scotland and Northern Ireland mandatory MRSA surveillance began in 2002. Mandatory MRSA surveillance began in Wales in 2001.

Bloodstream infections

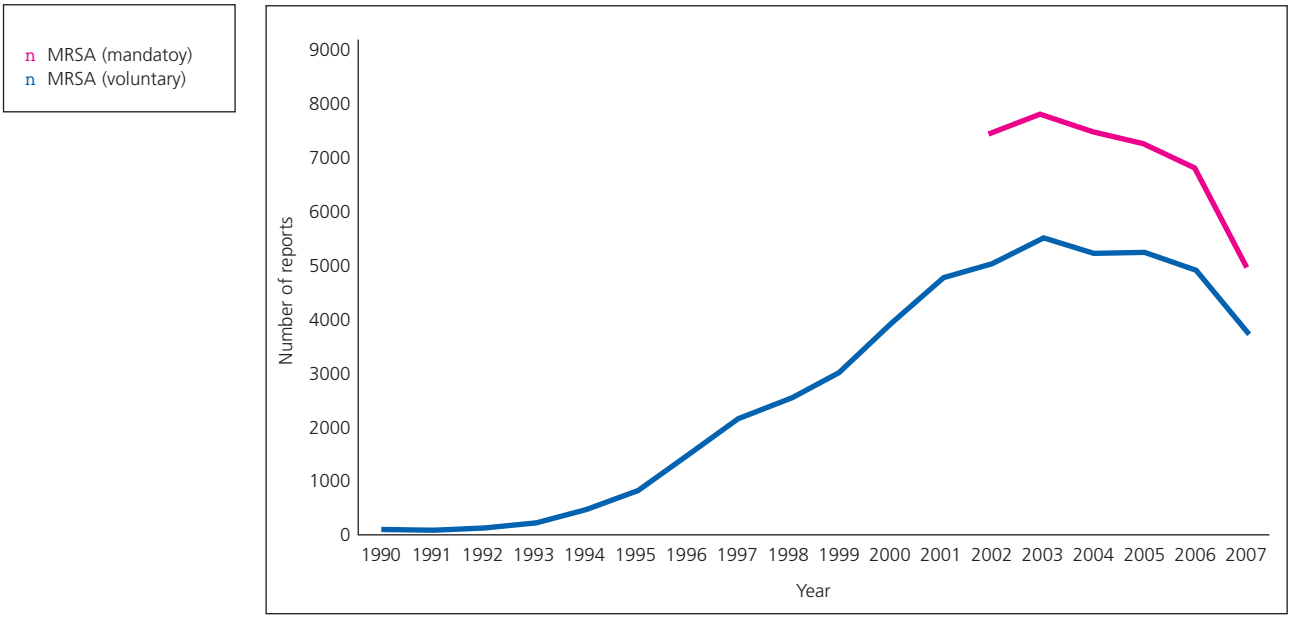
Bloodstream infections represent the severe end of the spectrum for HCAIs. Indications for taking blood cultures, as well as the methods used to detect the responsible micro-organisms are more consistent than for other forms of infection, thus providing a more robust basis for surveillance.

MRSA bloodstream infections

Over the last decade, progress has been made in reducing MRSA as a cause of bacteraemia. In England, since 2001, more than 7,000 MRSA bloodstream infections have been reported annually; this figure declined to 6,381 for 2006/07 (see **Figure 2**). Since 2003, there has been a downward trend in the rate of MRSA infection in both voluntary and mandatory surveillance.[15] In Scotland, available data from 14 NHS Boards have shown that from 2003 to 2007 there has been no statistically significant change in the rate of MRSA infections.[16] The rates for MRSA bacteraemia have also remained relatively static in Wales[17] and Northern Ireland.[18]

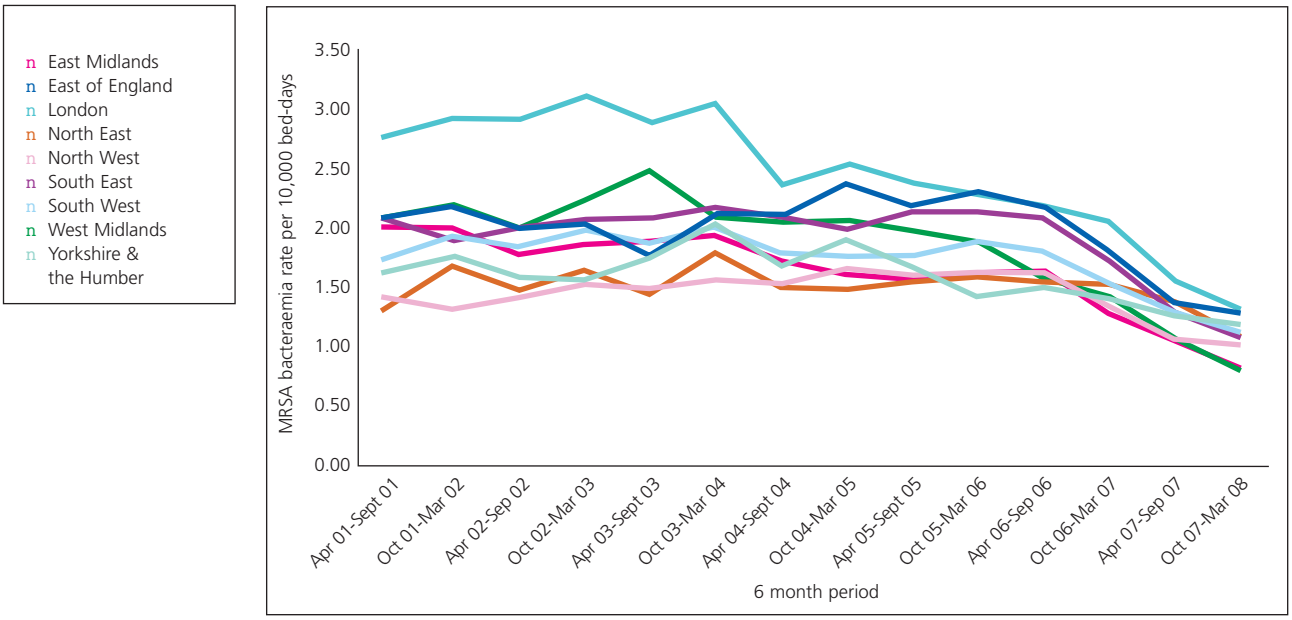
Data from mandatory surveillance of MRSA bacteraemia show variations in MRSA infection rates by region and type of NHS Trust. In England, for example, the London region has had the highest reported proportion of MRSA bloodstream infections; this may be explained by the large proportion of teaching Trusts in this region, as rates of MRSA bacteraemia are higher in this type of Trust (see **Figure 3**). In Northern Ireland the Belfast region has the highest reported proportion of MRSA bloodstream infections; this may be partly attributed to the size of the inpatient population as well as the specialty mix.[18] Bloodstream infection rates for MRSA have typically been highest in non-specialist acute Trust hospitals in England, which account for almost 90 per cent of all English Trusts (see **Figure 4**).[15] In Scotland, the specialties with the highest rates of MRSA infection are general medicine, general surgery, intensive care, and nephrology.[16] Surveillance data by Trust category are not available for Wales.

Figure 2: MRSA bloodstream infection reports received under voluntary and mandatory schemes, England, 1990 to 2007



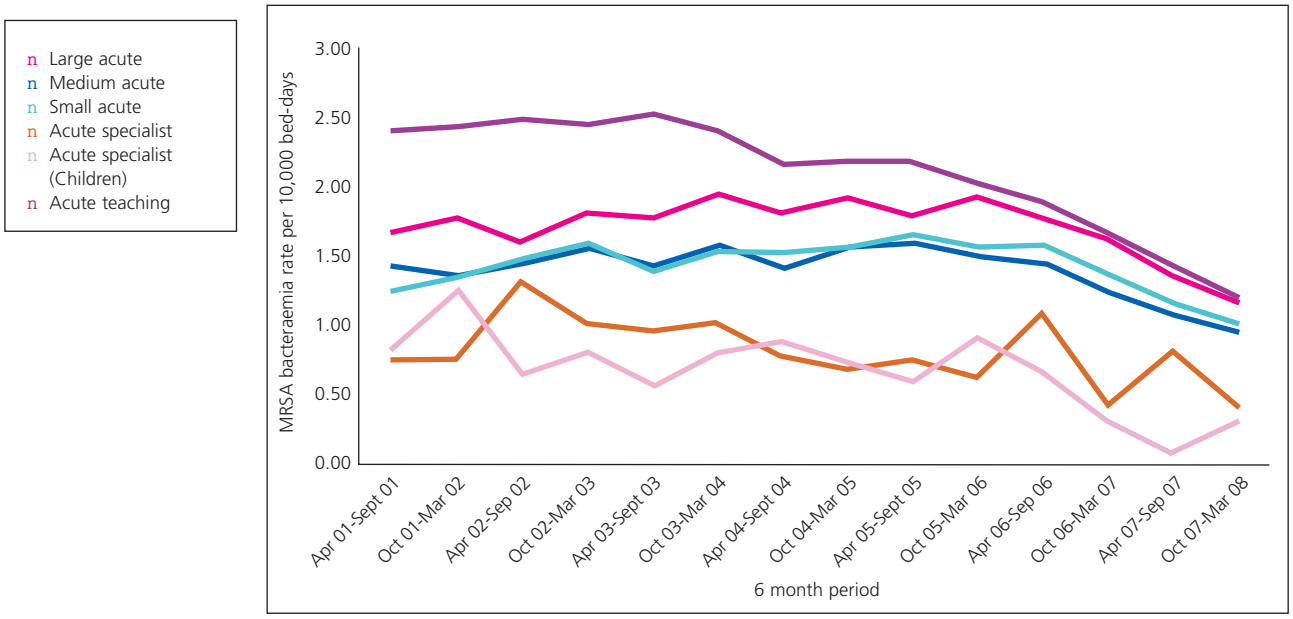
Source: Health Protection Agency (2008) *Surveillance of healthcare associated infections report 2008*. London: Health Protection Agency.

