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

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SECTION 1

INTRODUCTORY SECTION

1.1 Forward (Department of Health)

1.2 Executive Summary

National evidence-based guidelines for preventing healthcare-associated infections (HCAI) in National Health Service (NHS) hospitals in England were commissioned by the Department of Health (DH) and developed during 1998-2000 by a nurse-led multi-professional team of researchers and specialist clinicians. Following extensive consultation, they were published in January 2001.¹ These guidelines describe the precautions healthcare workers should take in three areas: standard principles for preventing HCAI, which include hospital environmental hygiene, hand hygiene, the use of personal protective equipment, and the safe use and disposal of sharps; preventing infections associated with the use of short-term indwelling urethral catheters and central venous catheters.

The evidence for these guidelines was identified by multiple systematic reviews of experimental and non-experimental research and expert opinion as reflected in systematically identified professional, national and international guidelines, which were formally assessed by a validated appraisal process. In 2003, we developed complementary national guidelines for preventing HCAI in primary and community care on behalf of the National Collaborating Centre for Nursing and Supportive Care (National Institute for Health and Clinical Excellence).²

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. Periodically updating the evidence base and guideline recommendations is essential in order to maintain their validity and authority.

Consequently, the DH commissioned a review of new evidence published following the last systematic reviews. We have now updated the evidence base for making infection prevention and control recommendations. A critical assessment of the updated evidence indicates that the current guidelines remain robust, relevant and appropriate but that adjustments need to be made to some guideline recommendations.

The updated national guidelines (**epic2**) provide comprehensive recommendations for preventing HCAI in hospitals and other acute care settings based on the best currently available evidence. Because this is not always the best possible evidence, we have included a suggested agenda for further research in each section of the guidelines. National evidence-based guidelines are broad principles of best practice which need to be integrated into local practice guidelines. To monitor implementation, we have suggested key audit criteria for each section of recommendations.

Clinically effective infection prevention and control practice is an essential feature of protecting patients. By incorporating these guidelines into routine daily clinical practice, patient safety can be enhanced and the risk of patients acquiring an infection during episodes of healthcare in NHS hospitals in England can be minimised.

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- Pellowe CM, Pratt RJ, Harper P, Loveday HP, Robinson N, Jones S, MacRae ED, and the Guideline Development Group. Infection Control: Prevention of healthcare –associated infection in primary and community care. *Journal of Hospital Infection* 2003;55(Supplement 2):1-127.

1.3 Guideline Advisory Group

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- Royal College of Nursing Intravenous Therapy Forum.
- Liz Simcock, Clinical Nurse Specialist for Central Venous Access, Cancer Services, University College London Hospitals NHS Trust, London.
- Dr Godfrey W Smith, Consultant, Department of Medical Microbiology, Royal Liverpool and the University of Liverpool.

1.4 Acknowledgements

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1.5 Source of Funding

The Department of Health (England)

1.6 Conflict of Interest

None

1.7 Relationship of Author(s) with Sponsor

Department of Health (England) commissioned authors to update the evidence and guideline recommendations.

1.8 Responsibility for Guidelines

The views expressed in this publication are those of the authors and, following extensive consultation, have been endorsed by the Department of Health (England).

1.9 Index

Section	Section Title	Page(s)
1	Introductory Section	ii-xxxii
1.1	Forward (Department of Health)	iii
1.2	Executive Summary	iv
1.3	Guideline Advisory Group	v
1.4	Acknowledgements	v
1.5	Source of Funding	v
1.6	Conflict of Interests	v
1.7	Relationship of Author(s) with Sponsor	v
1.8	Responsibility for Guidelines	v
1.9	Index	vi
1.10	Summary of Guidelines	viii
1.11	Introduction	xviii
1.12	Guideline Development Methodology	xxi
1.13	Consultation Process	xxiii
1.14	Glossary	xxiv
2	Standard principles for preventing healthcare-associated infections in hospital and other acute care settings	1-38
2.1	Introduction	2
2.2	The systematic review process	2
2.3	Hospital environmental hygiene	3
2.4	Hand hygiene	7
2.5	The use of personal protective equipment	18
2.6	The safe use and disposal of sharps	24
2.7	Areas for further research	28
2.8	Key Audit criteria	29
2.9	The Use of hazard analysis critical control points (HACCP) in hospital environmental hygiene	30
2.10	Standard Principles systematic review process	31
3	Guidelines for preventing infections associated with the use of short-term urethral catheters	39-54
3.1	Introduction	40
3.2	The systematic review process	40
3.3	Assessing the need for Catheterisation	41
3.4	Selection of catheter type	42
3.5	Aseptic catheter insertion	45
3.6	Catheter maintenance	46
3.7	Education of healthcare personnel and patients	50
3.8	Areas for further research	51
3.9	Key Audit criteria	52
3.10	Urinary Catheter systematic review process	53
4	Guidelines for preventing infections associated with the use of central venous catheters	55-90
4.1	Introduction	56
4.2	The systematic review process	57
4.3	Education of healthcare personnel and patients	59
4.4	General asepsis	60
4.5	Selection of catheter type	61
4.6	Selection of catheter insertion site	66
4.7	Maximal sterile barrier precautions during catheter insertion	69
4.8	Cutaneous antisepsis	71
4.9	Catheter and catheter site care	74
4.10	Catheter replacement strategies	76
4.11	General principles for catheter management	79

4.12	Areas for further research	87
4.13	Key Audit criteria	88
4.14	Central Venous Catheter systematic review process	89
A	Appendices	91-93
A.1	Systematic Review Process	92
A.2	Stakeholders Consulted	93

1.10 Summary of Guidelines

Standard Principles for preventing healthcare-associated infections in hospital and other acute care settings

This guidance is based on the best critically appraised evidence currently available. The type and grade 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.

This guidance on infection control precautions should be applied by all healthcare practitioners to the care of every patient. The recommendations are divided into four 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.

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

Hospital environmental hygiene

SP1	The hospital environment must be visibly clean, free from dust and soilage and acceptable to patients, their visitors and staff.	Category C
SP2	Increased levels of cleaning should be considered in outbreaks of infection where the pathogen concerned survives in the environment and environmental contamination may be contributing to spread.	Category D
SP3	The use of hypochlorite 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.	Category D
SP4	Clinical equipment must be decontaminated appropriately after each use.	Category D
SP5	All hospital staff need to be aware of their individual responsibility for maintaining a safe care environment for patients and staff. Every member of staff needs to be clear about their specific responsibilities for cleaning equipment and clinical areas (especially those areas in close proximity to patients). They must be educated about the importance of ensuring that the hospital environment is clean and that opportunities for microbial contamination are minimised.	Category B

Hand hygiene

SP6	Hands must be decontaminated immediately before each and every episode of direct patient contact/care and after any activity or contact that potentially results in hands becoming contaminated.	Category B
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SP7	Hands that are visibly soiled or potentially grossly contaminated with dirt or organic material (ie following the removal of gloves) must be washed with liquid soap and water.	<i>Category A</i>
SP8	Hands should be decontaminated, preferably with an alcohol-based handrub unless hands are visibly soiled or local infection control advice recommends an alternative product, between caring for different patients or between different care activities for the same patient.	<i>Category A</i>
SP9	Before regular hand decontamination begins all wrist and ideally hand jewellery should be removed. Cuts and abrasions must be covered with waterproof dressings. Fingernails should be kept short, clean and free from nail polish. False nails and nail extensions must not be worn by clinical staff.	<i>Category D</i>
SP10	An effective handwashing technique involves three stages: preparation, washing and rinsing, and drying. Preparation requires wetting hands under tepid running water <u>before</u> applying liquid soap or an antimicrobial preparation. The handwash solution must come into contact with <u>all</u> of the surfaces of the hand. The hands must be <u>rubbed</u> 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 prior to drying with good quality paper towels.	<i>Category D</i>
SP11	When decontaminating hands using an alcohol-based handrub, hands should be free of dirt and organic material. The handrub 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.	<i>Category D</i>
SP12	An emollient hand cream should be applied to protect skin from the drying effects of regular hand decontamination. Infection control teams should advise staff on the use of hand creams and alcohol-based handrub and their effect on the persistent effects of antiseptic soaps that may be in use.	<i>Category D</i>
SP13	If a particular soap, antiseptic hand wash or alcohol-based product causes skin irritation an occupational health team should be consulted.	<i>Category D</i>
SP14	Near patient alcohol-based hand rub should be made available in all healthcare facilities.	<i>Category D</i>
SP15	Hand hygiene resources and individual practice should be audited at regular intervals and the results fed back to healthcare staff.	<i>Category D</i>
SP16	Education and training in risk assessment, effective hand hygiene and glove use should form part of all healthcare workers annual updating.	<i>Category D</i>

The use of personal protection equipment

SP17	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.	<i>Category D/H&S</i>
SP18	Everyone involved in providing care should be educated about standard principles and trained in the use of protective equipment.	<i>Category D/H&S</i>
SP19	Adequate supplies of disposable plastic aprons and single use gloves should be made available wherever care is delivered. Gowns should be made available when advised by the infection control team.	<i>Category D/H&S</i>
SP20	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 instruments.	<i>Category D/H&S</i>
SP21	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.	<i>Category D/H&S</i>
SP22	Gloves must be disposed of as clinical waste and hands decontaminated after the gloves have been removed.	<i>Category D/H&S</i>
SP23	Gloves that are acceptable to healthcare personnel and conform to European Community (CE) standards must be available in all clinical areas.	<i>Category H&S</i>
SP24	Sensitivity to natural rubber latex in patients, carers and healthcare personnel must be documented and alternatives to natural rubber latex must be available.	<i>Category B/H&S</i>
SP25	Neither powdered nor polythene gloves should be used in health care activities.	<i>Category C/H&S</i>
SP26	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.	<i>Category D/H&S</i>
SP27	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.	<i>Category D/H&S</i>
SP28	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 personnel (for example when assisting with childbirth).	<i>Category D/H&S</i>

SP29 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. *Category D/H&S*

SP30 Respiratory protective equipment, i.e., a particulate filter mask, must be used when recommended for the care of patients with respiratory infections transmitted by airborne particles. *Category D/H&S*

The safe use and disposal of sharps

SP31 Sharps must not be passed directly from hand to hand and handling should be kept to a minimum. *Category D/H&S*

SP32 Needles must not be recapped, bent broken or disassembled before use or disposal. *Category D/H&S*

SP33 Used sharps must be discarded into a sharps container (conforming to UN3291 and BS 7320 standards) at the point of use by the user. These must not be filled above the mark that indicates the bin is full. *Category D/H&S*

SP34 All sharps bins should be positioned out of the reach of children at a height that enables safe disposal by all members of staff. They should be secured to avoid spillage. *Category D/H&S*

SP35 All staff both clinical and non clinical must be educated about the safe use and disposal of sharps. *Category D/H&S/GPP*

SP36 Consider the use of needlestick-prevention devices where there are clear indications that they will provide safe systems of working for healthcare practitioners. *Category B/H&S*

SP37 Conduct a rigorous evaluation of needlestick-prevention devices to determine their effectiveness, acceptability to practitioners, impact on patient care and cost benefit prior to widespread introduction. *Category D*

SP38 The introduction of new intravascular devices that includes needle-free devices, should be monitored for an increase in the occurrence of device associated infection *Category D*

Guidelines for preventing infections associated with the use of short-term indwelling urethral catheters

This guidance is based on the best critically appraised evidence currently available. The type and grade 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 and should be read in conjunction with the guidance on Standard Principles. The recommendations are divided into five distinct interventions:

1. Assessing the need for catheterisation;
2. Selection of catheter type and system;
3. Catheter insertion;
4. Catheter maintenance; and
5. Education of patients, relatives and healthcare personnel.

Assessing the need for catheterisation

UC1	Only use indwelling urethral catheters after considering alternative methods of management.	<i>Category D/GPP</i>
UC2	Document the need for catheterisation, catheter insertion and care.	<i>Category D/GPP</i>
UC3	Review regularly the patient's clinical need for continuing urinary catheterisation and remove the catheter as soon as possible.	<i>Category D/GPP</i>

Selection of Catheter Type

UC4	Choice of catheter material will depend on clinical experience, patient assessment and anticipated duration of catheterisation.	<i>Category D</i>
UC5	Select the smallest gauge catheter that will allow free urinary outflow. A catheter with a 10 ml balloon should be used. Urological patients may require larger gauge sizes and balloons.	<i>Category D</i>

Catheter Insertion

UC6	Catheterisation is an aseptic procedure. Ensure that health care personnel are trained and competent to carry out urethral catheterisation.	<i>Category D</i>
UC7	Clean the urethral meatus prior to the insertion of the catheter.	<i>Category D</i>
UC8	Use an appropriate lubricant from a single use container to minimise urethral trauma and infection.	<i>Category D</i>

Catheter Maintenance

UC9	Connect indwelling urethral catheters to a sterile closed urinary drainage system.	<i>Category A</i>
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UC10	Ensure that the connection between the catheter and the urinary drainage system is not broken except for good clinical reasons, e.g., changing the bag in line with manufacturer’s recommendation.	<i>Category A</i>
UC11	Decontaminate hands and wear a new pair of clean, non-sterile gloves before manipulating a patient’s catheter and decontaminate hands after removing gloves.	<i>Category D</i>
UC12	Obtain urine samples from a sampling port using an aseptic technique.	<i>Category D/GPP</i>
UC13	Position urinary drainage bags below the level of the bladder on a stand that prevents contact with the floor. Where such drainage cannot be maintained, e.g., during moving and handling, clamp the urinary drainage bag tube and remove the clamp as soon as dependent drainage can be resumed.	<i>Category D/GPP</i>
UC14	Empty the urinary drainage bag frequently enough to maintain urine flow and prevent reflux. Use a separate and clean container for each patient and avoid contact between the urinary drainage tap and container.	<i>Category D/GPP</i>
UC15	Do not add antiseptic or antimicrobial solutions into urinary drainage bags.	<i>Category A</i>
UC16	Do not change catheters unnecessarily or as part of routine practice.	<i>Category D/GPP</i>
UC17	Routine personal hygiene is all that is needed to maintain meatal hygiene.	<i>Category A</i>
UC18	Bladder irrigation, instillation and washout should not be used to prevent catheter-associated infection.	<i>Category A</i>
Education of patients, relatives and healthcare personnel		
UC19	Healthcare personnel must be trained in catheter insertion and maintenance.	<i>Category D/GPP</i>
UC20	Patients and relatives should be educated about their role in preventing urinary tract infection.	<i>Category D/GPP</i>

Guidelines for preventing infections associated with the use of central venous catheters

This guidance is based on the best critically appraised evidence currently available. The type and grade 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 adolescents and should be read in conjunction with the guidance on Standard Principles. The recommendations are divided into 9 distinct interventions:

1. Education of healthcare personnel 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; and
9. General Principles for Catheter Management.

