epic3
National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England

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# SECTION 1

## INTRODUCTORY SECTION

### 1.1 Index

<table>
<thead>
<tr>
<th>Section</th>
<th>Section Title</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory Section</td>
<td>2</td>
</tr>
<tr>
<td>1.1</td>
<td>Index</td>
<td>2</td>
</tr>
<tr>
<td>1.2</td>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>1.3</td>
<td>Guideline Development Methodology</td>
<td>5</td>
</tr>
<tr>
<td>1.4</td>
<td>Consultation Process</td>
<td>8</td>
</tr>
<tr>
<td>1.5</td>
<td>Glossary</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td><strong>Standard principles for preventing healthcare-associated infections in hospital and other acute care settings</strong></td>
<td>19</td>
</tr>
<tr>
<td>2.1</td>
<td>Introduction</td>
<td>20</td>
</tr>
<tr>
<td>2.2</td>
<td>Hospital environmental hygiene</td>
<td>20</td>
</tr>
<tr>
<td>2.3</td>
<td>Hand hygiene</td>
<td>27</td>
</tr>
<tr>
<td>2.4</td>
<td>The use of personal protective equipment</td>
<td>43</td>
</tr>
<tr>
<td>2.5</td>
<td>The safe use and disposal of sharps</td>
<td>51</td>
</tr>
<tr>
<td>2.6</td>
<td>Asepsis</td>
<td>57</td>
</tr>
<tr>
<td>3</td>
<td><strong>Guidelines for preventing infections associated with the use of short-term urethral catheters</strong></td>
<td>58</td>
</tr>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td>59</td>
</tr>
<tr>
<td>3.2</td>
<td>Background and context of the Guidelines</td>
<td>59</td>
</tr>
<tr>
<td>3.3</td>
<td>Assessing the need for catheterisation</td>
<td>62</td>
</tr>
<tr>
<td>3.4</td>
<td>Selection of catheter type</td>
<td>64</td>
</tr>
<tr>
<td>3.5</td>
<td>Catheter insertion</td>
<td>68</td>
</tr>
<tr>
<td>3.6</td>
<td>Catheter maintenance</td>
<td>69</td>
</tr>
<tr>
<td>3.7</td>
<td>Education of healthcare workers and patients</td>
<td>74</td>
</tr>
<tr>
<td>3.8</td>
<td>System intervention for reducing the risk of infection</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td><strong>Guidelines for preventing infections associated with the use of intravascular access devices</strong></td>
<td>77</td>
</tr>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>78</td>
</tr>
<tr>
<td>4.2</td>
<td>What is the evidence for these guidelines?</td>
<td>80</td>
</tr>
<tr>
<td>4.3</td>
<td>Education of healthcare workers and patients</td>
<td>81</td>
</tr>
<tr>
<td>4.4</td>
<td>General asepsis</td>
<td>82</td>
</tr>
<tr>
<td>4.5</td>
<td>Selection of catheter type</td>
<td>83</td>
</tr>
<tr>
<td>4.6</td>
<td>Selection of catheter insertion site</td>
<td>89</td>
</tr>
<tr>
<td>4.7</td>
<td>Maximal sterile barrier precautions during catheter insertion</td>
<td>92</td>
</tr>
<tr>
<td>4.8</td>
<td>Cutaneous antisepsis</td>
<td>93</td>
</tr>
<tr>
<td>4.9</td>
<td>Catheter and catheter site care</td>
<td>96</td>
</tr>
<tr>
<td>4.10</td>
<td>Catheter replacement strategies</td>
<td>99</td>
</tr>
<tr>
<td>4.11</td>
<td>General principles for catheter management</td>
<td>102</td>
</tr>
</tbody>
</table>

### A Appendices

| A.1     | Guideline Development Team                                                   | 113     |
| A.2     | Guideline Advisory Group                                                      | 113     |
| A.3     | Consultation Process                                                          | 114     |
| A.4     | Standard Principles systematic review process                                 | 115     |
| A.5     | Short-term indwelling urethral catheters systematic review process             | 123     |
| A.6     | Intravascular access devices systematic review process                         | 125     |
| A.7     | Systematic Review Process                                                     | 128     |
1.2 Introduction – the epic3 Guidelines

National evidence-based guidelines for preventing healthcare-associated infections (HCAI) in (National Health Service) NHS hospitals were first published in January 2001 and updated in 2007. This second updating was commissioned by the Department of Health in 2012 for publication in 2013.

What are national evidence-based guidelines?
These are systematically developed broad statements (principles) of good practice. They are driven by practice need, based on evidence and subject to multi-professional debate, timely and frequent review, and modification. National guidelines are intended to inform the development of detailed operational protocols at local level and can be used to ensure that these incorporate the most important principles for preventing HCAI in NHS hospitals and other acute care health services.

Why do we need national guidelines for preventing healthcare-associated infections?
During the past two decades, HCAI have become a significant threat to patient safety. The technological advances made in the treatment of many diseases and disorders are often undermined by the transmission of infections within healthcare settings, particularly those caused by antimicrobial-resistant strains of disease-causing microorganisms that are now endemic in many healthcare environments. The financial and personal cost of these infections, in terms of the economic consequences to the NHS and the physical, social and psychological costs to patients and their relatives, have increased both government and public awareness of the risks associated with healthcare interventions, especially that of acquiring a new infection.

Although not all HCAI can be prevented, many can. Clinical effectiveness, i.e., using prevention measures that are based on reliable evidence of efficacy, is a core component of an effective strategy designed to protect patients from the risk of infection and when combined with quality improvement methods can account for significant reductions in HCAI such as meticillin resistant Staphylococcus aureus and Clostridium difficile.

What is the purpose of the guidelines?
These guidelines describe clinically effective measures that are used by healthcare workers for preventing infections in hospital and other acute care health services.

What is the scope of the guidelines?
Three sets of guidelines were originally developed and have now been updated. They include:

- Standard infection control principles include best practice recommendations for hospital environmental hygiene, effective hand hygiene, the appropriate use of personal protective equipment, the safe use and disposal of sharps and the principles of asepsis;
- Guidelines for preventing infections associated with the use of short-term indwelling urethral catheters; and
- Guidelines for preventing infections associated with the use of intravascular access devices.
What is the evidence for these guidelines?
The evidence for these guidelines was identified by multiple systematic reviews of
peer-reviewed research. In addition, evidence from expert opinion as reflected in
systematically identified professional, national and international guidelines was
considered following formal assessment using a validated appraisal tool. All
evidence was critically appraised for its methodological rigour and clinical practice
applicability and the best available evidence influenced the guideline
recommendations.

Who developed these guidelines?
A team of specialist infection prevention and control researchers and clinical
specialists and a Guideline Development Advisory Group, comprising lay and
specialist clinical practitioners developed the epic3 guidelines. (Appendix A1 and A2)

Who are these guidelines for?
These guidelines can be appropriately adapted and used by all hospital practitioners.
This will inform the development of more detailed local protocols and ensure that
important standard principles for infection prevention are incorporated. Consequently, they are aimed at hospital managers, members of hospital infection
prevention and control teams, and individual health care practitioners. At an
individual level, they are intended to influence the quality and clinical effectiveness of
infection prevention decision-making. The dissemination of these guidelines will also
help patients and carers/relatives understand the standard infection prevention
precautions they can expect all healthcare workers to implement to protect them from
HCAI.

How are these guidelines structured?
Each set of guidelines follows an identical format, which consists of:
- a brief introduction;
- the intervention heading;
- a headline statement describing the key issues being addressed;
- a synthesis of the related evidence;
- guideline recommendation(s) classified according to the strength of the
  underpinning evidence;
- a bibliography listing the cited evidence.

How frequently are the guidelines reviewed and updated?
A cardinal feature of evidence-based guidelines is that they are subject to timely
review in order that new research evidence and technological advances can be
identified, appraised and, if shown to be effective in preventing HCAI, incorporated
into amended guidelines. The evidence base for these guidelines will be reviewed in
two years (2015) and the guidelines will be considered for updating approximately
four years after publication (2017).

How can these guidelines be used to improve your clinical effectiveness?
In addition to informing the development of detailed local operational protocols, these
guidelines can be used as a benchmark for determining appropriate infection
prevention decisions and, as part of reflective practice, to assess clinical
effectiveness. They also provide a baseline for clinical audit, evaluation and
education, and facilitate ongoing quality improvements.

How much will it cost to implement these guidelines?
Significant additional costs are not anticipated in implementing these guidelines.
However, where current equipment or resources do not facilitate the implementation
of the guidelines, or where staff levels of adherence to current guidance are poor, there may be an associated increase in costs. Given the social and economic costs of HCAI, the consequences associated with not implementing these guidelines would be unacceptable to both patients and health care professionals.

Consultation process
These guidelines have been subject to extensive external consultation with key stakeholders, including Royal Colleges, professional societies and organisations, including patients, and trades unions (Appendix A3).

References

1.3 Guideline Development Methodology

The guidelines were developed using a systematic review process (Appendix A.4-A.6). In each set of guidelines a summary of the relevant guideline development methodology is provided.

Search Process
Electronic databases were searched for national and international guidelines and research studies published during the periods identified for each search question (Appendix A4-A7). A two-stage search process was used.

Stage 1 Identification of systematic reviews and guidelines
For each set of epic guidelines, an electronic search was conducted for systematic reviews of randomised controlled trials and other study designs and current national and international guidelines (Appendix A4-A7).

International and national guidelines were retrieved and subjected to critical appraisal using the AGREE II Instrument, an evaluation method used internationally for assessing the methodological quality of clinical guidelines.

Following appraisal, accepted guidelines were included as part of the evidence base supporting guideline development and where appropriate for delineating search limits. They were also used to verify professional consensus and in some instances, as the primary source of evidence.

Stage 2 Systematic search for additional evidence
Review questions for the systematic reviews of the literature were then developed for each set of epic guidelines following recommendations from expert advisors.
Searches were constructed using relevant MeSH (medical subject headings) and free-text terms. On completion of the main search, an economic filter was applied. The following databases were searched:

- Medline
- Cumulated Index of Nursing and Allied Health Literature
Abstract review – identifying studies for appraisal
Search results were downloaded into a Refworks™ database and titles and abstracts printed for review. Titles and abstracts were assessed independently by two reviewers and studies retrieved where the title or abstract: addressed one or more of the review questions; identified primary research or systematically conducted secondary research; indicated a theoretical/clinical/ in use study. Where no abstract was available and the title indicated one or more of the above criteria, the study was retrieved. Due to the limited resources available for this review, foreign language studies were not identified for retrieval.

Full-text studies were retrieved and read in detail by two experienced reviewers and those meeting study inclusion criteria were independently quality-assessed for inclusion in the systematic review.

Quality Assessment and Data Extraction
Included studies were appraised using tools based on systems developed by the Scottish Intercollegiate Guideline Network (SIGN) for study quality assessment. Studies were appraised independently by two reviewers and data extracted by one experienced reviewer. Any disagreement between reviewers was resolved through discussion. Evidence tables were constructed from the quality assessments and the studies summarised in adapted considered judgement forms. The evidence was classified using methods from SIGN and adapted to include interrupted time series design and controlled before after studies using criteria developed by the Cochrane Effective Practice and Organisation of Care Group (Table 1). This system is similar that used in the previous epic and NICE infection prevention guidelines.

Table 1 - Levels of Evidence for Intervention Studies

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>1++</td>
<td>High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias</td>
</tr>
<tr>
<td>1+</td>
<td>Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias</td>
</tr>
<tr>
<td>1 -</td>
<td>Meta-analyses, systematic reviews, or RCTs with a high risk of bias*</td>
</tr>
<tr>
<td>2++</td>
<td>High quality systematic reviews of case control or cohort studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal. Interrupted time series with a control group (i) there is a clearly defined point in time when the intervention occurred and (ii) at least three data points before and three after the intervention.</td>
</tr>
<tr>
<td>2+</td>
<td>Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal. Controlled before after studies with two or more intervention and control sites.</td>
</tr>
<tr>
<td>2 -</td>
<td>Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal. Interrupted time series without a parallel control group (i) there is a clearly defined point in time when the intervention occurred and (ii) at least three data points before and three after the intervention. Controlled before after studies with one intervention and one control site.</td>
</tr>
<tr>
<td>3</td>
<td>Non-analytic studies, e.g., uncontrolled before-after studies, case reports,</td>
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</table>
The evidence tables and considered judgement reports were presented to the Guideline Development Advisory Group for discussion. Following extensive discussion the guidelines were drafted.

Factors influencing the guideline recommendations included:
- the nature of the evidence;
- the applicability of the evidence to practice;
- patient preference and acceptability;
- costs and knowledge of healthcare systems.

The classification scheme adopted by SIGN was used to define the strength of recommendation (Table 2).  

| A | At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results |
| B | A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+ |
| C | A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++ |
| D | Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+ |

**Good Practice Points**
- Recommended best practice based on the clinical experience of the guideline development group and patient preference and experience.
- Recommendation from NICE Interventional Procedures guidance

**References**
1.4 Consultation Process
The draft guidelines were circulated to stakeholders for comment (see Appendix A3). The list of stakeholders included all those consulted for the epic2 guidelines and others identified by the Guideline Development Advisory Group and by the DH (England).

Comments were requested on:
- the format;
- the content;
- practice applicability of the guidelines;
- patient preference and acceptability
- specific sections or recommendations.

All comments received will be collated for consideration by the Guideline Development Advisory Group who will agree any changes to these draft recommendations.
<table>
<thead>
<tr>
<th><strong>1.5 Glossary</strong></th>
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<tbody>
<tr>
<td><strong>Acinetobacter</strong></td>
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<td><strong>Adenosine triphosphate</strong></td>
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<tr>
<td><strong>Alcohol handrub</strong></td>
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<tr>
<td><strong>Antimicrobial</strong></td>
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<tr>
<td><strong>Antisepsis</strong></td>
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<tr>
<td><strong>Antiseptic</strong></td>
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<tr>
<td><strong>Aseptic non-touch technique (ANTT)</strong></td>
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<tr>
<td><strong>Bacteraemia</strong></td>
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<td><strong>Bacteriuria</strong></td>
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<tr>
<td><strong>Biofilm</strong></td>
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<tr>
<td><strong>Bloodstream infection (BSI)</strong></td>
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<tr>
<td><strong>Case-control study</strong></td>
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<tr>
<td><strong>Catheter-associated urinary tract infection (CAUTI)</strong></td>
</tr>
<tr>
<td><strong>Catheter colonisation (CLABSI)</strong></td>
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</table>
| **Catheter related bloodstream infection (CR-BSI)** | An infection of the bloodstream where microorganisms are found in a blood culture taken from a peripheral vein of a patient with a CVAD, the patient has clinical signs of infection (e.g. fever, chills, hypotension) and there is no other apparent source for the infection. For surveillance purposes this often refers to BSI that occur in patients with a CVAD and where other possible sources of infection have been excluded. A more rigorous definition is where the same microorganism is cultured from the tip of the catheter as grown from the blood; simultaneous quantitative blood cultures with at least a 5 to 1 ratio of microorganisms cultured
from the CVAD versus peripheral; differential time to positivity of at least 2 hours for blood cultures cultured peripherally versus from CVAD

<p>| Catheter-related infection (CR-infection) | Any infection related to a central venous access device and includes local (e.g., insertion site) and systemic (e.g., bloodstream) infections |
| Central venous catheter (CVC) | A vascular catheter inserted (from a variety of sites) with the tip located in the superior vena cava. CVCs are used for giving multiple infusions, medication or chemotherapy, temporary haemodialysis, monitoring of central venous pressure and frequent blood sampling |
| Clinical waste | Waste material that consists wholly or partly of human or animal tissue, blood or body fluids, excretions, drugs or other pharmaceutical products, swabs/ dressings, syringes, needles or other sharp instruments |
| Clostridium difficile | A microorganism that can infect the gut and cause disease, e.g., diarrhoea and/or pseudomembranous colitis, especially in patients on antibiotics |
| Colonisation | Microorganisms that establish themselves in a particular environment such as a body surface without producing disease |
| Colony-forming unit (CFU) | Colony forming units are a measure of the number of viable cells, capable of producing new colonies when seeded that are contained in a culture. |
| Cross-over trial | A comparison of the outcome between two or more groups of patients that are exposed to different regimens of treatment/intervention where the groups exchange treatment/intervention after a prearranged period |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Diatheses</strong></td>
<td>A tendency to a disease</td>
</tr>
<tr>
<td><strong>Disinfection</strong></td>
<td>A process that reduces the number of microorganisms to a level at which they are not able to cause harm, but which does not usually destroy spores</td>
</tr>
<tr>
<td><strong>Encrustation</strong></td>
<td>Urinary proteins, salts and crystals that adhere to the internal and external surface of a urinary catheter</td>
</tr>
<tr>
<td><strong>Engineering controls</strong></td>
<td>The use of equipment designed to prevent injury to the operator</td>
</tr>
<tr>
<td><strong>Exogenous infection</strong></td>
<td>Infections caused by microorganisms acquired from another person, animal or the environment. Secondary exogenous infections occur when the microorganisms transferred initially colonises the host and subsequently causes infection</td>
</tr>
<tr>
<td><strong>Expert opinion</strong></td>
<td>Opinion derived from seminal works and appraised national and international guidelines</td>
</tr>
<tr>
<td><strong>Haematogenous seeding</strong></td>
<td>Microorganisms causing infection establish infection at another body site as a result of being transferred in the bloodstream</td>
</tr>
<tr>
<td><strong>Hand decontamination</strong></td>
<td>The process of performing an antiseptic hand rub or antiseptic handwash to remove organic matter and transient microorganisms and reduce the number of resident microorganisms from the hands</td>
</tr>
<tr>
<td><strong>Healthcare-associated infection (HCAI)</strong></td>
<td>Infection acquired as a result of the delivery of healthcare either in a acute (hospital) or non-acute setting</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
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<tr>
<td>Healthcare worker</td>
<td>Any person employed by a health service, social service, local authority or agency to provide care for sick, disabled or elderly people.</td>
</tr>
<tr>
<td>High Risk</td>
<td>Patients with an increased probability of infection due to their underlying medical condition. Often refers to patients in intensive care units, those receiving total parenteral nutrition, and immunocompromised patients</td>
</tr>
<tr>
<td>Hypochlorite</td>
<td>A chlorine-based disinfectant</td>
</tr>
<tr>
<td>Implantable intravascular devices</td>
<td>A central venous access device that is tunnelled under the skin with a subcutaneous port or reservoir with a self-sealing septum that is accessible by needle puncture through intact skin</td>
</tr>
<tr>
<td>Incidence</td>
<td>The number of new events (e.g., cases of disease) occurring in a population over defined period of time</td>
</tr>
<tr>
<td>Indwelling urethral catheter</td>
<td>A catheter inserted into the bladder via the urethra and left in place for a period of time</td>
</tr>
<tr>
<td>Infection</td>
<td>Microorganisms that have entered the body and are multiplying in the tissues, typically causing specific symptoms</td>
</tr>
<tr>
<td>Klebsiella pneumonia</td>
<td>Gram-negative bacteria frequently responsible for healthcare associated infections of wound and urinary tract, particularly in immunocompromised patients</td>
</tr>
<tr>
<td>Meatus (urethral)</td>
<td>External opening of the urethra</td>
</tr>
<tr>
<td>MeSH</td>
<td>Medical subject heading</td>
</tr>
<tr>
<td>Meta-analysis</td>
<td>The combination of data from several studies to produce a single estimate of an effect of a</td>
</tr>
</tbody>
</table>
Meticillin-resistant *Staphylococcus aureus* (MRSA)  
Strains of *Staphylococcus aureus* that are resistant to many of the antibiotics commonly used to treat infections. Epidemic strains also have a capacity to spread easily from person-to-person.

Needle-free devices (also needleless intravascular catheter connectors)  
Intravascular connector systems developed to help reduce the incidence of needlestick injury while facilitating medication delivery through intravascular catheters. There are three types of needle-free connectors: blunt cannula (two-piece) systems, one-piece needle-free systems, and one-piece needle-free systems with positive pressure.

Needle safety device (also needle protection/prevention device)  
Any device designed to reduce the risk of injury associated with a contaminated needle. This may include needle-free devices or mechanisms on a needle, such as an automated resheathing device, that cover the needle immediately after use.

Nitrile  
A synthetic rubber made from organic compounds and cyanide.

Occupational exposure to blood/body fluid  
Healthcare worker receives a percutaneous injury (e.g., a needlestick or cut with a sharp object) or contact of mucous membrane or nonintact skin (e.g., exposed skin that is chapped, abraded, or afflicted with dermatitis) with blood, tissue, or other body fluids that are potentially infectious.

Outbreak  
Two or more cases of the same disease where there is evidence of an epidemiological link between them.

Particulate filter masks (or respirator masks)  
Facemasks which are designed to protect the wearer from inhaling airborne particles including microorganisms. They are made to defined performance standards that include filtration efficiency. To be effective they must be fitted close to the face to minimise leakage.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percutaneous injury</td>
<td>An injury that results in a sharp instrument/object, e.g., needle, scalpel, cutting or puncturing the skin</td>
</tr>
<tr>
<td>Peripheral inserted central venous catheters (PICC)</td>
<td>A vascular catheter inserted into the superior vena cava from the basilic or cephalic vein</td>
</tr>
<tr>
<td>Personal protective equipment (PPE)</td>
<td>Specialised clothing or equipment worn to protect against health and safety hazards</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>Inflammation of the wall of a vein</td>
</tr>
<tr>
<td>Post exposure prophylaxis</td>
<td>Drug treatment regimen administered as soon as possible after an occupational exposure to reduce the risk of acquisition of a blood borne virus</td>
</tr>
<tr>
<td>Prevalence</td>
<td>The number of events (e.g. cases of disease) present in a defined population at one point in time</td>
</tr>
</tbody>
</table>
### Prospective clinical trial
Follow-up or longitudinal study where data on exposure is first collected and patients are followed-up for the development of a given condition or outcome, e.g., CR-BSI

### Pseudomembranous colitis
Inflammation of the large intestine (colon) associated with antibiotic use, typically hospital-acquired and most commonly caused by *Clostridium difficile*. Symptoms include diarrhoea, sometimes bloody, rarely progressing to sepsis and acute abdomen.

### Peripheral venous catheter(PVC)
A peripheral venous catheter (PVC or peripheral venous line or peripheral venous access catheter) is a catheter (small, flexible tube) placed into a peripheral vein for the safe infusion of medications, hydration fluids, blood products, and nutritional supplements.