Figure 3: Regional distribution of MRSA bloodstream infection rates, England, April 2001 to March 2008



Source: Health Protection Agency (2008) *Surveillance of healthcare associated infections report 2008*. London: Health Protection Agency.

Figure 4: MRSA bloodstream infection rate by Trust category, England, April 2001 to March 2008

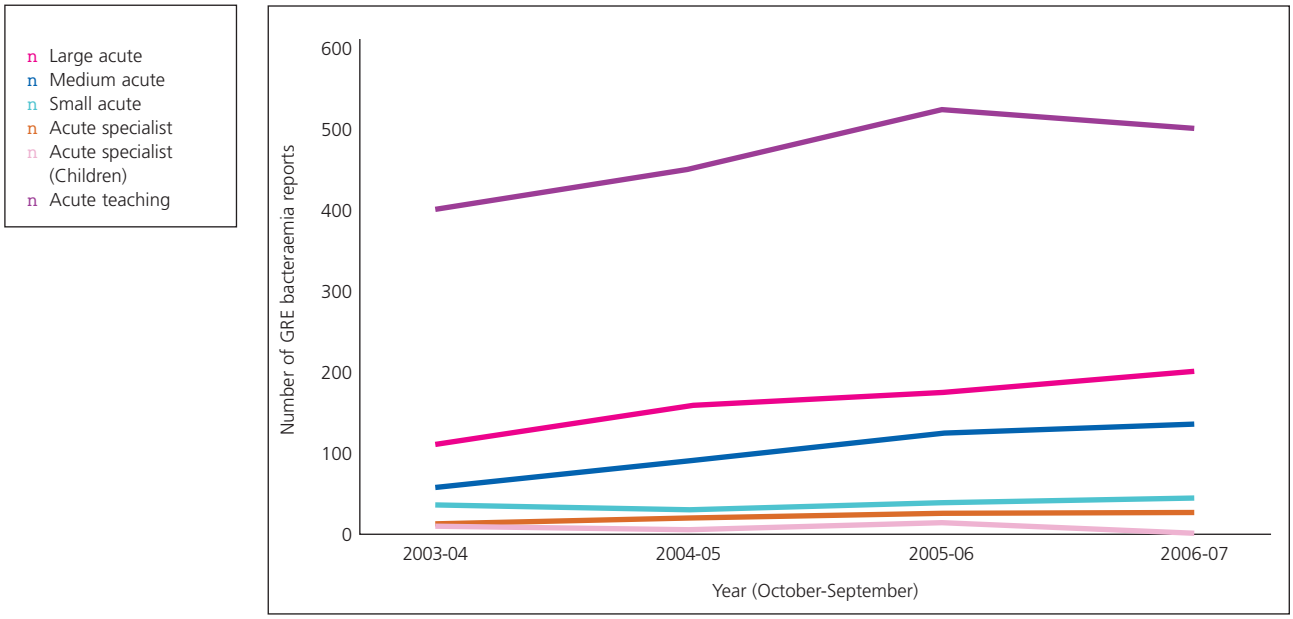


Source: Health Protection Agency (2008) *Surveillance of healthcare associated infections report 2008*. London: Health Protection Agency.

GRE bloodstream infections

In England, the number of clinically significant GRE infections has increased annually since the introduction of mandatory reporting of GRE infection in acute Trusts in 2003.[15] The majority of GRE positive cases are seen in acute teaching Trusts. Although the number of GRE reports increased by 30 per cent in the first two years of mandatory surveillance, the number of reports remained stable between 2006 and 2007 (see **Figure 5**).[15] Surveillance data for GRE in Scotland, Wales and Northern Ireland are not currently collected.

Figure 5: GRE bloodstream infections by Trust category, England, 2003 to 2007



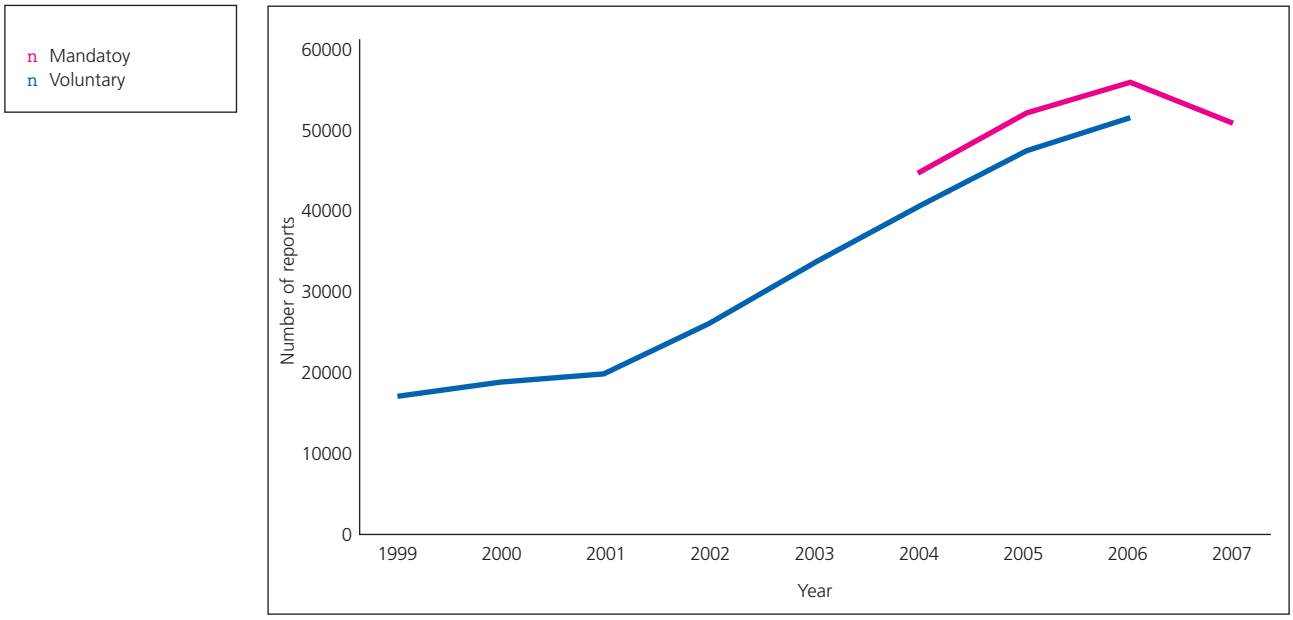
Source: Health Protection Agency (2008) *Surveillance of healthcare associated infections report 2008*. London: Health Protection Agency.

Gastrointestinal infections

Clostridium difficile

Data from voluntary laboratory-based surveillance indicate that reports of *C. difficile* have been increasing throughout the 1990s, although at least some of this increase may have been due to increased case ascertainment. The number of cases of *C. difficile* in acute Trusts in England among patients aged 65 and over peaked at 55,365 in 2006, increasing by 16 per cent between 2004 and 2005 (see **Figure 6**).[15] The number of reports has subsequently decreased; it is not yet possible to determine whether these recent trends are indicative of long-term changes.[15] Following the introduction in 2006 of a mandatory surveillance scheme for *C. difficile* in Scotland in patients aged over 65, there was an increase in the number of reported cases from 2006/07 to 2007/08. This increase was not significant in terms of the number of occupied bed days.[19] In Wales the rate of *C. difficile* infection per 1,000 admissions in patients aged 65 and over increased from 13.74 in 2005/06 to 16.16 in 2006/07.[20] In Northern Ireland *C. difficile* surveillance was introduced in 2005. Rates of infection fell slightly from 2006 to 2007. It is not possible to conclude whether this is a long-term change.[18]

Figure 6: *C. difficile* reports in patients aged 65 and over, England, 1999 to 2007