Education of healthcare personnel and patients

CVC1	Healthcare personnel caring for a patient with a central venous catheter should be trained, and assessed as competent in using and consistently adhering to the infection prevention practices described in this guideline.	<i>Category D</i>
CVC2	Before discharge from hospital, patients with long-term catheters and their carers should be taught any techniques they may need to use to prevent infection and safely manage a central venous catheter.	<i>Category D/GPP</i>
CVC3	Follow-up training and support should be available to patients with central venous catheters and their carers.	<i>Category D/GPP</i>

General asepsis

CVC4	An aseptic technique must be used for catheter insertion, site care and for accessing the system.	<i>Category B</i>
CVC5	Before accessing or dressing central vascular catheters, hands must be decontaminated either by washing with an antimicrobial liquid soap and water, or by using an alcohol handrub.	<i>Category A</i>
CVC6	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.	<i>Category A</i>
CVC7	Following hand antisepsis, clean gloves and a no-touch technique or sterile gloves should be used during catheter placement or when changing the insertion site dressing.	<i>Category D</i>

Selection of Catheter Type

CVC8	Use a single-lumen catheter unless multiple ports are essential for the management of the patient.	<i>Category D</i>
CVC9	Designate one port exclusively for hyperalimentation if a multilumen catheter is used to administer parenteral nutrition.	<i>Category D</i>
CVC10	Use a tunnelled or a totally implanted vascular device (one with a subcutaneous port) for patients in whom long-term (more than 3-4 weeks') vascular access is anticipated.	<i>Category A</i>
CVC11	Consider the use of an antimicrobial impregnated CVC for adult patients who require short-term (1 to 3 weeks') central venous catheterisation and who are at high risk for CR-BSI.	<i>Category A</i>

Selection of Catheter Insertion Site

CVC12	In selecting an appropriate insertion site, assess the risks for infection against the risks of mechanical complications.	<i>Category D/GPP</i>
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CVC13 Unless medically contraindicated, use the subclavian site in preference to the jugular or femoral sites for nontunneled catheter placement. *Category C*

CVC14 Use totally implantable access devices for patients who require long-term, intermittent vascular access. For patients requiring frequent or continuous access, a peripherally inserted central venous catheter or tunneled central venous catheter is preferable. *Category C*

Maximal Sterile Barrier Precautions during Catheter Insertion

CVC15 Use maximal sterile barriers, including a sterile gown, sterile gloves, and a large sterile drape, for the insertion of central venous catheters. *Category A*

Cutaneous Antisepsis

CVC16 Decontaminate the skin site with an alcoholic chlorhexidine gluconate solution (preferably 2% chlorhexidine gluconate in 70% isopropyl alcohol) prior to CVC insertion. Use an alcoholic povidone-iodine solution for patients with a history of chlorhexidine sensitivity. Allow the antiseptic to dry before inserting the catheter. *Category A*

CVC17 Do not apply organic solvents, e.g., acetone, ether, to the skin before catheter insertion. *Category D/GPP*

CVC18 Do not routinely apply antimicrobial ointment to the catheter placement site prior to insertion. *Category D/GPP*

Catheter and Catheter Site Care

CVC19 Preferably, a sterile, transparent, semi-permeable polyurethane dressing should be used to cover the catheter site. *Category A*

CVC20 Transparent dressings should be changed every 7 days, or sooner if they are no longer intact or moisture collects under the dressing. *Category A*

CVC21 If a patient has profuse perspiration or if the insertion site is bleeding or oozing, a sterile gauze dressing is preferable to a transparent, semi-permeable dressing. *Category D/GPP*

CVC22 Gauze dressings should be changed when inspection of the insertion site is necessary or when they become damp, loosened or soiled, and the need for a gauze dressing should be assessed daily. A gauze dressing should be replaced by a transparent dressing as soon as possible. *Category D*

CVC23 Dressings used on tunneled or implanted CVC sites should be replaced every 7 days until the insertion site has healed, unless there is an indication to change them sooner. *Category A*

- CVC24** Preferably, an alcoholic chlorhexidine gluconate solution should be used to clean the catheter site during dressing changes, and allowed to air dry. An aqueous solution of chlorhexidine gluconate should be used if the manufacturer's recommendations prohibit the use of alcohol with their product. *Category A*
- CVC25** Individual single use sachets of antiseptic solution or individual packages of single use antiseptic-impregnated swabs or wipes, or sprays should be used to disinfect the dressing site. *Category D/GPP*
- CVC26** Do not apply antimicrobial ointment to catheter insertion sites as part of routine catheter site care. *Category D/GPP*
- CVC27** Healthcare personnel should ensure that 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. *Category D/GPP*

Catheter Replacement Strategies

- CVC28** Do not routinely replace non-tunnelled central venous catheters as a method to prevent catheter-related infection. *Category A*
- CVC29** Use guide wire assisted catheter exchange to replace a malfunctioning catheter, or to exchange an existing catheter if there is no evidence of infection at the catheter site or proven catheter-related bloodstream infection. *Category A*
- CVC30** If catheter-related infection is suspected, but there is no evidence of infection at the catheter site, removed the existing catheter and insert a new catheter over a guide wire; if tests reveal catheter-related infection, the newly inserted catheter should be removed and, if still required, a new catheter inserted at a different site. *Category A*
- CVC31** Do not use guide wire assisted catheter exchange for patients with catheter-related infection. If continued vascular access is required, removed the implicated catheter, and replace it with another catheter at a different insertion site. *Category A*
- CVC32** Replace all fluid administration tubing and connectors when the vascular device is replaced. *Category D/GPP*

General Principles for Catheter Management

- CVC33** Preferably, an alcoholic chlorhexidine gluconate solution should be used to decontaminate the injection port or catheter hub before and after it has been used to access the system, unless contraindicated by the manufacturer's recommendations, in which case aqueous povidone iodine should be used. *Category A*
- CVC34** In-line filters should not be used routinely for infection prevention. *Category D*
- CVC35** Antibiotic lock solutions should not be used routinely to prevent catheter-related bloodstream infections. *Category D*

CVC36	Do not routinely administer intranasal or systemic antimicrobials before insertion or during the use of a central venous catheter to prevent catheter colonisation or bloodstream infection.	<i>Category A</i>
CVC37	Preferably, 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.	<i>Category D</i>
CVC38	Preferably, sterile 0.9 percent sodium chloride for injection should be used to flush and lock catheter lumens.	<i>Category A</i>
CVC39	When recommended by the manufacturer, implanted ports or opened-ended catheter lumens should be flushed and locked with heparin sodium flush solutions.	<i>Category D</i>
CVC40	Systemic anticoagulants should not be used routinely to prevent catheter-related bloodstream infection.	<i>Category D</i>
CVC41	The introduction of new intravascular devices that includes needle free devices, should be monitored for an increase in the occurrence of device associated infection.	<i>Category D</i>
CVC42	If needleless devices are used, the manufacturer’s recommendations for changing the needleless components should be followed.	<i>Category D/GPP</i>
CVC43	When needleless devices are used, healthcare personnel should ensure that all components of the system are compatible and secured, to minimise leaks and breaks in the system.	<i>Category D/GPP</i>
CVC44	When needleless devices are used, the risk of contamination should be minimised by decontaminating the access port with an alcoholic chlorhexidine gluconate solution unless contraindicated by the manufacturer’s recommendations, in which case aqueous povidone iodine should be used.	<i>Category D</i>
CVC45	In general, administration sets in continuous use need not be replaced more frequently than at 72 hour intervals unless they become disconnected or a catheter-related infection is suspected or documented.	<i>Category A</i>
CVC46	Administration sets for blood and blood components should be changed every 12 hours, or according to the manufacturer’s recommendations.	<i>Category D</i>
CVC47	Administration sets used for total parenteral nutrition (TPN) infusions should generally be changed every 24 hours. If the solution contains only glucose and amino acids, administration sets in continuous use do not need to be replaced more frequently than every 72 hours.	<i>Category D</i>

1.11 Introduction – the **epic2** Guidelines

National evidence-based guidelines for preventing healthcare-associated infections (HCAI) in NHS hospitals were commissioned by the Department of Health (England) (DH) and developed during 1998-2000 by a nurse-led multi-professional team of researchers and specialist clinicians. They were intended to provide reliable best evidence for the development of local infection prevention and control guidelines and protocols and facilitate clinically effective practice. Having been developed within the 'epic initiative' in the Richard Wells Research Centre at Thames Valley University, they became known as the 'epic' guidelines. Following extensive consultation, they were published in January 2001.¹ Two years later, under the auspices of the National Institute for Health and Clinical Excellence (NICE), a complementary set of national evidence-based guidelines were developed by the *epic* initiative, focused on preventing HCAI in primary and community care.²

Following an evidence review in 2004,^{3,4} it seemed appropriate to amend and update some of the original epic guideline recommendations to ensure that they continue to reflect new and emerging evidence, remain relevant to infection control and prevention practice and enjoy the confidence of practitioners and patients.

Additional updating systematic reviews were conducted in 2005 and the original *epic* guidelines have now been revised. They are referred to in this publication as the **epic2** infection prevention and control guidelines and they replace the original 2001 guidelines.

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.

What is the purpose of the guidelines?

These guidelines describe clinically effective measures that are used by healthcare workers for preventing and controlling 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 prevention and control principles include best practice recommendations for hospital environmental hygiene, effective hand hygiene, the appropriate use of personal protective equipment, and the safe use and disposal of sharps;
- Guidelines for preventing infections associated with the use of short-term indwelling urethral catheters; and
- Guidelines for preventing infections associated with the use of central venous catheters.

What is the evidence for these guidelines?

The evidence for these guidelines was identified by multiple systematic reviews of experimental and non-experimental research. In addition, evidence from expert opinion as reflected in systematically identified professional, national and international guidelines was considered following formal assessment by a validated appraisal process.³⁻⁵ 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?

The *epic2* guidelines were updated by a nurse-led group of researchers, a senior infection control nurse and a Director of Microbiology and Infection Prevention and Control in a large NHS Teaching Hospital Trust.

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 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 also help patients understand the standard infection prevention and control precautions recommended to protect them from HCAI.

How are these guidelines structured?

Each set of guidelines follows an identical format, which consists of:

- a *resume of the systematic review process*,
- the *intervention heading*;
- a *headline statement* describing the key issues being addressed;
- a *synthesis* of the related evidence and corresponding evidence grade;
- an *economic opinion*, where appropriate;
- *guideline recommendation(s)* with the corresponding recommendation grade(s);
- a *bibliography* listing the cited evidence.

Finally, at the end of each section there is a description of areas for *further research* and suggested *audit criteria*.

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 (2009) and the guidelines will be updated approximately four years after publication (2011).

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 and trades unions.

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1.12 Guideline Development Methodology

The guidelines were developed using a systematic review process (Appendix A.1). In each set of guidelines a resume 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 period 01 January 1999 to 31 August 2005. 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 current national and international guidelines. The following data bases were searched:

- Cochrane Library
- National Guideline Clearinghouse
- National Electronic Library of Health
- National Institute for Health and Clinical Excellence

Guidelines were retrieved and subjected to critical appraisal using the AGREE Instrument,¹ an evaluation method used in Europe for assessing the methodological quality of clinical practice guidelines.

Following appraisal, accepted guidelines were included as part of the evidence base supporting guideline development. They were also used to verify professional consensus. The emphasis given to each guideline depended on the rigour of its development and its comprehensiveness in relation to the review questions. In some instances they were used 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
- Embase
- The Cochrane Library

Abstract review – identifying studies for appraisal

Search results were downloaded into a Reference Manager™ database and titles and abstracts printed for preliminary review. Reviewers identified and retrieved all studies 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. No research designs were specifically excluded but wherever possible, in use rather than *in vitro* studies were retrieved

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 reviewed.

All full-text studies retrieved were independently assessed by two experienced reviewers who identified those studies meeting the above inclusion criteria for critical appraisal.

Quality Assessment and Data Extraction

Included studies were appraised using an adapted data extraction process based on systems developed by the Scottish Intercollegiate Guideline Network for study quality assessment.² Due to the limited resources available for this review, studies were not double-blind appraised. However, all studies were appraised and data extracted by one experienced reviewer and then checked by a second experienced reviewer. Any disagreement between reviewers was resolved through discussion. Evidence tables were constructed from the quality assessments and the studies summarised in the evidence reports. The evidence was graded using methods developed by the National Institute for Health and Clinical Excellence (NICE) (Table 1).³

Table 1 - Levels of Evidence for Intervention Studies³

Level of evidence	Type of evidence
1 ⁺⁺	High-quality meta-analyses, systematic reviews of randomised controlled trials (RCT), or RCT with a very low risk of bias
1 ⁺	Well-conducted meta-analyses, systematic reviews of RCT, or RCT with a low risk of bias
1 ⁻	Meta-analyses, systematic reviews of RCT, or RCT with a high risk of bias*
2 ⁺⁺	High-quality systematic reviews of case-control or cohort studies High-quality case-control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
2 ⁺	Well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal
2 ⁻	Case-control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*
3	Non-analytic studies (for example, case reports, case series)
4	Expert opinion, formal consensus
*Studies with a level of evidence '–' should not be used as a basis for making a recommendation	

The evidence tables and reports were presented to the advisors for discussion. At this stage, expert advice derived from seminal works and appraised national and international guidelines were considered. Following extensive discussion the guidelines were drafted.

Factors influencing the guideline recommendations included:

- the nature of the evidence;
- the applicability of the evidence;
- costs and knowledge of healthcare systems.

The grading scheme developed by NICE was used to define the strength of recommendation (Table 2).³

Table 2 - Classification of Recommendations ³

Class	Evidence
A	<ul style="list-style-type: none"> • At least one meta-analysis, systematic review, or randomised controlled trial (RCT) that is rated as 1++, and is directly applicable to the target population, or • A systematic review of RCT or a body of evidence that consists principally of studies rated as 1+, is directly applicable to the target population and demonstrates overall consistency of results • Evidence drawn from a NICE technology appraisal
B	<ul style="list-style-type: none"> • A body of evidence that includes studies rated as 2++, is directly applicable to the target population and demonstrates overall consistency of results, or • Extrapolated evidence from studies rated as 1++ or 1+
C	<ul style="list-style-type: none"> • A body of evidence that includes studies rated as 2+, is directly applicable to the target population and demonstrates overall consistency of results, or • Extrapolated evidence from studies rated as 2++
D	<ul style="list-style-type: none"> • Evidence level 3 or 4, or • Extrapolated evidence from studies rated as 2+, or • Formal consensus
D (GPP)	<ul style="list-style-type: none"> • A good practice point (GPP) is a recommendation for best practice based on the experience of the Guideline Development Group
IP	<ul style="list-style-type: none"> • Recommendation from NICE Interventional Procedures guidance

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3. National Institute for Clinical Excellence. *Guideline*.
4. *Development Methods: Information for National Collaborating Centres and Guideline Developers*. February 2004 (updated 2005). Available from: www.nice.org.uk (accessed 15 September 2005).

1.13 Consultation Process

The draft guidelines were circulated to stakeholders for comment (see A2). The list of stakeholders included all those consulted for the phase 1 guidelines and others agreed by the Department of Health (England).

Comments were requested on:

- the format;
- the content;
- practice applicability of the guidelines;
- Specific sections or recommendations.

All comments received were collated in a word table for consideration by the guideline developers and advisers who agreed any changes to the draft recommendations. The response to each comment was noted in the table and made available on the Richard Wells Research Centre website [www.richardwellsresearch.com].