### Quasi experimental study
True experiments involve research designs where a control group is similar to the experimental group in every way except that the control group does not receive the treatment that the experimental group receives. Experimental research most often involves the random assignment of participants to either the experimental or the control group Quasi-experimental research involves research where it is not possible to meet the conditions of true experiments, usually randomisation of participants

### Randomised controlled trial (RCT) and non-randomised control trial (NRCT)
A clinical trial where at least two treatment groups are compared, one of them serving as the control group, and treatment allocation is carried out using a random, unbiased method. A non-randomised controlled trial compares a control and treatment group but allocation to each group is not random. Bias is more likely to occur in NRCT

### Resident (hand) flora
Microorganisms that colonise the deeper crevices of skin and hair follicles as they have adapted to the hospital environment. Not readily transferred to other people or objects, or removed by the mechanical action of soap
and water. They can be reduced in number with the use of antiseptic soap.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Residual effect (handwash agent)</strong></td>
<td>A chemical that persists on the skin and continues to kill microorganisms for a period of time</td>
</tr>
<tr>
<td><strong>Safe systems of work</strong></td>
<td>A set of instructions that defines how to perform a task safely by identifying the risks and the control measures required</td>
</tr>
<tr>
<td><strong>Severe acute respiratory syndrome (SARS)</strong></td>
<td>A severe form of pneumonia caused by a coronavirus</td>
</tr>
<tr>
<td><strong>Sharps</strong></td>
<td>Instruments used in delivering healthcare that can inflict a penetrating injury. Examples include needles, lancets and scalpels</td>
</tr>
<tr>
<td><strong>Sharps injury</strong></td>
<td>See percutaneous injury</td>
</tr>
<tr>
<td><strong>Sterilisation</strong></td>
<td>A process that removes or destroys all microorganisms including spores</td>
</tr>
<tr>
<td><strong>Surgical masks</strong></td>
<td>A mask that covers the mouth and nose to prevent droplets from the wearer being expelled into the environment. As they are also fluid repellent they also provide some protection for the wearer against exposure of mucous membranes to splashes of blood/body fluid</td>
</tr>
<tr>
<td><strong>Thrombophlebitis</strong></td>
<td>Inflammation of the wall of a vein with secondary thrombosis occurring within the affected segment of vein</td>
</tr>
<tr>
<td><strong>Transient (hand) flora</strong></td>
<td>Microorganisms acquired on the skin through contact with surfaces. The hostile environment of skin means that they can usually only survive for a short time, but they are readily transferred to other surfaces touched. Can be removed by washing with soap and water</td>
</tr>
<tr>
<td><strong>Urinary tract infection (UTI)</strong></td>
<td>The presence of symptoms or signs attributable to microorganisms that have invaded the urinary tract</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Vancomycin resistant enterococcus (VRE)</strong></td>
<td>Enterococci are Gram-positive bacteria that are naturally present in the intestinal tract of all people. Vancomycin is an antibiotic to which some strains of enterococci have become resistant. These resistant strains are referred to as VRE and are frequently resistant to other antibiotics generally used to treat enterococcal infections. Serious VRE infections usually occur in hospitalised patients with serious underlying illnesses.</td>
</tr>
</tbody>
</table>
SECTION 2

STANDARD PRINCIPLES FOR PREVENTING HEALTHCARE-ASSOCIATED INFECTIONS IN HOSPITAL AND OTHER ACUTE CARE SETTINGS
Section 2 - Standard Principles for preventing healthcare-associated infections in hospital and other acute care settings

2.1 Introduction
This guidance is based on the best critically appraised evidence currently available. The type and class of supporting evidence explicitly linked to each recommendation is described. All recommendations are endorsed equally and none is regarded as optional. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines.

Standard infection control precautions need to be applied by all healthcare practitioners to the care of all patients, i.e., adults, children and neonates. The recommendations are divided into five distinct interventions:

1. Hospital environmental hygiene,
2. Hand hygiene;
3. The use of personal protective equipment; and
4. The safe use and disposal of sharps;
5. The principles of asepsis.

These guidelines do not address the additional infection control requirements of specialist settings, such as the operating department or for outbreak situations.

2.2 Hospital Environmental Hygiene

Hospital hygiene is important in preventing HCAI in hospitals
This section discusses the evidence upon which recommendations for hospital environmental hygiene are based. Hospital environmental hygiene encompasses a wide range of routine activities. Guidelines are provided here for:

- cleaning the general hospital environment;
- cleaning items of shared equipment;
- education and training of staff.

Maintain a clean hospital environment
Current legislation, regulatory frameworks and quality standards emphasise the importance of the healthcare environment and shared clinical equipment being clean and properly decontaminated to minimise the risk of transmission of HCAI and to maintain public confidence.\(^1\,^6\) Research evidence in this field remains largely limited to ecological studies and weak quasi-experimental and observational study designs.

There is evidence from outbreak reports and observational research that demonstrates the hospital environment becomes contaminated with microorganisms responsible for HCAI. Pathogens may be recovered from a variety of surfaces in clinical environments, including those near to the patient that are frequently touched by healthcare workers.\(^6\,^16\) There is also limited evidence from outbreak reports for an association between contaminated environments and the acquisition of norovirus.\(^16\,^17\)
However, there are few studies that demonstrate the direct transmission of the same strain of microorganism found in the environment to those found in colonised or infected patients. We identified two retrospective cohort studies that demonstrated an increased risk of acquiring healthcare-associated pathogens from a previous occupant of a room. In one study, 11% of 134 patients who acquired *Clostridium difficile* infection (CDI) were in a room where a prior occupant had CDI, compared to 4.6% where there was no prior occupant with CDI (*p*=0.002). However, the conclusions that can be drawn from this study are limited by the lack of a sensitive test and the lack of screening for asymptomatic carriage or related strains. In the second study, patients were significantly more likely to acquire meticillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin resistant enterococci (VRE) if in a room previously occupied by a carrier of the organism, with odds ratios (OR) of 1.3 (95% CI 1.0 to 1.8; *p*=0.04) and 1.4 (95% CI 1.0 to 1.8; *p*=0.04), but the effect was not independent of underlying illness or length of prior intensive care unit (ICU) stay, and data on antibiotic exposure was not available.

Many microorganisms recovered from the hospital environment do not cause HCAI. Cleaning will not completely eliminate microorganisms from environmental surfaces and reductions in their numbers will be transient. There is some evidence that improved cleaning regimens are associated with the control of outbreaks of HCAI. Disinfectants have been recommended for cleaning of the hospital environment, however, a systematic review (SR) failed to confirm a link between disinfection and the prevention of HCAI, although contamination of detergent and inadequate disinfection strength could have been an important confounder. Often, a range of interventions are introduced in order to control an outbreak and it is difficult to clearly distinguish the effect of a single component, such as cleaning, in these circumstances.

Enhanced cleaning of single rooms and bed spaces following the transfer or discharge of patients who were colonised or infected with a HCAI, is referred to as ‘terminal cleaning’. We searched for robust evidence from studies conducted in the healthcare environment that demonstrated cleaning interventions that were associated with reductions in both environmental contamination and HCAI. A randomised crossover study of daily enhanced cleaning of high touch surfaces in ICU demonstrated a reduction in the daily number of sites in a bed-area contaminated with MRSA (OR 0.59; 95% CI 0.4 to 0.86; *p*=0.006), and the aerobic colony count in communal areas (OR 0.65; 95% CI 0.47 to 0.92; *p*=0.013). Although the reduction in MRSA in the environment was associated with a large reduction in MRSA contaminating doctors’ hands (OR 0.26; 95% CI 0.07 to 0.95; *p*=0.25), there was no effect on the incidence of MRSA acquisition by patients (OR 0.98; 95% CI 0.58 to 1.65; *p*=0.93).

Emerging technology

New technologies for cleaning and decontaminating the healthcare environment have become available during the past ten years, including hydrogen peroxide vapour (HPV), and others are in the the early stages of development. However, their effectiveness, cost effectiveness and practicality in terms of reducing HCAI and use in hospitals in the UK has not been demonstrated, as some require the closure of rooms/wards for periods of time to ensure safe and effective use of the technology.

We identified three studies conducted in patient care environments that provided evidence for the effectiveness of different products on environmental contamination but not reductions in HCAI. A prospective randomised crossover study provided evidence for the effectiveness of daily cleaning of high touch surfaces with...
microfiber/copper impregnated cloths on the reduction of MRSA, as discussed above. A randomised controlled trial (RCT) demonstrated the efficacy of daily high touch surface cleaning with peracetic acid on MRSA and *C. difficile* contamination of the environment, with a significant reduction in MRSA and *C. difficile* isolated from samples taken from surfaces with gloved hands (*p*<0.001) and the hands of healthcare workers (3/27 in peracetic acid group vs. 15/38 in standard cleaning group; *p*=0.13).25 Another non-randomised controlled trial (NRCT)26 in two wards at a single hospital, provided evidence that an additional cleaner was associated with a 32.5% reduction in environmental microbial contamination of hand touch sites (95% CI 20.2 to 42.9; *p*=0.0001) and 26.6% reduction in acquisition of MRSA infection (95% CI 7.7 to 92.3; *p*=0.032), although the type of infections were not specified.

Hydrogen peroxide vapour has been used as a method of enhanced cleaning in situations where wards/beds can be closed or left unused for the required period of time.27,28 We identified a prospective, randomised before-after study29 comparing the efficacy of hypochlorite and a HPV dry-mist system for terminal cleaning of rooms used by a patient with CDI in reducing environmental contamination with *C. difficile*. Although both methods significantly reduced environmental contamination compared to cleaning alone, HPV achieved a significantly greater reduction (91% vs. 30% decrease in proportion of samples with *C. difficile*; *p*=0.005). A prospective cohort study30 provided evidence for the efficacy of HPV when used for terminal decontamination after standard cleaning in significantly reducing acquisition of multidrug resistant organisms, mainly VRE, in patients subsequently admitted to the rooms (adjusted IRR 0.36; 95% CI 0.19 to 0.7).

The efficacy of antimicrobial surfaces in the clinical environment to reduce surface contamination and HCAI is an area of emerging research. Four non-randomised, experimental studies, conducted in clinical environments, demonstrated significant reductions in microbial burden of between 80 and 90%, on high touch surfaces coated with copper, compared with comparable, non-coated surfaces.31,32 One RCT in an ICU reported a significantly lower acquisition of HCAI in patients allocated to rooms with 6 high touch copper coated surfaces (3.4% vs. 8.1%; *p*=0.031).35 However, this association was not independent of underlying illness, and evidence of poor reliability in detection methods and some between-group contamination undermined the reliability of this evidence. The evidence of the effectiveness and cost-effectiveness of these technologies and their contribution to reductions in HCAI are not currently available.

Indicators of cleanliness based on levels of microbial or adenosine triphosphate (ATP) contamination have been proposed. However, relationships between ATP and aerobic colony counts are not consistent and neither method distinguishes normal environmental flora and pathogens responsible for HCAI.36,37 Benchmark values of between 250 and 500 relative light units (RLU) have been proposed as a more objective measure of assessing the efficacy of cleaning than visual assessment, although these are based on arbitrary standards of acceptable contamination that have not been shown to be associated with reductions in HCAI.38-40 We identified a number of uncontrolled before-after studies that used ATP in various forms to highlight the extent of contamination of the healthcare environment. In addition, some described the use of ATP monitoring as an intervention to improve cleaning, but the lack of control in the study design precluded their inclusion in this review. Since cleaning will only have a transient effect on the numbers of microorganisms, regular cleaning of hospital surfaces will not guarantee complete elimination. Hand decontamination before every patient contact is therefore required to ensure that pathogens acquired by touch are not transferred to patients.
The hospital environment must be visibly clean, free from non-essential items and equipment, dust and dirt and acceptable to patients, their visitors and staff.

Increased levels of cleaning and disinfection should be undertaken in outbreaks of infection where the pathogen concerned survives in the environment and environmental contamination may be contributing to spread.

The use of chlorine releasing agents and detergent should be considered in outbreaks of infection where the pathogen concerned survives in the environment and environmental contamination may be contributing to spread.

References
32. Schmidt MG, Attaway III HH, Fairey SE, Steed LL, Michels HT, Salgado CD. Copper continuously limits the concentration of bacteria resident on bed rails within the intensive care unit. Infect Control Hosp Epidemiol 2013 May; 34(5): 530-3.
37. Boyce JM, Havill NK, Dumigan DG; Monitoring the Effectiveness of Hospital Cleaning Practices by Use of an Adenosine Triphosphate Bioluminescence Assay infection control and hospital epidemiology Infect Control Hosp Epidemiol 2009 Jul; 30(7): 678-84.


**Shared equipment must be decontaminated after use**

Shared clinical equipment used to deliver care in the clinical environment comes into contact with intact skin and is therefore unlikely to directly introduce infection. However, it can act as a vehicle by which microorganisms are transferred between patients, which may subsequently result in infection. Equipment should therefore be cleaned and decontaminated after each use with cleaning agents compatible with the piece of equipment being cleaned. In some outbreak situations, the use of chlorine-releasing agents and detergent should be considered.1-4

SP4 Shared pieces of equipment, used in the delivery of patient care, must be cleaned and decontaminated after each use with products that are compatible with the equipment. [Revised wording]

**References**


**Hospital hygiene is everybody’s responsibility**

In a SR of healthcare workers’ knowledge about MRSA and/or frequency of cleaning practices, three studies indicated that staff were not utilising appropriate cleaning practices with sufficient frequency to ensure minimisation of MRSA contamination of personal equipment.1 Staff education was lacking on optimal cleaning practices in the clinical areas. Knowledge deficits may hinder the application of cleaning practices and monitoring and evaluation was indicated. This is further reinforced by an observational study, which noted that lapses in adherence to the cleaning protocol were linked with an increase in environmental contamination with isolates of Acinetobacter baumannii.2 A second SR of four cohort studies comparing the use of detergents and disinfectants on microbial contaminated hospital environmental surfaces, suggested that a lack of effectiveness was, in many instances, due inadequate strengths of disinfectants, probably resulting from a lack of knowledge.3

We identified no new, robust research studies of education or system interventions for this review. However, creating a culture of responsibility for maintaining a clean
environment and increasing knowledge about how to decontaminate equipment and high touch surfaces effectively requires education and training of both healthcare cleaning professionals and clinical staff.

All healthcare workers need to be aware of their individual responsibility for maintaining a safe care environment for patients and staff and educated about the importance of minimising the opportunities for microbial contamination of the patient environment. Every healthcare worker needs to be clear about their specific responsibilities for cleaning and decontaminating equipment and clinical areas and high touch surfaces close to the patient.

[Revised wording]

References


2.3 Hand Hygiene

The following section provides the evidence for recommendations concerning hand hygiene practice. Designing and conducting robust, ethical, randomised controlled trials (RCT) in the field of hand hygiene is challenging, meaning that recommendations in these areas are largely based on evidence from non-randomised controlled trials (NRCT), quasi-experimental studies, observational studies and expert opinion derived from systematically retrieved and appraised professional, national and international guidelines. The areas discussed in this section include:

- assessment of the need to decontaminate hands;
- the efficacy of hand decontamination agents and preparations;
- the rationale for choice of hand decontamination practice;
- technique for hand decontamination;
- care required to protect hands from the adverse effects of hand decontamination practice;
- promoting adherence to hand hygiene guidelines;
- involving patients and carers in hand hygiene.

Why is hand decontamination crucial to the prevention of healthcare-associated infection?

Cross-transmission is the transfer of organisms between humans. It can occur directly via hands, or indirectly via an environmental source, such as a commode or wash-bowl. It precedes cross-infection and epidemiological evidence indicates that hand-mediated cross-transmission is a major contributing factor in the current infection threats to hospital in-patients.\(^1\,\!\!^2\,\!\!^3\,\!\!^4\) The hands are colonised by two categories of microbial flora. Resident flora is found on the surface and just below the uppermost layer of the skin and generally serves a protective function. These organisms include *Staphylococcus epidermidis* and coagulase negative staphylococci and are less likely to cause HCAI, but if transferred to susceptible sites such as wounds, may cause infection. Transient flora colonise the surface of the skin and are acquired during contact with the environment and direct contact with the patient. Microorganisms found in transient flora are those more commonly associated with HCAI and include meticillin-sensitive and meticillin-resistant *Staphylococcus aureus* (MSSA/MRSA), multi-resistant Gram-negative organisms, such as *Acinetobacter spp*, and vancomycin resistant enterococci (VRE). Hand-mediated cross-transmission, from resident and transient skin flora to susceptible sites or devices, such as surgical wounds, endo-tracheal tubes during pulmonary ventilation, intravascular insertion sites, enteral feeding systems or urinary catheter drainage systems, cause life-threatening infections. Cross-transmission to non-vulnerable sites can leave a patient colonised with pathogenic and antibiotic-resistant organisms, which may result in a HCAI at some point in the future.\(^2\,\!\!^3\,\!\!^4\,\!\!^5\) Outbreak reports and observational studies of the dynamics of bacterial hand contamination demonstrate an association between patient care activities that involve direct patient contact and hand contamination.\(^2\,\!\!^3\,\!\!^4\,\!\!^5\) The association between hand decontamination with a range of hand-wash, and more recently waterless alcohol-
based hand rub (ABHR) preparations and reductions in infection have been confirmed by clinically-based non-randomised trials \cite{7,8} and observational studies. \cite{9,10}

Current national and international guidance consistently identifies that effective hand decontamination results in significant reductions in the carriage of potential pathogens on the hands and logically decreases the incidence of preventable HCAI, leading to a reduction in patient morbidity and mortality. \cite{1,11}

When **must** you decontaminate your hands in relation to patient care?

Decontamination refers to a process for the physical removal of blood, body fluids, and the removal or destruction of microorganisms from the hands. \cite{3} Four key factors influence the need for hand decontamination: \cite{2,3}

- the level of the anticipated contact with patients or objects;
- the extent of the contamination that may occur as a result of that contact;
- the patient care activities being performed;
- the susceptibility of the patient.

Patients are put at risk of developing a HCAI when informal carers or healthcare workers caring for them have contaminated hands. The World Health Organisation’s (WHO) ‘My Five Moments for Hand Hygiene’ and associated multimodal tools for implementation and audit have been widely adopted across the world as a framework for improving hand hygiene compliance among healthcare workers. The five moments are built around accepted hand hygiene practice. \cite{3,12} Hands must be decontaminated at critical points before and after patient care activity to prevent cross-transmission. \cite{1-3,11}

**SP6** Hands must be decontaminated: \textit{Class C}

- immediately before each and every episode of direct patient contact;
- immediately before an aseptic procedure or handling an invasive device;
- immediately after contact with body fluids, mucous membranes and non-intact skin, whether or not gloves have been worn;
- between different care activities for the same patient;
- immediately after the removal of sterile or non-sterile gloves;
- immediately after contact with objects and equipment in the immediate patient environment.

[Revised recommendation]

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**References**


**Is any one hand cleaning preparation better than another?**

Current national and international guidelines consider the efficacy of various preparations for the decontamination of hands using liquid soap and water, antiseptic hand-wash agents and ABHR in laboratory studies and their effectiveness in clinical use. Overall, there is no compelling evidence to favour the general use of antiseptic hand-washing agents over liquid soap or one antiseptic agent over another.1-5

Many studies have been conducted during the past 15 years comparing hand hygiene preparations, including ABHR and gels, antiseptic hand washes and liquid soap. Randomised controlled trials and other quasi-experimental studies generally demonstrate alcohol-based preparations to be a more effective hand hygiene agent than non-medicated soap and antiseptic hand-washing agents, with a small number of studies demonstrating no statistically significant difference.6-23 Many of these studies involve the use of ABHR as part of a number of interventions or multimodal campaigns to improve hand hygiene practice and have methodological flaws that weaken the causal relationship between the introduction of ABHR and reductions in HCAI.24

We identified one multivariate, interrupted time series study that suggested that the amount of ABHR used per patient day was the only factor associated with a reduction in MRSA incidence density (p=0.011) in a neonatal intensive care unit in Japan. Incidence density fell over a four-year period from an average of 15 per 1,000 patient days, with a peak of 20 per 1,000 patient days in August 2006, to 0 per 1,000 patient days in October 2008 and sustained to July 2009 (average incidence density 7.5 per 1,000 patient days). The supporting evidence from laboratory studies of the efficacy of ABHR indicates that these products are highly effective at reducing hand carriage, whilst overcoming some of the recognised barriers to hand-washing; most importantly, the ease of use at the point of patient care.

These studies underpin a continuing trend to adopt ABHR and gels for routine use in clinical practice. However, some studies highlight the need for continued evaluation of the use of ABHR within the clinical environment to ensure staff adherence to guidelines and effective hand decontamination technique.22, 23
Choice of decontamination: is it always necessary to wash hands to achieve decontamination?
Choosing the method of hand decontamination will depend upon the assessment of what is appropriate for the episode of care, the available resources, what is practically possible and, to some degree, personal preferences based on the acceptability of preparations or materials.

In general, effective hand washing with a liquid soap and water or the effective use of ABHR will remove transient microorganisms and render the hands socially clean. The effective use of ABHR will also substantially reduce resident microorganisms. This level of decontamination is sufficient for general social contact and most clinical care activities. The use of a liquid soap preparation that contains an antiseptic will reduce both transient microorganisms and resident flora and exert a residual effect, which may be required in situations where prolonged reduction in microbial flora on the skin is required e.g. surgery and some invasive procedures. Preparations containing antiseptics are not normally necessary for everyday clinical practice, but may be used in outbreak situations.

Alcohol-based hand rub is not effective against some microorganisms such as *C. difficile*, will not remove dirt and organic material and may not be effective in some outbreak situations. We identified two laboratory studies that demonstrated that ABHR was not effective in removing *C. difficile* spores from hands. In the first study, a comparison of liquid soap and water, chlorhexidine gluconate (CHG) soap and water, antiseptic hand wipes and ABHR resulted in all the soap and water protocols yielding greater mean colony forming units (CFU) reductions, followed by the antiseptic hand wipes, than ABHR. Alcohol-based hand rub was equivalent to no intervention (0.06 log$_{10}$ CFU/mL [95% CI, -0.34 to 0.45 log$_{10}$ CFU/mL]). In the second study, three ABHR preparations with a minimum 60% alcohol concentration were compared with antiseptic (CHG) soap and water. Antiseptic soap and water significantly reduced spore counts, compared with each of the ABHRs (CHG vs. Isagel, $p=.005$; CHG vs. Endure, $p=.010$; CHG vs. Purell, $p=.005$). In addition, 30% or the residual spores were readily transferred by handshake following the use of ABHR. Recent evidence from a laboratory study comparing the efficacy of liquid soap and water and ABHR with and without CHG against H1N1 virus, demonstrated that all the hand hygiene protocols were effective in reducing virus copies. A further study comparing the use of liquid soap and water and 65% ethanol hand sanitisers for the removal of Rhinovirus, indicated that the hand sanitisers were more effective than soap and water.