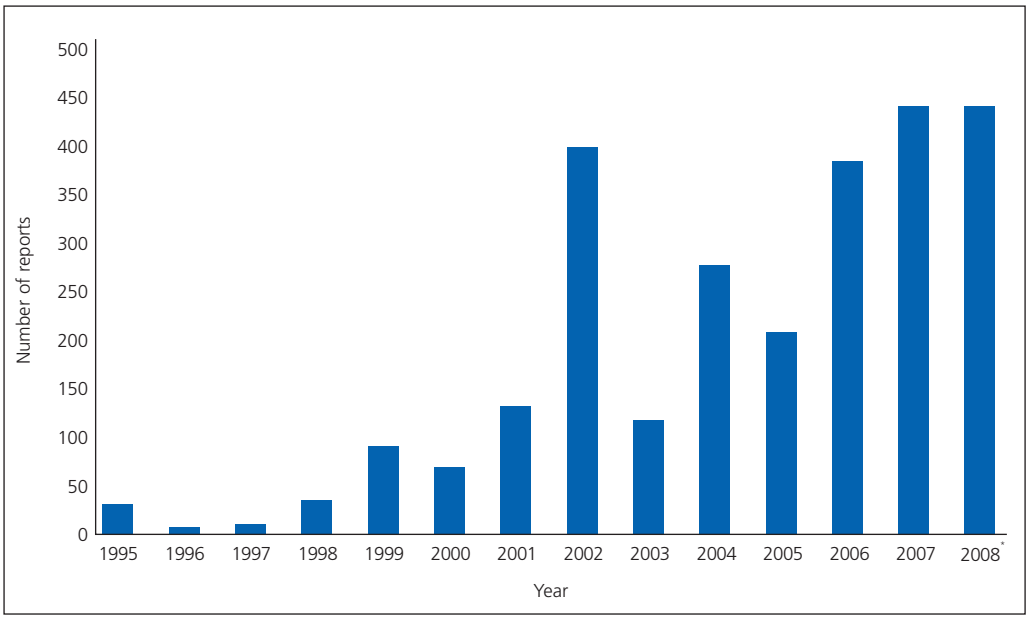


Source: Health Protection Agency (2008) *Surveillance of healthcare associated infections Report 2008*. London: Health Protection Agency.

Norovirus

There is currently no national mandatory scheme for the surveillance of norovirus outbreaks in hospitals in Wales and Scotland, but a reporting scheme is currently in development for hospitals in England.[15] Focused research has demonstrated the wintertime seasonality of outbreaks of norovirus.[15] In Northern Ireland surveillance data show a steady increase from 1995 to 2008, peaking in 2002 and 2007/08 (see **Figure 7**). It is not possible to determine whether these data represent a true increase in infection rates, or are resultant of more accurate surveillance procedures.[21]

Figure 7: Laboratory reports of norovirus, Northern Ireland, 1995 to 2008*



Source: Communicable Disease Surveillance Centre Northern Ireland.

* Data for 2008 is provisional

Surgical site infections

In England, since 2004, NHS Trusts have been required to collect a minimum of 3 months data on SSIs that occur following orthopaedic surgery. Between 2004 and 2008, there has been a statistically significant reduction in rates of SSI in the three main categories of orthopaedic procedure: hip and knee replacement, and hip hemiarthroplasty.[15] These trends are difficult to interpret as they may be affected by fluctuations in the number of procedures, or changes in the hospitals contributing data. In Scotland recent figures show SSIs account for 15.9 per cent of all HCAIs.[22] A statistically significant reduction in SSI rates was observed between 2002 and 2007 for surgical procedures related to breast surgery, caesarean section, hip arthroplasty, knee arthroplasty, and open reduction of long bone fracture.[22]

In Wales, the 2007 National Public Health Service for Wales (NPHS) publication *Orthopaedic surgical site infection report: January – December 2006* found that the proportion of SSIs related to hemiarthroplasties of the knee, hip and knee arthroplasty, and open reduction of long bone fracture, fell from 3.2 per cent in 2003 to 2.5 per cent in 2006. In Northern Ireland, the 2007 Healthcare Associated Infection Surveillance Centre (HISC) *Fourth report of surveillance of surgical site infection related to procedures performed by orthopaedic surgeons in Northern Ireland: 2003 to 2006 data* found that the proportion of SSIs related to orthopaedic surgical procedures fell from 1.55 in 2003 to 1.36 per cent in 2006.

Data on SSI from Scotland, Wales and Northern Ireland are collated centrally as a part of the Pan Celtic surveillance programme. This programme aims to use the data to improve the understanding of SSIs and inform good clinical practice.

Policies for tackling healthcare associated infections

A range of infection control policies have been identified to minimise the risk of acquiring a HCAI. These focus on preventing the spread of micro-organisms between patients and their introduction during invasive procedures and other treatments. The policies relate to behavioural characteristics (eg adherence to hygiene protocols) and organisational factors (eg workforce management), as well as wider policy initiatives such as surveillance and research.

In the UK policies for tackling HCAIs are set by the respective Health Departments. These include advice and guidance on infection control practices, awareness campaigns, regular assessments and targets, legislative regulations, and financial sanctions and incentives (see **Appendix 1**). The government approach to reducing HCAIs has been the subject of criticism due to an over-emphasis on short-term solutions and a lack of commitment to infection control priorities in developing broader healthcare policies (eg performance targets). There has also been a disproportionate focus on reducing MRSA and *C. difficile* infection rates, rather than tackling the range of micro-organisms that can cause HCAIs. There is limited focus, for example, on reducing rates of ventilator-associated pneumonia infection, urinary tract infection, and SSI. More patients than ever before are receiving care in the primary and community setting. While many of the policies such as high standards of hygiene and prudent antimicrobial prescribing apply equally to these settings, insufficient attention has been given to the specific infection control requirements for tackling HCAIs in primary and community care.

'HCAIs can be fatal and destroy patients' lives, yet they are controllable and avoidable. Tackling this problem can only be achieved with a strong commitment from our political leaders that places infection prevention at the heart of healthcare policy.'
BMA member

The following sections review the evidence for the range of infection control policies that are currently in place, and identify areas for action.

Behavioural factors

A number of infection control policies relate to the behaviour of those in the clinical environment including healthcare professionals as well as patients and visitors.

Antimicrobial prescribing

As highlighted in *Healthcare associated infections – a guide for healthcare professionals* (BMA, 2006), it is widely acknowledged that complacency, poor prescribing practice and the misuse of antimicrobials are major factors in the emergence of drug resistant infections. A 2006 review found that up to 50 per cent of antimicrobial drug prescribing in hospitals is inappropriate and this is largely a consequence of the selective pressures of antimicrobial drug use.[3]

Common to all antimicrobial prescribing recommendations is the challenge to reduce inappropriate prescribing. In June 2000, the DH published the *UK Antimicrobial Resistance Strategy and Action Plan* outlining the need to promote optimal antimicrobial prescribing in clinical practice through professional education, tailored information, guidelines and prescribing supports, as well as organisational support.[23] A 2005 Cochrane review found that interventions to improve antibiotic prescribing can be successful in reducing antimicrobial resistance (see **Box 2**).[3] While variations in methodology complicate direct comparisons, the authors tentatively concluded that restrictive interventions on prescribing practice had a greater impact on HCAI levels than persuasive

interventions.[3] It was also found that interventions shown to be effective at promoting good prescribing behaviour are likely to be successful if there is evidence that practice is already developing in a positive direction.[3]

Box 2: Types of intervention to improve antimicrobial prescribing

Persuasive interventions
- distribution of educational materials
- educational meetings
- local consensus processes
- educational outreach visits
- local opinion leaders
- reminders provided verbally/on paper/electronically
- audit and feedback

Restrictive interventions
- selective reporting of laboratory susceptibilities
- formulary restriction
- authorisation of prescriptions by infectious disease physicians/microbiologists/pharmacists
- therapeutic substitutions

Structural
- influence on prescribing of the shift from paper to electronic records
- quality monitoring mechanisms

Source Davey P, Brown E, Fenelon L et al (2005) Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews* **4**: CD003543.

In light of the paucity of evidence for effective interventions, strategies for promoting optimal antimicrobial prescribing need to be developed and implemented through local consultation (see **Box 3**). Prescribing policies will be governed by local information about trends in resistance or a known sensitivity of the organism. Optimal antimicrobial prescribing should also be facilitated by close collaboration between clinical pharmacists, medical microbiologists and infectious diseases physicians. In a broader sense, it is also important to recognise how veterinary and agricultural use of antimicrobials may impact on the development of antimicrobial resistance.[e]

e Further information on the medical, veterinary and agricultural use of antimicrobials can be found in Wise R, Hart T, Cars O et al (1998) Antimicrobial resistance. *British Medical Journal* **317**: 609-10.

Box 3: Southampton University Hospital NHS Trust antimicrobial prescribing policy

The Southampton University Hospitals NHS Trust (SUHT) has developed clear policy on the prudent prescribing of antimicrobials which are available on all wards in hard-copy, and which are kept up to date by ward pharmacists. The policy outlines that:

- antimicrobial therapy should not be started without clear and documented justification
- when prescribing it is necessary to document the indication for antimicrobial therapy in the case notes and on the drug chart, and record a stop date or a review date on the drug chart
- antimicrobial therapy should be used solely as an adjunct in cases where surgery or wound management is the primary intervention
- before starting antimicrobial therapy, every effort must be made to collect relevant specimens for microbiological investigations
- prescribers must follow Trust guidelines for the treatment of infection, or the British National Formulary (BNF) where Trust guidelines do not exist
- non-formulary antimicrobials must not be prescribed without authorisation from a consultant microbiologist or the Trust medical director
- alert antimicrobials[f] must not be prescribed without an authorisation from a consultant microbiologist or the Trust medical director unless in accordance with a Trust guideline or antimicrobial sensitivity report
- narrow-spectrum antimicrobial agents should be prescribed in preference to broad-spectrum agents where appropriate
- broad-spectrum empirical antimicrobial therapy may be indicated in certain circumstances, which include among others, patients with life threatening infections, patients who are immunosuppressed, as well as patients who are suspected or confirmed to have polymicrobial infection
- empirical antimicrobials must be reviewed no later than 48 hours and de-escalated to narrow spectrum agents promptly when appropriate
- antimicrobial prophylaxis for surgery must not be prescribed beyond 24 hours for the majority of surgical procedures
- antimicrobial therapy must be prescribed at an appropriate dose, as recommended in Trust guidelines or the BNF
- the oral route of administration for antimicrobials is preferred to the intravenous route wherever possible
- intravenous antimicrobial therapy must be reviewed at 48 hours and switched to oral alternatives when clinically appropriate.

f Certain antimicrobial agents have been designated as 'alert' antimicrobials by the Trust Drugs Committee because of their broad spectrum of activity, potential toxicity, as well as potential for error or prohibitive cost.