1.14 Glossary

Adenosine triphosphate	A chemical compound that contains 'energy-rich bonds' and is used by cells to store and deliver energy
Alcohol handrub	A hand decontamination preparation based on alcohol, for the purposes of this guideline encompasses agents that are based on either rinses or gels
Antisepsis	The use of chemical or physical methods to prevent infection by destroying or inhibiting the growth of harmful microorganisms
Antiseptic	A substance that destroys or inhibits the growth of microorganisms and is sufficiently non-toxic to be applied to skin or mucous membranes
Asymptomatic bacteriuria	The presence of microorganisms in the urine in the absence of signs or symptoms of infection
Bacteraemia	Presence of microorganisms in the bloodstream
Bacteriuria	The presence of microorganisms in the urine. If there are no symptoms of infection this is called asymptomatic bacteriuria
Bloodstream infection (BSI)	The presence of microbes in the blood with significant clinical consequences (e.g. fever, chills, hypotension)

Case-control study	Analytical observational study that aims to investigate the relationship between an exposure or risk factor, e.g., insertion of a central venous catheter, and one or more outcomes, e.g., the occurrence of CR-BSI.
Catheter colonisation	A significant growth of microorganisms cultured by quantitative or semi-quantitative methods from the tip, subcutaneous segment or hub of the vascular catheter. Catheter colonisation is associated with catheter-related BSI
Catheter related bloodstream infection (CR-BSI)	An infection of the bloodstream infection where microorganisms are found in a blood culture taken from a peripheral vein of a patient with a CVC, 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 CVC 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 CVC versus peripheral; differential time to positivity of at least 2 hours for blood cultures cultured peripherally versus from CVC.
Catheter-associated infection	The presence of symptoms or signs attributable to microorganisms that have invaded the urinary tract, where the patient has, or has recently had, a urinary catheter
Catheter-related infection (CR-infection)	Any infection related to a vascular catheter, 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 consist 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
<i>Clostridium difficile</i>	A micro-organism that lives in the gut of some people. Toxin producing strains can cause pseudomembranous colitis.
Colonisation	Microorganisms that establish themselves in a particular environment such as a body surface without producing disease
Cross-over trial	A comparison of the outcome between two or more groups of patients that are exposed to different regimes of treatment/intervention where the groups exchange treatment/intervention after a prearranged period
Diatheses	A tendency to a disease
Disinfection	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
Encrustation	Urinary proteins, salts and crystals that accumulate on foreign material inserted into the body
Engineering controls	The use of equipment designed to prevent injury to the operator

Exogenous infection	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
Expert opinion	Opinion derived from seminal works and appraised national and international guidelines.
Haematogenous seeding	Microorganisms causing infection establish infection at another body site as a result of being transferred in the bloodstream.
Hand decontamination	The removal of blood, body fluid and harmful microorganisms from the hands using a detergent or disinfectant
Healthcare-associated infection (HCAI)	Infection acquired as a result of the delivery of healthcare either in a acute (hospital) or non-acute setting
Healthcare personnel	Any person employed by the health service, social service, local authority or agency to provide care for sick, disabled or elderly people.
Hospital-acquired infection (HAI)	Infection acquired during hospitalisation or as a result of an intervention during hospitalisation
Hypochlorite	A chlorine-based disinfectant
Incidence	The number of new events (e.g. cases of disease) occurring in a population over defined period of time
Indwelling urethral catheter	A catheter inserted into the bladder via the urethra and left in place for a period of time

Infection	Microorganisms that have entered the body and are multiplying in the tissues, typically causing specific symptoms
Meatus (urethral)	External opening of the urethra
MeSH	Medical subject heading
Meta-analysis	The combination of data from several studies to produce a single estimate of an effect of a particular intervention
Meticillin-resistant <i>Staphylococcus aureus</i> (MRSA)	Strains of <i>Staphylococcus aureus</i> 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 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 with an instrument/object contaminated with blood/body fluid; or the eyes, inside of nose or mouth, or an area of non-intact skin is exposed to blood/body fluid.
Outbreak	A cluster of 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 including filtration efficiency. To be effective must be fitted close to the face to minimise leakage
Percutaneous injury	An injury that results in a sharp instrument/object ,e.g. needle, scalpel, cutting or puncturing the skin
Peripherally inserted central venous catheters (PICC)	A vascular catheter inserted into the superior vena cava from the cephalic and basilar veins of the antecubital space
Personal protective equipment (PPE)	Specialised clothing or equipment worn to protect against health and safety hazards.
Phlebitis	Inflammation of the wall of a vein
Post exposure prophylaxis	Drug treatment regime administered as soon as possible after an occupational exposure to reduce the risk of acquisition of a blood borne virus
Prevalence	The number of events (e.g. cases of disease) present in a defined population at one point in time
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.
Pyuria	Presence of pus cells in urine. Pus cells may be indicative of an immune response against invading microorganisms

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.
Residual effect (handwash agent)	A chemical that persists on the skin and continues to kill microorganisms for a period of time
Safe systems of work	A set of instructions that defines how to perform a task safely by identifying the risks and the control measures required
Severe acute respiratory syndrome (SARS)	A severe form of pneumonia caused by a coronavirus
Sharps	Instruments used in delivering healthcare that can inflict a penetrating injury. Examples include needles, lancets and scalpels

Sharps injury	See percutaneous injury
Sterilisation	A process that removes or destroys all microorganisms including spores
Surgical masks	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
Terminal disinfection	Decontamination of the room/bed area after a patient with an infectious disease has been discharged
Thrombophlebitis	Inflammation of the wall of a vein with secondary thrombosis occurring within the affected segment of vein
Totally implantable intravascular devices	A central vascular catheter that is tunneled under the skin with a subcutaneous port or reservoir with a self-sealing septum that is accessible by needle puncture through intact skin
Transient (hand) flora	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.
Urinary tract infection (UTI)	The presence of symptoms or signs attributable to microorganisms that have invaded the urinary tract

**Vancomycin resistant
enterococcus (VRE)**

Enterococci are normal commensals of the gut that can cause infections in seriously ill patients. They are intrinsically resistant to many antibiotics, glycopeptide drugs such as vancomycin are often used to treat them therefore infections caused by vancomycin resistant enterococcus are difficult to treat.

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 grade 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.

This guidance on infection control precautions should be applied by all healthcare practitioners to the care of every patient. The recommendations are divided into four 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.

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

2.2 Systematic Review Process

We have previously described the systematic review process in Section 1. For detailed descriptions of previous systematic reviews which have contributed to the evidence base underpinning these guidelines, readers should consult the original guidelines,¹ the guidelines for the prevention of health-care associated infections in primary and community care² and our interim report.³ Search questions were developed from advice received from our specialist advisers and the results of the searches are found in Appendix SP1. The process outlined in Section 2.9 refers only to the most recent systematic review of the literature undertaken in 2005.

Following our reviews, guidelines were drafted which described 38 recommendations within the below intervention categories:

1. Hospital Environmental Hygiene;
2. Hand Hygiene;
3. Personal Protective Clothing; and
4. Safe Use and Disposal of Sharps.

References

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Infection December 2003;55(Supplement 2):1-127 and *British Journal of Infection Control* December 2003 (Supplement):4(6):1-100. Available at: <http://www.richardwellsresearch.com>

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2.3 Hospital Environmental Hygiene

Good hospital hygiene is an integral and important component of a strategy for preventing healthcare-associated infections 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 that are generally considered to be central to the prevention of healthcare-associated infection (HCAI) in hospitals.^{1,2} They include: cleaning and decontamination; laundry and housekeeping; safe collection and disposal of general and clinical waste; and kitchen and food hygiene. Guidelines are provided for:

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

Maintain a clean hospital environment

Our initial systematic review concluded that there was little research evidence of an acceptable quality upon which to base guidance related to the maintenance of hospital environmental hygiene.³ However, there was a body of clinical evidence, derived from case reports and outbreak investigations, which suggested an association between poor environmental hygiene and the transmission of microorganisms causing healthcare-associated infections in hospital.^{4,5}

Attention had been drawn to perceived falling standards in the cleanliness of hospitals since the introduction of compulsory comprehensive tendering and the internal market. This concern was addressed by the Infection Control Nurses Association and the Association of Domestic Managers, resulting in the adoption and publication by the Department of Health of quality standards for hospital cleanliness.^{6,7} In addition, existing regulations,⁸⁻¹⁰ specialist advice,^{11,12} and clinical governance,¹³ all provide a framework within which hospital environmental hygiene can be improved and monitored. It is anticipated that the NHS Code of Practice on the Prevention and Control of Healthcare Associated infection will come into effect in April 2007. The purpose of this Code of Practice is to help NHS bodies plan and implement how they can prevent and control HCAI. It sets out criteria by which managers of NHS organisations and other healthcare providers should ensure that patients are cared for in a clean environment, where the risk of HCAI is kept as low as possible. Failure to comply with the Code may result in an Improvement Notice being issued or other measures.

There is new evidence highlighting that the hospital environment can become contaminated with microorganisms responsible for HCAI. However, the extent of environmental contamination depends on the site of infection, the type of microorganism and its ability to survive in dry environments.¹⁴⁻¹⁹

Transmission of microorganisms from the environment to patients may occur through direct contact with contaminated equipment, or indirectly as a result of touching by hands. Meticillin resistant *Staphylococcus aureus* (MRSA) and other pathogens have been recovered from a range of surfaces commonly touched, such as door handles, ^{15,20} computer keyboards, ²¹ soap dispensers, ^{22,23} and sink taps, ^{14,18,22} and sites where dust is allowed to accumulate. ^{16,24} However, whilst the presence of the same strain of micro-organism in the environment as those infecting/colonising patients demonstrates that the environment becomes contaminated with microorganisms from patients, it does not provide confirmation that the environment is responsible for contamination of patients. Evidence suggesting that contamination of the environment is to blame for the transmission of HCAI is therefore not conclusive. However, the evidence that pathogens responsible for HCAI can be widely found in the hospital environment and hence readily acquired on hands by touching surfaces, does demonstrate the importance of decontaminating hands before every patient contact.

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. ¹⁶ There is some evidence that improved cleaning regimens are associated with the control of outbreaks of HCAI. In one study, the control of an outbreak of an epidemic strain of MRSA was linked with increased cleaning hours and an emphasis on the removal of dust. ²⁴ However, 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.

Some evidence suggests that routine cleaning methods may not be sufficient to eliminate surface contamination with MRSA. ^{18,24} Disinfectants have been recommended for cleaning of the hospital environment but there is a lack of evidence to link disinfection with the prevention of HCAI. ²⁵ The use of hypochlorite for cleaning has been associated with a reduction in incidence of *Clostridium difficile* infection in one study but this was in the absence of a detectable change in environmental contamination when either detergent or hypochlorite was used. ¹⁷ In laboratory tests a combination of cleaning with detergent followed by hypochlorite was required to consistently eliminate norovirus from surfaces and prevent cross contamination. ¹⁵ Dusting and cleaning using detergent was reported to have no effect on the number of MRSA isolated from the hospital environment, but the organism was virtually eliminated by exposure to hydrogen peroxide vapour. ¹⁸

Indicators of cleanliness based on levels of microbial or adenosine triphosphate (ATP) contamination have been proposed but are based on arbitrary standards of acceptable contamination and do not distinguish between normal environmental flora and pathogens responsible for HCAI. ^{14,26} The relationship between these proposed standards and the risk of acquiring infection through contact with the environment have not been established. Since cleaning will only have a transient effect on the numbers of micro-organisms, 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.

SP1 The hospital environment must be visibly clean, free from dust and soilage and acceptable to patients, their visitors and staff. Category C

- SP2** **Increased levels of cleaning should be considered in outbreaks of infection where the pathogen concerned survives in the environment and environmental contamination may be contributing to spread.** *Category D*
- SP3** **The use of hypochlorite 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.** *Category D*

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Shared equipment must be cleaned after use

Equipment used to deliver care to patients can act as a vehicle by which microorganisms are transferred and may result in infection. The risk of infection depends on how the piece of equipment is used. The risk is high where items penetrate the skin or are used in sterile body cavities and this equipment must be sterile when used. Items in contact with mucous membranes which are already colonised with microorganisms need to undergo disinfection. Equipment used in contact with intact skin are unlikely to introduce infection but may act as a vehicle by which microorganisms are transferred between patients and should therefore be cleaned between uses.¹

There is some evidence demonstrating that clinical equipment becomes contaminated with pathogens. One study found that more than 50% of commodes tested were contaminated with *Clostridium difficile*.² A systematic review identified a number of studies demonstrating that pathogens can be recovered from a range of non-invasive clinical equipment, including stethoscopes, lifting equipment, ultrasound probes and laryngoscope blades. Although none of these studies demonstrated a link between the contamination and infection in a patient.³ The evidence that pathogens responsible for HCAI can be found on equipment does demonstrate the importance of decontamination before and after each use.

SP4 Clinical equipment must be decontaminated appropriately after each use. Category D

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Hospital hygiene is everybody's business

Three studies in a systematic review of staff knowledge about MRSA and/or frequency of cleaning practices 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 adhering to the cleaning protocol were linked with an increase in environmental contamination with isolates of *Acinetobacter baumannii*.² A second systematic review 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 detergents, probably resulting from a lack of knowledge.³

SP5	All hospital staff need to be aware of their individual responsibility for maintaining a safe care environment for patients and staff. Every member of staff needs to be clear about their specific responsibilities for cleaning equipment and clinical areas (especially those areas in close proximity to patients). They must be educated about the importance of ensuring that the hospital environment is clean and that opportunities for microbial contamination are minimised.	Category B
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2.4 Hand Hygiene

The following section provides the evidence for recommendations concerning hand hygiene practice. The difficulty in designing and conducting robust, ethical, randomised controlled trials in the field of hand hygiene means that recommendations in these areas are based on evidence from non-randomised controlled trials (NRCT), quasi-experimental studies and expert opinion derived from systematically retrieved and appraised professional, national and international guidelines. The areas discussed 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.