Two economic evaluations from the USA, included in recent NICE Primary Care guidelines, suggest that non-compliance with hand hygiene guidelines results in increased infection-related costs. Although compliance increases procurement costs of hand hygiene products, even a small increase in compliance is likely to result in reduced infection costs. Alcohol-based hand rub is likely to be less costly and result in greater compliance.

National and international guidelines suggest that the acceptability of agents and techniques is an essential criterion for the selection of preparations for hand hygiene. Acceptability of preparations is dependent upon the ease with which the preparation can be used in terms of time and access, together with their dermatological effects. Due to their efficacy and ease of use, ABHRs are recommended for routine use and offer a practical and acceptable alternative to hand washing for most clinical activities.
SP7 Use an alcohol-based hand rub for routine decontamination of hands during clinical care. \textit{Class A}  
[Revised recommendation]

SP8 Use liquid soap and water to decontaminate hands that are visibly soiled or potentially contaminated with dirt or organic material and following caring for patients with vomiting or diarrhoeal illness, whether or not gloves have been worn. \textit{Class A}  
[Revised recommendation]

SP9 Hands should be washed with soap and water after several consecutive applications of alcohol-based hand rub. \textit{Class D/ GPP}  
[No change]

References


Is hand decontamination technique important?

Investigations into the technique of hand decontamination are limited in terms of their sample size and observational design. Hand hygiene technique involves both the preparation for and the physical process of decontamination. Hands and wrists need to be fully exposed to the product being used for hand decontamination and therefore should be free from jewellery and long sleeved clothing. There are a number of small-scale observational studies that have demonstrated that wearing rings and false nails is associated with increased carriage of microorganisms and, in some cases, linked to the carriage of outbreak strains. Department of Health guidance on uniforms and work wear and NICE guidelines indicate that healthcare workers should remove rings and wrist jewellery and wear short sleeves whilst delivering patient care.

Evidence for the duration of hand hygiene has been considered in previous systematic reviews (SR) underpinning guidelines and suggests that the effect of different durations of hand washing and hand rubbing on bacterial reduction is not significant. The WHO guidelines indicate that decontamination using ABHR should take 20-30 seconds for a seven-step process and that hand washing should take 40-60 seconds for a nine-step process.

We identified one recent RCT in a single hospital, which demonstrated that allowing staff to decontaminate their hands ‘in no particular order’ took less time and was as effective as using the WHO seven-step technique, using ABHR or liquid antimicrobial soap and water ($p=.04; p<.001$, respectively). All three of the protocols tested in this study were effective in reducing hand bacterial load ($p<.01$). A similar result was reported by authors of a laboratory study that tested the EN1500 six-step technique against a range of other protocols. They reported that allowing volunteers to use his or her own ‘responsible application’ or a new five-step technique resulted in better coverage of the hands.

There have been a number of studies investigating methods of hand drying in the laboratory setting that suggest that there is no significant difference in the efficacy of different methods of drying hands, but that good quality paper towels dry hands efficiently and remove bacteria effectively. Current guidance on infection control in the built environment suggests that air and jet driers are not appropriate for use in clinical areas. We identified one SR of hand drying studies that failed to meet the quality criteria for inclusion.

Due to the methodological limitations of studies, evidence recommendations are based on national and international guidelines, which state that the duration of hand decontamination, the exposure of all aspects of the hands and wrists to the preparation being used, the use of vigorous rubbing to create friction, thorough rinsing in the case of hand washing, and ensuring that hands are completely dry are key factors in effective hand hygiene and the maintenance of skin integrity.

SP10 Healthcare workers should ensure that their hands can be decontaminated throughout the duration of clinical work by:

- removing all wrist and hand jewellery;
- wearing short sleeved clothing when delivering patient care;
- making sure that fingernails are short and clean, free from false nails and nail polish;
- covering cuts and abrasions with waterproof dressings.

[Revised recommendation]

**SP11** Effective hand washing technique involves three stages: preparation, washing and rinsing, and drying.
- Preparation: wet hands under tepid running water before applying the recommended amount of liquid soap or an antimicrobial preparation.
- Washing: the hand wash solution must come into contact with all of the surfaces of the hand. The hands must be rubbed together vigorously for a minimum of 10-15 seconds, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers. Hands should be rinsed thoroughly.
- Drying: use good quality paper towels to dry the hands thoroughly.

[No change]

**SP12** When decontaminating hands using an alcohol-based hand rub, hands should be free of dirt and organic material. The hand rub solution must come into contact with all surfaces of the hand. The hands must be rubbed together vigorously, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers, and until the solution has evaporated and the hands are dry.

[No change]

**References**

Does hand decontamination damage skin?

Expert opinion concludes that skin damage is generally associated with the detergent base of the preparation and/or poor hand washing technique. However, the frequent use of some hand hygiene agents may cause damage to the skin and alter normal hand flora. Sore hands are associated with increased colonisation of potentially pathogenic microorganisms and increase the risk of infection. The irritant and drying effects of liquid soap and antiseptic soap preparations have been identified as one of the reasons why healthcare practitioners fail to adhere to hand hygiene guidelines. In addition, washing hands regularly with liquid soap and water before or after the use of ABHR is associated with dermatitis and is not necessary.

Systematic reviews conducted to underpin national guidelines identify a range of studies that compare the use of alcohol-based preparations with liquid soap and water using self-assessment of skin condition by nurses. These studies indicate that ABHR is associated with less skin irritation than liquid soap and water. In addition, a longitudinal study of the introduction and subsequent use of ABHR over a seven year period observed no reports of irritant and contact dermatitis associated with the use of ABHR.

We identified a recent study by the same group, which suggests that two ABHR preparations containing a glycerol emollient are more acceptable to staff (p<.001). Hand lotions may be become contaminated and have been reported to be associated with an outbreak of infection in a neonatal unit.

Current national and international guidance suggests that skin care, through the appropriate use of hand lotion or moisturisers added to hand hygiene preparations, is an important factor in maintaining skin integrity, encouraging adherence to hand decontamination practices and assuring the health and safety of healthcare practitioners.

Clinical staff should be aware of the potentially damaging effects of hand decontamination products and encouraged to use an emollient hand cream regularly, for example, after washing hands before a break or going off duty and when off duty, to maintain the integrity of the skin.

Consult the occupational health team if a particular soap, antiseptic hand wash or alcohol-based hand rub causes skin irritation.
References


How can adherence to hand hygiene guidance be promoted?

National and international guidelines emphasise the importance of adherence with hand hygiene guidance and provide an overview of the barriers and factors that impact on hand hygiene compliance. 1-4

The use of multimodal approaches to improving hand hygiene practice has been advocated for over ten years. Evidence from observational studies of multimodal interventions involving the introduction of near patient ABHR, audit and feedback, reminders and education is consistently associated with greater compliance by healthcare staff. 5-19

An early systematic review of 21 studies involving interventions to improve hand hygiene compliance concluded that:

- single interventions have a short-term influence on hand hygiene;
• reminders have a modest but sustained effect;
• feedback increases rates of hand hygiene but must be regular;
• near patient alcohol-based preparations improve the frequency with which healthcare workers clean their hands;
• multi-faceted approaches have a more marked effect on hand hygiene and rates of HCAI.¹

National hand hygiene campaigns have been modelled on the multimodal approach and implemented across the world.² In England and Wales the National Patient Safety Agency’s ‘Cleanyourhands Campaign’ was piloted and implemented between 2004 and 2008 with the aim of creating sustainable change in hand hygiene compliance. The campaign comprised the use of near patient ABHR, national poster materials, audit and feedback and materials for patient engagement.

Recent Cochrane Reviews of randomised and controlled clinical trials, interrupted time series and controlled before-after studies have suggested that the majority of studies conducted in this field have methodological biases that exclude them from this review.²⁰,²¹ We identified four SRs of interventions to improve hand hygiene compliance.²¹-²⁴ The most recent review identified 84 studies published after 2006 for potential inclusion, but only four studies, one RCT, two interrupted time series and one controlled before-after study, were included following detailed quality assessment.²¹ The heterogeneity of interventions and methods precluded the pooling and meta-analysis of results and concluded that multifaceted campaigns that include social marketing or staff engagement may be more effective than campaigns without these components, and that education or product substitution alone are less effective. An integrative SR of 35 studies reporting a wide range of interventions, including multimodal interventions and hand hygiene product changes, only scored nine of the included studies as having limited or no fatal flaws.²² The authors concluded that design limitations made it difficult to generalise study results or isolate the specific effects of hand hygiene (or other interventions) on reductions of HCAI. An earlier SR of ‘bundled’ behavioural intervention studies that reported HCAI or rates of colonisation as the primary outcome, identified 33 potential studies for inclusion and of these only four had quality scores of >80%. Again, due to the heterogeneity of study interventions and outcomes, the results were narratively synthesised.²³ The authors concluded that the formation of multidisciplinary quality improvement teams and educational interventions might be effective strategies to improve hand hygiene and reduce rates of HCAI. The final SR focused specifically on educational interventions to improve hand hygiene compliance in hospital settings and included all study designs reporting at least one outcome measure of hand hygiene competence and with a follow-up of at least six months.²⁴ Thirty studies met the inclusion criteria for the review, but it was not possible to separate competence from compliance. Educational interventions taught or re-taught the correct methods for hand hygiene and then assessed compliance. The authors concluded that educational interventions had a greater impact if compliance to hand hygiene was low. Multiple interventions were better than single interventions in sustaining behaviour change, as were continuous, rather than one-off interventions. However, it was not possible to determine the duration or sustainability of behaviour change in these studies.

Our SR also identified one cluster RCT and process evaluation, one step-wedge cluster RCT, two interrupted time series studies and one controlled before-after study that evaluated multimodal interventions with varying components.²⁵-²⁹ In a cluster RCT that also included a process evaluation, the authors tested a set of core elements in a ‘state of the art strategy’ (SAS) against a team leaders directed strategy (TDS), at baseline (T1), immediately following the intervention (T2) and six
months later (T3), to ascertain the additional benefits of leadership and staff engagement components. In the intention to treat analysis (ITT), an odds ratio (OR) of 1.64 (95% CI 1.33 to 2.02; p<0.001) in favour of the TDS between T2 and T3 suggests that engaging ward leadership and the involvement of teams in setting norms and targets results in greater compliance with hand hygiene. However, there was no significant difference between the groups’ compliance at T3 in the ITT (p=0.187), with the SAS also having a sustained effect. The process evaluation examined the extent to which the content, dosage and coverage of the intervention had been delivered. An as treated analysis demonstrated a greater effect size for the TDS at T3 with a significant difference in hand hygiene compliance (p<0.01). The process evaluation also suggested that experienced feedback about individual hand hygiene performance at T2 and T3 (p<0.05 and p<0.01, respectively), challenging colleagues on undesirable hand hygiene practice (p<0.01) and support from colleagues in performing hand hygiene (p<0.01) were positively correlated with changes in nurses’ hand hygiene compliance.

The second cluster RCT used a step-wedge design to assess a behavioural feedback intervention in intensive care units (ICU) and acute care of the elderly (ACE) wards at sites participating in the ‘Cleanyourhands Campaign’. The intervention was delivered over a four-week cycle, which involved observation of individual healthcare workers with immediate feedback and team feedback with action planning. There was a lack of fidelity to the intervention, with only 33% of the implementing wards returning four data forms per month. The ITT analysis showed an estimated OR for an increase in hand hygiene compliance of 1.103 (95% CI 1.026 to 1.188; p=0.008) for each returned data form, but no similar effect in ACE wards, with an estimated OR of 0.998 (95% CI 0.948 to 1.050; p=0.9) for each returned form. The per-protocol analysis showed an increased OR for ICU (OR 2.09; 95% CI 1.55 to 2.81; p<0.003) that also showed greater fidelity to the intervention and ACE wards (OR 1.67; 95% CI 1.28 to 2.22; p<0.001). Authors concluded that individual feedback and team action-planning resulted in moderate but sustained improvements in hand hygiene adherence. The difficulties in implementing this intervention point to the problems that might be faced in a non-trial context.

Two interrupted time series studies of a four year national ‘Cleanyourhands Campaign’ in England and a four year hospital-wide programme in Taiwan both demonstrated increased hand hygiene compliance (measured by procurement of ABHR and liquid soap) and reductions in HCAI (MRSA and C. difficile and MRSA and extensively drug-resistant Acinetobacter XDRAB). In the national study, increased procurement of soap was independently associated with reductions in C. difficile infection (adjusted incidence rate ratio for 1 mL increase per patient bed day 0.993; 95% CI 0.990 to 0.996; p<0.0001) and MRSA in the last four quarters of the study (adjusted incidence rate ratio for 1 mL increase per patient bed day 0.990; 95% CI 0.985 to 0.995; p<0.0001). The ‘Cleanyourhands Campaign’ was not independent of other national programmes to reduce MRSA bloodstream infections and C. difficile infection. Analysis also identified that the publication of the Health Act and the Department of Health improvement team visits were associated with reductions in MRSA and C. difficile. In the hospital-wide study, authors demonstrated a decrease in the cumulative incidence of HCAIs caused by MRSA (change in level, p=0.03; change in trend, p=0.04); and XDRAB (change in level p=0.78; change in trend p<0.001) during the intervention period. Hand Hygiene compliance was significantly correlated with increased consumption of ABHR and improved overall from 43.3% in 2004 to 95.6% in 2007 (p<.001) and for professional categories of healthcare workers (p<.001), in both general wards and intensive care units (p<.001).
The controlled before after study of a range of patient safety interventions in England, including hand hygiene, as measured by ABHR and soap consumption in non-specialist acute hospitals, reported no significant differences in the rate of increase in consumption of ABHR \( (p=0.760 \text{ favouring controls}) \) and non-significant decreases in \( C. \) difficile \( (p=0.652) \) and MRSA \( (p=0.693) \).

SP15  Near patient alcohol-based hand rub should be made available in all healthcare facilities.  \( \text{Class C} \)  
[No change]

SP16  Hand hygiene resources and individual adherence to hand hygiene guidelines should be audited at regular intervals and the results fed back to healthcare workers to improve and sustain high levels of compliance.  \( \text{Class C} \)  
[Revised recommendation]

SP17  Education and training in risk assessment, effective hand hygiene and glove use should form part of all healthcare workers’ annual updating.  \( \text{Class D/GPP} \)  
[No change]

SP18  Local programmes of education, social marketing, and audit and feedback should be refreshed regularly and promoted by senior managers and clinicians to maintain focus, engage staff and produce sustainable levels of compliance.  \( \text{Class C} \)  
[New recommendation]

References


Patient Involvement in Hand Hygiene

Patient involvement in multimodal strategies to improve hand hygiene among healthcare workers is established, although research suggests that many patients and carers do not feel empowered to challenge doctors in particular.\textsuperscript{1-5} Many NHS trusts have promoted hand hygiene among visitors by placing ABHR at the entrances to wards and patient rooms. However, despite being highlighted as an important gap in research, the role of patient hands in the cross transmission of microorganisms has not been investigated systematically, other than in ecologic studies that describe hand or skin contamination\textsuperscript{6-8} or observations of non-use of hand hygiene products.\textsuperscript{9} Studies of effective interventions to enable patients to clean their hands remain small-scale and descriptive in nature.\textsuperscript{10-13}

We identified three studies that described interventions to improve patient hand hygiene, one in an outbreak situation, one uncontrolled before-after study of parent education in a single paediatric intensive care unit and the other as part of a prospective observational study in a community hospital, but none met the quality criteria for inclusion in this SR.\textsuperscript{14-16} However, all suggested that improving patient/carer hand hygiene had some effect on cross-transmission of microorganisms and hand hygiene technique. National guidelines indicate that it is important to educate patients and carers about the importance of hand hygiene and inform them about the availability of hand hygiene facilities and their role in maintaining standards of healthcare worker hand hygiene.\textsuperscript{17}

SP19 Patients and relatives should be informed about the need to keep their own hands clean and encouraged to ask healthcare workers to decontaminate their hands before delivering care. \textit{[New recommendation]} \textit{Class D/ GPP}

SP20 Patients should be offered the opportunity to clean their hands before meals, after using the toilet, commode or bedpan/urinal and at other times as appropriate. Products available should be tailored to patient needs and may include alcohol-based hand rub, hand wipes or access to hand wash basins. \textit{[New recommendation]} \textit{Class D/ GPP}

References

2.4 The use of Personal Protective Equipment

This section discusses the evidence and associated recommendations for the use of personal protective equipment (PPE) by healthcare workers in acute care settings and includes the use of aprons, gowns, gloves, eye protection and face masks/respirators. Where appropriate, in addition to the classification of the evidence underpinning the recommendations, there is an indication of a Health and Safety (H&S) requirement.

Infection prevention and control dress code – protect your patients and yourself.

The primary uses of PPE is to protect staff and reduce opportunities for cross-transmission of microorganisms in hospitals.\(^1\)-\(^3\) There is no evidence that uniforms or work clothing are associated with HCAI. However, there is a public expectation that healthcare workers will wear work and protective clothing to minimise any potential risk to patients.\(^4\)-\(^5\) The decision to use or wear PPE must be based upon an assessment of the level of risk associated with a specific patient care activity or intervention and take account of current H&S legislation.\(^6\)-\(^8\) However, studies have identified that both a lack of knowledge of guidelines and non-adherence to guideline recommendations are common and that regular in-service education and training is required.\(^9\)-\(^13\)

SP21 Selection of protective equipment must be based on an assessment of the risk of transmission of microorganisms to the patient or to the carer, and the risk of contamination of the healthcare practitioners’ clothing and skin by patients’ blood, body fluids, secretions or excretions.

[No Change]

SP22 Everyone involved in providing care should be educated about standard precautions and trained in the assessment of risk and the appropriate use of gloves in clinical care and other personal protective equipment.

[Revised recommendation]

SP23 Adequate supplies of disposable plastic aprons, single use gloves and face protection should be made available wherever care is delivered. Gowns should be made available when advised by the infection prevention and control team.

[Revised wording]

References


Gloves: use them appropriately

Since the mid-1980s the use of gloves as an element of PPE has become an everyday part of clinical practice for healthcare workers.\(^1\)\(^-\)\(^3\) There are two main indications for the use of gloves in preventing HCAI:\(^1\)

- to protect hands from contamination with organic matter and microorganisms;
- to reduce the risks of transmission of microorganisms to both patients and staff.

In addition, there may be other indications not related to preventing the cross-transmission of infection, which require clinical gloves to be worn, e.g. the use of some chemicals or medications.

Gloves should not be worn unnecessarily, as their prolonged and indiscriminate use may cause adverse reactions and skin sensitivity and may lead to cross-contamination of the patient environment.\(^1\)\(^,\)\(^2\) We identified four observational studies that suggested that clinical gloves are not used in line with current guidance and that glove use impacts negatively on hand hygiene.\(^4\)\(^-\)\(^7\)

The need to wear clinical gloves and the selection of appropriate glove materials requires careful assessment of the task to be carried out and its related risks to patients and healthcare workers.\(^1\)\(^-\)\(^3\),\(^6\)\(^-\)\(^9\) Risk assessment should include consideration of:

- who is at risk (patient or healthcare worker) and whether sterile or non-sterile gloves are required;
- the potential for exposure to blood, body fluids, secretions and excretions;
- contact with non-intact skin or mucous membranes during care and invasive procedures;
• healthcare worker and patient sensitivity to glove materials.

Gloves must be removed immediately after each care activity for which they were worn in order to prevent the cross-transmission of microorganisms to other susceptible sites in that individual or to other patients. Gloves should not be washed or decontaminated with ABHR as a substitute for changing gloves between care activities.

Gloves are not infallible

There is evidence that hands become contaminated when clinical gloves are worn, even when the integrity of the gloves appear undamaged. In terms of leakage, gloves made from natural rubber latex (NRL) perform better than vinyl gloves in laboratory test conditions. Revised standards for the manufacture of medical gloves for single use require all clinical gloves to perform to the same standard, regardless of material. However, the integrity of gloves cannot be guaranteed, and additionally, hands may become contaminated during the removal of gloves. The appropriate use of clinical gloves provides barrier protection and reduces the risk of hand contamination from blood, body fluids, secretions and excretions, but do not eliminate the risk. Hands cannot be considered to be clean because gloves have been worn. Hands should be decontaminated with soap and water and dried with good quality paper towels following the removal of gloves.

SP24 Gloves must be worn for invasive procedures, contact with sterile sites, and non-intact skin or mucous membranes, and all activities that have been assessed as carrying a risk of exposure to blood, body fluids, secretions and excretions; and when handling sharp or contaminated devices. [No change]

SP25 Gloves must be worn as single use items. They are put on immediately before an episode of patient contact or treatment and removed as soon as the activity is completed. Gloves are changed between caring for different patients, or between different care/treatment activities for the same patient. [Revised wording]

SP26 Gloves must be disposed of as clinical waste and hands decontaminated with liquid soap and water immediately after the gloves have been removed. [Revised wording]

References

Making choices
Clinical gloves should be used by healthcare workers to prevent the risk of hand contamination with blood, body fluids, secretions and excretions and to protect patients from potential cross-contamination of susceptible body sites or invasive devices.1,2 Having decided that gloves should be used for a healthcare activity, the healthcare worker must make a choice between the use of:

- sterile or non-sterile gloves, based on contact with susceptible sites or clinical devices;
- surgical or examination gloves, based on the aspect of care or treatment to be undertaken.

Healthcare organisations must provide gloves that conform to European Standards (EN455-1, 455-2, 455-3), and which are acceptable to healthcare practitioners.1,4 Gloves are available in a variety of materials, the most common being NRL, which remains the material of choice, due to its efficacy in protecting against blood borne viruses and properties that enable the wearer to maintain dexterity.1,5 Patient or healthcare practitioner sensitivity to NRL proteins must also be taken into account when deciding on glove materials.6

Synthetic glove materials are generally more expensive than NRL and may not be suitable for all purposes.1 Nitrile gloves have the same chemical range as NRL and may also lead to sensitivity problems in healthcare workers and patients. Polythene gloves are not suitable for clinical use, due to their permeability and tendency to damage easily.1 A study comparing the performance of nitrile, latex, copolymer and vinyl gloves under stressed and unstressed conditions found that nitrile gloves had the lowest failure rate, suggesting that nitrile gloves are a suitable alternative to NRL, providing there are no sensitivity issues. Importantly, the study noted variation in performance of the same type of glove produced by different manufacturers.5 The
Health and Safety Executive (H&SE) also provide a guide to glove selection for employers.\(^7\)

**SP27** Gloves that are acceptable to healthcare personnel and CE marked must be available in all clinical areas. Class\(D/\) GPP/ H&S

**SP28** Sensitivity to natural rubber latex in patients, carers and healthcare workers must be documented and alternatives to natural rubber latex must be available. [Revised wording]

**SP29** Do not use polythene gloves for healthcare activities. Class\(D/\) GPP/ H&S

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**References**


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**Aprons or gowns?**

We identified a systematic review (SR) of the evidence that microbial contaminants found on the work clothing of healthcare practitioners are a significant factor in cases of HCAI. Reviewers identified seven small scale studies describing the progressive contamination of work clothing during clinical care and a further two studies that suggested a link with microbial contamination and infection.\(^1\)-\(^11\) One of the two studies was conducted in a simulated scenario and demonstrated that it was possible to transfer *Staphylococcus aureus* from nurses' gowns to patients' bed sheets, but was not associated with clinical infection.\(^10\) A further study, associated with an outbreak of *Bacillus cereus*, showed an epidemiological link between contaminated clothing and HCAI, but this occurred when surgical scrub suits became highly contaminated in an industrial laundry, rather than as a result of clinical care.\(^11\) A further study demonstrated high levels of contamination of gowns, gloves and stethoscopes with vancomycin-resistant enterococci (VRE) following examination of patients known to be infected.\(^12\)

A SR of eight studies assessing the effects of gowning by attendants and visitors found no evidence to suggest that over gowns are effective in reducing mortality, clinical infection or bacterial colonisation in infants admitted to newborn nurseries.\(^13\) One quasi-experimental study investigated the use of gowns and gloves as opposed
to gloves only in preventing the acquisition of VRE in a medical intensive care unit (ICU) setting. A further prospective observational study investigated the use of a similar intervention in a medical ICU. These studies suggested that the use of gloves and gowns may minimise the transmission of VRE when colonisation pressure is high.