The SUHT has also produced a pocket antibiotic guideline, which is issued to all prescribers, as well as being available through the Trust infection control website. The chief pharmacist is responsible for supporting the Trust antimicrobial prescribing policy through the activities of the Trust pharmacists. All Trust pharmacists are responsible for making prescribers aware of the policy, encouraging adherence to the policy and for reporting non-adherence to a consultant microbiologist or the consultant pharmacist.

Hand hygiene

While many factors can influence the risk of acquiring an infection within the healthcare setting, hands are considered a key route by which pathogens are transmitted between patients, and inadequate hand decontamination is recognised as a significant factor in transmitting HCAIs.[24] A 2005 World Health Organization (WHO) review of best practice identified that improved hand hygiene can reduce the frequency of HCAIs.[24] In 2006, the WHO developed the *Five Moments for Hand Hygiene* toolkit in order to define the key moments for hand hygiene and promote adherence as a part of the natural workflow of care. The five key moments for hand hygiene identified in the toolkit are:

- before patient contact
- before aseptic task
- after body fluid exposure risk
- after patient contact
- after contact with patient surroundings.[25]

Despite considerable effort on the part of healthcare workers and regulators, compliance with hand hygiene protocols remains relatively low.[26] A 2007 Cochrane review cited barriers to hand hygiene compliance that included understaffing, poor design of facilities, confusing and impractical guidelines and policies, failure to apply behavioural change theory, and insufficient commitment and enforcement by infection control personnel.[26] A 2001 systematic review of research published before 2000, examined different interventions and combinations of interventions aimed at improving hand hygiene adherence.[27] It concluded that:

- single interventions have a short-term influence on hand hygiene
- reminders have a modest but sustained effect
- regular feedback increases rates of hand hygiene
- near patient alcohol-based preparations improve the frequency with which healthcare workers clean their hands
- multifaceted approaches have a more marked effect on hand hygiene and rates of HCAI.[27]

A 2007 systematic review by Whitby et al identified that the main influences on hand hygiene behaviour include the hygiene practices developed and established in early life, and self-protection (ie the desire to wash hands as a result of emotive sensations including feelings of unpleasantness, rather than on the basis of actual microbial risk).[28] The review found that sensations related to self-protection are not normally associated with the majority of patient contact in the clinical environment and there is

not always the intrinsic motivation to wash hands.[28, 29] Senior staff and doctors were also found to have a positive influence with hand hygiene compliance of others, while poor hand hygiene practices in senior medical and nursing staff can provide a negative influence.[28, 30] It also demonstrates that doctors' perceptions of themselves as being a role model to other colleagues has a positive influence on their own hand hygiene compliance, independent of access, or hand hygiene knowledge.[28, 31] Whitby et al identified a number of target areas for improving hand hygiene compliance:

- education in how, when and why to perform hand hygiene (with an emphasis on the derivation of their community and occupational hand hygiene behaviour patterns)
- motivation through role modelling and peer pressure from senior medical, nursing and administrative staff. This will require continuing support as an institutional priority as directed by top-level management commitment
- cues to action such promotional material and reminders.[28]

'As doctors we all know the importance of keeping our hands clean and encouraging others to act accordingly. Yet this can only be achieved if we have access to the right facilities and foster a culture where it is unacceptable not to do so.'

BMA member

Influencing a system change at a structural level has also been found to be an important factor in changing hand hygiene behaviour.[28] Easy access to alcohol-based hand rubs at the point of care, for example, has been shown to be independently associated with improved compliance.[31, 32] Improving hand hygiene compliance requires comprehensive training in how, when and why to perform hand hygiene, and commitment at the most senior levels through role modelling. Consideration should also be given to the accessibility and design of hand washing facilities, including the use of elbow operated or no touch activated taps. The use of rewards and/or sanctions for acceptable or unacceptable behaviour, as well social marketing techniques, are important considerations.

Use of indwelling devices

When the body's natural defences are transiently breached it is common for infection to enter at the site where devices, such as catheters, tubes and cannulae enter the body. A 2007 Cochrane review by Conterno et al found that between 60 and 87 per cent of primary bloodstream infections are associated with central venous lines, 86 per cent of nosocomial pneumonia infections are associated with mechanical ventilation, and 80 to 95 per cent of urinary tract infections are associated with the use of urinary catheters.[34] The use of peripheral intravenous cannula is also commonly associated with an increased risk of infection.[35]

Various reviews have considered approaches to reducing the risk of infection associated with the use of indwelling devices. Conterno el (2007) found evidence that educational programmes, meetings and outreach relating to indwelling devices, decreased the incidence of HCAIs by 30 to 35 per cent.[34] A 2008 systematic review found that the implementation of educational interventions can significantly reduce the incidence of HCAIs resulting from the use of indwelling devices.[36] The interventions included various educational tools such as lectures or classes, video presentations, posters, questionnaires and fact sheets, and practical demonstrations, as well as the development and implementation of device management protocols. The review was unable to determine which interventions are most effective due to variation in the approaches used, and the difficulty in determining the effect of educational interventions in relation to other strategies aimed at reducing HCAIs.[36]

In recent years, increasing emphasis has been placed on the use of high impact interventions through the use of 'care bundles' (see **Box 4**). The aim of these interventions is to provide a simple way of promoting and measuring compliance with evidence-based practice and guidelines every time a clinical procedure is performed. The use of care bundles has been recognised and recommended by the Institute for Healthcare Improvement (IHI). A 2007 systematic review of the effectiveness of bundled behavioural interventions concluded that educational programmes and multidisciplinary teams may be effective strategies for reducing HCAI rates.[37] The review also concluded that each component of a care bundle should be well defined and based on strong evidence.[37]

Box 4: High impact interventions – a care bundle approach

The purpose of high impact interventions is to minimise unwarranted variation in practice by providing a way of identifying where compliance needs to be increased and a measure of how often all elements are performed for a given procedure.

High impact interventions are based on a care bundle approach, which links evidence, a measuring tool and a strategy for improving the clinical process to deliver evidence-based practice. Instead of looking at a single element of care, high impact interventions link together a number of care elements in a procedure. Patient outcomes can be systematically improved when all these elements are performed consistently. Leaving specific elements out or not doing them correctly increases the risk of infection. The method relies on a mix of cognitive (educational), administrative (charting the clinical process) and behavioural (feedback of results) aspects.

It is essential that systems are in place to ensure that the greatest possible care is taken to avoid introducing or transmitting infection during invasive procedures (eg readily available sterile equipment supplies, adequate systems for the safe disposal of sharps and the decontamination of equipment), and to ensure aseptic management of all indwelling devices to prevent micro-organisms accessing the device during manipulation or from the point of insertion (see **Box 5**).

Box 5: Preventing infections associated with peripheral intravenous cannula

At King George Hospital, Havering and Redbridge Trust, significant reductions in MRSA bacteraemia were found to have occurred following the implementation of a programme to prevent infections associated with the use of peripheral intravenous cannula. In 2007, all wards were provided with skin decontamination devices (Chlorprep Single Swab Applicator), venflon packs, labels for date of insertion and removal for the cannula, and Tegaderm to replace tape and gauze dressings. All junior doctors and nurses were trained in the use of these packs, including how to label and insert cannulae in an aseptic manner. Over the period June 2007 to March 2008, total episodes of MRSA bacteraemia Trust-wide declined from 56 to 32 (42.9%) compared with the preceding 10 months.[38] Over this 20-month period, policies on the selective screening of high risk patients remained unchanged.

Patients and visitors

The role of patients and visitors in tackling HCAIs has received little attention and limited formal policy exists. Patients and visitors are commonly advised to practice good hand hygiene, avoid direct contact with hospital apparatus, and limit movement within the healthcare setting. Visitors, who themselves are unwell are also advised to avoid visiting in-patients. The clinical efficacy of these measures in relation to infection control is unknown and it is important that formal policy supported by robust clinical evidence is developed.

Organisational factors

There are a range of organisational, management and leadership factors that can impact on infection control policies and HCAI rates. These include factors affecting the physical environment and the functioning of healthcare teams, as well as organisational, management and leadership strategies.