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

Overviews of epidemiological evidence conclude that hand-mediated transmission is a major contributing factor in the current infection threats to hospital in-patients.¹ These include both meticillin-sensitive and meticillin-resistant *Staphylococcus aureus* (MRSA), and multi-resistant Gram-negative aerobes and enterococci. The transmission of microorganisms from one patient to another via the hands, or from hands that have become contaminated from the environment, may result in adverse clinical outcomes. Primary exogenous infection is a direct clinical threat to patients where microorganisms are introduced into susceptible sites, such as surgical wounds, intravascular cannulation sites, enteral feeding systems or urinary catheter drainage systems. Secondary endogenous infection creates an indirect clinical threat to patients where potential pathogens transmitted by the hands establish themselves as temporary or permanent colonisers of the patient and subsequently cause infection at susceptible sites on the patient or are available for transfer to other patients. Current evidence based guidelines conclude that in outbreak situations contaminated hands are responsible for transmitting infections and that effective hand decontamination can significantly reduce infection rates in gastro-intestinal infections and in high-risk areas, such as intensive care units.¹ A recent case control study, conducted during an outbreak of *Klebsiella pneumoniae* in a neonatal intensive care unit, demonstrated an association between being cared for by a nurse with positive hand cultures for the outbreak strain and infants developing infection or colonisation.²

Recent descriptive studies of the dynamics of bacterial hand contamination demonstrate an association between patient care activities that involve direct patient contact and hand contamination.^{3,4} In an observational study of hand contamination during routine patient care in a large teaching hospital high levels of hand contamination were associated with direct patient contact, respiratory care and handling body fluids.³ A further descriptive study of hand contamination during routine neonatal care demonstrated that hands become increasingly contaminated and that gloves do not fully protect healthcare workers hands from becoming contaminated.⁴

The association between hand decontamination and reductions in infection have been confirmed by two recent clinically-based trials^{5,6} and two descriptive studies.⁷⁻⁸ A NRCT introducing the use of alcohol-based hand gel to a long term elderly care facility, demonstrated a reduction of 30% in HCAI over a period of 34 months when compared with the control unit.⁵ A further NRCT, demonstrated a 45% reduction in respiratory illness in the post-intervention period following the introduction of a hand washing programme⁶ One descriptive study conducted over a four year period during which alcohol-based handrub was introduced for routine hand hygiene demonstrated a reduction in HCAI from 16.9% to 9.9%.⁷ A second study that compared rates of HCAI caused by MRSA, vancomycin-resistant *Enterococcus* (VRE) and *Clostridium difficile* (*C. diff.*) in the three years prior to the introduction of alcohol-based handrub showed reductions of 21% in MRSA and 41 % decrease in VRE. Rates of *C.diff* remained unchanged throughout the intervention period.⁸

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 HAI leading to a reduction in patient morbidity and mortality.^{1,9}

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,⁹ Current national and international guidance suggests that in deciding when it is necessary to decontaminate hands four key factors need to be considered:^{1,9}

- the level of the anticipated contact with patients or objects;
- the extent of the contamination that may occur with 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 personnel caring for them have contaminated hands. Hands must be decontaminated before every episode of care that involves direct contact with patients' skin, their food, invasive devices or dressings. Current expert opinion recommends that hands need to be decontaminated after completing an episode of patient care and following the removal of gloves to minimise cross contamination of the environment.^{1,9}

SP6 Hands must be decontaminated immediately before each and every episode of direct patient contact/care and after any activity or contact that potentially results in hands becoming contaminated. Category B

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Is any one hand cleaning preparation better than another?

Current national and international guidelines^{1,2} consider the effectiveness of various preparations for the decontamination of hands using: plain soap and water, antiseptic handwash agents, and alcohol-based handrubs. Overall there is no compelling evidence to favour the *general* use of antiseptic handwashing agents over soap, or one antiseptic agent over another.^{1,2}

Systematic reviews conducted to underpin guidelines for community and primary care and update the 2001 epic guidance^{3,4} identified nineteen studies comparing hand hygiene preparations including alcohol-based handrubs and gels, antiseptic hand washes and liquid soap. Five randomised controlled trials (RCT) were conducted in clinical settings and compared the use of alcohol-based preparations with other agents.⁵⁻⁹ Four RCTs demonstrated alcohol-based preparations to be a more effective hand hygiene agent than non-medicated soap and antiseptic handwashing agents,⁵⁻⁸ while a fifth study found no statistical difference between the use of alcohol-based preparations and antiseptic soap.⁹ A clinical crossover trial conducted over 11 months within a neonatal intensive care unit demonstrated no statistical difference between infection rates during the hand washing and handrub phases of the trial.¹⁰ Three clinically based, quasi-experimental studies¹¹⁻¹³ and nine controlled laboratory experiments¹⁴⁻²² also demonstrated an association between reductions in microbiological flora and the use of alcohol-based preparations. These studies underpin a growing trend to adopt the use of alcohol-based handrubs and gels in clinical practice. However, two of the above laboratory studies highlight the need for continued evaluation of the use of alcohol-based handrubs within the clinical environment to ensure staff adherence to guidelines and effective hand decontamination.^{21,22} The first study, using European Union (EU) reference standard raises the possibility that alcohol-based gels may not be as effective as handrubs for short durations of use.²¹ The second laboratory study, comparing 14 different hand hygiene agents used for a 'clinically realistic' 10 second hand hygiene episode, suggests that some alcohol-based handrubs may lose efficacy after 10 consecutive uses.²² One clinically-based quasi-experimental study compared the use of 4% chlorhexidine gluconate and 1% triclosan antiseptic handwash preparations in reducing MRSA hand carriage in a specialist surgical ward.²³ Both preparations effectively reduced total hand bacterial counts but 1% triclosan was more effective at eliminating MRSA.

Choice of decontamination: is it always necessary to wash hands to achieve decontamination?

Choosing the method of decontaminating hands 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 handwashing with a liquid soap will remove transient microorganisms and render the hands socially clean. This level of decontamination is sufficient for general social contact and most clinical care activities.^{1,23} The use of an liquid soap preparation that contains an antiseptic will reduce both transient microorganisms and resident flora.^{1,2} The effective use of alcohol-based handrubs will also result successfully remove transient micro-organisms and substantially reduce resident microorganisms. However, alcohol is not effective against some microorganisms such as *Clostridium difficile*, will not remove dirt and organic material and may not be effective in some outbreak situations.^{23, 24} When deciding which hand decontamination preparation to use, the practitioner must consider the need to remove transient and/or resident hand flora. Preparations containing certain

antiseptics that exert a residual effect on skin flora can be useful in situations where prolonged reduction in microbial flora on the skin is required e.g. surgery and some invasive procedures. They are not normally necessary for everyday clinical practice but may be used in outbreak situations.

National and international guidelines suggest that the acceptability of agents and techniques is an essential criterion for the selection of preparations for hand hygiene.^{1,2} 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, alcohol-based handrubs are recommended for *routine* use and offer a practical and acceptable alternative to handwashing when hands are not grossly soiled.²

There are no robust economic evaluations of the comparative costs associated with different hand hygiene agents and rates of HCAI. In an unpublished study of the potential cost savings associated with a national hand hygiene campaign the cost of a single HCAI is estimated at over £3 000. The authors hypothesise that even a small reduction in infections through the use of alcohol-based handrubs, would result in a cost saving.²⁵

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| SP7 | Hands that are visibly soiled or potentially grossly contaminated with dirt or organic material (ie following the removal of gloves) must be washed with liquid soap and water. | Category A |
| SP8 | Hands should be decontaminated, preferably with an alcohol-based handrub unless hands are visibly soiled or local infection control advice recommends an alternative product, between caring for different patients or between different care activities for the same patient. | Category A |

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Is hand decontamination technique important?

Investigations into the technique of hand decontamination are limited and observational in design. Two studies were identified that focused on different aspects of hand hygiene technique.^{1,2} The first study proposes that there is an association between effective hand contamination and the wearing of rings by healthcare staff for clinical care.¹ It suggests that the removal of rings should result in decreased frequency of hand carriage of pathogens before and after the performance of hand hygiene. In a case control study, conducted during an outbreak of *Klebsiella pneumoniae* in a neonatal intensive care unit, investigators suggest an association between being cared for by a nurse who wore false nails and had positive hand cultures for the outbreak strain, and infants developing infection or colonisation.²

Systematic reviews conducted to underpin guidelines for community and primary care and update the 2001 epic guidance^{3,4} identified one RCT comparing different durations of handwashing and handrubbing on bacterial reduction that found no significant differences between the two study groups.⁵ In addition a laboratory study conducted following a period of clinical observation of hand hygiene technique identified that practitioners on average applied a product for 11.6 seconds and concluded that some alcohol-based handrubs become less effective following 10 consecutive hand hygiene episodes. The authors suggest that periodic decontamination of hands, using liquid soap and water, is advisable throughout a shift.⁶

Two small-scale laboratory studies investigating methods of hand drying were identified. One found no statistically significant differences between the four methods studied⁷ and the other suggests that warm air drying, when the hands are not rubbed simultaneously, may be more effective at reducing the numbers of bacteria on the hands following hand washing than the use of paper towels.⁸

Due to the methodological limitations of the above studies evidence recommendations continue to be based on existing expert opinion 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 handwashing, and ensuring that hands are completely dry are key factors in effective hand hygiene and the maintenance of skin integrity.^{9,10}

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| SP9 | Before regular hand decontamination begins all wrist and ideally hand jewellery should be removed. Cuts and abrasions must be covered with waterproof dressings. Fingernails should be kept short, clean and free from nail polish. False nails and nail extensions must not be worn by clinical staff. | <i>Category D</i> |
| SP10 | An effective handwashing technique involves three stages: preparation, washing and rinsing, and drying. Preparation requires wetting hands under tepid running water <u>before</u> applying liquid soap or an antimicrobial preparation. The handwash solution must come into contact with <u>all</u> of the surfaces of the hand. The hands must be <u>rubbed</u> 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 prior to drying with good quality paper towels. | <i>Category D</i> |

SP11 When decontaminating hands using an alcohol-based handrub, hands should be free of dirt and organic material. The handrub 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.

Category D

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Does hand decontamination damage skin?

Expert opinion concludes that skin damage is generally associated with the detergent base of the preparation and/or poor handwashing technique.¹ However, the frequent use of hand hygiene agents may cause damage to the skin and alter normal hand flora. This may result in increased carriage of pathogens responsible for HCAI.^{1,2} In addition, the irritant and drying effects of hand preparations have been identified as one of the reasons why healthcare practitioners fail to adhere to hand hygiene guidelines.^{1,2}

Systematic reviews conducted to underpin guidelines for community and primary care and update the 2001 epic guidance^{3,4} identified ten studies of which four were RCT conducted in clinical settings.⁵⁻⁸ They compared the use of alcohol-based preparations with liquid soap and water using self-assessment of skin condition by nurses. In these studies a greater level of irritation was associated with the use of soap. Three further studies, one clinically-based quasi-experimental study, one descriptive clinical study and one non-clinical experimental study concluded that alcohol-based handrubs caused less skin irritation.⁹⁻¹¹ In addition, one longitudinal study of the introduction and subsequent use of alcohol-based handrub over a seven year period observed no reports of irritant and contact dermatitis associated with the use of alcohol-based handrubs.¹² A laboratory study demonstrated a strong relationship between the frequency of handwashing with a chlorhexidine preparation and dermatitis.¹³

Current national and international guidance suggests that skin care, through the appropriate use of hand lotion or moisturizers 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.^{1,2}

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|-------------|--|-------------------|
| SP12 | An emollient hand cream should be applied to protect skin from the drying effects of regular hand decontamination. Infection control teams should advise staff on the use of hand creams and alcohol-based handrub and their effect on the persistent effects of antiseptic soaps that may be in use. | <i>Category D</i> |
| SP13 | If a particular soap, antiseptic hand wash or alcohol-based product causes skin irritation an occupational health team should be consulted. | <i>Category D</i> |

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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.^{1,2}

In a systematic review of 21 studies of interventions to improve hand hygiene compliance reviewers 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.³

Recent observational studies of multimodal interventions involving the introduction of alcohol-based handrubs support findings that the use of near patient alcohol-based handrub is consistently associated with greater compliance by healthcare staff.⁴⁻⁹

However, observational studies identify that staff fail to assess risk appropriately and therefore make inappropriate choices in relation to hand hygiene and glove use.¹⁰⁻¹⁴ One study suggests that the use of motivational strategies, for example feedback may be beneficial¹³ There is some evidence from small-scale observational studies that providing patient information and actively involving patients in hand hygiene improvement programmes has a positive effect on hand hygiene compliance.¹⁵⁻¹⁷

SP14	Near patient alcohol-based hand rub should be made available in all healthcare facilities.	<i>Category D</i>
SP15	Hand hygiene resources and individual practice should be audited at regular intervals and the results fed back to healthcare staff.	<i>Category D</i>
SP16	Education and training in risk assessment, effective hand hygiene and glove use should form part of all healthcare workers annual updating.	<i>Category D</i>

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2.5 Personal Protective Equipment

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

Infection control dress code – protect your patients and yourself!

Expert opinion suggests that the primary uses of PPE are to protect staff and reduce opportunities for transmission of microorganisms in hospitals.¹⁻³ A trend to eliminate the inappropriate wearing of aprons, gowns and masks in general care settings has evolved over the past twenty years due to the absence of evidence that they are effective in preventing HCAI.^{1,2}

The decision to use or wear personal protective equipment 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 health and safety legislation.³⁻⁶ However, several studies have identified both a lack of knowledge of guidelines and non-adherence are commonplace and on going in service education and training is required.⁷⁻¹⁰

SP17	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.	Category D/H&S
SP18	Everyone involved in providing care should be educated about standard principles and trained in the use of protective equipment.	Category D/H&S
SP19	Adequate supplies of disposable plastic aprons and single use gloves should be made available wherever care is delivered. Gowns should be made available when advised by the infection control team.	Category D/H&S

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Gloves: their uses and abuses

Since the mid-1980s the use of gloves as an element of PPE has become an everyday part of clinical practice for healthcare practitioners.¹ Expert opinion agrees that there are two main indications for the use of gloves in preventing HAI:^{1,2}

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

To glove or not to glove?

Gloves should not be worn unnecessarily as their prolonged and indiscriminate use may cause adverse reactions and skin sensitivity.^{1,2} As with all items of PPE the need for gloves and the selection of appropriate materials must be subject to careful assessment of the task to be carried out and its related risks to patients and health care practitioners.^{1,2} Risk assessment should include consideration of:

- who is at risk (whether it is the patient or the healthcare practitioner) 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 general care and invasive procedures.

Gloves must be discarded after each care activity for which they were worn in order to prevent the transmission of microorganisms to other sites in that individual or to other patients. Washing gloves rather than changing them is not safe.¹

Gloves leak!

Our previous systematic review provided evidence that gloves used for clinical practice may leak when apparently undamaged.^{1,2} In terms of leakage, gloves made from natural rubber latex (NRL) performed better than vinyl gloves in laboratory test conditions. Revised standards (2000) relating to the manufacture of medical gloves for single use have been devised and implemented.³⁻⁵ These standards require gloves regardless of material to perform to the same standard.

Expert opinion supports the view that the integrity of gloves cannot be taken for granted and additionally, hands may become contaminated during the removal of gloves.^{1,2} An additional study provided evidence that vancomycin resistant enterococcus remained on the hands of healthcare personnel after the removal of gloves.⁶ Therefore, the use of gloves as a method of barrier protection reduces the risk of contamination but does not eliminate it and hands are not necessarily clean because gloves have been worn.

SP20	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 instruments.	<i>Category D/H&S</i>
SP21	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.	<i>Category D/H&S</i>
SP22	Gloves must be disposed of as clinical waste and hands decontaminated after the gloves have been removed.	<i>Category D/H&S</i>

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Making choices

Expert opinion is quite clear about when gloves *must* be used by healthcare practitioners in general clinical practice.^{1,2} Having decided that gloves should be used for a healthcare activity, the practitioner 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.

NHS Trusts need to provide gloves that conform to European Community Standard (CE), and which are acceptable to health care practitioners.^{1,2} Gloves are available in a variety of materials, the most common being natural rubber latex (NRL) and synthetic materials. NRL remains the material of choice due to its efficacy in protecting against bloodborne viruses and properties that enable the wearer to maintain dexterity.^{1,2} The problem of patient or health care practitioner sensitivity to NRL proteins must be considered when deciding on glove materials.