National and international guidelines recommend that protective clothing should be worn by all healthcare workers when close contact with the patient, materials or equipment may lead to contamination of uniforms or other clothing with microorganisms, or when there is a risk of contamination with blood, body fluids, secretions, or excretions (with the exception of perspiration). Disposable plastic aprons are recommended for general clinical use. Full body gowns need only be used where there is the possibility of extensive splashing of blood, body fluids, secretions or excretions and should be fluid repellent.

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**SP30** Disposable plastic aprons must be worn when close contact with the patient, materials or equipment are anticipated and when there is a risk that clothing may become contaminated with pathogenic microorganisms or blood, body fluids, secretions or excretions, with the exception of perspiration. **[No change]**

**SP31** Plastic aprons/gowns should be worn as single-use items, for one procedure or episode of patient care, and then discarded and disposed of as clinical waste. Non-disposable protective clothing should be sent for laundering. **[No change]**

**SP32** Full-body fluid-repellent gowns must be worn where there is a risk of extensive splashing of blood, body fluids, secretions or excretions, with the exception of perspiration, onto the skin or clothing of healthcare workers. **[No change]**

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**References**

When is a facemask, respiratory protection and eye protection necessary?

Healthcare workers (and sometimes patients) may use standard, fluid-repellent surgical facemasks to prevent respiratory droplets from the mouth and nose being expelled into the environment. Facemasks are also used, often in conjunction with eye protection, to protect the mucous membranes of the wearer from exposure to blood and/or body fluids when splashing may occur. Our previous SRs failed to reveal any robust experimental studies that demonstrated that healthcare workers wearing surgical facemasks protected patients from HCAI during routine ward procedures, such as wound dressing or invasive medical procedures.¹ ²

Facemasks are also used to protect the wearer from inhaling minute airborne respiratory particles. As surgical facemasks are not effective at filtering out such particles, specialised respiratory protective equipment is recommended for the care of patients with certain respiratory diseases, e.g. active multiple drug-resistant pulmonary tuberculosis, ³ Severe Acute Respiratory Syndrome (SARS) and pandemic influenza. ⁴ The filtration efficiency of these masks (sometimes called ‘respirators’) will protect the wearer from inhaling small respiratory particles, but to be effective, they must fit closely to the face to minimise leakage around the mask.¹ ² ⁵

We identified four SRs of the use of facial protection, all of which had been undertaken in the aftermath of the SARS outbreak and in response to the H1N1 influenza pandemic. A range of study designs were considered in each of the reviews, including cluster randomised controlled trials, randomised controlled trials (RCTs), cohort studies and descriptive before-after studies. Overall, many studies were poorly controlled and confounders, such as poor compliance in the weaker studies, was not accounted for. Reviewers concluded that there was no strong evidence that masks/respirators alone are effective in prevention of respiratory viral infections. Masks/respirators should be used together with other protective measures to reduce transmission. ⁶ ⁴

Our previous SR indicated that different protective eyewear offered protection against physical splashing of infected substances into the eyes (although not on all occasions), but that compliance was poor.¹ Expert opinion recommends that face
and eye protection reduce the risk of occupational exposure of healthcare workers to splashes of blood, body fluids, secretion or excretions.\textsuperscript{1,2,10,11}

SP33 Fluid repellent surgical face-masks and eye protection must be worn where there is a risk of blood, body fluids, secretions or excretions splashing into the face and eyes. \textsuperscript{[Revised recommendation]}

SP34 An FFP3 facemask must be used when recommended for the care of patients with respiratory infections transmitted by airborne particles. Each FFP3 device must be fit tested and fit checked for each use. \textsuperscript{[Revised recommendation]}

SP35 Personal protective equipment should be removed in the following sequence to minimise the risk of cross-contamination:

- Gloves
- Gown or apron
- Eye protection (when worn)
- Respirator or fluid-repellent surgical mask \textsuperscript{[New recommendation]}

References


2.5 The Safe Use and Disposal of Sharps

This section discusses the evidence and associated recommendations for the safe use and disposal of sharps in general care settings. This includes minimising the risks associated with sharps use and disposal and the use of needle protection devices. Where appropriate, in addition to the classification of evidence underpinning the recommendations, there is an indication of a Health and Safety (H&S) legislation requirement.

Sharps injuries – what’s the problem?
The Health and Safety Executive (HSE) define a sharp as a needle, blade or other medical instrument capable of cutting or piercing the skin. Similarly, a sharps injury is an incident, which causes a needle, blade or other medical instrument to penetrate the skin (percutaneous injury). The safe handling and disposal of needles and other sharp instruments forms part of an overall strategy of clinical waste disposal to protect staff, patients and visitors from exposure to bloodborne pathogens.¹

In 2003, the National Audit Office found that needlestick and sharps injuries ranked alongside moving and handling, falls, trips and exposure to hazardous substances as the main types of accidents experienced by National Health Service (NHS) staff.² In 2008, a Royal College of Nursing survey of 4,407 nurses found that almost half (48%) had, at some point in their career, sustained a sharps injury from a device that had previously been used on a patient. A similar number (52%) reported fearing sharps injuries and nearly half (45%) reported that they had not received training from their employer on safe needle use.³ The 2012 ‘Eye of the Needle’ report from the Health Protection Agency confirms that healthcare workers continue to be exposed to bloodborne virus infections, even though such exposures are largely preventable. The number of reported occupational exposures has almost doubled from 276 in 2002 to 541 in 2011, with almost half of all exposures occurring in nurses.⁴ However, in 2011, medical and dental professions reported a similar number of occupational exposures as nursing professions, with exposures in these groups increasing by 131% between 2002 and 2011. The report draws attention to the need for NHS Trusts to comply with the European Council Directive 2010/32/EU and adopt safety devices in order to prevent sharps injuries.¹³

The average risk of transmission of bloodborne viruses following a single percutaneous exposure from an infected person, in the absence of appropriate post exposure prophylaxis, has been estimated to be:⁴⁻⁸

- hepatitis B virus (HBV) (1 in 3)
- hepatitis C virus (HCV) (1 in 30)
- human immunodeficiency virus (HIV) (1 in 300)

National and international guidelines are consistent in their recommendations for the safe use and disposal of sharp instruments and needles.⁶⁻¹¹ As with many infection prevention and control policies, the assessment and management of the risks associated with the use of sharps is paramount and safe systems of work and engineering controls must be in place to minimise any identified risks.¹² A European Council Directive 2010/32/EU ‘Implementing the Framework Agreement on Prevention from Sharps Injuries in the Hospital and Healthcare Sector’ requires the UK and all EU member states to introduce further protection for all healthcare workers exposed to the risk of sharps injuries.¹³ Specifically, from May 2013, the
“Sharps Directive” requires all employers, under existing health and safety law, to conduct risk assessments and put in place appropriate control measures. Employers must also provide employees with adequate information and training. Any healthcare worker sustaining an occupational exposure to blood or body fluids needs to be assessed for the potential risk of infection by a specialist practitioner, e.g. a physician or occupational health nurse, and offered testing, immunisation and post-exposure prophylaxis, where appropriate.

Avoiding sharps injuries is everybody’s responsibility

The European Sharps Directive includes a new duty for employees who receive a sharps injury whilst undertaking their work to inform their employer as soon as is practicable. All healthcare workers must be aware of their responsibility in avoiding sharps injuries.

We identified a systematic review (SR) that included the consideration of studies focusing on education and training interventions to minimise the incidence of occupational injuries involving sharps devices. The authors identified five primary before-after studies that demonstrated a consistent reduction in the incidence of percutaneous injuries when other safety initiatives, e.g. training, were implemented before and during the introduction of safer sharps devices. These studies used a range of interventions in one setting and are not generalisable. However, education is essential in ensuring that staff understand safe ways of working and how to use safety sharps devices. This should form a part of induction programmes for new staff and on-going in-service education. The introduction of new devices should include an appropriate training programme as part of staff introduction.

SP36 Sharps must not be passed directly from hand to hand and handling should be kept to a minimum. [No change]  

SP37 Needles must not be recapped, bent broken or disassembled after use. [No change]  

SP38 Used sharps must be discarded immediately, at the point of use by the person generating the waste, into a sharps container conforming to current national and international standards. These must not be filled above the mark that indicates the bin is full. [Revised wording]  

SP39 All sharps containers must:  
- be positioned safely, away from public areas and out of the reach of children, and at a height that enables safe disposal by all members of staff;  
- be secured to avoid spillage;  
- be temporarily closed when not in use;  
- be disposed of when the fill line is reached or every three months whichever is the sooner;  
- not be filled above the fill line. [Revised wording]  

SP40 All clinical and non-clinical staff must be educated ClassD/ GPP/
about the safe use and disposal of sharps.  

H&S

[No change]

References
Do needle protection devices reduce avoidable injuries?

To improve patient and staff safety the Department of Health and legislation requires healthcare providers and their employees to pursue safer methods of working through consideration of the benefits of new safety devices.\textsuperscript{1,2} The incidence of sharps injuries has led to the development of safety devices in many different product groups.\textsuperscript{3} They are designed to minimise the risk of operator injury during sharps use, as well as “downstream” injuries that occur after disposal, often involving the housekeeping or portering staff responsible for the collection of sharps disposal units.

The lack of well-designed, controlled intervention studies means that evidence to show whether or not safety devices are effective in reducing rates of infection is limited. However, a small number of studies have shown significant reductions in injuries associated with the use of safety devices\textsuperscript{4} in cannulation,\textsuperscript{5,6} phlebotomy\textsuperscript{7-9} and injections.\textsuperscript{10}

It would seem logical that where needle-free or other safety devices are used, there should be a resulting reduction in sharps injuries. A review of needlestick injuries in Scotland suggested that 56\% of injuries would ‘probably’ or ‘definitely’ have been prevented if a safety device had been used.\textsuperscript{11} However, some studies identify a range of barriers to the expected reduction in injuries, including staff resistance to using new devices, complexity of device operation or improper use, and poor training.\textsuperscript{4} A comprehensive report and product review conducted in the USA provides background information and guidance on the need for and use of needlestick-prevention devices, but also gives advice on establishing and evaluating a sharps injury prevention programme.\textsuperscript{3} The report identifies that all devices have limitations in relation to cost, applicability and/or effectiveness. Some of the devices available are more expensive than standard devices, may not be compatible with existing equipment, and may be associated with an increase in bloodstream infection rates if used incorrectly.\textsuperscript{12}

The National Institute for Health and Care Excellence (NICE) identified three randomised controlled trials (RCT) comparing safety cannulae with standard cannulae. The studies were all in hospital settings and of low/very low quality. The quality of evidence for safety needle devices was low, with no RCTs identified and the five before-after implementation studies being of very low quality. The quality of evidence for training was similarly low, with the type of training varying across the five observational studies identified.\textsuperscript{13}

We identified a SR undertaken by the HSE, which reviewed 41 studies that provided evidence for reductions in the incidence of occupational sharps injuries associated with use of sharps safety devices in reducing occupational injury, education and training and the acceptability of sharps safety devices.\textsuperscript{14} Thirteen studies, predominantly with observational designs, demonstrated that sharps safety devices were associated with a significant reduction in the incidence of healthcare worker needlestick injury.\textsuperscript{7,9,15-24} However, safety devices were not the total solution to reducing occupational injury. The beneficial outcome of consulting with end users of safer sharps devices before they are introduced was adequately demonstrated in five studies identified in this review.\textsuperscript{7,16,25-28}

In the USA, the Occupational Safety Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) suggest that a thorough evaluation of any device is essential before purchasing decisions are made.\textsuperscript{29,30} Similarly, the HSE identifies that the end-users of any safer sharps device should be involved in assessing user acceptability and clinical applicability of any needle safety devices.\textsuperscript{31} The evaluation should ensure that the safety feature works effectively and...
reliably, that the device is acceptable to healthcare practitioners and that it does not adversely affect patient care.

**SP41** Use safety sharps devices where there are clear indications that they will provide safe systems of working for healthcare practitioners.  
[Revised wording]

**SP42** Evaluate the use of safety sharps devices to determine their effectiveness, acceptability to practitioners, impact on patient care and cost benefit, prior to widespread introduction.  
[Revised wording]

**References**


2.6 Asepsis

Asepsis can be defined as the purposeful prevention of the transfer of potentially pathogenis microorganisms and is an essential component in the prevention of HCAI, particularly those associated with the insertion and maintenance of invasive devices and the management of non-intact skin and wounds. The principles of aseptic technique are based on a priori scientific knowledge about the way in which microorganisms can be transferred and about the susceptibility of unwell individuals, who have compromised immune systems or body defences, due to injury or healthcare intervention, e.g. surgery or the insertion of a medical device.

The main principle of an aseptic technique is that a susceptible site, e.g. a wound or invasive device, should not come into contact with any item that is not sterile and that any items of equipment that have been in contact with a susceptible site should be disposed of safely or decontaminated. Aseptic technique should be used for the insertion and manipulation of any sterile medical device. When conducting an aseptic procedure ensure that:

- sterile packs are placed on clean surfaces;
- all the materials and fluids in contact with the susceptible site are sterile and packs/containers are undamaged;
- hands are decontaminated immediately prior to the procedure or the donning of gloves;
- sterile gloves are used where susceptible body sites will be touched or a sterile invasive device manipulated;
- items that become contaminated during the procedure are discarded and replaced with new sterile items, e.g. gloves, fluids or containers.

SP43  Use an aseptic technique for all procedures that entail contact with a susceptible site or sterile invasive device.  
Class D/ GPP  
[New recommendation]

References
   Accessed 6 June 2013.
SECTION 3

GUIDELINES FOR PREVENTING INFECTIONS ASSOCIATED WITH THE USE OF SHORT-TERM INDWELLING URETHRAL CATHETERS
Section 3 - Guidelines for preventing infections associated with the use of short-term indwelling urethral catheters

3.1 Introduction
This guidance is based on the best critically appraised evidence currently available. The type and class of supporting evidence explicitly linked to each recommendation is described. All recommendations are endorsed equally and none is regarded as optional. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines.

These guidelines apply to adults and children aged one year and older who require a short term indwelling urethral catheter (28 days or less), and should be read in conjunction with the guidance on Standard Principles. The recommendations are divided into six distinct interventions:

1. Assessing the need for catheterisation;
2. Selection of catheter type and system;
3. Catheter insertion;
4. Catheter maintenance;
5. Education of patients, relatives and healthcare workers and;
6. System interventions for reducing the risk of infection.

3.2 Background and context of the Guidelines
Urinary tract infection (UTI) is the most common infection acquired as a result of healthcare, accounting for 19% of HCAI, with between 43 to 56% of these UTI associated with a urethral catheter. Catheter predisposes to infection because microorganisms are able to bypass natural host mechanisms such as the urethra and micturition and gain the entry to the bladder. Most microorganisms causing these catheter associated urinary tract infection (CAUTI) gain access to the urinary tract either extraluminally or intraluminally. Extraluminal contamination may occur as the catheter is inserted, by contamination of the catheter from the health care worker’s hands or from the patient’s own perineal flora. Extraluminal contamination is also thought to occur by microorganisms ascending from the perineum. Intraluminal contamination occurs by reflux of microorganisms from a contaminated urine drainage bag. The bladder is normally sterile and in the non-catheterised patient a UTI is usually readily identifiable from the symptoms of dysuria and frequency. Patients who develop a UTI with an indwelling catheter in place will not experience these symptoms, and diagnosis is based on other signs such as fever, suprapubic or loin tenderness. After a few days of catheterisation microorganisms may be isolated from urine and, in the absence of any symptoms of UTI this is called bacteriuria. The duration of the catheterisation is the dominant risk factor for (CAUTI) and virtually all catheterised patients develop bacteriuria within one month. For the purpose of these guidelines a duration of catheterisation of 28 days or less is considered to be a short-term catheterisation.
Several factors contribute to the potential development of CAUTI including the formation of biofilms and encrustation of the catheter. Bacteria on the catheter surface and drainage bag multiply rapidly, adhering to the surface by excreting extracellular polysaccharides and forming a layer known as biofilm. Bacteria within the biofilm are morphologically and physiologically different from free-living planktonic bacteria in the urine, and have considerable survival advantages as they are protected from the action of antibiotic therapy.

Whilst biofilms commonly form on devices inserted into the body, they can cause additional problems on urethral catheters if the bacteria produce the enzyme urease, such as *Proteus mirabilis*. This enzyme causes the urine to become alkaline inducing crystallisation of calcium and magnesium phosphate within the urine. These crystals are incorporated into the biofilm and over time result in encrustation of the catheter. Encrustation is generally associated with long-term catheterisation, as it has a direct relationship with the length of catheterisation.

Urinary catheterisation is a frequent intervention during clinical care in hospital affecting a significant number of patients. It has been estimated that 15 to 25% hospitalised patients receive urinary catheter during their stay. This number is much higher in ICU/ITU where most patients are catheterised. The risk of infection is associated with the method and duration of catheterisation, the quality of catheter care and patient susceptibility. Between 20% and 30% of catheterised patients develop bacteriuria, of whom 2-6% percent develop symptoms of CAUTI. Approximately 3% of those with CAUTI develop life threatening secondary infections such as bacteraemia or sepsis, where mortality rates range from 10% to 33%. CAUTI is associated with prolonged hospitalisation, readmissions and increased mortality. Those particularly at risks are immunocompromised, elderly, debilitated and patients with diabetes.

Physical and psychological discomfort associated with insertion, removal and the catheter in situ are common. Complications such as inflammation, urethral strictures, mechanical trauma, bladder calculi and inflammation of renal system also occur. Urine retention after catheter removal is also a frequent occurrence. In some instances, especially in older people, CAUTI may also contribute to falls and delirium. The treatment of both CAUTI and other infection sequelae contribute to the emerging problem of antibiotic resistance in hospitals and uropathogens are a major source of antimicrobial resistant organisms.

CAUTI also affects the costs of healthcare due to delayed discharge from hospital, treatment and staff resources. The financial burden of CAUTI on NHS has been estimated as £99 million/year with estimated cost per episode of £1968. However, there are no robust economic assessments of the cost of CAUTI.

References

### 3.3 Assessing the need for catheterisation

Catheters place patients at significant risk of acquiring a urinary tract infection. The longer a catheter is in place, the greater the danger.

There is a strong association between the duration of catheterisation and risk of infection, i.e., the longer the catheter is in place, the higher the incidence of urinary tract infection\(^1,2,3\). In acute care facilities, 20-30% of catheterised patients develop bacteriuria, with the risk approximately 5 percent for each day of catheterisation\(^1,4,5\). Between 2 and 6% of bacteriuric patients with develop CAUTI and of these, 1-4 percent develop a bloodstream infection.

Advice from best practice emphasises the importance of documenting all procedures involving the catheter or drainage system in the patient’s records\(^6\) and providing patients with adequate information in relation to the need for catheterisation and details of the insertion procedures, maintenance and removal of their catheter\(^6,7\). There is some evidence to suggest that computer management systems improve documentation and in so doing reduce the duration of catheterisation\(^8\).

**What are the indications for using a short-term urinary catheter?**

The use of a short-term urethral catheter is appropriate in patients with acute urinary retention or obstruction, those who require precise urine output measures to monitor an underlying condition, patients undergoing certain surgical procedures, especially with prolonged duration and urological procedures. Furthermore, an indwelling catheter may be appropriate to improve patient comfort during end-of-life care or in the management of open sacral or perineal wounds when the patient is incontinent.\(^9\)

While the use of the urinary catheter is sometimes unavoidable, there is evidence that catheters are inserted without a clear clinical indication, clinicians are not always aware they are *in situ*, and they are not removed promptly when no longer required.\(^10,11\) Using an indwelling urethral catheter only when necessary and after considering alternatives, and ensuring the catheter is removed as soon as possible are simple and effective methods to preventing CAUTI. Interventions that prompt or facilitate the removal of unnecessary catheters may therefore reduce the risk of CAUTI. These interventions have been categorised as reminder systems, which remind clinicians that the catheter is in place and removal should be considered, or stop orders that indicate that catheters should be removed after a set period of time or when defined clinical criteria have been met\(^8,12-14\).

A well-conducted SR of 14 studies (one RCT, one NRCT, three controlled before-after (CBA) and nine uncontrolled before after studies) on reminder and stop order systems found that these interventions significantly decreased the rate of CAUTI and did not increase the need for re-catheterisation, although as some of the studies were not controlled, they were susceptible to bias in favour of the intervention.\(^12\)

A second SR identified a number of uncontrolled before after studies that used ultrasound bladder scanners to assess for urinary retention and support appropriate catheterisation. When used in combination with guidelines\(^16\), insertion checklist/kit, education, audit and feedback\(^17\) and reminder/stop orders\(^18\), ultrasound bladder scanners were found to decrease the use of urethral catheters by between 5 and 15%.\(^15\)
Only use an indwelling urethral catheter in patients for whom it is clinically indicated and following the assessment of alternative methods. [Revised recommendation]

Document the clinical indication(s) for catheterisation, date of insertion, expected duration, type of catheter inserted and planned date of removal. [Revised recommendation]

Assess and document each day of the clinical need for continuing catheterisation and ongoing care. Remove the catheter when no longer clinically indicated. [Revised recommendation]

References
3.4 Selection of a catheter type

Is one catheter better than another?