Dress code and personal protective equipment

Considerable professional and media attention has been focused on uniform and dress code in relation to reducing infection rates. This has led to the introduction of revised dress code policies for healthcare staff in the UK (see **Box 6**).

Box 6: Dress code policies for healthcare staff in the UK

In England and Wales, policy on dress code is set locally. In England, in September 2007, the DH introduced guidance for setting policy locally based on a 'bare-below-the-elbows' dress code.[39] This includes advice on measures such as the use of short sleeves, no wristwatches or jewellery, and avoidance of ties and white coats. The guidance also advises that if staff have direct patient contact then suitable protection, such as plastic aprons, should be worn. A number of healthcare employers have subsequently introduced uniform policies for employees where previously no uniform had been worn or where the wearing of long-sleeved white coats had been abandoned for reasons of infection control. The types of uniforms imposed have been various, including short-sleeved white tunics to be worn over normal clothes, scrubs, full tunics and polo shirts.

In Scotland, the Scottish Government Health Directorates (SGHD) have introduced guidance for all NHS staff prohibiting the use of white coats, ties, and wristwatches when providing patient care, as well as the wearing of pens and scissors in outside pockets.[40] The new dress code will also prohibit staff from leaving work in their uniforms, except where it is part of duties to work in the community or in emergencies.[40] All NHS staff in Scotland who currently wear uniforms will be required to wear a consistent uniform set across Scotland in order to promote a coherent corporate image and maximise financial savings through bulk purchase. A dress code policy for Northern Ireland was introduced in February 2007 to provide a standard dress code for all staff regardless of whether or not a uniform is worn. The policy requires clinical staff to wear short sleeves or roll the sleeves to elbow length and remove all jewellery when visiting or working in clinical areas. Staff who wear a uniform are also required to change into and out of uniform at the workplace, and are not permitted to go shopping or socialising in their uniform.[41]

'Before anything is drawn up, any uniform policy must be discussed in its very early stages, in detail, with junior doctor representatives in the trust, with the LNC [Local Negotiating Committee]*, and with the BMA locally. Without buy-in from potential uniform-wearers, a uniform policy is likely to be difficult to implement successfully.'*

BMA Junior Doctors Committee brief on dress code (November 2008)

Research has shown that pathogenic micro-organisms including *S. aureus*, *C. difficile* and GRE are frequently carried on clothes, representing a potential source of cross infection in the clinical setting.[42-45] A 2007 systematic review by Wilson et al found no conclusive evidence to establish a relationship between contaminated uniforms and the spread of infection.[46] Loveday et al also concluded that there is no good evidence to suggest uniforms are a significant infection risk.[47]

A small number of studies provide evidence relating to the decontamination of uniforms; these are focused on laundering of patient linen rather than uniforms.[46, 47] The studies suggest that micro-organisms are removed and killed during laundering, and dilution during washing and rinsing is important.[47] Significant reductions in micro-organisms were also found to occur at lower temperatures more commonly used in home laundering.[47] It has been suggested that domestic washing machines may not provide a sufficiently controlled environment in which to decontaminate uniforms, and that uniforms washed with other clothing could result in cross contamination with hospital pathogens. Wilson et al and Loveday et al (2007) found that there

is no strong evidence to suggest that home laundering of uniforms is inferior to industrial laundering as a means of decontamination.[46, 47] Domestic laundering was also not found to increase the risk of cross-contamination with hospital pathogens of other items in the wash-load.[8]

'…patients want to know who is treating them and that they judge the professionalism and trustworthiness of doctors based on the clothes that they wear. LNCs should ensure that whatever local policies are implemented, assist in maintaining a professional appearance.'

Guidance from the BMA Central Consultants and Specialist Committee (December 2007).

In developing dress code policies (eg bare-below-the-elbows, white coats etc), it is essential that this is evidence-based and done in partnership with clinicians locally with consideration given to what supporting resources may be necessary. Loveday et al (2007) found that patients judge the professionalism and trustworthiness of practitioners based on the clothes they wear.[47] Consideration therefore needs to given to how dress code policies assist healthcare professionals in maintaining a professional appearance,[9] as well as appropriate identification of healthcare professionals. Dress code policies will also impact on the wearing of religious dress (eg headscarves and long-sleeved gloves) by healthcare professionals.

The use of protective clothing (eg plastic aprons and gloves) has been shown to significantly reduce microbial contamination.[48] Emphasis should therefore be placed on the appropriate use of disposable protective clothing such as gowns and gloves when healthcare staff are exposed to potential contamination. This requires adequate provision of protective clothing, along with facilities for dispensing and disposal.

Cleaning and environmental hygiene

Ensuring that micro-organisms are not allowed to build up in the environment through regular cleaning is an important component of effective infection control, including in the control of MRSA,[49] *C. difficile*,[50, 51] vancomycin-resistant enterococci (VRE),[52-54] norovirus,[55-58] and *Acinetobacter* spp.[59] There is little direct evidence that demonstrates that cleaning has an effect on rates of HCAI.[49] A 2007 review by Pratt et al found that the hospital environment can become contaminated with micro-organisms responsible for HCAIs, and that infection causing pathogens have been recovered from a range of surfaces including door handles, computer keyboards, soap dispensers, sink taps, and sites where dust is allowed to accumulate.[8] The presence of the same strain of micro-organism in the environment as those infected or colonised patients only demonstrates that the environment becomes contaminated.[8] There is no conclusive evidence that contamination of the environment is responsible for the transmission of HCAIs.[8] Pratt et al (2007) did find that improved cleaning regimens are associated with the control of HCAI outbreaks. As a range of interventions are normally introduced in order to control an outbreak, it is difficult to clearly distinguish the effect of a single component, such as cleaning.[8]

In relation to transmission via contact with the environment, the greatest risk for patients is contaminated near-patient hand-touch sites (eg bed rails, bedside lockers, infusion pumps, door handles, and various switches),[49] which are only poorly cleaned and rarely feature in domestic cleaning specifications.[60, 61] In the UK, ward cleaners are required to work to a set cleaning specification that encompasses, and emphasises, the cleaning of floors and toilets.[62] These areas do not constitute

g Uniform and dress code for doctors - Guidance from the BMA Central Consultants and Specialist Committee (December 2007) available at www.bma.org.uk.

near-patient hand-touch sites. Recently, attention has focused on the introduction of compulsory comprehensive tendering of cleaning contracts, the reduction in the number of cleaners in the healthcare environment, and the rapid turnover of cleaning personnel over time. Considerable attention has also been paid to the use of 'deep cleaning' and whether it has any impact on infection rates. While deep cleaning may be effective at reducing the presence of infectious pathogens, it has been suggested that it is not effective in significantly reducing infection rates.[63] Deep cleaning of a ward with detergent and a steam cleaner, followed by use of 1,000 parts per million chlorine disinfectant for all hard surfaces, has been shown to be ineffective at completely eradicating MRSA from the clinical environment.[64, 65] In light of this and the practicalities around ward closure, deep cleaning is therefore only likely to be an important measure in the management of outbreaks of HCAI where the environment is implicated in transmission of infection.[63]

'It is the sites of direct patient contact that need priority in any cleaning regimen. Focusing efforts on cleaning these thoroughly everyday will be far more effective than responding to the latest political whim.'
BMA member

As part of a comprehensive infection control regime, it is essential that adequate resources are provided for thorough everyday cleaning. This should emphasise cleaning of high-risk near-patient hand-touch sites. Ward cleaners should also be included as an integral part of the infection control team. The use of more intensive deep clean regimes must take into consideration the implications on resources and service delivery.

Bed occupancy

Evidence from various retrospective surveys suggests that bed occupancy[h] level is associated with HCAIs, and in particular MRSA.[66-68] In 2005, the House of Commons Committee of Public Accounts noted that high levels of bed occupancy are not consistent with effective infection control policies.[69] A high bed occupancy may potentially impact in several ways, including:

- increasing the proximity of patients and therefore the risk of direct and indirect patient-to-patient contact
- making it more difficult to clean thoroughly between patients or to leave beds 'fallow' (not in use)
- reducing the ability to isolate patients when there is an outbreak of infection
- increasing the frequency with which patients are moved around a hospital, thus increasing the risk of inappropriate mixing of high risk and low risk patients.