Synthetic materials are generally more expensive than NRL and due to certain properties may not be suitable for all purposes.¹ Nitrile gloves have the same chemical range as NRL and may also lead to sensitivity problems. Vinyl gloves made

to European Community standards provide the same level of protection as NRL.¹ 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, adding further evidence that nitrile gloves, providing there are no sensitivity issues, are a suitable alternative to latex. Importantly, the study noted variation in performance of the same type of glove produced by different manufacturers and propose a test and rating system to assist healthcare workers.³

SP23	Gloves that are acceptable to healthcare personnel and conform to European Community (CE) standards must be available in all clinical areas.	<i>Category H&S</i>
SP24	Sensitivity to natural rubber latex in patients, carers and healthcare personnel must be documented and alternatives to natural rubber latex must be available.	<i>Category B/H&S</i>
SP25	Neither powdered nor polythene gloves should be used in health care activities.	<i>Category C/H&S</i>

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Aprons or gowns?

We identified four small scale observational studies that investigated the potential for uniforms to become contaminated during clinical care. However none of these studies established an association between contaminated uniforms and HCAI.¹⁻³ 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.⁴

A systematic review of eight studies reporting outcomes of 3,811 babies to assess the effects of wearing an gowning by attendants and visitors in newborn nurseries found no evidence to suggest that over gowns are effective in reducing mortality, clinical infection or bacterial colonisation in infants admitted to newborn nurseries.⁵ One quasi-experimental study investigated the use of gowns and gloves as opposed to gloves only in preventing the acquisition of (VRE) in medical intensive care unit setting.⁶ A further prospective observational study investigated the use of a similar intervention in a medical intensive care unit. These studies suggest that the use of gloves and gowns may minimise the transmission of VRE when colonisation pressure is high.⁷

National and international guidelines recommend that protective clothing should be worn by all healthcare practitioners 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 sweat).⁸⁻¹⁰ Disposable plastic aprons are recommended for general clinical use.⁸⁻¹⁰ However, unused aprons need to be stored in an appropriate area away from potential contamination.¹ 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.⁸⁻¹⁰

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|-------------|--|---------------------------|
| SP26 | 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. | <i>Category D/H&S</i> |
| SP27 | 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. | <i>Category D/H&S</i> |
| SP28 | 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 personnel (for example when assisting with childbirth). | <i>Category D/H&S</i> |

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When is a facemask, eye protection or other facial protection necessary?

Healthcare workers (and sometimes patients) may use standard 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 systematic review 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 One study suggested that the use of surgical masks by healthcare workers reduced their acquisition of MRSA on hands, and in the nose and throat. However, this study was too small to demonstrate statistical significance.²

Facemasks are also used to protect the wearer from inhaling minute airborne respiratory particles. As surgical facemasks are not effective in filtering out such small respiratory 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), pandemic influenza. 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.^{1,4,5} Although the advice to use particulate filter masks is based on expert opinion there is evidence from one study that staff exposed to patients with SARS acquired the infection when they did not use particulate filter masks.⁶ Another study demonstrated a lack of knowledge about guidance on using particulate respirator masks among staff caring for patients with SARS and suggests that focused training on the use of personal protective equipment and the transmission risk of SARS is required.⁷

Our previous systematic review 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 practitioners to splashes of blood, body fluids, secretion or excretions.^{1,8}

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| SP29 | 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. | <i>Category D/H&S</i> |
| SP30 | Respiratory protective equipment, i.e., a particulate filter mask, must be used when recommended for the care of patients with respiratory infections transmitted by airborne particles. | <i>Category D/H&S</i> |

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2.6 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 and includes minimising the risks associated with sharps use and disposal, and the use of needle protection devices. Where appropriate, in addition to the grade 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 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 blood borne pathogens.¹ In 2003 the National Audit Office found that needlestick injuries ranked alongside moving and handling, falls, trips and exposure to hazardous substances as the main types of accidents experienced by NHS staff.² In 2001 the Royal College of Nursing launched its *Be Sharp Be Safe* campaign aimed at reducing sharps injuries. A component, of the campaign is surveillance using the software EPINet™. Fifteen sites contributed to the 2002 survey and reported a total of 1,445 injuries.³ Although many injuries (52.6%) were superficial, 44.6% (n = 626) ranked moderate including some bleeding and 2.8% (n=39) were severe. Nurses were the staff group with the highest proportion of sharps injuries, accounting for 41.2% of all reported injuries.

The Health Protection Agency in its report of all occupational exposures of healthcare workers to bloodborne viruses in 155 centres over a seven year period from 1st July 1996 up until 30th June 2004, noted that too many preventable exposures continue to occur in healthcare settings.⁴ Seventy six percent were percutaneous injuries (1,664/2,140). However, as there is no national surveillance these reports are likely to underestimate the true picture in the UK.

The average risk of transmission of bloodborne pathogens following a single percutaneous exposure in the absence of appropriate post exposure prophylaxis has been estimated to be:⁵

- Hepatitis B Virus (HBV) 33.3 percent (1 in 3)
- Hepatitis C Virus (HCV) 3.3 percent (1 in 30)
- Human Immunodeficiency Virus (HIV) 0.31 percent (1 in 319)

National and international guidelines, are consistent in their recommendations for the safe use and disposal of sharp instruments and needles.⁶⁻⁹ 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, e.g., positioning the sharps bin as close as possible to the site of the intended clinical procedure.¹⁰ Any healthcare worker experiencing an occupational exposure to blood or body fluids needs to be assessed for the potential risk of infection by a specialist practitioner, e.g., physician, occupational health nurse and offered testing, immunisation and post-exposure prophylaxis if appropriate.¹¹

Avoiding sharps injuries is everybody's responsibility

All staff both clinical and non clinical must be aware of their responsibility in avoiding needle stick injuries. This should be a part of induction programmes for new staff and on-going in-service education.

SP31	Sharps must not be passed directly from hand to hand and handling should be kept to a minimum.	<i>Category D/H&S</i>
SP32	Needles must not be recapped, bent broken or disassembled before use or disposal.	<i>Category D/H&S</i>
SP33	Used sharps must be discarded into a sharps container (conforming to UN3291 and BS 7320 standards) at the point of use by the user. .These must not be filled above the mark that indicates the bin is full.	<i>Category D/H&S</i>
SP34	All sharps bins should be positioned out of the reach of children at a height that enables safe disposal by all members of staff. They should be secured to avoid spillage.	<i>Category D/H&S</i>
SP35	All staff both clinical and non clinical must be educated about the safe use and disposal of sharps.	<i>Category D/H&S/GPP</i>

References

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Do needle protection devices reduce *avoidable* injuries?

Many agencies, including the Department of Health and National Health Service Employees encourage health care providers and their employees to pursue safer methods of working through considering the benefits of new safety devices.^{1,2} The incidence of sharps injuries has led to the development of needlestick-prevention devices in many different product groups.³ They are designed to minimise the risk of operator injury during needle use as well as so-called “downstream” injuries that occur after disposal, often involving the housekeeping or portering staff responsible for the collection of sharps disposal units.

Our previous systematic reviews^{4,5} failed to identify any convincing evidence that needlestick-prevention devices were responsible for any significant impact on injury rates. This was primarily due to the lack of well-designed, controlled intervention studies. More recent studies have shown significant reductions in injuries associated with the use of safety devices in cannulation,^{6,7} phlebotomy⁸⁻¹⁰ and injections.¹¹

It would seem to be logical that where needle-free or other protective devices are used, there should be a resulting reduction in sharps injuries. 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.⁴ A comprehensive report and product review conducted in the United States of America (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 program.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.¹²

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.^{13,14} Similarly in the United Kingdom, the National Health Service Purchasing and Supply Agency identifies that meaningful evaluations are paramount in assessing user acceptability and clinical applicability of any needle safety devices.¹⁵ The evaluation should ensure that the safety feature works effectively and reliably, that the device is acceptable to health care practitioners and that it does not adversely affect patient care.

- | | | |
|-------------|--|---------------------------|
| SP36 | Consider the use of needlestick-prevention devices where there are clear indications that they will provide safe systems of working for healthcare practitioners. | <i>Category B/H&S</i> |
| SP37 | Conduct a rigorous evaluation of needlestick-prevention devices to determine their effectiveness, acceptability to practitioners, impact on patient care and cost benefit prior to widespread introduction. | <i>Category D</i> |

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2.7 Areas for Further Research

Adherence / behaviour change

- Action research studies to explore the use of behavioural and quality management sciences to improve adherence of health care professionals to infection prevention guidelines, specifically in relation to:
 - hand hygiene;
 - the effect of different products, e.g., gels, foams and lotions on improving adherence to recommended hand hygiene regimens;
 - standard principles for the prevention of the transmission of bloodborne pathogens;
 - cleanliness of the hospital environment.
- Trials of the effectiveness of different educational methods to increase adherence to guidelines.
- Development and evaluation of appropriate strategies for auditing adherence to infection prevention guidelines.

Staffing

- Investigate the relationship between health care workers' staffing levels, workload and skill mix and risk for nosocomial infections.

Surveillance

- Develop appropriate and realistic methods and tools to facilitate local surveillance of hospital-acquired infections.

Needle Safety Devices

- Studies to establish the cost-effectiveness, acceptability and efficacy of needle safety devices

2.8 Key Audit Criteria

Aim	Criteria
To ensure all healthcare personnel have access to appropriate hand decontamination equipment and protective clothing whenever they deliver care	<p>All healthcare areas should have an appropriate supply of hand decontamination equipment, gloves, aprons and protective clothing in their care setting.</p> <p>Standard 100%</p> <p>Data collection: self audit</p>
Ensure that all healthcare personnel are trained and competent in hand decontamination and risk assessment.	<p>All healthcare personnel involved in care are trained and updated in hand decontamination.</p> <p>Standard 100%</p> <p>Data collection: review of staff education records</p>
To ensure that all healthcare personnel respond appropriately to any sharps injury	<p>All healthcare personnel should be aware of their local sharps injury policy and how to access appropriate help should they sustain a sharps injury.</p> <p>Standard 100%</p> <p>Data collection: direct questioning</p>
To ensure patients and carers are informed and educated about standard principles.	<p>All patients and carers are aware of the need to:</p> <ul style="list-style-type: none"> • Decontaminate their hands; • Use protective clothing; • Dispose of sharps safely. <p>Standard 100%</p> <p>Data collection: direct questioning of patients and carers.</p>

2.9 The Use of hazard analysis critical control points (HACCP) in hospital environmental hygiene

Hazard analysis critical control points (HACCP) has been used for many years in the food industry to identify and control hazards in food production. It is a systems approach involving a seven stage process starting with the development of a flowchart describing the process, identifying areas (critical control points) where a hazard may occur and then establishing monitoring and control procedures.

Clinical governance introduced audit and quality improvement into the NHS. *Winning Ways*¹ recommended the use of HACCP in preventing HCAs and the introduction of HACCP is particularly suitable for hospital environmental hygiene. Within the catering industry there are several good examples of cleaning and disinfection HACCP flowcharts, which could be adapted for acute care settings. However all processes need to be defined locally in order to address the particular hazards within the organisation and the people responsible for monitoring them. In adapting these guidelines into local protocols, one should also consider the use of HACCP. Courses on HACCP and hospital hygiene are currently available at the Royal Institute of Public Health.²

References

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2.10 Standard Principles Systematic Review Process

Hospital Hygiene - Systematic Review Process

Systematic Review Questions

1. What is the evidence that inadequate hospital hygiene contributes to rates of hospital acquired infection?
2. What are the most effective methods and agents for: - terminal disinfection, decontamination of spills of blood or other, potentially infectious body substances?
3. Is there any evidence that routine use of disinfectants as opposed to detergents for environmental cleaning is more efficacious at preventing healthcare associated infection?
4. How effective is hydrogen peroxide vapour for environmental or terminal cleaning?
5. Is there any cost effectiveness evidence relating to the above?
6. What are the training and education implications for staff and patients?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARING HOUSE

MeSH TERMS

infection control; cross infection; universal precautions, equipment contamination; disease transmission; disinfection; disinfectants; soaps; anti-infective agents; surface-active agents; hospital housekeeping

THESAURUS AND FREE TEXT TERMS

Risk assessment; occupational accident; hospital hygiene; hospital housekeeper

Search Results

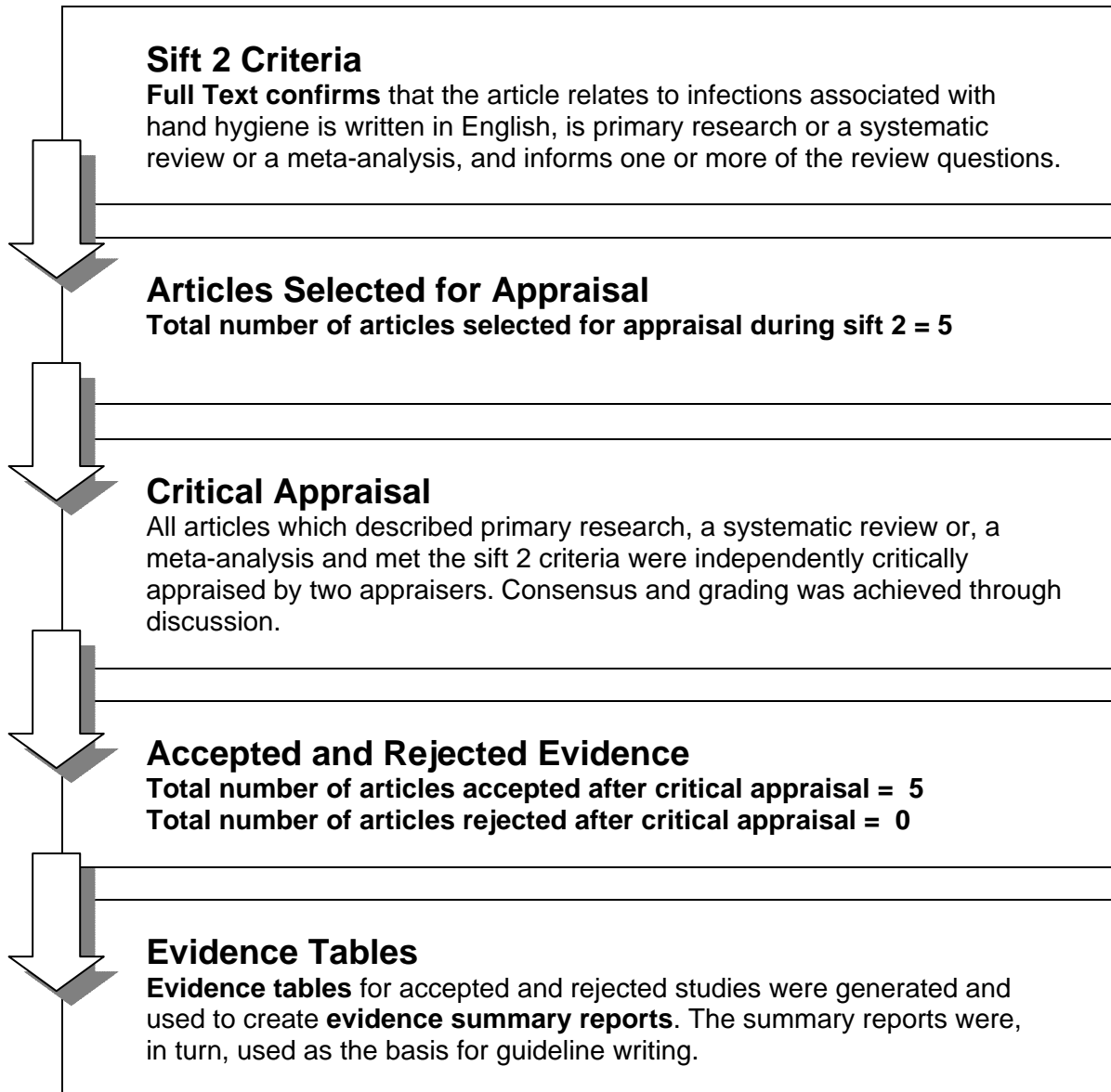
Total number of articles located = 7830

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 = 34



Hand hygiene - Systematic Review Process

Systematic Review Questions

1. What is the evidence that contaminated hands are a cause of healthcare associated infection?
2. Which hand disinfection agents are the most effective at removing / reducing organisms responsible for healthcare associated infection?
3. When must hands be disinfected in relation to patient care activities?
4. What is the most effective hand washing technique for removing / reducing organisms responsible for healthcare associated infection?
5. Which hand disinfection agents are least toxic to users?
6. Which hand disinfection agents are associated with greatest compliance among healthcare workers?
7. Is there any cost effectiveness evidence relating to the above?
8. What are the training and education implications for staff and patients?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARING HOUSE

MeSH TERMS

infection control; cross infection; universal precautions, equipment contamination; disease transmission; disinfectants; chlorhexidine; soaps; anti-infective agents; surface active agents

THESAURUS AND FREE TEXT TERMS

Handwashing; skin; epidermis; nails; antisepsis; decontamination

Search Results

Total number of articles located = 32,088

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 = 194

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 = 31

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 = 31

Total number of articles rejected after critical appraisal = 13

Evidence Tables

Evidence tables for accepted and rejected studies were generated and used to create **evidence summary reports**. The summary reports were, in turn, used as the basis for guideline writing.