Evidence from best practice indicates that the incidence of CAUTI in patients catheterised for a short time (up to one week) is not influenced by any particular type of catheter material. However, many practitioners have strong preferences for one type of catheter over another. This preference is often based on clinical experience, patient assessment, and materials that induce the least allergic response. Smaller gauge catheters with a 10 ml balloon minimise urethral trauma, mucosal irritation and residual urine in the bladder, all factors that predispose to CAUTI. However, in adults that have recently undergone urological surgery, larger gauge catheters may be indicated to allow for the passage of blood clots. Our previous evidence–based guidelines identified three experimental studies that compared the use of latex with silicone catheters. No significant difference in the incidence of bacteriuria was found.

We identified one new SR that included three trials comparing different types of standard (non-antiseptic/antimicrobial impregnated) catheters. These studies did not provide sufficient evidence to suggest that one type of catheter may be more effective than another in preventing bacteriuria. However, there is a risk of urethral trauma associated with using a female catheter in a male patient and systems should be in place to ensure this does not occur.

In our previous SR we found evidence related to the efficacy of using urinary catheters coated or impregnated with antiseptic or antimicrobial agents from four SRs and one meta-analysis that have examined this issue. In general, all of these five studies suggested antiseptic impregnated or antimicrobial-coated urinary catheters can significantly prevent or delay the onset of CAUTI when compared to standard untreated urine catheters. The consensus in these five reviews of evidence however, is that the individual studies reviewed are generally of poor quality; for instance in one case only eight studies out of 117 met the inclusion criteria and in another, of the six reports describing seven trials included, only one scored five in the quality assessment the other five scored only one. The studies included in these reviews investigated a wide range of coated or impregnated catheters including: catheters coated or impregnated with: silver alloy, silver oxide, silver oxide, gentamicin, and silver-hydrogel; minocycline, rifampicin; chlorhexidine–silver sulfadiazine, chlorhexidine–sulfadiazine–triclosan; nitrofurazone, and nitrofurazone. Four studies compared the use of silver coated (silver alloy or silver oxide) catheters with silicone, hydrogel or Teflon® latex. A SR and meta-analysis of these and other studies found that silver alloy (but not silver oxide) catheters were associated with a lower incidence of bacteriuria. Despite their unit cost, these devices may provide a a cost-effective option if overall numbers of infections are significantly reduced through their use. However, the few studies that have explored the cost benefit / effectiveness of using these devices have however, also been inconclusive.

We identified two new SR of the efficacy of silver coated or antimicrobial impregnated catheters in preventing CAUTI. The first SR included 22 RCT as well as one NRCT, and concluded that silver coated (alloy or oxide) indwelling catheters for
short-term catheterisation reduced the risk of bacteriuria but did not demonstrate an
effect on CAUTI. Catheters impregnated with antimicrobial agents (minocycline,
rifampicin or nitrofurazone) were found to reduce the rate of bacteriuria during the
first week of catheterisation but not for catheter durations of greater than a week.
Although antimicrobial impregnated catheters reduced the risk of CAUTI, the number
cases was too small to demonstrate a significant effect.

The second SR included nine RCTs and 3 quasi-experimental studies and concluded
that, compared to standard catheters, both nitrofurazone impregnated and silver alloy
coated catheters can both prevent and delay the onset of bacteriuria during short
term use, however there was no data on the risk of CAUTI.

We identified one high-quality multicentre RCT that compared silver alloy and
nitrofurazone impregnated catheters with standard Teflon® coated latex for short-
term catheterisation. Although the nitrofurazone and silver alloy catheters were
associated with a reduced risk of CAUTI (adjusted OR 0.81; 95%CI 0.66 -1.01 and
0.96; 95%CI 0.78-1.19 respectively) compared to the Teflon® coated latex, the effect
was not considered to be clinically effective at this level. The nitrofurazone, but not
the silver alloy catheter, was associated with significantly lower incidence of
bacteriuria (OR 0.68; 95%CI 0.48-0.99, p=0.017). However, the nitrofurazone
impregnated catheter was associated with increased discomfort during the period the
catheter was in place. A limitation of this study is that the median duration of
catheterisation was two days (range 1 to 3 days) and the risk of CAUTI associated with
this short period is correspondingly low. However, UTI developing up to six weeks
post randomisation were included in the outcome measurement, even though they
may not have been directly associated with the catheterisation. The economic
analysis suggested that nitrofurazone-impregnated but not silver-alloy catheters may
be cost effective, however the measures of cost were associated with a large amount
of uncertainty.

UC4 Assess patient’s needs prior to catheterisation in terms of:

- Latex allergy;
- Length of catheter (male, female, paediatric);
- Type of drainage: bag (uretometer, 2 litre bag, leg; bag) or catheter valve;
- Comfort and dignity.

[New recommendation]

UC5 Select a catheter that minimizes urethral trauma, irritation and discomfort and is appropriate for the anticipated duration of short-term catheterisation.

[Revised wording]

UC6 Select the smallest gauge catheter that will allow free urinary outflow and use a 10 ml retention balloon.

Urological patients may require larger gauge sizes and balloons.

[Revised wording]
References

3.5 Catheter insertion

What technique should be used to insert a catheter?

In our previous review we found evidence from two SR which suggests that the use of aseptic technique has not demonstrated a reduction in the rate of CAUTI. However, principles of good practice, clinical guidance and expert opinion, together with findings from another systematic review agree that urinary catheters must be inserted using sterile equipment and an aseptic technique.

Expert opinion indicates that there is no advantage in using antiseptic preparations for cleansing the urethral meatus prior to catheter insertion. Whilst there is low quality evidence to suggest pre-lubrication of the catheter decreases the risk of bacteriuria, it is also important to use lubricant or anaesthetic gel in order to minimise urethral trauma and discomfort. There is no evidence suggesting a general benefit of securing the catheter in terms of preventing the risk of CAUTI, but it is important in order to minimise patient discomfort.

Ensuring healthcare practitioners are trained and competent in the insertion of urinary catheters will minimise trauma, discomfort and the potential for CAUTI.

Neither we, nor HICPAC guideline developers, identified any additional evidence of acceptable quality whilst updating our systematic reviews.

UC7 Catheterisation is an aseptic procedure and should only be undertaken by healthcare workers trained and competent in this procedure. [Revised wording]

Class D/ GPP

UC8 Clean the urethral meatus with sterile normal saline prior to the insertion of the catheter. [No change]

Class D/ GPP

UC9 Use lubricant from a sterile single use container to minimize urethral discomfort, trauma and infection. Ensure the catheter is comfortably secured. [Revised wording]

Class D/ GPP

References

3.6 Catheter maintenance

How should the drainage system be managed?

Maintaining a sterile, continuously closed urinary drainage system is central to the prevention of CAUTI.16 The risk of infection reduces from 97 percent with an open system to 8-15 percent when a sterile closed system is employed.7,8 Breaches in the closed system such as unnecessary emptying, or changing of the urinary drainage bag, or taking a urine sample, will increase the risk of CAUTI and therefore should be avoided.4,9,10 Hands must be decontaminated and clean, non-sterile gloves worn before manipulation of the catheter or the closed system including drainage taps. A SR has suggested that sealed (e.g., taped, pre-sealed) drainage systems contribute to preventing bacteriuria.11 However, there is limited evidence as to how often catheter bags should be changed. One study showed higher rates of symptomatic and asymptomatic CAUTI were associated with a three day urinary drainage bag change regimen when compared to no routine change regimen.14 Best practice suggests that changing drainage bags only when necessary, i.e. according either to the manufacturer’s recommendations or the patient's clinical need.4,6 Reflux of urine is associated with infection and consequently, drainage bags should be positioned in a way that ensures the free flow of urine and prevents back-flow.4,5 It is also recommended that urinary drainage bags should be hung on an appropriate stand that prevents contact with the floor.9

A number of studies have investigated the addition of disinfectants and antimicrobials to drainage bags as a way of preventing CAUTI.15 Three acceptable studies16-18 from our original SR19 demonstrated no reduction in the incidence of bacteriuria following the addition of hydrogen peroxide or chlorhexidine to urinary drainage bags. These findings are supported by a SR which suggests that adding bacterial solutions to drainage bags has no effect on catheter associated infection.11

Neither we nor HICPAC guideline developers identified any additional evidence of acceptable quality whilst updating our systematic reviews.

UC10 Connect an indwelling urethral catheter to a sterile closed urinary drainage system. Class A

[Revised wording]

UC11 Do not break the connection between the catheter and the urinary drainage system unless clinically indicated. Class A
UC12  Change urinary catheters and drainage bags when clinically indicated and in line with the manufacturer recommendations.  [New recommendation]

UC13  Decontaminate hands and wear a new pair of clean, non-sterile gloves before manipulating the patient’s catheter. Decontaminate hands immediately following the removal gloves.  [Revised wording]

UC14  If a urine sample is required use the sampling port and an aseptic technique to obtain a catheter sample of urine.  [Revised wording]

UC15  Position the urinary drainage bag below the level of the bladder on a stand that prevents contact with the floor.  [Revised wording]

UC16  Position the urinary drainage bag below the level of the bladder on a stand that prevents contact with the floor.  [Revised wording]

UC17  Do not allow the urinary drainage bag to fill beyond three-quarters full. Use a separate, clean container for each patient and avoid contact between the urinary drainage tap and the container.  [Revised recommendation]

UC18  Do not add antiseptic or antimicrobial solutions into urinary drainage bags.  [No change]

References


Routine meatal cleansing with antiseptic solutions is unnecessary
Our previous SRs found eight acceptable studies that compared meatal cleansing with a variety of antiseptic/antimicrobial agents or soap and water. No reduction was demonstrated in bacteriuria when using any of these preparations for meatal/periurethral hygiene compared with routine bathing or showering. 3-12

Expert opinion and other SR support the view that active meatal cleansing is not necessary and may increase the risk of infection.13-18 Daily routine bathing or showering is all that is needed in order to maintain patient comfort.

Neither we, nor HICPAC guideline developers, identified any additional evidence of acceptable quality whilst updating our systematic reviews.

Routine daily personal hygiene is all that is required for Class A meatal cleansing.

[Revised wording]
References


Irrigation, instillation and washout do not prevent infection
Our previous SR evidence did not demonstrate any beneficial effect of bladder irrigation, instillation or washout with a variety of antiseptic or antimicrobial agents in preventing catheter-associated infection.1-13
Evidence from best practice supports the findings in respect of bladder irrigation, instillation and washout and indicates that the introduction of such agents may have local toxic effects and contribute to the development of resistant microorganisms. However, continuous or intermittent bladder irrigation may be required for other urological or catheter management indications.14-16

UC20 Do not use bladder irrigation, instillation and washout to prevent catheter-associated infection. [Revised wording]

References
Educating patients, relatives and healthcare workers

Given the frequency of urinary catheterisation in hospital patients and the associated risk of UTI, it is important that patients, their relatives and healthcare workers responsible for catheter insertion and management are educated about infection prevention. All those involved must be aware of the signs and symptoms of UTI and how to access expert help when difficulties arise. Healthcare professionals must be confident and proficient in associated procedures.

We identified two SR that reported the evidence of the efficacy of healthcare workers’ education on reducing the risk of CAUTI within other system interventions. Most of the studies included in these reviews provided low grade evidence from uncontrolled before after studies where a combination of different system interventions focusing on reducing the use of urethral catheters and risk of CAUTI were introduced. The first SR identified one small CBA study of an educational intervention with guideline change and posters that was associated with a reduction in use of urethral catheters (RR 0.86; 95%CI 0.68-1.10). Another SR included one CBA study that demonstrated a significant (p<0.01) increase in adherence to a clinical guideline on the insertion and maintenance of urethral catheters in association with an education programme. Another study reported a reduction in CAUTI and increase in adherence to protocols for hand hygiene and catheter care in association with an education programme; however this study did not include a control group.

UC21 Healthcare workers should be trained and updated in the appropriate use, selection, insertion, maintenance and removal of urinary catheters.

[Revised wording]

UC22 Ensure patients, relatives and carers are given information regarding: reasons for catheter insertion; participating in the management of the catheter; minimising the risk of urinary tract infection and support and review from healthcare professionals if discharged with a catheter.

[Revised recommendation]

References

3.8 System interventions for reducing the risk of infection

There have been a number of studies that report the effect of quality improvement programmes on the risk of CAUTI. The components of these programmes include various combinations of clinical guidelines for catheter insertion and maintenance, education, audit and feedback of compliance with policy, physician/nurse reminder systems (to prompt removal if no longer necessary), automated or nurse-driven removal protocols (where the catheter is removed after a specified period e.g. 48-72hr, unless countermanded by the physician) and the use of bladder scanners to assess urinary retention and support appropriate catheterisation.

We identified three SR relevant to this question. The first was a review of interventions to remind physician/nurse to remove unnecessary catheters and the outcome on CAUTI, urinary catheter use and catheter replacement and included 14 studies (one RCT, one NRCT, three CBA and nine uncontrolled before after studies). Interventions included prewritten or computer generated stop order, nurse generated daily bedside reminders to remove catheters and daily use of a checklist or protocol to review need for the catheter. Some studies also implemented catheter placement restrictions and education. The meta-analysis suggested that the use of reminder or stop order systems reduced the rate of CAUTI was by 52% (p<0.001) and the mean duration of catheterisation by 37%, with 2.61 fewer days of catheterisation in the intervention versus control groups, and no difference in re-catheterisation rates.

The second SR was a review of interventions to minimise the placement of urethral catheters in patients in acute care. It included one RCT, one NRCT and six uncontrolled before after studies. Interventions included various combinations of clinician reminders, stop orders and indication checklist, use of bladder scanners and education. Authors concluded that the studies were too small and heterogeneous to draw a definitive conclusion about the efficacy in terms of reducing inappropriate catheter placement.

The third SR included three CBA and seven uncontrolled before after studies measuring interventions that increased adherence to catheter care protocols or reduced unnecessary catheter use. Interventions included reminders, stop orders, use of bladder scanners, education and catheterisation protocols with audit and feedback on performance. Physician/nurse reminders, in particular automatic stop orders, were found to reduce the duration of catheterisation although there was insufficient data to determine their effect on CAUTI.

Many studies in this area are uncontrolled before after designs and therefore susceptible to bias in favour of the intervention. However these interventions constitute best practice and this evidence supports the use of systems to minimise the insertion of catheters and promote timely removal to reduce both the duration of catheterisation and the risk of CAUTI.
UC23 Use quality improvement systems to support the appropriate use and management of short-term urethral catheters and ensure their timely removal. These may include:

- Protocols for catheter insertion
- Use of the bladder ultrasound scanners to assess and manage urinary retention
- Reminders to view the continuing use or prompt the removal of catheters
- Audit and feedback of compliance with practice guidelines
- Continuing professional education.

[New recommendation]

UC24 No patient should be discharged or transferred with an indwelling urethral catheter without a plan documenting the:

- Clinical indication(s) for continuing catheterisation
- Type of catheter inserted
- Date of insertion
- Planned date for removal or a date for review by an appropriate clinician e.g., urologist, continence adviser.

[New recommendation]
SECTION 4
GUIDELINES FOR PREVENTING INFECTIONS ASSOCIATED
WITH THE USE OF INTRAVASCULAR ACCESS DEVICES
(IVAD)
Section 4 - Guidelines for preventing infections associated with the use of Intravascular Access Devices (IVAD)

4.1 Introduction

This guidance is based on the best critically appraised evidence currently available. The type and class of supporting evidence explicitly linked to each recommendation is described. All recommendations are endorsed equally and none are regarded as optional. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines.

Background and context to the Guidelines

Intravascular access devices, including peripheral, central venous and arterial catheters, are commonly used in the management of patients in acute care settings. Central venous catheters (CVC) are frequently used during clinical care and include peripherally inserted, non-tunneled and tunneled, and totally implantable CVC (Table 1). The use of any of these catheters can result in bloodstream infection.

Catheter-related bloodstream infections (CR-BSI) associated with the insertion and maintenance of CVC are potentially among the most dangerous complications associated with healthcare. The Health Protection Agency reports that 0.5% prevalence accounts for 6.8% of HCAI. Sixty-four per cent of CR-BSI occur in patients with a device, with previous point prevalence data reporting that 0.85% prevalence accounts for 7% of HCAI and, of these, 70% are primary CR-BSI.

Although the prolonged use of peripheral venous catheters (PVC) may cause phlebitis, they are rarely associated with CR-BSI.

Catheter-related bloodstream infection involves the presence of systemic infection and evidence implicating the intravascular catheter as its source, i.e. the isolation of the same microorganism from blood cultures as that shown to be significantly colonising the intravascular catheter with clinical features of bacteraemia. Catheter colonisation, also referred to as central line-associated bloodstream infection (CLABSI), refers to a significant growth of microorganisms on either the endoluminal or the external catheter surface beneath the skin in the absence of systemic infection.

The microorganisms that colonise catheter hubs and the skin adjacent to the insertion site are the source of most CR-BSI. Coagulase-negative staphylococci, particularly Staphylococcus epidermidis, are the most frequently implicated microorganisms associated with CR-BSI. Other microorganisms commonly involved include Staphylococcus aureus, Candida species and enterococci.

Catheter-related bloodstream infection is generally caused either by skin microorganisms at the insertion site, which contaminate the catheter during insertion and migrate along the cutaneous catheter track, or microorganisms from the hands of healthcare workers that contaminate and colonise the catheter hub during care interventions. Less commonly, infusate contamination or bloodstream seeding from a different site of infection in the body is implicated as a cause of CR-BSI.
Table 1. Catheters used for venous and arterial access

(Adopted from O’Grady et al. 2011)

<table>
<thead>
<tr>
<th>Catheter type</th>
<th>Entry Site</th>
<th>Length</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral venous catheters</td>
<td>Usually inserted in veins of forearm or hand</td>
<td>&lt;3 inches</td>
<td>Phlebitis with prolonged use; rarely associated with bloodstream infection</td>
</tr>
<tr>
<td>Peripheral arterial catheters</td>
<td>Usually inserted in radial artery; can be placed in femoral, axillary, brachial, posterior tibial arteries</td>
<td>&lt;3 inches</td>
<td>Low infection risk; rarely associated with bloodstream infection</td>
</tr>
<tr>
<td>Midline catheters</td>
<td>Inserted via the antecubital fossa into the proximal basilic or cephalic veins; does not enter central veins, peripheral catheters</td>
<td>3 to 8 inches</td>
<td>Anaphylactoid reactions have been reported with catheters made of elastomeric hydrogel; lower rates of phlebitis than short peripheral catheters</td>
</tr>
<tr>
<td>Nontunneled central venous catheters</td>
<td>Percutaneously inserted into central veins (subclavian, internal jugular, or femoral)</td>
<td>≥8 cm depending on patient size</td>
<td>Account for majority of CRBSI</td>
</tr>
<tr>
<td>Pulmonary artery catheters</td>
<td>Inserted through a Teflon® introducer in a central vein (subclavian, internal jugular, or femoral)</td>
<td>≥30 cm depending on patient size</td>
<td>Usually heparin bonded; similar rates of bloodstream infection as CVCs; subclavian site preferred to reduce infection risk</td>
</tr>
<tr>
<td>Peripherally inserted central venous catheters (PICC)</td>
<td>Inserted into basilic, cephalic, or brachial veins and enter the superior vena cava</td>
<td>≥20 cm depending on patient size</td>
<td>Lower rate of infection than nontunneled CVCs</td>
</tr>
<tr>
<td>Tunneled central venous catheters</td>
<td>Implanted into subclavian, internal jugular, or femoral veins</td>
<td>≥8 cm depending on patient size</td>
<td>Cuff inhibits migration of organisms into catheter tract; lower rate of infection than nontunneled CVC</td>
</tr>
<tr>
<td>Totally implantable</td>
<td>Tunneled beneath skin and have subcutaneous port accessed with a needle; implanted in subclavian or internal jugular vein</td>
<td>≥8 cm depending on patient size</td>
<td>Lowest risk for CRBSI; improved patient self-image; no need for local catheter-site care; surgery required for catheter removal</td>
</tr>
<tr>
<td>Umbilical catheters</td>
<td>Inserted into either umbilical vein or umbilical artery</td>
<td>≤6 cm depending on patient size</td>
<td>Risk for CRBSI similar with catheters placed in umbilical vein versus artery</td>
</tr>
</tbody>
</table>

References

4.2 What is the evidence for these guidelines?

These guidelines are primarily based upon an expert review of evidence-based guidelines for preventing intravascular device-related infections, developed at the Centers for Disease Control and Prevention (CDC) in the United States of America by the Healthcare Infection Control Practices Advisory Committee (HICPAC), published in 2011.1

The AGREE II collaboration appraisal instrument was used by four appraisers to independently review the updated guidelines.2 The appraisal process resulted in the decision that the development processes were valid and that the guidelines were evidence-based, categorised to the strength of the evidence examined, reflective of current concepts of best practice, and acknowledged as the most authoritative reference guidelines currently available. They were subsequently used as the principal source of evidence for updating the epic2 guidelines.3

Following our expert review, we systematically searched, retrieved and appraised additional evidence published since the 2011 HICPAC guidelines were developed. Our Search period for additional evidence spanned from 2009 to 2012. The recommendations are divided into nine distinct interventions:

1. Education of healthcare workers and patients;
2. General asepsis;
3. Selection of catheter type;
4. Selection of catheter insertion site;
5. Maximal sterile barrier precautions during catheter insertion;
6. Cutaneous antisepsis;
7. Catheter and catheter site care;
8. Catheter replacement strategies;
9. General principles for catheter management.

These guidelines apply to caring for all adults and children over the age of one year in National Health Service (NHS) acute care settings with a central or peripheral intravascular catheter that is being used for the administration of fluids, medications, blood components and/or total parenteral nutrition (TPN). They should be used in conjunction with the recommendations on Standard Principles for Preventing HCAI, previously described in these guidelines.

Although these recommendations describe general principles of best practice that apply to all patients in hospital in whom an intravascular catheter is being used, they do not specifically address the more technical aspects of the care of infants under the age of one year, or those children or adults receiving haemodialysis, who will generally have their intravascular catheters managed in dialysis centres.

References

4.3 Education of Healthcare Workers and Patients

To improve patient outcomes and reduce healthcare costs, it is essential that everyone involved in caring for patients with intravascular catheters is educated about infection prevention. Healthcare workers in hospitals need to be confident and proficient in infection prevention practices and to be aware of the signs and symptoms of clinical infection. Well-organised educational programmes that enable healthcare workers to provide, monitor, and evaluate care and continually increase their competence are critical to the success of any strategy designed to reduce the risk of infection. Evidence reviewed by HICPAC consistently demonstrated that the risk of infection declines following the standardisation of aseptic care and increases when the maintenance of intravascular catheters is undertaken by inexperienced healthcare workers.