Several recent retrospective studies found a significant and positive relationship between bed occupancy levels and rates of MRSA, with high bed occupancy leading to higher infection rates.[66-68] In 2007, the DH reported that 40 per cent of hospitals in the NHS in the UK operate at 85 per cent bed occupancy and over, and that 15 per cent at 90 per cent bed occupancy.[70] Ecological analysis by the DH suggested that when all other variables are constant, a Trust with an occupancy rate above 90 per cent could expect a 10.3 per cent higher MRSA rate compared to a Trust with an occupancy rate below 85 per cent.[70] The bed turnover interval[i] is also an

h Annual bed occupancy refers to the annual number of admissions leading to overnight stay; the average length of stay, and the annual number of available beds.

i The bed turnover interval corresponds to the time between a bed being vacated and another patient occupying it.

important factor in hospital bed management, with turnover intervals being found to be negatively correlated to MRSA rates.[66, 68] Following analysis, the influence of turnover intervals on rates of MRSA was suggested to be greater than those of bed occupancy levels per se.[66]

At a time of rising patient admissions, bed occupancy levels in the UK have increased due to the continued reduction in the number of available hospital beds. In England the average number of available beds for all specialties (excluding day only) has decreased from 186,091 in 2000-01 to 160,297 in 2007-08.[71] In Scotland the average available staffed beds for all acute specialties has fallen from 18,456 in 2000 to 17,466 in 2007.[72] This problem has been compounded by the introduction of the private finance initiative (PFI) which has led to a downsizing of hospital and community healthcare provision. In order to facilitate robust infection control practices, it is essential that bed occupancy rates in UK hospitals are reduced, which in turn requires action on the number of available beds, targets governing admissions, and bed management policies. Possible options include the provision of care closer to home, where community health and social services are utilised to prevent avoidable hospital admissions.[73] In a recent article in the *Lancet* it was suggested that up to half of all adult emergency admissions to NHS hospitals in England are avoidable.[73] The authors propose that by setting a target to halve the number of these admissions, and preventing hospitals from decreasing the number of acute care beds, bed occupancy rates could be significantly reduced.[73]

'The enormous pressure on space and frenetically high turnover contributes to infections spread. It is obvious that robust infection control and high bed occupancy is incompatible. Reducing bed occupancy must be a priority in all healthcare policy.'
BMA member

Screening and isolation

Screening is the process of identifying individuals who are colonised by a micro-organism in order to prevent them from being infected and to reduce the risk of spread to other individuals. Where a patient is found to be colonised, the micro-organism is eradicated via decolonisation therapy. Decolonisation can be an intensive process; for example, decolonisation of carriers of MRSA comprises daily use of an antimicrobial shampoo and body wash, as well as application of an antibacterial nasal cream. Screening is only applicable where colonisation is associated with an increased risk of transmission, where there is an effective rapid screening test, and where the micro-organism can be successfully eliminated following identification. Reducing the risk of transmission also requires adequate facilities for patient isolation and cohorting (the imposed grouping of people, such as patients or healthcare workers, potentially exposed to infection).

Screening programmes in the UK have been the subject of considerable debate, not least as a result of comparisons with countries, such as the Netherlands, which have low HCAI rates and have adopted aggressive 'search and destroy' policies.[74] This approach includes systematically screening patients, and often staff, as well as isolating or decolonising those found to be infected. It is also supported by restrictive antibiotic prescribing policies. It is important to note that international comparisons are complex due to historical and geographical variations in infection rates, as well as differences in infection control policies and wider healthcare policies. Information on the effectiveness of screening in relation to HCAI levels is limited. Evidence suggests that screening for MRSA colonisation can be effective in certain high-risk patients (eg those known to be previously infected with MRSA) and high-risk units (eg intensive care units);[75] there is no clear evidence on the use of universal screening programmes. Screening of staff is also only recommended as part of an MRSA outbreak control initiative.[75]

'Screening will only be effective if we have the facilities and resources available to reduce the risk of infection spreading'
BMA member

The availability of single rooms and isolation facilities is thought to play a role in reducing infection rates by reducing direct and indirect contact between patients and making it easier to isolate vulnerable or infected patients. A 2004 systematic review found there to be major methodological weaknesses and inadequate reporting in research into the effectiveness of isolation measures, to the extent that many alternative explanations for reductions in reported levels of infection cannot be excluded.[76] Despite these limitations, evidence was found that concerted interventions, that include isolation, can reduce infection transmission significantly, even in settings where HCAIs are endemic.[76]

In England, the DH has introduced MRSA screening for all elective patients, and plans to extend this to all emergency admissions within the next three years. A similar programme is currently being piloted in Scotland. It is essential that the introduction of screening policies takes into account the evidence for effectiveness. Consideration should also be given to practical and cost implications in terms of the need to isolate and decolonise all those found to be positive. This will require adequate isolation facilities, staff education and training, as well as procedures to manage screening, results, patient notification, patient isolation and follow-up. It will also be important to consider the impact of screening policies on targets for admissions, bed occupancy and waiting times. Consideration should also be given to the design of clinical areas in new healthcare buildings, with a focus on single occupancy rooms as opposed to multi-bed wards.

'While we support any measure which seeks to avoid infection, one of the major barriers to doctors following these policies is time and the pressure to treat patients and meet targets.'
BMA member

Performance targets

In the UK, healthcare organisations are assessed annually against nationally agreed targets that relate to a number of areas including safety, clinical and cost-effectiveness, and access to services. The need to meet these competing priorities may adversely impact on the implementation of robust infection control practices. A 2006 survey of acute Trusts in England found that a significant number of these Trusts were experiencing difficulties in reconciling the management of HCAIs and cleanliness with the fulfilment of accident and emergency (A&E) admission, waiting time and financial targets.[77] With many organisations struggling to reconcile the management of HCAIs with the fulfilment of performance targets, it is essential that infection control priorities are considered in the implementation of national and local targets.

Management and leadership

It is increasingly being recognised that infection control policies exist within complex clinical settings in large organisations. Consideration therefore needs to be given to management and leadership at a corporate and local level in order to develop the appropriate organisational culture for tackling HCAIs. The importance of developing an appropriate organisational culture has been highlighted by the success of the *5 Million Lives Campaign* set up in the United States of America (USA) by the IHI (see **Box 7**).

Box 7: 5 Million Lives Campaign

The IHI *5 Million Lives Campaign* was established to reduce the number of patients harmed in US hospitals every day as a result of HCAIs, adverse drug events, surgical errors, pressure sores, and other complications. The campaign was originally introduced as the *100,000 Lives Campaign* – a national effort to reduce preventable deaths through the commitment by hospitals to implement changes in care that have been proven to prevent morbidity and mortality. An estimated 122,000 lives were saved by the implementation of the *100,000 Lives Campaign* in an 18-month period.[78] Following the success of this campaign, its focus was expanded with the aim of protecting patients from five million incidents of medical harm. The *5 Million Lives Campaign* challenges American hospitals to adopt 12 changes in care that save lives and reduce patient injuries, including:

- preventing central line infections, SSIs, and ventilator-associated pneumonia by implementing a series of interdependent, scientifically grounded steps
- reducing MRSA infection by reliably implementing scientifically proven infection control practices
- securing Board commitment by defining and disseminating the best-known leveraged processes for hospital Boards of Directors.

There is limited evidence on the impact of management and leadership on the control of HCAIs. A 2008 review of organisation and management factors in infection control found that positive leadership at a ward level and above appears to be a necessary prerequisite to maximising effective action in relation to infection control.[79] In 2007, the Healthcare Commission report *Healthcare associated infection: what else can the NHS do?* identified that effective leadership requires action at a board level, including emphasising the importance of preventing and controlling infection through their inclusion in all aspects of strategic planning.[77] At an organisational level, teamworking and good relationships between doctors, nurses and infection control teams are also important factors in reducing infection rates.[80, 81]

'While promoting good infection control is the responsibility of the entire healthcare team, developing an effective organisational culture needs commitment and leadership from the most senior levels.'
BMA member

Embodying the corporate culture of safety in relation to infection control at a local level requires senior staff to act as role models through exemplary practice, and to challenge the unacceptable behaviour of others.[77] Evidence suggests that positive leadership can be hindered by having to directly supervise large numbers of staff.[79] Leadership at a local level must therefore be facilitated by a clearly defined management structure. The implementation of modern matrons as middle level clinical management has been associated with reduced cases of infection.[79]

It is also important that effective measures are in place to ensure compliance with infection control policies through appropriate clinical governance procedures including systems for reviewing performance, training, audit, feedback, and clear accountability. A 2006 Cochrane review found that audit and feedback can have a positive effect on improving professional practice (including antibiotic prescribing, hand washing and glove use) although the effects were generally small to moderate.[82] Evidence from a large observational study suggests that the benefits are moderated by wider organisational support, where the provision of administrative support to the audit programme provides greatest improvements.[83] Information from audits (eg into prescribing antimicrobials and HCAI-related investigation) was also found to be effective in tailoring staff training on infection control policies.

Workforce management

Effective management and control of HCAIs is reliant on adequate staffing levels and appropriate workloads. A number of reviews have found a negative correlation between staffing levels and the risk of infection.[75, 84-86] A 2008 systematic review by Clements et al found that transmission of MRSA and other HCAIs is greater during periods of understaffing, as defined by a low healthcare worker to patient ratio.[87] Outbreaks of infections in intensive or neonatal care units have also been found to be associated with understaffing, and the success of HCAI outbreak control has been linked to staff workload.[87] It is suggested that low staffing and high workloads mean healthcare staff have less time for routine infection control procedures. Compliance with hand hygiene practices, for example, has been found to be adversely affected by understaffing and high workload.[31, 87-92]

There are a number of other mechanisms by which understaffing is associated with incidence of HCAI including higher healthcare staff to patient interaction rates, reduced levels of cohorting, staff turnover rate, staff burn-out and absenteeism, and staff satisfaction.[89, 93, 94] The composition of healthcare staff in terms of the ratio of regular staff to bank or agency staff, or the proportion of experienced staff, is also associated with the incidence of HCAI.[87, 95-97] This most likely occurs as a result of temporary staff being less aware of infection control procedures and moving within and between hospitals more frequently. It is not clear whether the use of bank or agency staff is independently associated with other conditions, such as job vacancies, high turnover or poor morale.