Personal Protective Equipment - Systematic Review Process

Systematic Review Questions

1. Which glove materials are least toxic to health care workers (HCWs) for general use?
2. What is the evidence that hands need to be disinfected following the use of gloves?
3. What is the evidence that HCWs use gloves appropriately, as a part of Standard Principles?
4. What is the evidence that the uniforms / clothes of HCWs are a source of healthcare-associated infection?
5. What is the evidence that the use of protective clothing reduces the incidence of healthcare-associated infection?
6. What is the evidence that gowns are more beneficial than aprons?
7. Is there any cost effectiveness evidence relating to the above?
8. What are the training and education implications for staff and patients?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARINGHOUSE.

MeSH TERMS

infection control; cross infection; universal precautions; equipment contamination; disease transmission; protective clothing; disposable equipment; masks; gloves, protective; eye protective devices.

THESAURUS AND FREE TEXT TERMS

Infection; contamination; antiseptis; universal precaution; disease transmission; disinfection; sterilisation; decontamination; disposable equipment; masks; gloves; face shield; goggles; apron; uniform; gown; protective clothes; visor; hood; eye protection devices

Search Results

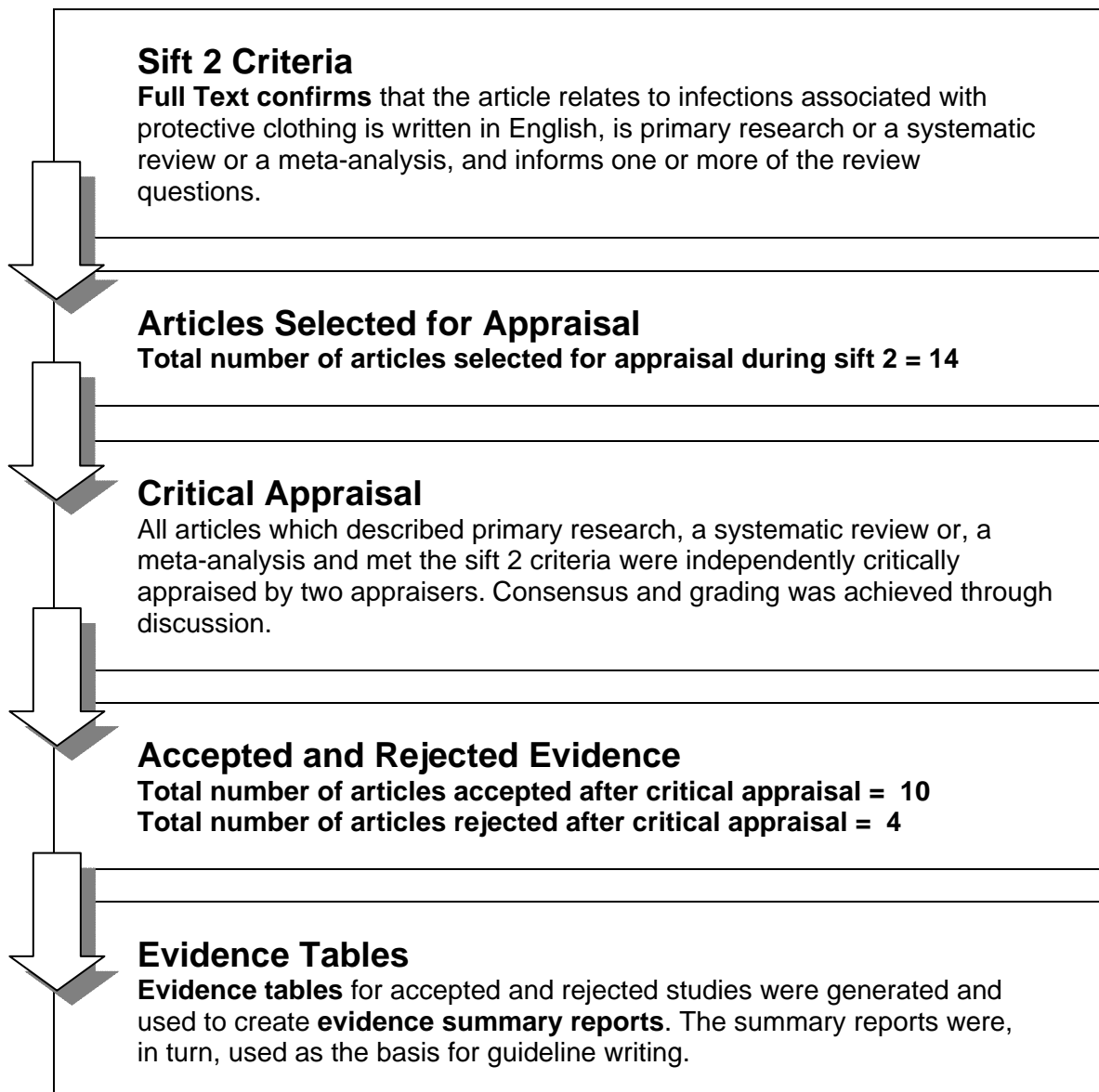
Total number of articles located = 17,966

Sift 1 Criteria

Abstract indicates that the article: relates to infections associated with protective clothing, 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 = 112



Sharps - Systematic Review Process

Systematic Review Questions

1. What is the evidence that recommended modes of use and disposal of sharps reduce the incidence of sharps injury in health care workers?
2. What is the evidence that education and training interventions improve health care workers adherence to recommended modes of practice?
3. What is the evidence that the use of needle-free devices reduce occupational exposure to bloodborne pathogens?
4. Is there any cost effectiveness evidence relating to the above?
5. What are the training and education implications for staff and patients?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARING HOUSE

MeSH TERMS

infection control; cross infection; universal precautions, equipment contamination; disease transmission; needlestick injuries

THESAURUS AND FREE TEXT TERMS

Needles; syringes; occupational accident; occupational exposure; medical waste disposal; bloodborne pathogens; exposure prone procedures; sharps; punctures; percutaneous injuries; resheathing

Search Results

Total number of articles located = 8130

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 = 49

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 = 19

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 = 12

Total number of articles rejected after critical appraisal = 7

Evidence Tables

Evidence tables for accepted and rejected studies were generated and used to create **evidence summary reports**. The summary reports were, in turn, used as the basis for guideline writing.

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 grade 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 and should be read in conjunction with the guidance on Standard Principles. The recommendations are divided into five distinct interventions:

1. Assessing the need for catheterisation;
2. Selection of catheter type and system;
3. Catheter insertion;
4. Catheter maintenance; and
5. Education of patients, relatives and healthcare personnel.

3.2 Systematic Review Process

We have previously described the systematic review process in Section 1. For detailed descriptions of previous systematic reviews which have contributed to the evidence base underpinning these guidelines readers should consult the original guidelines,¹ the guidelines for the prevention of healthcare associated infections in primary and community care² and our interim report.³ Search questions were developed from advice received from our specialist advisers and the results of the searches are found in Appendix UC1. The process outlined in Section 3.10 refers only to the most recent systematic review of the literature undertaken in 2005.

References

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3.3 Assessing the Need for Catheterisation

Catheterising patients places them in significant danger of acquiring a urinary tract infection. The longer a catheter is in place, the greater the danger

There is consistent evidence that a significant number of healthcare-associated infections in hospital are related to urinary catheterisation.¹⁻⁴ The risk of infection is associated with the method and duration of catheterisation, the quality of catheter care and host susceptibility. Urinary catheterisation is a frequent intervention during clinical care in hospital affecting a significant number of patients at any one time. The highest incidence of infection is associated with indwelling urethral catheterisation.⁵ Many of these infections are serious and lead to significant morbidity. Between 20 and 30 percent of catheterised patients develop bacteriuria, of whom 2-6 percent develop symptoms of urinary tract infection (UTI).⁵ The risk of acquiring bacteriuria is approximately 5 percent for each day of catheterisation.^{6,7} Of patients with a UTI, 1-4 percent develops bacteraemia and, of these, 13-30 percent die.^{1,2} Duration of catheterisation is strongly associated with risk of infection, i.e., the longer the catheter is in place, the higher the incidence of urinary tract infection.^{5,8}

Advice from best practice emphasises the importance of documenting all procedures involving the catheter or drainage system in the patient's records¹ and providing patients with adequate information in relation to the need for catheterisation and details of the insertion, maintenance and removal of their catheter.^{1,9} There is some evidence to suggest that computer management systems improve documentation and in so doing reduce the length of time catheters are in situ.¹⁰

UC1	Only use indwelling urethral catheters after considering alternative methods of management.	Category D/GPP
UC2	Document the need for catheterisation, catheter insertion and care.	Category D/GPP
UC3	Review regularly the patient's clinical need for continuing urinary catheterisation and remove the catheter as soon as possible.	Category D/GPP

References

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3.4 Selection of Catheter Type

Is one catheter better than another?

Current evidence –based guidelines¹ identified three experimental studies that compared the use of latex with silicone catheters.²⁻⁴ No significant difference in the incidence of bacteriuria was found. Four studies compared the use of silver coated (silver alloy or silver oxide) catheters with silicone, hydrogel or Teflon latex.⁵⁻⁸ A systematic review 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.^{9,10}

New evidence related to the efficacy of using urinary catheters coated or impregnated with antiseptic or antimicrobial agents has emerged since our original review in 2000. Two subsequent reviews,^{11,12} together with the current update review undertaken by us, have identified four systematic reviews and one meta-analysis that have examined this issue.¹³⁻¹⁷ In general, all of these five studies suggest antiseptic impregnated or antimicrobial-coated urinary catheters can significantly prevent or delay the onset of UTI when compared to standard untreated urine catheters. The consensus in these five reviews of evidence however, is that individual studies reviewed are generally of poor quality; for instance in one case¹⁵ only 8 studies out of 117 met the inclusion criteria and in another, of the six reports describing 7 trials included, only one scored 5 in the quality assessment the other five scored only 1.¹⁷

Studies investigating a wide range of coated or impregnated catheters are explored in the new evidence including: catheters coated or impregnated with: silver alloy^{13,15,17,18-24}; silver oxide¹⁵; Gendine²⁵; Gentamicin²⁶ and silver-hydrogel²⁷⁻²⁹; minocycline³⁰; rifampicin³⁰; chlorhexidine–silver sulfadiazine²⁹; chlorhexidine-sulfadiazine-triclosan²⁹; nitrofurazone²⁹; and nitrofuraxone.³¹

New evidence suggests that catheters coated with silver alloy are clinically effective in reducing UTI, but many studies are of poor methodological quality. Consequently there remains inconclusive evidence to recommend their use in preference to other types of catheter at this time. Despite their unit cost, there is a suggestion that these devices might be a cost-effective option if overall numbers of infections are significantly reduced through their use. The few studies that have explored the cost benefit / effectiveness of using these devices have however, also been inconclusive.^{20,22,24,28,}

Evidence from best practice indicates that the incidence of catheter-associated infection in patients catheterised for a short time (up to one week) is not influenced by any particular type of catheter material.^{32,33} However, many practitioners have strong preferences for one type of catheter over another. This preference is often based on clinical experience, patient assessment, and which materials 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 catheter-associated infection.^{34,35} However, in patients that have recently undergone urological surgery larger gauge catheters may be indicated to allow for the passage of blood clots.

UC4 **Choice of catheter material will depend on clinical experience, patient assessment and anticipated duration of catheterisation.** *Category D*

UC5 **Select the smallest gauge catheter that will allow free urinary outflow. A catheter with a 10 ml balloon should be used. Urological patients may require larger gauge sizes and balloons.** *Category D*

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3.5 Catheter Insertion

Catheterisation is a skilled aseptic procedure

Despite evidence from one systematic review¹ which suggests that the use of aseptic technique has not demonstrated a reduction in the rate of catheter associated urinary tract infection, principles of good practice, clinical guidance^{2,3} and expert opinion⁴⁻¹⁰, together with findings from another systematic review¹¹ 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.^{1,8} Urethral trauma and discomfort will be minimised by using an appropriate sterile, single-use lubricant or anaesthetic gel. Ensuring healthcare practitioners are trained and competent in the insertion of urinary catheters will minimise trauma, discomfort and the potential for catheter-associated infection.^{2,4,8,10}

UC6	Catheterisation is an aseptic procedure. Ensure that health care personnel are trained and competent to carry out urethral catheterisation.	Category D
UC7	Clean the urethral meatus prior to the insertion of the catheter.	Category D
UC8	Use an appropriate lubricant from a single use container to minimise urethral trauma and infection.	Category D

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3.6 Catheter Maintenance

Leave the closed system alone!

Maintaining a sterile, continuously closed urinary drainage system is central to the prevention of catheter-associated infection.¹⁻⁶ The risk of infection reduces from 97 percent with an open system to 8-15 percent when a sterile closed system is employed.⁷⁻⁹ Breaches in the closed system such as unnecessary emptying of the urinary drainage bag or taking a urine sample, will increase the risk of catheter-related infection and should be avoided.^{4,9,10} Hands must be decontaminated and clean, non-sterile gloves worn before manipulation. A systematic review¹¹ suggests that sealed (e.g., taped, pre-sealed) drainage systems contribute to preventing bacteriuria.