We identified two recent systematic reviews (SR) that assessed the effectiveness of education interventions in reducing CR-BSI. The first concluded that current evidence comes predominantly from uncontrolled before-after studies that do not convincingly distinguish intervention effectiveness from secular trends. Clinical practices are being addressed by a wide variety of educational strategies that do not draw upon pedagogic, theoretical or conceptual frameworks and consequently do not provide generalisable conclusions about the most effective approaches to education to improve practice.
The second SR concluded that educational interventions appear to have the most prolonged and profound effect when used in conjunction with audit and feedback, and when availability of clinical equipment is consistent with the content of the education provided. Second, educational interventions will have a greater impact if baseline compliance to best practice is low. Third, repeated sessions, fed into daily practice, using practical participation, appear to have a small, additional effect on practice change, when compared to education alone.10

IVAD 1 Healthcare workers caring for patients with IV intravascular catheters should be trained and assessed as competent in using and consistently adhering to the infection prevention practices for the prevention of catheter-related bloodstream infection. [Revised wording]

IVAD 2 Before discharge from hospital, patients with IV intravascular catheters and their carers should be taught any techniques they may need to use to prevent infection and safely manage their device. [Revised wording]

References

4.4 General Asepsis
Hand antisepsis and meticulous aseptic technique are essential during catheter insertion, manipulation, changing catheter site dressings and for accessing the system. Hand antisepsis can be achieved by washing hands with an antimicrobial liquid soap and water, or by using an alcohol-based handrub (ABHR).1 When hands are visibly dirty or potentially contaminated with organic material, such as blood and
other body fluids or excretions, they must first be washed with liquid soap and water if ABHR is going to be used to achieve hand antisepsis.

Appropriate aseptic technique should be used for the insertion and management of intravenous catheters. Gloves should be worn for procedures involving contact with blood or body fluids. These can be a new pair of non-sterile gloves, used in conjunction with a non-touch technique, for insertion of a peripheral vascular catheter or replacement of a soiled insertion site dressing, however, sterile gloves must be worn for placement of central catheters.

Standard principles for infection prevention, previously described in these guidelines, give additional advice on hand decontamination, the use of gloves and other protective equipment.

**IVAD 3** Use an aseptic technique for the insertion and care of an intravascular access device and when administering intravenous drugs. [Revised wording]

**IVAD 4** Hands must be decontaminated, either by washing with liquid soap and water or with an alcohol handrub, before and after any contact with the intravascular catheter or insertion site. [Revised recommendation]

**IVAD 5** Hands that are visibly soiled or contaminated with dirt or organic material must be washed with liquid soap and water before using an alcohol handrub. [No change]

### References


### 4.5 Selection of Catheter Type

Different types of intravascular devices are available:

- made of different materials;
- have one or more lumens;
- coated or impregnated with antimicrobial or antiseptic agents or heparin-bonded;
- cuffed and designed to be tunneled;
- have totally implantable ports.

The selection of the most appropriate intravascular catheter for each individual patient can reduce the risk of subsequent catheter-related infection.
Catheter material

Intravascular catheter material may be an important determinant in the development of catheter-related infection. Polytetrafluoroethylene (Teflon®) and polyurethane catheters have been associated with fewer infections than catheters made of polyvinyl chloride or polyethylene.1-3

Number of catheter lumens

Multi-lumen intravascular access devices may be used because they permit the concurrent administration of various fluids and medications, hyperalimentation, and haemodynamic monitoring among critically ill patients.

Several randomised controlled trials (RCT) and other studies suggest that multi-lumen catheters are associated with a higher risk of infection than single lumen catheters.4-10 However, other studies examined by HICPAC failed to demonstrate a difference in the rates of CR-BSI.11,12

HICPAC noted that multi-lumen catheter insertion sites may be particularly prone to infection because of increased trauma at the insertion site or because multiple ports increase the frequency of CVC manipulation.7,8 Although patients with multi-lumen catheters tend to be more ill than those without such catheters, the infection risk observed with these catheters may have been independent of the patient’s underlying disease severity.9

Two additional studies were identified in our previous SRs.13 In a SR and quantitative meta-analysis focused on determining the risk of CR-BSI and catheter colonisation in multi-lumen catheters compared with single-lumen catheters, reviewers reported that, although CR-BSI was more common in patients with multi-lumen catheters, when confined to high quality studies that control for patient differences, there is no significant difference in rates of CR-BSI for the two types of catheter.14 This analysis suggests that multi-lumen catheters are not a significant risk factor for increased CR-BSI or local catheter colonisation compared with single-lumen CVC.

Another SR and quantitative meta-analysis tested whether single- versus multi-lumen CVC had an impact on catheter colonisation and CR-BSI. Study authors concluded that there is some evidence from five RCTs with data on 530 CVC, that for every 20 single-lumen catheters inserted, one CR-BSI (which would have occurred had multi-lumen catheters been used) would be avoided. As authors were only able to analyse a limited number of trials, further large RCTs of adequate methodology are needed to confirm these findings. In the meantime, it may be reasonable for patients who need a CVC to choose a single-lumen catheter whenever there is no indication for a multi-lumen catheter.15

Neither we nor HICPAC guideline developers identified any additional evidence of acceptable quality whilst updating our systematic reviews.

IVAD 6 Use a catheter with the minimum number of ports or lumens essential for the management of the patient. [Revised wording]

Class A

IVAD 7 If a multi-lumen catheter is used, designate one port exclusively for hyperalimentation to administer parenteral nutrition.

Class D/ GPP
Tunneled and totally implantable ports

Surgically implanted (tunneled) devices, e.g. Hickman® catheters, are commonly used to provide vascular access (and stable anchorage) to patients requiring long-term intravenous therapy. Alternatively, totally implantable intravascular access devices, e.g. Port-A-Cath®, are also tunneled under the skin, but have a subcutaneous port or reservoir with a self-sealing septum that is accessible by needle puncture through intact skin.

In developing their 1996 guidelines, HICPAC examined multiple studies that compared the incidence of infection associated with long-term tunneled CVC and/or totally implantable intravascular devices with that from percutaneously (non-tunneled) inserted catheters. Although, in general, most studies reported a lower rate of infection in patients with tunneled CVC, some studies (including one RCT) found no significant difference in the rate of infection between tunneled and non-tunneled catheters. Additionally, most studies examined by HICPAC concluded that totally implantable devices had the lowest reported rates of CR-BSI compared to either tunneled or non-tunneled CVC.

[Revised wording]

References


[Revised wording]
Additional evidence was obtained from studies of efficacy of tunnelling to reduce catheter-related infections in patients with short-term CVC. One RCT demonstrated that subcutaneous tunnelling of short-term CVC inserted into the internal jugular vein reduced the risk for CR-BSI. In a later RCT, the same investigators failed to show a statistically significant difference in the risk for CR-BSI for subcutaneously tunneled femoral vein catheters.

An additional meta-analysis of RCTs focused on the efficacy of tunnelling short-term CVC to prevent catheter-related infections. Data synthesis demonstrated that tunnelling decreased catheter colonisation by 39% and decreased CR-BSI by 44%, in comparison with non-tunnelled placement. The majority of the benefit in the decreased rate of catheter-sepsis came from one trial of CVC inserted at the internal jugular site. The reduction in risk was not significant when pooled with data from five subclavian catheter trials. Tunnelling was not associated with increased risk of mechanical complications from placement or technical difficulties during placement. However, these outcomes were not rigorously evaluated. This meta-analysis concluded that tunnelling decreased catheter-related infections, however, a synthesis of the evidence in this meta-analysis does not support routine subcutaneous tunnelling of short-term subclavian venous catheters and this cannot be recommended unless efficacy is evaluated at different placement sites and relative to other interventions.

Neither we nor HICPAC identified any additional evidence of acceptable quality whilst updating our SR.

IVAD 8 Use a tunnelled or implanted central venous access Class A device with a subcutaneous port for patients in whom long-term vascular access is required e.g. oncology patients. [Revised wording]

References


**Antimicrobial impregnated catheters and cuffs**

Some catheters and cuffs are marketed as anti-infective and are coated or impregnated with antimicrobial or antiseptic agents, e.g. chlorhexidine/silver sulfadiazine, minocycline/ rifampin, platinum/silver, and ionic silver in subcutaneous collagen cuffs attached to CVC. Evidence reviewed by HICPAC indicated that the use of antimicrobial or antiseptic-impregnated CVC in adults whose catheter is expected to remain in place for more than five days could decrease the risk for CR-BSI. This may be cost-effective in high-risk patients (intensive care, burn and neutropenic patients) and in other patient populations in whom the rate of CR-BSI exceeds 3.3 per 1,000 catheter days despite implementing a comprehensive strategy to reduce rates of CR-BSI.

A meta-analysis of 23 RCTs published between 1988-1999 included data on 4,660 catheters (2,319 anti-infective and 2,341 control). Eleven of the trials in this meta-analysis were conducted in intensive care unit (ICU) settings; four among oncologic patients, two among surgical patients; two among patients receiving TPN and four among other patient populations. Study authors concluded that antibiotic and chlorhexidine-silver sulfadiazine coatings are anti-infective for short (approximately one week) insertion time. For longer insertion times, there was no data on antibiotic coating, and there is evidence of lack of effect for first generation chlorhexidine-silver sulfadiazine coating. For silver-impregnated collagen cuffs, there is evidence of lack of effect for both short- and long-term insertion.
Second generation chlorhexidine/silver sulfadiazine catheters with chlorhexidine coating on both the internal and external luminal surfaces are now available. The external surface of these catheters have three times the amount of chlorhexidine and extended release of the surface bound antiseptics than that in the first generation catheters (which are coated with chlorhexidine/silver sulfadiazine only on the external luminal surface). Early studies indicated that the prolonged anti-infective activity associated with the second generation catheters improved efficacy in preventing infections.\textsuperscript{13}

A SR and economic evaluation in 2006 concluded that rates of CR-BSI are statistically significantly reduced when an antimicrobial CVC was used. Studies in this review report the best effect when catheters were treated with minocycline/rifampin, or internally and externally treated with silver or chlorhexidine/silver sulfadiazine. A trend to statistical significance was seen in catheters only extraluminally coated. Investigation of other antibiotic treated catheters is limited to single studies with non-significant results.\textsuperscript{14}

We identified one additional SR and one RCT in our updated search. A collaborative network meta-analysis of CVC use in adults conducted in 2010 indicated that rifampicin-based impregnated CVC was the only type of impregnated/coated CVC that reduced catheter colonisation and CR-BSI compared with standard CVC.\textsuperscript{15} In a single blind non-inferiority trial, authors concluded that CVC coated with 5-fluorouracil were non-inferior to chlorhexidine and silver sulfadiazine coated CVCs with respect to the incidence of catheter colonisation (2.9% vs. 5.3%, respectively).\textsuperscript{16}

Expert guidelines recommend the use of a chlorhexidine/sulfadiazine or minocycline/rifampin-impregnated CVC in patients whose catheter is expected to remain in place more than five days if rates of CLABSI is not decreasing following the implementation of a comprehensive strategy to reduce rates of CLABSI.\textsuperscript{17}

**IVAD 9** Use an antimicrobial impregnated central venous Class A access device for adult patients whose catheter is expected to remain in place for > 5 days if rates remain above the agreed benchmark despite implementing a comprehensive strategy to reduce catheter related bloodstream infection.

[Revised recommendation]

**References**


4.6 Selection of Catheter Insertion Site

The site at which a vascular access catheter is placed can influence the subsequent risk of CR-BSI because of variation in both the density of local skin flora and the risk of thrombophlebitis. Central venous catheters are generally inserted in the subclavian, jugular or femoral veins, or peripherally inserted into the superior vena cava by way of the major veins of the upper arm, i.e. the cephalic and basilary veins of the antecubital space. Peripheral venous catheters are normally inserted in the upper extremity, although alternatives, such as the foot and scalp, may be used in children and babies.

Subclavian, jugular and femoral placements

HICPAC examined a number of studies comparing insertion sites and concluded that CVC inserted into subclavian veins had a lower risk for catheter-related infection than those inserted into either jugular or femoral veins. 1-11 Guideline developers suggested that internal jugular insertion sites may pose a greater risk for infection because of their proximity to oropharyngeal secretions and because CVC at this site are difficult to immobilise. 12 However, mechanical complications associated with catheterisation might be less common with internal jugular than with subclavian vein insertion.
Femoral catheters have been demonstrated to have relatively high colonisation rates compared to subclavian and internal jugular sites when used in adults, and current guidelines suggest the femoral site should be avoided because it is presumed to be associated with both a higher risk of deep vein thrombosis (DVT) and catheter-related infection than are internal jugular or subclavian catheters. One study also found that the risk of infection associated with catheters placed in the femoral vein is accentuated in obese patients. Thus, in adult patients, a subclavian site is preferred for infection control purposes, although other factors, e.g. the potential for mechanical complications, risk for subclavian vein stenosis, and catheter-operator skill, should be considered when deciding where to place the catheter.

Two meta-analyses indicate that the use of real-time two dimensional ultrasound for the placement of CVC substantially reduced mechanical complications, compared with the standard landmark placement technique. Consequently, the use of ultrasound may indirectly reduce the risk of infection by facilitating mechanically uncomplicated subclavian placement. In the UK, guidelines from the National Institute for Health and Clinical Excellence (NICE) provide recommendations for the 2D placement of CVC.

Antecubital placement
Peripherally inserted central venous catheters (PICC) may be used as an alternative to subclavian or jugular vein catheterisation. These are inserted into the superior vena cava by way of the major veins of the upper arm. HICPAC indicate that they are less expensive, associated with fewer mechanical complications, e.g. thrombosis, haemothorax, infiltration and phlebitis, and easier to maintain than short peripheral venous catheters, due to a reduced need for frequent site rotation. Additionally, previous evidence examined by HICPAC suggested that PICC are associated with a lower rate of infection than that associated with other non-tunneled CVC, perhaps because the skin at the antecubital fossa is less moist and oily and colonised by fewer microorganisms than the chest and neck and because an antecubital placement removes the catheter away from endotracheal and nasal secretions. Finally, HICPAC noted that further studies were needed to adequately determine how long PICC could be safely left in place and to determine whether routine replacement influenced the risk of associated infection. In a prospective cohort study using data from two randomised trials and a SR to estimate rates of PICC-related bloodstream infection in hospitalised patients, authors concluded that PICC used in high-risk hospitalised patients are associated with a rate of CR-BSI similar to conventional CVC placed in the internal jugular or subclavian veins (2 to 5 per 1,000 catheter-days).

Peripheral venous catheters
To reduce the risk of catheter related-infection and phlebitis, it is preferable to use an upper-extremity site for inserting a PVC in adults and to replace a lower extremity to an upper extremity site as soon as possible. In paediatric patients, the upper or lower extremity and the scalp (in young infants) can be used for siting a PVC.

We identified a SR and meta-analysis from 2012, in which investigators reviewed two RCTs, eight cohort studies and data from a national HCAI programme. These provided evidence that the selection of insertion site is not a significant factor in preventing CR-BSI. The meta-analysis demonstrated no difference in the risk of CR-BSI between the femoral, subclavian and internal jugular sites, having removed two studies that were statistical outliers. The authors concluded that a pragmatic approach to site selection for central venous access, taking into account underlying disease (e.g. renal disease), the expertise and skill of the operator and the risks
associated with placement, should be utilised.\textsuperscript{25} Catheters placed in the internal jugular and femoral site should be placed under direct ultrasound guidance, as this technique reduces the risk of placement complications.\textsuperscript{18}

IVAD10 In selecting an appropriate intravascular insertion site, Class D/ GPP assess the risks for infection against the risks of mechanical complications and patient comfort.  
\textit{[Revised wording]}

IVAD11 Unless medically contraindicated, use the upper Class C extremity for nontunneled catheter placement.  
\textit{[Revised recommendation]}

IVAD12 Use implantable access devices for patients who Class C require long-term, intermittent vascular access. For patients requiring regular or continuous access, a tunneled central venous access device is preferable.  
\textit{[No change]}

References

### 4.7 Maximal Sterile Barrier Precautions during Catheter Insertion

**Using maximal sterile barrier precautions during the placement of central venous catheters will significantly reduce the risk of infection**

The importance of strict adherence to hand decontamination and aseptic technique as the cornerstone for preventing catheter-related infection is widely accepted. Although this is considered adequate for preventing infections associated with the insertion of short peripheral venous catheters, it is recognised that central venous catheterisation carries a significantly greater risk of infection.

Studies examined by HICPAC concluded that if maximal sterile barrier (MSB) precautions were consistently used during CVC insertion, catheter contamination and subsequent catheter-related infections could be significantly minimised.\(^{14}\) A prospective randomised trial that tested the efficacy of MSB to reduce infections associated with long-term, nontunneled subclavian silicone catheters, compared with routine procedures, found that they significantly decreased the risk of CR-BSI.\(^{1}\)

Maximal sterile barrier precautions involve wearing sterile gloves and gown, a cap, mask and using a full body sterile drape (similar to the drapes used in the operating theatre) during insertion of the catheter.\(^{6}\) However, there is no specific evidence that wearing a facemask or cap during catheter insertion is important in preventing CR-BSI.

It has been generally assumed that CVC inserted in the operating theatre pose a lower risk of infection than those inserted on inpatient wards or other patient care areas.\(^{6}\) However, data examined by HICPAC from two prospective studies suggests that the difference in risk of infection depended largely on the magnitude of barrier protection used during catheter insertion, rather than the surrounding environment, i.e. ward versus operating room.\(^{1,2}\)
A SR of the value of MSB to prevent CLABSI defined the components as: the person inserting the catheter should wear a head cap, facemask, sterile body gown and sterile gloves and use a full-size sterile drape. Their search identified 95 articles discussing the prevention of CLABSI. The majority of these articles were narrative reviews or consensus statements. Three primary research studies, differing in design, patient population and clinical settings, comparing infection outcomes using MSB with less stringent barrier techniques, concluded that the use of MSB resulted in a reduction in catheter-related infections. The authors concluded that using MSB appears to decrease transmission of microorganisms, delay colonisation and reduce the rate of HCAI. They also suggested that biological plausibility and the available evidence support using MSB during routine insertion of a CVC to minimise the risk of infection. They recommended that, given the lack of adverse patient reactions, the relatively low cost of MSB and the high cost of CR-BSI, it is probable that MSB will prove to be a cost-effective, or even a cost-saving intervention.

Neither we nor HICPAC guideline developers identified any additional evidence of acceptable quality whilst updating our systematic reviews.

IVAD13 Use maximal sterile barrier precautions, including a Class C sterile gown, sterile gloves, and a large sterile drape, for the insertion of central venous access devices.

[No change]

References


4.8 Cutaneous Antisepsis

Appropriate preparation of the insertion site will reduce the risk of catheter-related infection

Microorganisms that colonise catheter hubs and the skin surrounding the vascular catheter insertion site are the cause of most CR-BSIs. As the risk of infection increases with the density of microorganisms around the insertion site, skin cleansing/antisepsis of the insertion site is therefore one of the most important measures for preventing catheter-related infections. Since the early 1990s,
research has focused on confirming the most effective antiseptic agent for skin
preparation prior to the insertion of intravascular devices, in order to prevent
catheter-related infections, especially CR-BSI. In the UK, clinicians principally used
alcohol, or either povidone iodine (PVI) or chlorhexidine gluconate (CHG), in various
strengths, and the latter two as either aqueous or alcoholic solutions. During the last
several years, alcoholic CHG has become the standard solution for skin cleansing
prior to the insertion of intravascular access devices. The widespread use of this
solution is based on a variety of well-conducted studies that, in general, show that
CHG is superior to other skin disinfectants for pre-insertion skin cleansing in
contributing to multifaceted strategies for minimising the risk of CR-BSI. Alcoholic
solutions of CHG combine the benefits of quick drying, rapid action and excellent
residual activity.

A prospective randomised trial of agents used for cutaneous antisepsis demonstrated
that 2% aqueous CHG was superior to either 10% PVI or 70% alcohol for preventing
central venous and arterial catheter-related infections. A further prospective, ran-
domised trial demonstrated that a 4% alcohol-based solution of 0.25% CHG and
0.025% benzalkonium chloride was more effective in preventing central venous or
arterial catheter colonisation and infection than 10% PVI.

The use of 5% PVI solution in 70% ethanol has been shown to be associated with a
substantial reduction of catheter-related colonisation and infection compared with
10% aqueous PVI. Clinicians may find this useful for those patients for whom
alcoholic CHG is contra-indicated.

A meta-analysis of CHG compared with PVI solution for vascular catheter-site care
suggested that CHG preparations reduced the risk of catheter-related infection by
49% (95% CI .28 to .88). Additionally, an economic decision analysis based on
available evidence suggested that the use of CHG, rather than PVI, for skin care
would result in a 1.6% decrease in the incidence of CR-BSI, a 0.23% decrease in the
incidence of death, and financial savings per catheter used.

The application of organic solvents, such as acetone or ether, to ‘defat’ (remove skin
lipids) the skin before catheter insertion and during routine dressing changes has, in
the past, been considered a standard component of many hyperalimentation
protocols. However, there was no evidence available to HICPAC to show that the
use of these agents provided any protection against catheter-related infection, and
their use could greatly increase local inflammation and patient discomfort.

Several studies were examined that focused on the application of antimicrobial
ointments to the catheter site at the time of catheter insertion, or during routine
dressing changes, to reduce microbial contamination of catheter insertion sites.
Reported efficacy in preventing catheter-related infections by this practice yielded
contradictory findings. There was also concern that the use of polyantibiotic
ointments that were not fungicidal could significantly increase the rate of colonisation
of the catheter by Candida species.

We identified one recent SR of the clinical efficacy and perceived role of CHG in skin
antisepsis that included studies about intravascular access. The authors suggested
a potential source of bias, as many studies have overlooked the importance of
alcohol when assessing the efficacy of CHG. The authors assessed the attribution of
CHG in each study as correct, incorrect or intermediate. Studies were scored and
analysis was performed separately to assess CHG efficiency. Authors concluded
that CHG is more efficient than PVI or any other technique alone, but that the
presence of alcohol provides additional benefit. The authors suggested that vascular
catheters require an immediate activity of antiseptic provided by alcohol prior to insertion. They also require a long lasting antiseptic, as they stay in place for prolonged periods of time. Chlorhexidine gluconate meets this requirement well.

IVAD 14  Decontaminate the skin site with a single use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol prior to the insertion of a central venous access device. Allow the antiseptic to dry before inserting the central venous access device. [Revised wording]

IVAD 15  Use a single use application of alcoholic povidone-iodine solution for patients with a history of chlorhexidine sensitivity. Allow the antiseptic to dry before inserting the central venous access device. [Revised wording]

IVAD 16  Do not apply organic solvents, e.g., acetone, ether, to the skin before the insertion of a central venous access device. [No change]

IVAD 17  Do not routinely apply antimicrobial ointment to the catheter placement site prior to insertion. [No change]

References
4.9 Catheter and Catheter Site Care

Infections can be minimised by good catheter and insertion site care

The safe maintenance of an intravascular catheter and relevant care of the insertion site are essential components of a comprehensive strategy for preventing catheter-related infections. This includes good practice in caring for the patient’s catheter hub and connection port, the use of an appropriate intravascular catheter site dressing regimen and using flush solutions to maintain the patency of the catheter.