'Understaffing reduces the quality of any public service. The difference is that in the healthcare service, it is patient wellbeing and safety that is at risk.'
BMA member

With the shift in healthcare policy in the UK toward high-throughput systems, lower healthcare staff to patient ratios is an inevitable consequence. This understaffing is both an ongoing and long-term challenge to patient safety. To facilitate adherence with infection control practices, it is essential that there is effective workforce planning to ensure adequate staffing to match the workload. It is also important to ensure that all temporary and permanent staff receive regular training in infection control practices, and that this is included as a part of staff induction programmes.

Wider policy initiatives

In addition to factors affecting behavioural characteristics and organisational policies, tackling HCAIs requires action in wider policy areas including surveillance and research.

Surveillance

Surveillance systems that monitor the occurrence of HCAIs can help identify risks of infection, evaluate the effectiveness of interventions, identify areas for further investigation or research, reinforce good practice, and assist in the targeting of preventive measures. As noted previously, data on a number of key infections are acquired through voluntary or mandatory surveillance. A 2008 report from the Health Protection Agency (HPA) identified a number of priority areas for further action in relation to surveillance, including the need to:

- enhance surveillance of infections in special units, such as critical care, renal and haematology/oncology units
- improve reporting of outbreaks and untoward events (including unusual antimicrobial susceptibility), allied with enhanced collaboration in the investigation of these events
- implement surveillance of SSIs after discharge from hospital as well as broadening the focus of mandatory SSI surveillance to cover a wider selection of surgical categories
- establish routine monitoring of case fatality rates in patients with HCAIs
- improve the surveillance of the pathogens causing common infections such as urinary tract infections
- develop the current mandatory system for *S. aureus* surveillance to improve knowledge of MRSA risk factors, the extent to which MRSA bloodstream infections acquired prior to admission are hospital or community-related, the total burden of MRSA in acute Trusts, and meticillin-susceptible *Staphylococcus aureus* (MSSA) bloodstream infections
- improve surveillance of *Staphylococcus aureus* producing Panton-Valentine Leukocidin (PVL-SA)
- enhance existing mandatory system for *C. difficile* and surveillance of antimicrobial prescribing in hospitals
- develop systems for external validation of reported data.[15]

Research priorities

The prevention and control of HCAIs requires the continual monitoring and assessment of measures and intervention strategies aimed at reducing the spread of infections, inhibiting the development of antimicrobial resistance, and combating existing infections. This in turn requires scientific and clinical research to develop an understanding of best methods to reduce and control HCAIs.[98] It is essential that prioritisation is given to funding for further research into the prevention and management of HCAIs. There are a number of key research areas, including evaluation of:

- the effectiveness of educational and behavioural interventions in relation to compliance with hand hygiene protocols, prescribing behaviour, and the use of indwelling devices
- the role of organisational factors such as bed occupancy, workforce management, leadership, and resource allocation in relation to the implementation of infection control policies
- the effectiveness of current and emerging approaches to environmental decontamination, including different cleaning regimens
- the role and clinical effectiveness of different screening methods.

Conclusion

In the UK, considerable attention has focused on the impact of HCAIs on healthcare services and patient wellbeing. Over the past five years, efforts to tackle HCAIs have centred on reducing MRSA bacteraemia and rates of *C. difficile* infection. Despite some progress on reducing rates of MRSA bacteraemia, the problem remains significant. Much less attention has been paid to other types of HCAIs, and in particular, infections acquired in primary and community healthcare settings.

Effectively tackling HCAIs requires the implementation of a range of measures that minimise the spread of infection. Failures in any one area can negate the influence of all other policies. Infection control is the responsibility of all, from the highest level of hospital organisation and management, to healthcare professionals, patients, and visitors. The supporting evidence base for strategies that control and prevent HCAIs is relatively weak; further research should therefore be considered a priority. Central to all infection control policies is effective hand decontamination, minimisation of the risk of infection during invasive procedures, the correct use of antimicrobials, the use of protective clothing, robust surveillance systems that support good quality practice and rapid identification of increasing infection rates, and high standards of environmental hygiene.

'Prevention and control of the burgeoning problem that is HCAIs is everyone's business. Deep cleaning once in a blue moon or eye catching dress code policies are not long-term solutions. Making hospitals safer for patients, visitors and staff needs a comprehensive strategic approach – starting from top down.'
BMA member

Effective action on infection also necessitates consideration of wider factors relating to the functioning of healthcare teams. At an organisational level, this requires positive leadership by senior staff, clear allocation of direct supervision to appropriate management levels, adequate staffing levels to match workload, and mechanisms for supporting appraisal, clinical governance, regular training, and comprehensive induction programmes. To promote compliance with, and the success of, infection control practices, the development of organisational policies should incorporate the general principles of infection control and consider factors that are specific to their local circumstances (eg available facilities, type of hospital/unit/ward, patient profiles).

Reducing the burden of HCAIs also requires strong governmental commitment. Through an over-reliance on short-term solutions such as deep cleaning, dress code policies and alcohol hand gels, the UK Governments have failed to adequately address the problem of HCAIs. With the introduction of broader healthcare policies promoting higher patient throughput, many services operate at, or near full capacity. The resultant overcrowding and understaffing has adversely impacted on infection control practices through decreased hand hygiene compliance, increased movement of patients and staff between hospital wards, higher bed occupancy, decreased levels of cohorting, lower staff to patient ratios, and overburdening of screening and isolation facilities. It is essential that the drive for increased efficiency and economic rationalisation does not compromise patient safety. To effectively reduce HCAI rates, infection control needs to be considered a priority in the development of broader healthcare policies including performance targets, workforce planning, commissioning, and NHS estates and facilities. The introduction of new strategies to reduce HCAI rates – such as the recent move towards mandatory screening – must also take into account the evidence for effectiveness and the implications for local infrastructure and resources to ensure they are practical and cost-effective.

Areas for action

Set out below are the key areas for action in reducing the incidence and associated burden of HCAIs in the UK.

Behavioural factors

Antimicrobial prescribing

- Strategies for promoting optimal antimicrobial prescribing need to be developed and implemented through local consultation. Optimal antimicrobial prescribing should be facilitated by close collaboration between clinical pharmacists, medical microbiologists and infectious disease physicians.

Hand hygiene

- Compliance with hand hygiene protocols should be facilitated through:
  - education in how, when and why to perform hand hygiene
  - motivation through role modelling and peer pressure from senior medical, nursing and demonstrative staff. This will require continuing support as an institutional priority as directed by top-level management commitment
  - cues to action such promotional materials and reminders
  - improved accessibility to hand washing facilities and the use of elbow operated or no touch taps.

- Consideration should be given to the use of social marketing techniques as well as rewards and/or sanctions for acceptable or unacceptable behaviour.

Use of indwelling devices

- Aseptic management of indwelling devices should be facilitated through:
  - adequate provision of sterile equipment supplies, and robust systems for the safe disposal of sharps and the decontamination of equipment
  - the development and implementation of comprehensive educational programmes and device management protocols.

Patients and visitors

- Formal guidance aimed at promoting compliance by patients and visitors with good infection control practices should be developed.

Organisational factors

Dress code and personal protective equipment

- The development of dress code policies should be evidence-based and done in partnership with clinicians locally with consideration given to what supporting resources may be necessary and how:
  - healthcare professionals maintain a professional appearance
  - staff are identified as healthcare professionals
  - these policies will impact on the wearing of religious dress.

- Emphasis should be placed on the appropriate use of disposable protective clothing (eg gowns and gloves) when healthcare staff are exposed to potential contamination. Consideration should be given to the adequate provision, dispersal and disposal of protective clothing.

Cleaning and environmental hygiene

- Adequate resources should be provided for thorough everyday cleaning, with an emphasis on cleaning high-risk near-patient hand-touch sites. Ward cleaners should also be included as an integral part of the infection control team. The use of more intensive deep clean regimes must take into consideration the implications on resources and service delivery.

Bed occupancy

- Reducing bed occupancy rates should be considered a priority in the development of policies relating to the number of available beds, admissions targets, and bed management practices.

Screening and isolation

- The introduction of screening policies should take into account the evidence for effectiveness and should consider:
  - the requirement for adequate isolation facilities, comprehensive staff education and training, and procedures to manage screening, results, patient notification, patient isolation and follow-up
  - the practical and cost implications associated with the isolation and decolonisation of patients, visitors and staff who are carriers
  - the impact on targets for admissions, bed occupancy, and waiting times.

- Consideration should be given to the design of clinical areas in new healthcare buildings, with a focus on single occupancy rooms as opposed to multi-bed wards.

Performance targets

- The requirement to facilitate robust infection control practices should be considered a priority in the development and implementation of national and local performance targets.

Management and leadership

- Developing an effective organisational culture for tackling HCAIs requires:
  - senior staff to act as role models, and to challenge the unacceptable behaviour of others
  - clear allocation of direct supervision to appropriate managerial levels
  - the implementation of appropriate clinical governance procedures, including systems for reviewing performance, training, audit, feedback and clear accountability.

Workforce management

- Effective workforce planning is required to ensure adequate staffing to match workload. All temporary and permanent staff should receive regular training in infection control practices, and this should be included as a part of staff induction programmes.