There is limited evidence as to how often catheters should be changed. One study showed higher rates of symptomatic and asymptomatic UTI where associated with a 3 day urinary drainage bag change regimen when compared to no routine change regimen.¹² Best practice suggests changing only when necessary, i.e., according to either the manufacturers 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 prevents back-flow of urine.^{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 catheter-associated infection.¹³ Three acceptable studies¹⁴⁻¹⁶ from our original systematic review¹⁷ demonstrated no reduction in the incidence of bacteriuria following the addition of hydrogen peroxide or chlorhexidine to urinary drainage bags. A systematic review supports these findings in that it suggests that adding bacterial solutions to drainage bags has no effect on catheter associated infection.¹¹

UC9	Connect indwelling urethral catheters to a sterile closed urinary drainage system.	Category A
UC10	Ensure that the connection between the catheter and the urinary drainage system is not broken except for good clinical reasons, e.g., changing the bag in line with manufacturer's recommendation.	Category A
UC11	Decontaminate hands and wear a new pair of clean, non-sterile gloves before manipulating a patient's catheter and decontaminate hands after removing gloves.	Category D
UC12	Obtain urine samples from a sampling port using an aseptic technique.	Category D/GPP
UC13	Position urinary drainage bags below the level of the bladder on a stand that prevents contact with the floor. Where such drainage cannot be maintained, e.g., during moving and handling, clamp the urinary drainage bag tube and remove the clamp as soon as dependent drainage can be resumed.	Category D/GPP
UC14	Empty the urinary drainage bag frequently enough to maintain urine flow and prevent reflux. Use a separate and clean container for each patient and avoid contact between the urinary drainage tap and container.	Category D/GPP

UC15	Do not add antiseptic or antimicrobial solutions into urinary drainage bags.	<i>Category A</i>
UC16	Do not change catheters unnecessarily or as part of routine practice.	<i>Category D/GPP</i>

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Appropriate maintenance minimises infections

Meatal cleansing with antiseptic solutions is unnecessary

Our original systematic review¹ considered six 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 care compared with routine bathing or showering.²⁻⁷ Our subsequent reviews^{8,9} revealed two studies^{10,11} that support these findings in that the outcomes indicate that the use of antiseptics provides no benefit in respect of meatal / peri-urethral hygiene.

Expert opinion¹²⁻¹⁴ and another systematic review¹⁵ support the view that vigorous meatal cleansing is not necessary and may increase the risk of infection and that daily routine bathing or showering is all that is needed to maintain meatal hygiene.

UC17 Routine personal hygiene is all that is needed to maintain meatal hygiene. Category A

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Irrigation, instillation and washout do not prevent infection

None of our systematic review evidence demonstrates any beneficial effect of bladder irrigation, instillation or washout with a variety of antiseptic or antimicrobial agents in preventing catheter-associated infection.¹⁻¹² Three studies however suggest that an acid washout solution (Suby G) is effective in reducing catheter encrustation.¹³⁻¹⁵

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 indicated during urological surgery or to manage catheter obstruction.¹⁶⁻²⁰

UC18 Bladder irrigation, instillation and washout should not be used to prevent catheter-associated infection. Category A

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3.7 Education of Healthcare Personnel and Patients

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

UC19	Healthcare personnel must be trained in catheter insertion and maintenance.	<i>Category D/GPP</i>
UC20	Patients and relatives should be educated about their role in preventing urinary tract infection.	<i>Category D/GPP</i>

3.8 Areas for Further Research

In developing the recommendations we identified several areas that were inadequately addressed in the literature. We recommend further research in the following areas.

Intervention 1: Assessing the need for catheterisation

Epidemiological studies of the prevalence and incidence of bacteriuria/ urinary tract infection during short-term catheterisation in different populations and different care settings. These should at least encompass the predominant populations; older people and those undergoing surgery. There needs to be clear definition of the 'cases' and the populations from which they are drawn.

Intervention 2: Selection of catheter type

Randomised controlled trials of the efficacy of antiseptic/antimicrobial coated/impregnated urethral catheters for long-term use. These need to be high quality studies, using the hospital's actual catheter-associated UTI prevalence rather than national data and appropriate follow-up.

Intervention 4: Catheter maintenance

Randomised controlled trials of strategies to establish how often catheters and catheter bags need to be changed.

3.9 Key Audit Criteria

Aim	Criteria
Identify all patients with indwelling urinary catheters, their clinical need for catheterisation, assessed and documented.	<p>All patients should have a patient record that documents the reason for catheterisation, type of catheter, catheter insertion, changes and care.</p> <p>Standard 100%</p> <p>Data collection: review of patient notes</p>
Ensure that all healthcare personnel are trained and competent in urinary catheterisation.	<p>Healthcare personnel receive training and updates in the management of urinary catheters.</p> <p>Standard 100%</p> <p>Data collection: review of staff education records</p>
To prevent catheter-related urinary tract infections (CR-UTI)	<p>All healthcare personnel decontaminate their hands and wear a new pair of non-sterile gloves before manipulating the system.</p> <p>Standard 100%</p> <p>Data collection: observation/ self audit</p>
To reduce the incidence of CR-UTI by maintaining a closed system.	<p>All catheters must be connected to a sterile closed drainage system or valve.</p> <p>Standard 100%</p> <p>Data collection: observation</p>
To ensure patients and relatives are informed and educated about catheter management	<p>All patients and carers are aware of the need to:</p> <ul style="list-style-type: none"> • Decontaminate their hands; • Keep the system closed. <p>Standard 100%</p> <p>Data collection: direct patient questioning of patients and carers.</p>

3.10 Urinary Catheter Systematic Review Process

Systematic Review Questions

1. Which material should be used for short term catheters?
2. How effective are impregnated catheters?
3. What is the evidence that use of lubricating gel prior to insertion of a catheter prevents/reduces the risk of infection?
4. Should antiseptics/disinfectants be added to drainage bags?
5. Is continuous/intermittent irrigation/washout effective or harmful?
6. Is meatal cleansing effective or harmful?
7. How often should catheters be changed?
8. Does the use of antibiotic prophylaxis at the time of insertion and/or the time of changing catheters reduce symptomatic infection?
9. Is there any cost effectiveness evidence relating to the above?
10. What are the training and education implications for staff and patients?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARING HOUSE

MeSH TERMS

infection control; cross infection; disease transmission; urinary tract infections; urinary catheterization; indwelling catheters; irrigation; biofilms; hydrogen ion concentration; proteus infections; morganella.

THESAURUS AND FREE TEXT TERMS

Urinary catheterisation; urinary tract infection; cross infection; disease transmission; bacteriuria; pyuria; bladder irrigation; washout; instillment; lubrication.

Search Results

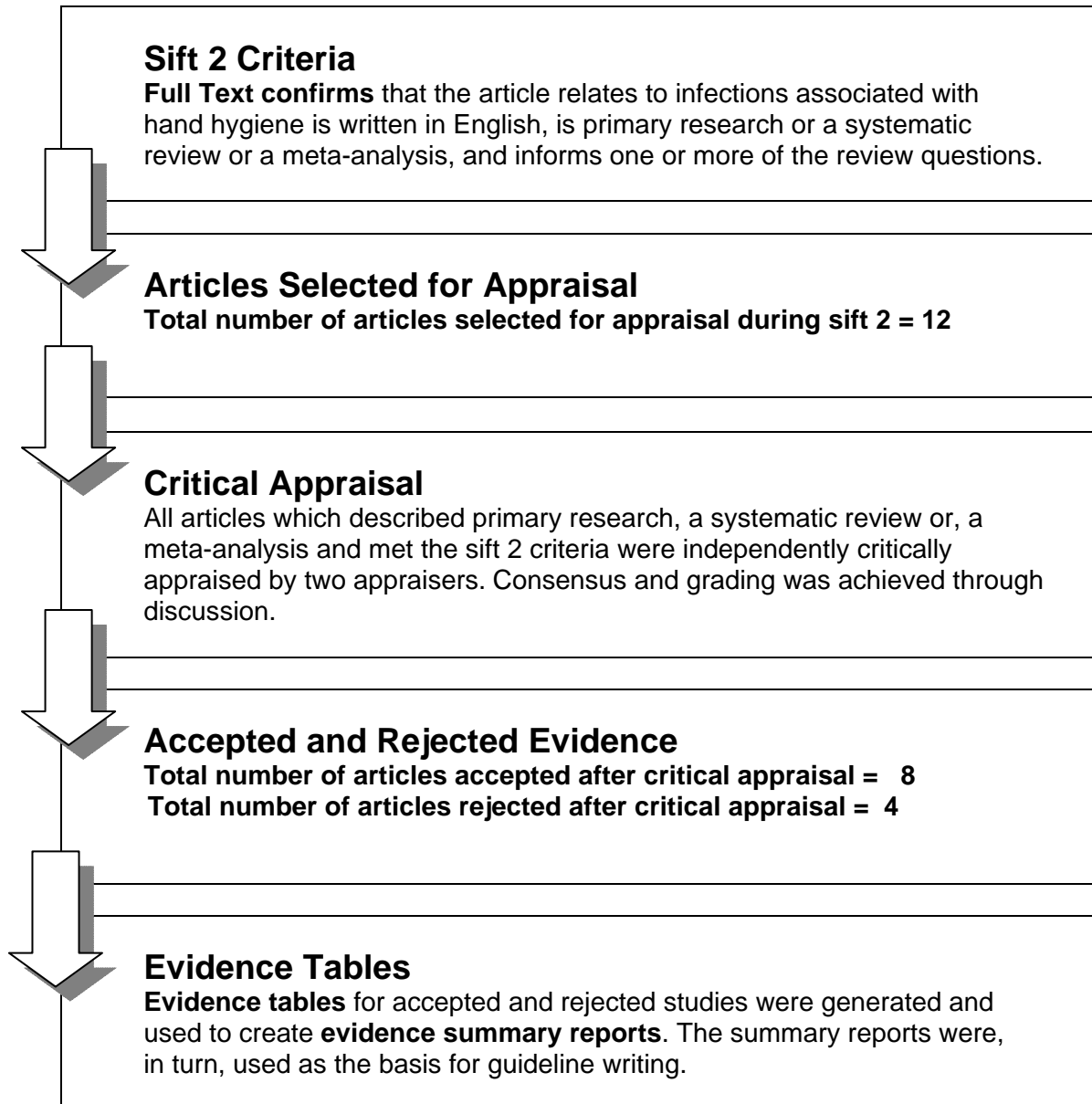
Total number of articles located = 6203

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 = 46



SECTION 4

GUIDELINES FOR PREVENTING INFECTIONS ASSOCIATED WITH THE USE OF CENTRAL VENOUS CATHETERS

Section 4 - Guidelines for preventing infections associated with the use of central venous catheters

4.1 Introduction

This guidance is based on the best critically appraised evidence currently available. The type and grade 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 adolescents and should be read in conjunction with the guidance on Standard Principles. These recommendations, divided into nine intervention categories, do not specifically address the more technical aspects of the care of patients receiving haemodialysis, who will generally have their CVC managed in dialysis centres.

1. Education of healthcare personnel 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; and
9. General Principles for Catheter Management.

Background and context to the Guidelines

Bloodstream infections associated with the insertion and maintenance of central venous catheters (CVC) are among the most dangerous complications of healthcare that can occur, worsening the severity of the patients' underlying ill health, prolonging the period of hospitalisation and increasing the cost of care.¹⁻⁶ Every year, almost 6,000 patients in the UK acquire a catheter-related bloodstream infection.⁵⁻⁷

Catheter-related bloodstream infection (CR-BSI) involves the presence of systemic infection and evidence implicating the CVC as its source, i.e., the isolation of the same microorganism from blood cultures as that shown to be significantly colonising the CVC of a patient with clinical features of bacteraemia. Catheter colonization 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.⁷⁻¹⁰

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.⁹

CR-BSI is generally caused either by skin microorganisms at the insertion site that contaminate the catheter during insertion or migrate along the cutaneous catheter track, or microorganisms from the hands of healthcare workers that contaminate and colonise the catheter hub during care interventions.⁷ Infusate contamination or

haematogenous seeding from site of infection elsewhere in the body is more rarely implicated as a cause of CR-BSI.

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What is the evidence for these guidelines?

Evidence upon which practice can be based is derived from a range of sources and through varying processes. 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) ¹ which were updated in 2002.² Using a validated guideline appraisal instrument developed by the AGREE collaboration,³ three experienced appraisers independently reviewed the updated guidelines, taking into consideration supplementary information provided by HICPAC at our request. We concluded 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 current guidelines.

4.2 Systematic review process

Following our expert review, we systematically searched, retrieved and appraised additional supporting evidence published since the 2002 HICPAC guidelines were developed. Previously, we had updated the systematic review we conducted in 2001 for the first version of the epic guidelines⁴ for the development of complementary national evidence-based guidelines for preventing HCAI in primary and community care (published in 2003 by the National Institute for Health and Clinical Excellence),⁵ and again in 2004.⁶ Comprehensive descriptions of the methodologies for the above

systematic reviews can be found in the original guidelines which are downloadable from the epic website [<http://www.richardwellsresearch.com>].

In preparing the **epic2** guidance, we conducted a final updating systematic review which is described in Section 4.14.

This search was confined to elements of infection prevention where expert members of the Guideline Development Group indicated new developments or changes in technology had occurred, or where pertinent new experimental trials or systematic reviews had been published.

Following our reviews, guidelines were drafted which described 47 recommendations within the 9 intervention categories listed below:

1. Education of healthcare personnel 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; and
9. General principles for catheter management.

These guidelines apply to caring for all adults and children in NHS acute care settings with CVC which are 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.

Although these recommendations describe general principles of best practice that apply to all patients in hospital in which CVC are used, they do not specifically address the more technical aspects of the care of infants and children or patients receiving haemodialysis, who will generally have their CVC managed in dialysis centres.

Because these recommendations describe broad general statements of best practice, they need to be adapted and incorporated into local practice guidelines.

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4.3 Education of Healthcare Personnel and Patients

To improve patient outcomes and reduce healthcare costs, it is essential that everyone involved in caring for patients with CVC is educated about infection prevention. Healthcare personnel 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 personnel to provide, monitor, and evaluate care and to 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 for infection declines following the standardisation of aseptic care and increases when the maintenance of intravascular catheters is undertaken by inexperienced healthcare personnel.¹ Additional evidence demonstrates that relatively simple education programmes focused on training healthcare personnel to adhere to local evidence-based CVC protocols may decrease the risk to patients of CR-BSI.²⁻⁶

CVC1	Healthcare personnel caring for a patient with a central venous catheter should be trained, and assessed as competent in using and consistently adhering to the infection prevention practices described in this guideline.	Category D
CVC2	Before discharge from hospital, patients with long-term catheters and their carers should be taught any techniques they may need to use to prevent infection and safely manage a central venous catheter.	Category D/GPP
CVC3	Follow-up training and support should be available to patients with central venous catheters and their carers.	Category D/GPP

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4.4 General Asepsis

Good standards of hand hygiene and antiseptic technique can reduce the risk of infection

Because the potential consequences of catheter-related infections (CR-infections) are so serious, enhanced efforts are needed to reduce the risk of infection to the absolute minimum. For this reason, hand antisepsis and proper aseptic technique are required for changing catheter dressings and for accessing the system.^{1,2}

Hand antisepsis can be achieved by washing hands with an antimicrobial liquid soap and water or by using an alcohol-based handrub.² When hands are visibly dirty or contaminated with organic material, such as blood and other body fluids or excretions, they must first be washed with liquid soap and water if alcohol-based handrubs are going to be used to achieve hand antisepsis.