Choose the right dressing and disinfectant for insertion sites to minimise infection

Following placement of a peripheral or venous intravascular catheter, a dressing is used to protect the insertion site. Because occlusive dressings trap moisture on the skin and provide an ideal environment for the rapid growth of local microflora, dressings for insertion sites must be permeable to water vapour. The two most common types of dressings used for insertion sites are sterile, transparent, semi-permeable polyurethane dressings coated with a layer of an acrylic adhesive (‘transparent dressings’) and gauze and tape dressings. Transparent dressings are permeable to water vapour and oxygen and impermeable to microorganisms.

HICPAC reviewed the evidence related to which type of dressing provided the greatest protection against infection, including the largest controlled trial of dressing regimens on PVCs, a meta-analysis comparing the risk of CR-BSI using transparent versus gauze dressings and a Cochrane review. All concluded that the choice of dressing can be a matter of preference. If blood is oozing from the catheter insertion site, a gauze dressing might be preferred.

Gauze dressings are not waterproof and require frequent changing in order to inspect the catheter site. They are rarely useful in patients with long-term intravascular catheters. Sterile transparent, semi-permeable polyurethane dressings have become a popular means of dressing catheter insertion sites. They reliably secure intravascular catheters, permit continuous visual inspection of the catheter site, allow patients to bathe and shower without saturating the dressing and require less frequent changing than that required for standard gauze and tape dressings, thus saving personal time.

We identified one SR and meta-analysis, undertaken as part of a quality improvement collaborative, which synthesised the effects of the routine use of CHG-impregnated sponge dressings in reducing centrally inserted CR-BSI. The reviewers concluded that CHG-impregnated sponge dressings are effective in preventing CR-BSI (OR 0.43; 95% CI 0.29 to 0.64) and catheter colonisation (OR 0.43; 95% CI 0.36. to 0.51).
A SR and meta-analysis of the efficacy of daily bathing with CHG for reducing bloodstream infections was also identified. Twelve studies were included: one RCT, one cluster non-randomised controlled trial and ten controlled interrupted time series, all performed in adult acute care settings, five of which reported insertion technique, including the use of CHG. There was a high level of clinical heterogeneity and moderate statistical heterogeneity, which remained following a subgroup analysis by type of CHG formulation. The authors concluded that among ICU patients, daily CHG bathing with CHG liquid (OR 0.47; 95% CI 0.31 to 0.71) or cloths (OR 0.41; 95% CI 0.25 to 0.65) reduces the risk of CR-BSI. Similar benefit is obtained regardless of whether CHG cloths or liquid preparation is used (OR 0.44; 95% CI 0.44 to 0.59). This review is not generalisable to paediatric care.

A single RCT compared the efficacy of two commercially available alcohol based antiseptic solutions for preparation and care of CVC insertion sites, with and without octenidine dihydrochloride. Data was collected from 2002-2005 and published in 2009. Authors concluded that octenidine in alcoholic solution to be a better option than alcohol alone for the prevention of CVC-associated infections and may be as effective as CHG in practice, but that a comparative trial is needed.

IVAD 18  Use a sterile, transparent, semi-permeable polyurethane dressing to cover the intravascular insertion site.  
[Revised wording]

IVAD 19  Transparent, semi-permeable polyurethane dressings should be changed every 7 days, or sooner if they are no longer intact or moisture collects under the dressing.  
[No change]

IVAD 20  Use a sterile gauze dressing if a patient has profuse perspiration or if the insertion site is bleeding or oozing and changed when inspection of the insertion site is necessary or when the dressing becomes damp, loosened or soiled. The continued need for a gauze dressing should be assessed daily and replaced by a transparent dressing as soon as possible.  
[Revised wording]

IVAD 21  Do not change the transparent, semi-permeable polyurethane dressings applied to peripheral vascular catheter insertion site unless the integrity of the dressing is disturbed or there is pooling of fluid/blood under the dressing.  
[New recommendation]

IVAD 22  Dressings used on tunneled or implanted catheter insertion sites should be replaced every 7 days until the insertion site has healed, unless there is an indication to change them sooner. A dressing is no longer required once the insertion site is healed.  
[Revised recommendation]
References

Use an appropriate antiseptic agent for disinfecting the catheter insertion site during dressing changes
Research previously described in this guideline has described the superior effectiveness of using CHG to minimise the density of microorganisms around vascular catheter insertion sites.1-3 Consequently, alcoholic CHG is now being widely used in the UK for disinfecting the insertion site during dressing changes.

Studies focused on the use of antimicrobial ointment applied under the dressing to the catheter insertion site to prevent catheter-related infection do not clearly demonstrate efficacy.4,5 Most modern intravascular catheters and other catheter materials are generally alcohol-resistant, i.e. they are not damaged by contact with alcohol. However, alcohol, and other organic solvents and oil-based ointments and creams, may damage some types of polyurethane and silicon catheter tubing, e.g. some catheters used in haemodialysis. The manufacturer’s recommendations for only using disinfectants that are compatible with specific catheter materials must therefore be followed.

IVAD 23 Use 2% chlorhexidine gluconate in 70% isopropyl alcohol (or alcoholic povidone iodine for patients with a sensitivity to chlorhexidine) to clean the catheter insertion site during dressing changes, and allow to air dry unless device specific recommendations from the manufacturer indicate otherwise. [Revised wording]

IVAD 24 Single use sachets of antiseptic solution or single use antiseptic-impregnated swabs or wipes should be used to disinfect the insertion site. [Revised wording]

IVAD 25 Do not apply antimicrobial ointment to catheter insertion sites as part of routine catheter site care. Class D/ GPP
Healthcare workers should ensure that intravascular catheter-site care is compatible with catheter materials (tubing, hubs, injection ports, luer connectors and extensions) and carefully check compatibility with the manufacturer’s recommendations.

References


4.10 Catheter Replacement Strategies

When and how catheters are replaced can influence the risk of infection

A catheter replacement strategy is composed of two elements; the frequency and the method of catheter replacement.

Frequency

The risk of phlebitis and catheter colonization, both associated with CR-infection, could be reduced by catheter replacement and site rotation every 72-96 hours. However, decisions regarding the frequency of CVC replacement are more complicated. The evidence showed duration of catheterisation to be a risk factor for infection and advocates routine replacement of CVC at specified intervals as a measure to reduce infection. Other studies, however, suggested that the daily risk of infection remains constant and showed that routine replacement of CVC, without a clinical indication, does not reduce the rate of catheter colonisation or the rate of CR-BSI. Conclusions from a systematic review agree that exchanging catheters by any method every three days was not beneficial in reducing infections, compared with catheter replacement on an as-needed basis.

Methods

Two methods are used for replacing CVC; placing a new catheter over a guide wire at the existing site, or percutaneously inserting a new catheter at another site. Guide wire insertion has been the accepted technique for replacing a malfunctioning catheter (or exchanging a pulmonary artery catheter for a CVC when invasive monitoring was no longer needed) as they are associated with less discomfort and a significantly lower rate of mechanical complications than those percutaneously inserted at a new site. Studies of the risks for infection associated with guide wire insertions examined by HICPAC yielded conflicting results. One prospective study showed a significantly higher rate of CR-BSI associated with catheters replaced over a guide wire compared with catheters inserted percutaneously. However, three prospective studies (two randomised) showed no significant difference in infection rates between catheters inserted percutaneously and those inserted over a guide wire. Because these studies suggest that the insertion of the new catheter at a
new site does not alter the rate of infectious complications per day but does increase
the incidence of mechanical complications, guidewire exchange is recommended. Most studies examined by HICPAC concluded that, in cases where the catheter being removed is known to be infected, guidewire exchange is contraindicated.\textsuperscript{7,8,12} A SR concluded that, compared with new site replacement, guidewire exchange was associated with a trend toward a higher rate of subsequent catheter colonisation, regardless of whether patients had a suspected infection at the time of replacement. Guidewire exchange was also associated with trends toward a higher rate of catheter exit-site infection and CR-BSI. However, guidewire exchange was also associated with fewer mechanical complications relative to new-site replacement.\textsuperscript{8}

Methods are available and techniques have been described which allow a diagnosis of CR-BSI to be made without the need for catheter removal.\textsuperscript{13} Such approaches could be used prior to the replacement of a new catheter over a guide wire in order to reduce the subsequent risk of CR-infection.\textsuperscript{13,14} Neither we nor HICPAC guideline developers identified and additional evidence for these recommendations whilst updating our systematic reviews.

**Peripheral vascular devices**

We identified one RCT comparing a routine three-day re-siting of PVC compared with a clinically indicated re-siting. Intravascular device related (IVD) complication rates were 68 per 1,000 IVD days (clinically indicated) and 66 per 1,000 IVD days (routine replacement) ($p=0.86$; HR 1.03; 95\% CI, 0.74-1.43). Re-siting a device on clinical indication would allow one in two patients to have a single cannula per course of intravenous treatment, as opposed to one in five patients managed with routine re-siting; overall complication rates appear similar. Clinically indicated re-siting would achieve savings in equipment, staff time and patient discomfort.\textsuperscript{15} A recent update of a Cochrane Review published in 2010 found no evidence to support changing catheters every 72 to 96 hours. Consequently, healthcare organisations may consider changing to a policy whereby catheters are changed only if clinically indicated. This would provide significant cost savings and would spare patients the unnecessary pain of routine re-sites in the absence of clinical indications.

To minimise peripheral catheter-related complications, the insertion site should be inspected at each shift change and the catheter removed if signs of inflammation, infiltration, or blockage are present.\textsuperscript{16}

**IVAD 27** Do not routinely replace central venous access devices as a method to prevent catheter-related infection. \textit{[Revised wording]}  \textbf{Class A}

**IVAD 28** Guide wire assisted catheter exchange to replace a malfunctioning catheter, or to exchange an existing catheter should only be used when there is no evidence of infection at the catheter site or a diagnosed catheter-related bloodstream infection. \textit{[Revised wording]}  \textbf{Class A}

**IVAD 29** Do not use guide wire assisted catheter exchange for patients with known or suspected catheter-related bloodstream infection. If continued vascular access is
required, remove the implicated catheter, and replace it with another catheter at a different insertion site.

[Revised wording]

IVAD 30 Peripheral vascular catheters should be removed as soon as they are no longer required or when complications occur. [New recommendation]  
Class D/ GPP

IVAD 31 The insertion site should be inspected at a minimum on every shift a Visual Infusion Phlebitis score recorded. The catheter should be removed if there are signs of inflammation, infiltration or blockage. [New recommendation]  
Class D/ GPP

IVAD 32 Peripheral vascular catheters should be re-sited when clinically indicated and not routinely at 72-96 hours, unless device specific recommendations from the manufacturer indicate otherwise. [New recommendation]  
Class B

References
15. Rickard CM, McCann D, Munnings J, McGrail MR. Routine resite of peripheral intravenous devices every 3 days did not reduce complications compared with clinically indicated resite: a randomised controlled trial. BMC Med. 2010; 8: 53.
A randomized prospective clinical trial investigated the use of needleless connectors or standard caps attached to CVC luer connections. Results suggested that the use of needleless connectors may reduce the microbial contamination rate of CVC luers compared with standard caps. Furthermore, disinfection of needleless connectors with either chlorhexidine/alcohol or povidone–iodine significantly reduced external microbial contamination. Both these strategies may reduce the risk of catheter-related infections acquired via the intraluminal route.

We found no evidence comparing the efficacy of different methods of decontaminating ports and hubs prior to access. Expert opinion, based on consensus and evidence from studies of skin decontamination prior to insertion and during dressing changes, suggests that injection ports or catheter hubs should be decontaminated before and after accessing the system using CHG in 70% alcohol. Although most intravascular catheters and catheter hub materials are now chemically compatible with alcohol or iodine, some may be incompatible and therefore the manufacturer's recommendations should be followed.

**IVAD33** Use 2% chlorhexidine gluconate in 70% isopropyl alcohol (or alcoholic povidone iodine for patients with a sensitivity to chlorhexidine) to decontaminate the access port or catheter hub and allow to dry before and after accessing the system unless device specific recommendations from the manufacturer indicate otherwise.

[Reworded recommendation]


13. NICE community

**Inline filters do not help prevent infections**

In-line filters are used to reduce the incidence of infusion-related phlebitis, however, HICPAC identified no good quality evidence to support the efficacy of in-line filters in preventing infections associated with intravascular catheters and infusion systems. Guideline developers concluded that filtration of medications or infusates in the pharmacy is a more practical and efficient method for removing the majority of particulates. In addition, in-line filters may become blocked, particularly when used with certain solutions, e.g., dextran, lipids, mannitol, resulting in increased line manipulations and decreased availability of administered drugs. There may be a role for the use of in-line filtration of parenteral nutrition solutions for reasons other than the prevention of infection but these are beyond the scope of these guidelines.

**IVAD34 In-line filters should not be used routinely for infection prevention purposes.** Class D/ GPP

[No change]

**Reference**


**Using antimicrobial solutions to prevent infection**

The procedure of flushing and then leaving the lumen of the CVC filled with an antibiotic solution is termed ‘antibiotic lock prophylaxis’ and has been described as a measure to prevent CR-BSI in specific circumstances, such as when treating a patient with a long-term cuffed or tunnelled catheter or port who has a history of multiple CR-BSI despite optimal maximal adherence to aseptic technique. Evidence reviewed by HICPAC demonstrated the effectiveness of this type of prophylaxis. However, the majority of the studies were conducted in haemodialysis patients and therefore outside the scope of this guideline.

We identified a systematic review of randomised controlled trials published in 2012 that concluded that the scientific evidence for the effectiveness of the routine use of...
antibiotic-based lock solutions is weak,\textsuperscript{2} thus supporting the HICPAC evidence. In addition, there is concern that the use of such solutions could lead to an increase in antimicrobial resistant microorganisms.

An additional placebo - RCT of daily ethanol locks to prevent CR-BSI in patients with tunneled catheters\textsuperscript{3} found the reduction in the incidence of endoluminal CR-BSI using preventive ethanol locks was non-significant, although the low incidence of endoluminal CR-BSI precludes definite conclusions and the low incidence of CR-BSI in the placebo arm meant the study was underpowered in retrospect. Significantly more patients treated with ethanol locks discontinued their prophylactic treatment due to non-severe, ethanol related adverse effects.

IVAD35  Antibiotic lock solutions should not be used routinely to prevent catheter-related bloodstream infections.  
\textit{Class D/GPP}  
\textit{[No change]}

References

Systemic antibiotic prophylaxis does not prevent CR-BSI
HICPAC identified no studies that demonstrated that oral or parenteral antibacterial or antifungal drugs reduced the incidence of CR-BSI among adults. However, among low birth weight infants, two studies on vancomycin prophylaxis demonstrated a reduction in CR-BSI but no reduction in mortality. Since the prophylactic use of vancomycin is an independent risk factor for the acquisition of vancomycin-resistant \textit{Enterococcus} (VRE), it is likely that the risk of acquiring VRE outweighs the benefit of using prophylactic vancomycin.\textsuperscript{1}

Long-term tunnelled CVC are frequently used for patients with cancer who require intravenous treatments. A Cochrane Review published in 2003 concluded that prophylactic antibiotics or catheter flushing with vancomycin and heparin may be of benefit in reducing the risk of catheter-related infections in these high risk cancer patients.\textsuperscript{2} However, this practice should not be used routinely in order to minimise the development of antimicrobial resistance.\textsuperscript{3}

IVAD36  Do not routinely administer intranasal or systemic \textit{Class A} antimicrobials before insertion or during the use of an intravascular device to prevent catheter colonisation or bloodstream infection.  
\textit{[Revised wording]}

References


**A dedicated catheter lumen is needed for parenteral nutrition**

A prospective epidemiologic study examining the risk for CR-BSI in patients receiving TPN reviewed by HICPAC concluded that either using a single lumen catheter or a dedicated port in a multilumen catheter for TPN would reduce the risk of infection. We identified no new evidence in our search for evidence.

**IVAD37** A single-lumen catheter should be used to administer parenteral nutrition. If a multilumen catheter is used, one port must be exclusively dedicated for hyperalimentation and all lumens must be handled with the same meticulous attention to aseptic technique. [Revised wording].

**References**


**Maintaining device patency and preventing catheter thrombosis may help prevent infections**

The placement of a CVC or pulmonary artery catheter leads to thrombus formation within a short period of insertion providing a focus for bacterial growth. Catheters manufactured from silicone or polyethylene, and placed in the subclavian vein are less often associated with thrombus formation. Between 35% and 65% of patients with long term CVC develop a thrombosis of the large vessels and patients are treated with prophylactic heparin to prevent the formation of both deep-vein thrombosis and catheter thrombus.

**The use of anticoagulants**

Heparin may be administered through several different routes. An early meta-analysis of randomised controlled trials compared the effectiveness of heparin administration via an infusion, subcutaneously or intermittent flush for the prevention of thrombus formation and CR-BSI in patients with short-term CVC. Prophylactic heparin infusion was associated with a decrease in catheter thrombus formation, deep vein thrombosis, catheter colonisation and a trend towards reductions in CR-BSI but was not statistically significant. HICPAC identified an additional prospective randomised trial, which demonstrated a significant decrease in the rate of CR-BSI in patients with non-tunnelled CVC who received continuous heparin infusion. Heparin bonded catheters have also been shown to reduce the risk of both thrombus formation and CR-BSI.

We identified one SR of heparin bonded CVC in children. The reviewers identified two RCT of 287 children aged one day to 16 years to receive either a heparin-bonded (HB) catheter or a standard catheter. There was no significant difference in the median duration of catheter patency in the two groups, seven days in the
heparin-bonded catheter group and six days in the standard catheter group. Authors also reported a trend towards a reduction in the risk of catheter-related thrombosis and catheter occlusion in the heparin bonded group. The risk of catheter colonisation and catheter-related infection were significantly reduced in the treatment group, with a delay to infection in the heparin-bonded catheter group. However the reviewers considered the need for further studies to confirm the efficacy the heparin-bonded catheters.

The use of warfarin has also been shown to reduce the risk of catheter-related thrombosis in some patient groups but not in others and is generally not associated with a reduction in infection related complications.17-23

Heparin versus Normal Saline Intermittent Flushes
Systemic heparin as either an infusion or flush has a number of side effects that contraindicate its routine use for maintaining the patency of CVC and prevent thrombus formation, these include thrombocytopenia, allergic reactions and bleeding.24 Sodium chloride injection (0.9%) is an alternative to the use of heparin flush.

Three SR and meta-analysis of RCT evaluating the effect of heparin on duration of catheter patency and on prevention of complications associated with the use of peripheral venous and arterial catheters concluded that heparin at doses of 10 U/ml for intermittent flushing is no more beneficial than flushing with normal saline alone.25-27 However, manufacturers of implanted ports or opened-ended catheter lumens may recommend heparin flushes for maintaining CVC that are infrequently accessed.

We identified one SR (CVC11) and two RCT comparing heparin vs 0.9% sodium chloride to maintain the patency of CVC (CVC12) and PVC (PVC1) respectively.28-30 A SR of heparin flushing and other interventions to maintain patency of central venous catheters concluded that the evidence base for heparin flushing and other interventions to prevent catheter occlusion is limited and published studies are of low quality. The reviewers concluded that there is no direct evidence of the effectiveness of heparin flushes to prevent catheter-related bloodstream infection or other central line complications.

In a single centre RCT of newly placed multi-lumen CVC in patients in MICU and surgical/burn/ trauma ICU, 0.9% sodium chloride and heparin flush solutions were found to have similar rates of lumen non-patency. Given potential safety concerns with the use of heparin, 0.9% sodium chloride may be the preferred flushing solution for short-term use central venous catheter maintenance. Secondary outcomes for CRBSI were non-significant between groups.

In a single centre cluster RCT of 214 medical patients found that twice-daily heparin (100 U/mL) flushes for maintenance of peripheral venous catheters was more effective than saline solution. The number of catheter-related phlebitis/ occlusions and the number of catheters per patient were reduced, with potential advantages to both patients and the health system, no infection outcomes were measured.
IVAD38  Do not use systemic anticoagulants routinely to prevent catheter-related bloodstream infection.  
Class D/ GPP [Revised wording]

IVAD39  Use sterile 0.9 percent sodium chloride for injection to flush and lock catheter lumens that are in frequent use.  
Class A [Revised wording]

References

Safer sharps devices require vigilance

Needle-free infusion systems and connection devices have been widely introduced to reduce the incidence of sharp injuries and minimise the risk of transmission of bloodborne pathogens to healthcare workers.1 There is limited evidence that needleless devices or valves reduce the risk of catheter colonisation when compared to standard devices.2 In addition, the design features of some of these devices pose a potential risk for contamination and have been associated with reports of an increase in bloodstream infection rates.3-6

IVAD40 The introduction of new intravascular devices or components should be monitored for an increase in the occurrence of device-associated infection. If an increase in infection rates is suspected, this should be reported to the Medicines and Healthcare Products Regulatory Agency. [No change]

Class D/ GPP

IVAD41 When safer sharps devices are used, healthcare workers should ensure that all components of the system are compatible and secured to minimise leaks and breaks in the system and the manufacturer's recommendations for changing the needle-free components should be followed. [Revised wording]

Class D/ GPP

IVAD42 When needle-free devices are used, the risk of contamination should be minimised by decontaminating the access port before and after use with a single use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol (or alcoholic povidone iodine for patients with a sensitivity to chlorhexidine) unless device specific recommendations from the manufacturer indicate otherwise. [Revised wording]

Class D/ GPP
References


Change intravenous administration sets appropriately

HICPAC reviewed three well-controlled studies on the optimal interval for the routine replacement of intravenous (IV) solution administration sets. A SR of 13 RCT with 4783 patients concluded that there is no evidence that changing intravenous administration sets more often than every 96 hours reduces the incidence of bloodstream infection. The reviewers were unable to conclude if changing administration sets less often than every 96 hours affects the incidence of infection from the studies. There were no differences between participants with central versus peripheral catheters; nor between participants who did and did not receive parenteral nutrition, or between children and adults. Administration sets that do not contain lipids, blood or blood products may be left in place for intervals of up to 96 hours without increasing the incidence of infection. There was no evidence to suggest that administration sets, which contain lipids should not be changed every 24 hours as currently recommended.