Primary and community care

- Greater emphasis is required on the development of policies related to the prevention of HCAIs in the primary and community care setting.

Wider policy initiatives

Surveillance

- In further developing surveillance systems, action is required to:
  - enhance surveillance of infections in special units, such as critical care, renal and haematology/oncology units
  - improve reporting of outbreaks and untoward events (including unusual antimicrobial susceptibility), allied with enhanced collaboration in the investigation of these events
  - implement surveillance of SSIs after discharge from hospital as well as broadening the focus of mandatory SSI surveillance to cover a wider selection of surgical categories
  - establish routine monitoring of case fatality rates in patients with HCAIs
  - improve the surveillance of the pathogens causing common infections such as urinary tract infections
  - develop the current mandatory system for *S. aureus* surveillance to improve knowledge of MRSA risk factors, the extent to which MRSA bloodstream infections acquired prior to admission are hospital or community-related, the total burden of MRSA in acute Trusts, and meticillin-susceptible *Staphylococcus aureus* (MSSA) bloodstream infections
  - improve surveillance of *Staphylococcus aureus* producing Panton-Valentine Leukocidin (PVL-SA)
  - enhance existing mandatory system for *C. difficile* and surveillance of antimicrobial prescribing in hospitals
  - develop systems for external validation of reported data.

Research priorities

- Further research is required into:
  - the effectiveness of educational and behavioural interventions in relation to compliance with hand hygiene protocols, prescribing behaviour and the use of indwelling devices
  - the role of organisational factors such as bed occupancy, workforce management, leadership, and resource allocation in relation to the implementation of infection control policies
  - the effectiveness of current and emerging approaches to environmental decontamination, including different cleaning regimens
  - the role and clinical effectiveness of different screening methods.

Appendix 1 – UK policies for tackling healthcare associated infections

In the UK, separate strategies have been developed to tackle HCAIs in England, Wales, Scotland and Northern Ireland. These strategies broadly focus on advice and guidance on infection control practices, awareness campaigns, regular assessments and targets, legislative regulations, and financial sanctions and incentives. A number of campaigns have also been adopted in more than one devolved nation, such as the National Patent Safety Agency (NPSA) *Clean your hands* campaign which is currently used in England, Wales and Northern Ireland,[99] and aims to minimise the risk to patient safety from low hand hygiene compliance.

England

The 2003 Chief Medical Officer (CMO) report *Winning ways: working together to reduce healthcare associated infection in England* identified six key action areas to reduce HCAI rates, and to curb the proliferation of antibiotic resistant organisms:

- active surveillance and investigation – to track progress, investigate underlying causes and instituting prevention and control measures
- reducing the infection risks from catheters, tubes, cannulae, instruments and other devices
- reducing reservoirs of infection – through guidance on movement of patients, bed occupancy, the isolation of infected individuals
- high standards of hygiene in clinical practice – to reduce the transmission of micro-organisms from staff to patients within the healthcare environment
- the prudent use of antibiotics – to prevent their indiscriminate and inappropriate usage restricting the emergence of antibiotic resistant organisms
- management and organisational commitment – to ensure that infection control is not left solely to clinical staff.[100]

The 2004 DH policy document *Towards cleaner hospitals and lower rates of infection* provided policy makers with an action plan for cleaner hospitals and lower rates of infection, and aimed to encourage collaborative working, and maintain public confidence.[101] This action plan included:

- being open with the public – achieved through publishing information on local MRSA rates, as well as publishing new information on other HCAIs
- giving power to patients – which include allowing patient inspections, as well as allowing patients to challenge NHS staff to ensure they are conforming to high standards of hygiene
- a matron's charter – whereby nurses are given the power and means to keep wards clean, through measures such as withholding payment for poor cleaning services
- independent inspection to monitor progress
- learning from the best – through knowledge sharing from within and outside the NHS
- harnessing the latest technology – which includes making infection control research a priority, as well as addressing issues with hospital design, such as insufficient single rooms.

The 2004 DH best practice guidance *A matron's charter: an action plan for cleaner hospitals* set out 10 broad principles for delivering cleaner hospitals.[102] The document outlined the commitments needed to establish a cleanliness culture across the NHS and made clear the roles and responsibilities for achieving, monitoring and reporting on standards of cleanliness. It included the need for infection control education for all and the need for investment of resources which deliver real improvement in standards. The 2008 DH document *Clean safe care: reducing infections and saving lives* drew together previous initiatives aimed at tackling HCAIs and improving cleanliness, as well as detailing new areas where the NHS should consider investing to ensure that patients receive clean and safe treatment.[103]

In October 2006, the *Health Act 2006: Code of practice for the prevention and control of healthcare associated infections* came into force in England.[104] The code of practice is designed to assist NHS bodies to plan and implement how they can prevent and control HCAIs. It sets out criteria by which managers of NHS organisations are to ensure that patients are cared for in a clean environment and where the risk of HCAIs is kept as low as possible. Failure to observe the code may result either in an improvement notice being issued by the Healthcare Commission or the NHS body being reported for significant failings and placed on 'special measures'. The DH has also introduced national targets to reduce HCAI rates for MRSA bacteraemia and *C. difficile*. The target to reduce *C. difficile* rates is also supported by financial penalties for any NHS body that breaches its target.

Scotland

In Scotland, the 2002 Ministerial HAI Task Force action plan *Preventing infections acquired while receiving healthcare* identified five key areas for action:

- a comprehensive implementation of infection control standards at ward/departmental level and the necessary resources to achieve this
- a properly developed and funded infection control infrastructure
- a culture change in hand washing, underpinned by hand washing audits for all staff
- implementation of a suggested infection control outbreak/episode risk matrix to allow consistent responses and communications across Scotland
- proper emphasis on all aspects of communications in infection control and in outbreaks, including a culture of openness.[105]

In 2004, the NHSScotland *Code of practice for the local management of hygiene and healthcare associated infection* was introduced for all NHS Boards across all clinical areas.[106] The code defined local management powers and responsibilities for delivering safe clinical care through ensuring high standards of hygiene and related measures to tackle HCAIs in the healthcare environment. It prescribed guidance on the management of hygiene and HCAIs in all clinical settings, and also for support services, within NHSScotland.

In 2008, NHS Quality Improvement Scotland (NHS QIS) published *Healthcare Associated Infection Standards*.[107] These standards emphasised the need for all staff to be involved in infection control, and that HCAI initiatives are not solely the responsibility of infection control teams. They reiterated that the role of infection control staff is to support measures to reduce HCAI within NHS boards by providing expert knowledge and guidance, enabling staff to carry out their role in a way which contributes to minimising HCAI. The 2002 Clinical Standards Board for Scotland (CSBS) document *Standards for Healthcare associated infection (HAI) – Cleaning services* set out standards to assess cleaning services throughout Scotland.

The 2005 NHS QIS document *The provision of alcohol-based products to improve compliance with hand hygiene* outlined that alcohol gel should be provided in hospitals for all staff who may come into contact with patients, and for hospital visitors, particularly where handwashing facilities are limited; however, it emphasised that alcohol gel should complement, not replace, existing handwashing facilities.

The 2008 NHSScotland document *The Scottish management of antimicrobial resistance action plan 2008* expanded on the guidance document *Antimicrobial prescribing policy and practice in Scotland* (2005) and outlined the national programme for Scotland over the next five years.[108] The major elements of the action plan included establishing a communications network for NHSScotland which brings together microbiologists, infection control professionals, pharmacists, prescribers and national experts within a national forum. It ensures robust and quality controlled systems for data gathering, both for surveillance of resistant organisms and use of antimicrobial agents, are in place. The action plan promotes coalition, analysis and interpretation of data at local and national levels, along with implementation and monitoring of antimicrobial prescribing policies, as well as education and training in prudent antimicrobial prescribing.

Wales

The 2004 Welsh Assembly Government policy document *Healthcare associated infections – a strategy for hospitals in Wales* aimed to support the reduction of HCAIs in Wales, with the main focus on developing an infection control infrastructure emphasising the responsibilities of all healthcare workers.[109] The strategy used a clinical governance and risk management approach that puts the emphasis with clinical teams, who must confront infection control, guided and supported by specialists in infection prevention and control. The strategic objectives identified for action were:

- standards
- infrastructure and organisation
- training and education
- surveillance and audit
- interventions and performance indicators
- information technology and communication

Northern Ireland

The 2005 Northern Ireland Department for Health, Social Services and Public Safety (DHSSPS) strategy document *Protecting patients and staff – A strategy for prevention and control of healthcare associated infections in Northern Ireland 2005-2010* prioritised the prevention and control of HCAIs and is based on working knowledge and best practice.[110] The document concentrated primarily on preventing HCAIs in acute hospital settings, however, the principles outlined apply across all settings, including community and primary care. The strategy outlined action to be taken in the priority areas of organisation and culture; education, training and practices, governance, audit and accountability, surveillance, and patient and public partnerships. Following consultation the 2006 DHSSPS document *Changing the culture: a regional action plan for the prevention and control of healthcare associated infections in Northern Ireland 2006/2009* superseded *Protecting patients and staff*,[111] and focused on the key action areas identified in the 2005 action plan.

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