Administration sets in continuous use do not need to be replaced more frequently every 96 hour unless device specific recommendations from the manufacturer indicate otherwise or they become disconnected or an intravascular access device is replaced. [Revised recommendation]

Administration sets for blood and blood components should be changed when the transfusion episode is complete or every 12 hours ( whichever is sooner), or according to the manufacturer’s recommendations. [No change]
Administration sets used for total parenteral nutrition (fat emulsion) infusions should be changed every 24 hours unless device specific recommendations from the manufacturer indicate otherwise.

[Revised recommendation]

References


System interventions to reduce catheter-related infection

Ensuring that patient’s receive care that is evidence based is an essential element of delivering high quality health care. In 2005 the Department of Health issued a series of high impact interventions (HIIs) that were derived from national and international evidence-based guidelines for the prevention of healthcare associated infection and base on experience from the Institute of Healthcare Improvement 100,000 Lives Campaign focused on reducing patient harm. The HIIs focused on increasing the reliability of care and ensuring that recommendations were implemented every time for every patient. The intervention for the prevention of infection associated with the use of intravascular devices included six key interventions often referred to as a ‘care bundle’ together with audit tools to measure adherence. These six practices included:

- aseptic insertion of an appropriate device;
- correct siting of the device;
- effective cutaneous antisepsis;
- and for the continuing care or the device:
  - hand decontamination and asepsis for any contact with the device;
  - daily observation of the insertion site; and
  - clean, intact dressing.

There have been a small number of well designed studies that describe the use of ‘bundled’ approaches to reducing CR-BSI, which have stimulated individual observational and quality improvement (QI) reports of the results of using key evidence based practices in preventing CR-BSI. The most prominent of these was a study conducted in the ICU setting of 108 hospitals in the USA which was then adopted by other countries including the UK. Authors reported the success of five evidence based practices combined with system and organisational support, which resulted in a 66% decrease in CR-BSI 18 months after the inception of the programme [0.62 (95% confidence interval [CI], 0.47 to 0.61)] to [0.34 (95% CI, 0.23 to 0.50)] and sustained reductions thereafter. The intervention comprised: hand hygiene using ABHR; maximum sterile barrier precautions for insertion; cutaneous antisepsis of the insertion site with 2% CHG; avoiding the femoral site, and removing CVC as soon as they were no longer clinically indicated. In addition, system changes that prompted the clinician to ‘do the right thing’ included placing all the equipment needed in a cart for ease of access; the use of a checklist; authorising staff to halt procedures if best practice was not being followed; daily rounds to ensure the timely removal of CVC; feedback of CR-BSI cases to clinical staff and organisational support to purchase essential equipment and solutions prior to the start of the study.
Audit and feedback are an essential component of any quality improvement intervention as it promotes a continuous "Hawthorne effect" and enables staff to maintain vigilance and sustain improvement. The use of dashboards and statistical process control charts alerts clinicians to variability outside control limits and prompts scrutiny of practice and organisational systems and remedial action to be taken.

We identified three additional studies that reported ‘bundled interventions to reduce CR-BSI’. None were included in the systematic review as they failed to meet study quality criteria. The features of any QI initiative need to be tailored to the local conditions and may include some or all of the following:

- Hand hygiene; aseptic insertion using maximum sterile barrier precautions (CVC) aseptic technique (PVC); cutaneous antisepsis using 2% CHG in alcohol unless contraindicated; appropriate siting of the CVC or PVC; and prompt removal when no longer indicated;
- Audit and feedback;
- Education and training;
- Accessibility of equipment and appropriate system changes developed with clinical staff to make best practice the norm.

**IVAD46 Use quality improvement systems to support the Class C/GPP appropriate use and management of intravascular access devices (CVC and PVC) and ensure their timely removal. These may include:**

- Protocols for device insertion and maintenance;
- Reminders to review the continuing use or prompt the removal of intravascular devices;
- Audit and feedback of compliance with practice guidelines;
- Continuing professional education.

[New recommendation]

**References**

SECTION A - APPENDICES

A.1 Guideline Development Team

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A.2 Guideline Development Advisory Group

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- Ms Theresa Neale, Urology Nurse Specialist, British Association of Urological Nurses (Consultant)
- Dr Jeff Phillips, Consultant Intensivist and Clinical Lead for Anaesthetics (Consultant)
- Dr Jacqui Prieto, University of Southampton (Infection Prevention Adviser)
- Mr Julian Shah, Consultant Urologist, (Consultant)
- Professor Mark Wilcox, Leeds Teaching Hospitals and University of Leeds
- Ms Caroly Fry, Department of Health (Observer)
- Professor Brian I. Duerden CBE, Duerden Microbiology Consulting Ltd (Chair of the face-to-face meeting)
- Ms Meg Morse, Administrator officer, University of West London
A.3 Consultation Process

The following organizations are approached for comment:

Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection
Association for Continence Advice
Association of British Healthcare Industries
Association of Healthcare Cleaning Professionals
British Association of Critical Care Nurses
British Association of Urological Surgeons
British Association Urological Nurses
British Health Care Trades Association
British Infection Association (BIA)
British Medical Association (BMA)
British Society for Antimicrobial Chemotherapy (BSAC)
C-diff Support
Chartered Society of Physiotherapy
Foundation Trust Network
General Medical Council (GMC)
Health and Safety Executive (HSE)
Health Education England
Health Professions Council
Health Protection Scotland
Healthcare Infection Society (HIS)
Healthwatch England
HPA Scotland
Infection Prevention Society (IPS)
Intensive Care Society
Medicines and Healthcare Products Regulatory Agency (MHRA)
MRSA Action UK
Northern Ireland Public Health Agency
NHS Confederation
NHS Trust Development Authority
Northern Ireland Executive
Nursing and Midwifery Council (NMC)
Public Health England
Public Health Wales Health Protection
Royal College of Anaesthetists
Royal College of Midwives
Royal College of Nursing
Royal College of Pathologists
Royal College of Physicians
Royal College of Radiologists
Royal College of Surgeons of England
Royal Pharmaceutical Society of Great Britain
Royal Society of Medicine
Scottish Government
Spinal Injury Association
The Lee Spark Necrotising Fasciitis Foundation
The Patients Association
UK Clinical Pharmacists Association
Unison
Welsh Assembly Government
A.4 Standard Principles Systematic Review Process

Hospital Hygiene - Systematic Review Process

Systematic Review Questions

1. What is the evidence that the patient environment (including clinical equipment) is a significant factor in the transmission of healthcare associated infection?
2. What is the effectiveness and cost effectiveness of conventional cleaning vs. enhanced cleaning of the patient bed space in reducing environmental contamination and healthcare associated infection?
3. What is the effectiveness and cost effectiveness of antimicrobial surfaces (e.g. silver, copper) in the patient environment in reducing environmental contamination and healthcare associated infection?
4. What is the effectiveness of education interventions in improving healthcare workers knowledge and behaviour in the maintaining a clean patient environment (including clinical equipment) and in reducing environmental contamination and healthcare associated infection?
5. What is the effectiveness of system interventions in driving improvements in hospital environmental hygiene and in reducing environmental contamination and healthcare associated infection?

Databases and Search Terms Used

DATABASES
Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, NEHL Guideline Finder, National Institute For Health and Clinical Excellence, The Cochrane Library (CDSR, CCRCT, CMR), US Guideline Clearing House, DARE (NHS Evidence, HTA), Prospero

MeSH TERMS
infection control; cross infection; equipment contamination; disease transmission; disinfection; disinfectants; soaps; anti-infective agents; surface-active agents; hospital housekeeping; Hydrogen Peroxide; Silver

THESAURUS AND FREE TEXT TERMS
hospital hygiene; hospital housekeeper; blood spill; blood exposure; blood splash

Search date:
Jan 2005-Nov 2012

Search Results
Total number of articles located = 5944

Sift 1 Criteria
Abstract indicates that the article: relates to infections associated with hospital hygiene, is written in English, is primary research or a systematic review or a meta-analysis, and appears to inform one or more of the review questions.

Articles Retrieved
Total number of articles retrieved from sift 1 = 164
Sift 2 Criteria
Full Text confirms that the article relates to infections associated with hospital hygiene is written in English, is primary research or a systematic review or a meta-analysis, and informs one or more of the review questions.

Articles Selected for Appraisal
Total number of articles selected for appraisal during sift 2 = 24

Critical Appraisal
All articles which described primary research, a systematic review or, a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

Accepted and Rejected Evidence
Total number of articles accepted after critical appraisal = 10
Total number of articles rejected after critical appraisal = 14
## Hand hygiene - Systematic Review Process

### Systematic Review Questions

1. What is the effectiveness and cost effectiveness of hand decontamination preparations on hand hygiene compliance among healthcare workers, reductions in healthcare associated infection, reduction in transient and/or resident skin microorganisms and the removal of organic soil?
2. What is the most effective hand decontamination technique, including duration, for achieving reductions in transient and/or resident skin microorganisms and the removal of organic soil?
3. What is the effectiveness of hand decontamination preparations on user preference and minimising contact dermatitis/allergy in healthcare workers?
4. What is the effectiveness of system interventions, electronic monitoring and education programmes in increasing hand hygiene compliance among healthcare workers and reducing infection?
5. What is the effectiveness of interventions that provide patients with opportunities to decontaminate their hands while in hospital?

### Databases and Search Terms Used

**DATABASES**
- Medline
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- Embase
- NEHL Guideline Finder
- National Institute For Health and Clinical Excellence
- The Cochrane Library (CDSR, CCRCT, CMR)
- US Guideline Clearing House
- DARE (NHS Evidence, HTA)
- Prospero
- PsycINFO

**MeSH TERMS**
- infection control; cross infection; equipment contamination; disease transmission; disinfectants; soaps; anti-infective agents; surface active agents;
- Guideline Adherence; consumer satisfaction

**THESAURUS AND FREE TEXT TERMS**
- Handwashing; skin; nails; antisepsis; decontamination; WHO Five Moments; Multimodal campaign; patient education; hand hygiene audit; hand hygiene compliance

**Search date**
- Jan 2006-Jan 2013

### Search Results

Total number of articles located = 8223

### Sift 1 Criteria

Abstract indicates that the article: relates to infections associated with hand hygiene, is written in English, is primary research or a systematic review or a meta-analysis, and appears to inform one or more of the review questions.

### Articles Retrieved

Total number of articles retrieved from sift 1 = 255
Sift 2 Criteria
Full Text confirms that the article relates to infections associated with hand hygiene is written in English, is primary research or a systematic review or a meta-analysis, and informs one or more of the review questions.

Articles Selected for Appraisal
Total number of articles selected for appraisal during sift 2 = 78

Critical Appraisal
All articles which described primary research, a systematic review or, a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

Accepted and Rejected Evidence
Total number of articles accepted after critical appraisal = 17
Total number of articles rejected after critical appraisal = 61
Personal Protective Equipment - Systematic Review Process

**Systematic Review Questions**

1. What is the evidence that healthcare workers use of clinical gloves is clinically appropriate and cost effective?
2. What is the effect of glove use on hand hygiene compliance?
3. What is the effect of glove material (vinyl, latex or nitrile) on user preference and hypersensitivity, protection against blood borne infections, glove porosity and tears? (adapted from NICE 139)
4. What is the evidence that the uniforms / clothes of healthcare workers contribute to the transmission of healthcare-associated infection?
5. What is the evidence that the use of protective clothing reduces the risk of transmission of healthcare-associated infection?
6. What is the effectiveness of personal protective equipment (aprons, gloves and mouth/facial protection) in preventing the transmission of blood borne viruses?
7. What is the effectiveness of facial protection (facemasks, respirators) in preventing the transmission of respiratory pathogens?
8. What is the effectiveness of education interventions in improving healthcare workers knowledge and behaviour in the appropriate use of personal protective equipment and reducing infection?

**Databases and Search Terms Used**

**DATABASES**
Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, NEHL Guideline Finder, National Institute For Health and Clinical Excellence, The Cochrane Library (CDSR, CCRCT, CMR), US Guideline Clearing House, DARE(NHS Evidence, HTA), Prospero

**MeSH TERMS**
infection control; cross infection; equipment contamination; universal precaution; disease transmission; protective clothing; disposable equipment; masks; gloves, protective; eye protective devices; education; health education; medical education; inservice training; health knowledge

**THESaurus AND FREE TEXT TERMS**
Infection; contamination; antisepsis; universal precaution; disease transmission; disinfection; sterilisation; decontamination; disposable equipment; masks; gloves; face shield; goggles; apron; gown; protective clothes; visor; hood; eye protection devices

**Search date**

**Search Results**
Total number of articles located = AG (867), FP (8160)
Critical Appraisal

All articles which described primary research, a systematic review or a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

Accepted and Rejected Evidence

Total number of articles accepted after critical appraisal = AG(6), FP(4)
Total number of articles rejected after critical appraisal = AG(0), FP(2)
Sharps - Systematic Review Process

Systematic Review Questions
1. What are the risk factors associated with sharps injuries in secondary healthcare? (B)
2. What are the changes in legislation in relation to the use and disposal of sharps and the prevention of injuries in healthcare settings? (B)
3. What is the effectiveness and cost effectiveness of using safety needle cannulae vs. standard cannulae on healthcare workers compliance with recommended use and disposal, risk of infection and injury to patients or healthcare workers? (adapted from NICE 139) Note: This question may refer to PVC RQs too.
4. What is the effectiveness and cost effectiveness of healthcare workers using safety needle devices (needle free, retractable needles, safety re-sheathing devices) vs. standard needles on healthcare workers compliance with recommended use and disposal, risk of infection and injury to patients or healthcare workers? (adapted from NICE 139)
5. What is the effectiveness of education interventions in improving healthcare workers knowledge and behaviour in the use and disposal of sharps?

Databases and Search Terms Used
DATABASES
Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, NEHL Guideline Finder, National Institute For Health and Clinical Excellence, The Cochrane Library (CDSR, CCRCT, CMR), US Guideline Clearing House, DARE(NHS Evidence, HTA), Prospero
MeSH TERMS
infection control; cross infection; universal precautions, equipment contamination; disease transmission; needlestick injuries; education; health education; medical education; inservice training; health knowledge
THESAURUS AND FREE TEXT TERMS
Needles; syringes; sharps; resheathing; safe needle; safe lancet; safe cannula, needle retract; needle covered; needle capped; needle fixed; needle uncapped; needleless; needle free
Search date
Jan 2005-feb 2013

Search Results
Total number of articles located = 3989

Sift 1 Criteria
Abstract indicates that the article: relates to infections associated with sharps, is written in English, is primary research or a systematic review or a meta-analysis, and appears to inform one or more of the review questions.

Articles Retrieved
Total number of articles retrieved from sift 1 = 18
**Sift 2 Criteria**

*Full Text confirms* that the article relates to infections associated with sharps is written in English, is primary research or a systematic review or a meta-analysis, and informs one or more of the review questions.

**Articles Selected for Appraisal**

Total number of articles selected for appraisal during sift 2 = 2

**Critical Appraisal**

All articles which described primary research, a systematic review or, a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

**Accepted and Rejected Evidence**

Total number of articles accepted after critical appraisal = 1

Total number of articles rejected after critical appraisal = 1
A.5 Short-term indwelling urethral catheters Systematic Review Process

Systematic Review Questions

1. What are the clinical indications for the use of short-term urinary catheters? (B)
2. What is the risk associated with short-term catheterisation in terms of bacteriuria, CAUTI, other morbidities and mortality? (B)
3. What is the effectiveness (in terms of patient acceptability and reduced risk of bacteriuria, CAUTI, other morbidities and mortality) and the cost effectiveness of different types of short-term indwelling urinary catheters (material, coatings and design)?
4. What is the most effective catheter insertion technique in terms of patient acceptability and minimisation of urethral trauma, bacteriuria, CAUTI and other morbidities?
5. What is the most effective and cost effective means of maintaining meatal hygiene and a closed drainage system?
6. What is the effectiveness of system interventions in reducing the use and duration of short-term urinary catheterisation to minimize the risk of bacteriuria, CAUTI, other morbidities and mortality?
7. What is the effectiveness of system interventions in improving healthcare workers' knowledge and behaviour relating to the insertion, maintenance and timely removal of indwelling urinary catheters to minimize the risk of bacteriuria, CAUTI, other morbidities and mortality?

Databases and Search Terms Used

DATABASES
Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, NEHL Guideline Finder, National Institute For Health and Clinical Excellence, The Cochrane Library (CDSR, CCRCT, CMR), US Guideline Clearing House, DARE (NHS Evidence, HTA), Prospero

MeSH TERMS
infection control; cross infection; disease transmission; urinary tract infections; urinary catheterisation; indwelling catheters; irrigation; biofilms; hydrogen ion concentration; nursing education; nursing care; inservice training

THESAURUS AND FREE TEXT TERMS
Urinary catheterisation; urinary tract infection; cross infection; disease transmission; bacteriuria; funguria; encrustation; bladder irrigation; washout; lubrication; urinary dipstick; patient education; quality improvement

Search date
Jan 2007-apr 2013

Search Results
Total number of articles located = 7073

Sift 1 Criteria
Abstract indicates that the article: relates to infections associated with
short-term indwelling urinary catheters, is written in English, is primary research or a systematic review or a meta-analysis, and appears to inform one or more of the review questions.

**Articles Retrieved**
Total number of articles retrieved from sift 1 = 54

**Sift 2 Criteria**
Full Text confirms that the article relates to infections associated with short-term indwelling urinary catheters is written in English, is primary research or a systematic review or a meta-analysis, and informs one or more of the review questions.

**Articles Selected for Appraisal**
Total number of articles selected for appraisal during sift 2 = 16

**Critical Appraisal**
All articles which described primary research, a systematic review or, a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

**Accepted and Rejected Evidence**
Total number of articles accepted after critical appraisal = 10
Total number of articles rejected after critical appraisal = 6
A.6 Intravascular Access Devices Systematic Review Process

Systematic Review Questions

1. What types of central vascular catheter (material, coating, antibiotic impregnation, cuffed, tunnelled, midline, PICC) and peripheral vascular catheter (material, coating, antibiotic impregnation) are most effective in reducing the risk of catheter-related bloodstream infections and related complications/adverse events including phlebitis, related mortality, catheter-tip colonisation, premature line removal?

2. Which central catheter/peripheral catheter insertion site is associated with the lowest risk of catheter-related bloodstream infection and related complications including (phlebitis, related mortality, catheter-tip colonisation and premature line removal)?

3. What is the evidence that additional ports or lumens increase the risk of catheter-related bloodstream infection) and related complications/adverse events including phlebitis, mortality, catheter tip colonisation and premature line removal?

4. Which infection prevention precautions used for inserting intravascular catheters, are most effective in reducing the risk of CR-BSI and related complications/adverse events including phlebitis, catheter-tip colonisation, premature line removal and mortality?

5. What levels of barrier precautions are most effective in reducing the risk of CR-BSI and related complications/adverse events including phlebitis, catheter-tip colonisation, premature line removal and mortality?

6. What is the most effective skin antisepsis solution/antiseptic impregnated product, for decontamination of the skin prior to insertion of CVC and PVC to reduce the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

7. What is the effectiveness of antisepsics vs. antiseptic impregnated products (sponges or cloths) for decontaminating the skin the insertion site or surrounding area skin whilst a CVC and PVC is in situ in reducing the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

8. What is the evidence for the effectiveness of using antibiotics or antiseptics to lock or flush or clean the catheter hub or entry ports of CVC and PVC in reducing the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

9. What is the effectiveness of the low-dose systemic anticoagulation to reduce the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

10. Which dressing type is the most clinically effective in reducing the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality and how frequently should dressings be changed?

11. What is the optimal frequency to change or re-site PVC or midline catheters to reduce the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

12. What is the evidence for the effectiveness of replacing administration sets to reduce the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

13. What is the effectiveness of the prophylactic administration of systemic antimicrobials in reducing the incidence of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and
14. What is the evidence that the needle-safe devices are associated with increased risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality?

15. What is the effectiveness of system interventions in reducing the risk of CR-BSI and related complications including, phlebitis, catheter-tip colonisation, premature line removal and mortality and improving healthcare workers’ knowledge and behaviour relating to the use of CVAD and PVD?

Databases and Search Terms Used
DATABASES
Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, NEHL Guideline Finder, National Institute For Health and Clinical Excellence, The Cochrane Library (CDSR, CCRCT, CMR), US Guideline Clearing House, DARE (NHS Evidence, HTA), Prospero

MeSH TERMS
infection control; cross infection; disease transmission; universal precautions; central venous catheter; bacteremia; chlorhexidine; povidone-iodine; anticoagulants; sepsis; sterilisation; antisepsis; catheterization; peripheral catheterization; peripheral catheter;

THESaurus AND FREE TEXT TERMS
PICC; TPN; catheter hub; implantable catheter; catheter port; needle-free devices; needleless connector; intravenous-access; skin preparation; care bundle; Matching Michigan; catheter team, IV team; specialist nurses

Search date
Jan 2010-feb 2013

Search Results
Total number of articles located = 8053

Sift 1 Criteria
Abstract indicates that the article: relates to infections associated with intravascular access devices, is written in English, is primary research or a systematic review or a meta-analysis, and appears to inform one or more of the review questions.

Articles Retrieved
Total number of articles retrieved from sift 1 = 96

Sift 2 Criteria
Full Text confirms that the article relates to infections associated with intravascular access devices is written in English, is primary research or a systematic review or a meta-analysis, and informs one or more of the review questions.
Articles Selected for Appraisal
Total number of articles selected for appraisal during sift = 27

Critical Appraisal
All articles which described primary research, a systematic review or, a meta-analysis and met the sift 2 criteria were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion.

Accepted and Rejected Evidence
Total number of articles accepted after critical appraisal = 20
Total number of articles rejected after critical appraisal = 7
## A.7 Systematic Review Process

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<thead>
<tr>
<th>Initial Search for Published evidence</th>
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<tr>
<td>An initial search was made for national and international guidelines and systematic reviews of randomised control trials.</td>
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<tr>
<th>Systematic Review Questions</th>
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<tr>
<td>Search questions were based on the scope of the original review and advice from the Guideline Development Group.</td>
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<tr>
<th>Literature Search</th>
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<tr>
<td>Databases to be searched were identified together with search strategy, i.e., relevant medical subject headings (MESH), free text and thesaurus terms.</td>
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<th>Sift 1</th>
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<tr>
<td>Abstracts of all articles retrieved from the search were reviewed against pre-determined inclusion criteria, e.g. relevant to a review question, primary research / systematic review / meta-analysis, written in English.</td>
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<th>Sift 2</th>
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<tr>
<td>Full text of all articles meeting inclusion criteria were reviewed against pre-determined criteria to identify primary research which answers review questions.</td>
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<tr>
<th>Critical Appraisal</th>
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<tbody>
<tr>
<td>All articles which describe primary research, a systematic review or, a meta-analysis were critically appraised by two experienced appraisers. Consensus and grading was achieved through discussion in the context of pre-determined grading criteria.</td>
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