Appropriate aseptic technique does not necessarily require sterile gloves; a new pair of disposable non-sterile gloves can be used in conjunction with a 'no-touch' technique, for example, in changing catheter site dressings.¹ The Standard Principles for preventing healthcare-associated infections previously described in these guidelines gives additional advice on hand decontamination and the use of gloves and other protective equipment.

CVC4	An aseptic technique must be used for catheter insertion, site care and for accessing the system.	Category B
CVC5	Before accessing or dressing central vascular catheters, hands must be decontaminated either by washing with an antimicrobial liquid soap and water, or by using an alcohol handrub.	Category A
CVC6	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.	Category A
CVC7	Following hand antisepsis, clean gloves and a no-touch technique or sterile gloves should be used during catheter placement or when changing the insertion site dressing.	Category D

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4.5 Selection of Catheter Type

Selecting the right catheter for the right patient can minimise the risk of infection

Different types of CVC are available, i.e.:

- 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 tunnelled;
- having totally implantable ports.

The selection of the most appropriate catheter for each individual patient can reduce the risk of subsequent catheter-related infection (CR-infection).

Catheter material

Although catheter material may be an important determinant of infection associated with CVC,¹ evidence available to HICPAC when developing their guidelines was inconclusive and they were unable to draw any specific conclusions about the contribution of catheter material to CR-infections.²

Teflon[®] and polyurethane catheters have been associated with fewer infections than catheters made of polyvinyl chloride or polyethylene. There is no additional evidence that demonstrates conclusively that CR-infection rates vary with different materials.³ In England, short-term CVC are almost always made of polyurethane and long-term tunnelled catheters are usually made of silicone.

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Number of catheter lumens

Clinicians often prefer multi-lumen CVC because they permit the concurrent administration of various fluids and medications, hyperalimentation, and haemodynamic monitoring among critically ill patients. HICPAC examined several randomised controlled trials and other studies which suggested that multi-lumen catheters were associated with a higher risk of infection than were single lumen catheters.¹⁻⁶ However, other studies examined by HICPAC failed to demonstrate a difference in the rates of CR-BSI.^{7,8}

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.^{4,5} HICPAC also noted that 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.⁶

Two additional studies were identified from our systematic reviews. A systematic review and quantitative meta-analysis focused on determining the risk of CR-BSI and catheter colonisation in multilumen catheters compared with single-lumen catheters. This reported that although CR-BSI was more common in patients with multilumen when compared with single-lumen catheters that when confined to high quality studies that control for patient differences, there is no significant difference in rates of CR-BSI. This analysis suggests that multilumen catheters are not a significant risk factor for increased CR-BSI or local catheter colonisation compared with single-lumen CVC.⁹

Another systematic review and quantitative meta-analysis tested whether single vs. multilumen CVC had an impact on catheter colonisation and CR-BSI. Study authors concluded that there is some evidence from 5 randomised controlled trials (RCTs) with data on 530 CVC, that for every 20 single-lumen catheters inserted, one CR-BSI will be avoided which would have occurred had multi-lumen catheters been used. As authors were only able to analyze 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.¹⁰

CVC8	Use a single-lumen catheter unless multiple ports are essential for the management of the patient.	<i>Category D</i>
CVC9	Designate one port exclusively for hyperalimentation if a multilumen catheter is used to administer parenteral nutrition.	<i>Category D</i>

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Tunnelled and totally implantable ports

Surgically implanted (tunnelled) CVC, 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 devices, e.g., Port-A-Cath,[®] are also tunnelled 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 tunnelled CVC and/or totally implantable intravascular devices with that from percutaneously (non-tunnelled) inserted CVC.¹ Although in general most studies reported a lower rate of infection in patients with tunnelled CVC,²⁻¹⁰ some studies (including one randomised controlled trial) found no significant difference in the rate of infection between tunnelled and non-tunnelled catheters.¹¹⁻¹² Additionally, most studies examined by HICPAC concluded that totally implantable devices had the lowest reported rates of CR-BSI compared to either tunnelled or non-tunnelled CVC.¹³⁻²³

Additional evidence was obtained from studies of efficacy of tunnelling to reduce CR-infections in patients with short-term CVC. One randomised controlled trial demonstrated that subcutaneous tunnelling of short-term CVC inserted into the internal jugular vein reduced the risk for CR-BSI.²⁴ In a later randomised controlled trial, the same investigators failed to show a statistically significant difference in the risk for CR-BSI for subcutaneously tunnelled femoral vein catheters.²⁵

An additional meta-analysis of randomised controlled trials focused on the efficacy of tunnelling short-term central venous catheters to prevent CR-infections.²⁶ 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 CR-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 in updating our systematic reviews.

CVC10 Use a tunnelled or a totally implanted vascular device (one with a subcutaneous port) for patients in whom long-term (more than 3-4 weeks') vascular access is anticipated. *Category A*

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Antimicrobial impregnated CVC

Evidence reviewed by HICPAC indicated that the use of an antimicrobial or antiseptic-impregnated CVC in adults whose catheter is expected to remain in place for more than 5 days can decrease the risk for CR-BSI. This may be cost-effective if rates of CR-BSI are very high despite implementing a comprehensive strategy to reduce rates of CR-BSI. The comprehensive strategy should include the following three components: educating persons who insert and maintain catheters; use of maximal sterile barrier precautions; and the use of a 2% chlorhexidine preparation for skin antisepsis for CVC insertion.¹⁻⁹

Two meta-analyses appraised by HICPAC which concluded that catheters impregnated with chlorhexidine-silver sulphadiazine decreased the incidence of CR-BSI by 2.2% compared with inactive control catheters,¹⁰ and a large, RCT that showed that catheters treated with minocycline and rifampin were more efficacious in preventing BSI compared with those treated with chlorhexidine-silver sulphadiazine.¹¹

Additional studies have since demonstrated that antimicrobial impregnated/coated CVC can favourably influence the incidence of catheter colonisation and CR-BSI in some situations.

A more recent study¹² analysed 23 RCTs published between 1988-1999 and which 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 setting; 4 among oncologic patients, 2 among surgical patients; 2 among patients receiving TPN; 4 among other patient populations. Study authors concluded that: antibiotic and chlorhexidine-silver sulfadiazine coatings are anti-infective for short (approx. 1 week) insertion time. For longer insertion times, there are no data on antibiotic coating, and there is evidence of lack of effect for chlorhexidine-silver sulfadiazine coating. For silver-impregnated collagen cuffs, there is evidence of lack of effect for both short- and long-term insertion.

The most recent appraisal of all of the evidence for the clinical and cost-effectiveness of CVC treated with antimicrobial agents in preventing CR-BSI is a systematic review and economic evaluation recently conducted by the Reviews and Implementation Group at the University of Liverpool.¹³ Study authors conclude that rates of CR-BSI are significantly reduced when any type of antimicrobial CVC are used. Studies report the best effect when CVC treated with antibiotics were used and the lowest efficacy was seen in extraluminally coated CVC. Rates of catheter colonisation were also significantly reduced in an antimicrobial CVC was used, however reviewers noted that there was significant heterogeneity in data supporting this finding.

CVC11 **Consider the use of an antimicrobial impregnated CVC for adult patients who require short-term (1 to 3 weeks') central venous catheterisation and who are at high risk for CR-BSI.** **Category A**

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4.6 Selection of Catheter Insertion Site

Selecting the best insertion site for the patient can minimise the risk of infection

Several factors need to be assessed when determining the site of catheter placement, including:

- patient-specific factors (e.g., pre-existing catheters, anatomic deformity, bleeding diathesis, some types of positive pressure ventilation);
- relative risk of mechanical complications (e.g., bleeding, pneumothorax, thrombosis);
- the risk of infection.

HICPAC concluded that the site at which a catheter is placed can influence the subsequent risk of CR-infection because of variation in both the density of local skin flora and risk of thrombophlebitis. CVC are generally inserted in the subclavian, jugular or femoral veins, or peripherally inserted into the superior vena cava by way of the cephalic and basilic veins of the antecubital space.

Subclavian, jugular and femoral placements

Multiple studies examined by HICPAC concluded that CVC inserted into subclavian veins had a lower risk for CR-infection than those inserted in either jugular or femoral veins, but none of these were randomised controlled trials. HICPAC stated 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. They noted, however, that mechanical complications associated with catheterisation might be less common with internal jugular than with subclavian vein insertion.

HICPAC noted that no RCT satisfactorily has compared CR-infection rates for catheters placed in jugular, subclavian, and femoral sites. However, both previous and new evidence examined by HICPAC demonstrated that catheters inserted into an internal jugular vein have been associated with higher risks for CR-infection than those inserted into a subclavian or femoral vein.¹⁻³ Femoral catheters have been demonstrated to have relatively high colonization rates when used in adults⁴ and should be avoided because they are presumed to be associated with a higher risk of DVT and CR-infection than are internal jugular or subclavian catheters.⁵⁻⁹ 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. HICPAC cited a meta-analysis of 8 studies¹⁰ and guidelines from the National Institute for Clinical Excellence (NICE)¹¹ and indicate that the use of bedside 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.

Antecubital placement

Peripherally inserted CVC (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 cephalic and basilic veins of the antecubital space. HICPAC stated 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, i.e., 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-tunnelled CVC,^{12,13} perhaps because the skin at the antecubital fossa is less moist and oily and colonised by fewer microorganisms than the chest and neck.^{13,14} HICPAC also noted that an antecubital placement removes the catheter away from endotracheal and nasal secretions. Finally, they 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.

Systematic Review Evidence

We examined a prospective cohort study using data from two randomized trials, plus a systematic review published in 2005.¹⁵ In the review the authors reported a rate of PICC-BSI of 2.1 per 1,000 PICC-days. This was comparable to the rates reported in their prospective cohort study (2.1 to 3.5 per 1,000 catheter-days) and similar to that

reported with prospectively studied, short-term non-cuffed CVC placed percutaneously in the internal jugular, subclavian or femoral veins in inpatients (approx. 2.3 per 1,000 days). Investigators concluded that PICC used in high-risk hospitalized 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). This rate is much higher than with PICC used exclusively in the outpatient setting (approximately 0.4 per 1,000 catheter-days).’ They question whether the growing trend in many hospital haematology and oncology services to switch from use of cuffed and tunneled CVC to PICC is justified, particularly since PICC are more vulnerable to thrombosis and dislodgment, and are less useful for drawing blood specimens. Moreover, PICC are not advisable in patients with renal failure and impending need for dialysis, in who preservation of upper-extremity veins is needed for fistula or graft implantation. Further: ‘... the assumption that PICC are safer than conventional CVC with regard to the risk of infection is in question and should be assessed by a larger, adequately powered randomized trial that assesses peripheral vein thrombo-phlebitis, PICC-related thrombosis, and premature dislodgment, as well as CR-BSI.’

CVC12	In selecting an appropriate insertion site, assess the risks for infection against the risks of mechanical complications.	<i>Category D/GPP</i>
CVC13	Unless medically contraindicated, use the subclavian site in preference to the jugular or femoral sites for nontunneled catheter placement.	<i>Category C</i>
CVC14	Use totally implantable access devices for patients who require long-term, intermittent vascular access. For patients requiring regular or continuous access, a tunneled central venous catheter is preferable.	<i>Category C</i>

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4.7 Maximal Sterile Barrier Precautions during Catheter Insertion

Using maximal sterile barrier precautions during CVC placement will significantly reduce the risk of infection

The primacy of strict adherence to hand decontamination and aseptic technique as the cornerstone for preventing CR-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. However, the level of barrier precautions needed to prevent infection during CVC insertion was controversial at the time of the development of the HICPAC guidelines.¹

Studies examined by HICPAC concluded that if maximal sterile barrier precautions (MSB) were used during CVC insertion, catheter contamination and subsequent CR-infections could be significantly minimised.²⁻⁵

One of these studies was a prospective randomised trial that tested the efficacy of maximal sterile barriers to reduce infections associated with long-term nontunneled subclavian silicone catheters.⁵ When MSB were compared with routine procedures, they significantly decreased the risk of CR-BSI.⁵

MSB involve wearing sterile gloves and gown, a cap, mask and using a large sterile drape during insertion of the catheter as opposed to routine infection prevention procedures that involve wearing only sterile gloves and the use of a small drape. In these guidelines, we refer to this as optimum aseptic technique. 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 posed a lower risk of infection than did those inserted on inpatient wards or other patient care areas.¹ 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.⁵⁻⁶

Previous expert reviewers who have examined the above evidence agree that maximal sterile barrier precautions are essential during CVC placement to reduce the risk of infection.⁷⁻¹¹

Systematic Review Evidence

Two new studies were accepted into our review. A systematic review published in 2004¹² aimed to determine the value of maximal sterile barriers (MSB) to prevent CVC-related infection. MSB were defined as: person inserting the CVC wear a head cap, facemask, sterile body gown, and sterile gloves and uses a full-size sterile drape. Their search identified 95 articles discussing the prevention of CVC-related infections. The majority of these articles were review articles or consensus statements. Only three primary research studies comparing infection outcomes using MSB with less stringent barrier techniques were identified and included in the review. Authors identified no additional unpublished or ongoing primary studies. All 3 studies included in the review concluded that the use of MSB resulted in a reduction in catheter-related infections. The 3 included studies differed notably in their patient populations, research designs, and healthcare settings. Study authors concluded that using MSB has been found to decrease transmission of microorganisms, to delay colonization, and to reduce the rate of hospital-acquired infections. They suggest that biological plausibility and the available evidence support using MSB during routine insertion of a CVC to minimise the risk of infection. They recommend 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.

A prospective, randomised, controlled study in Italy¹³ compared MSB [consisting of mask, cap, sterile gloves, gown, large drape] vs. control precautions [mask, cap, sterile gloves, small drape] on central venous nontunneled catheters, inserted via the jugular vein. However surveillance skin cultures revealed the common and changing nature of colonisation of skin at the insertion site but investigators concluded that the use of MSB reduces to approximately one-third the colonisation probability and can be routinely used.

CVC15 Use maximal sterile barriers, including a sterile gown, sterile gloves, and a large sterile drape, for the insertion of central venous catheters. Category A

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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 CVC insertion site are the cause of most CR-BSIs.¹⁻³ 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 CR-infection.⁴ An important prospective randomised trial of agents used for cutaneous antisepsis demonstrated that 2% aqueous chlorhexidine was superior to either 10% povidone-iodine or 70% alcohol for preventing central venous and arterial CR-infections.⁵ An additional study has since confirmed the superior efficacy of 2% aqueous chlorhexidine compared to povidone iodine in substantially reducing central venous catheter colonisation.⁶

Direct comparisons of aqueous versus alcoholic solutions of chlorhexidine have not been undertaken in relation to cutaneous antisepsis for preventing CR-infections. However, an alcoholic solution of chlorhexidine combines the benefits of rapid action and excellent residual activity.⁷

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 had been 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 CR-infection and their use could greatly increase local inflammation and patient discomfort.⁴

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.³ Reported efficacy in preventing CR-infections by this practice yielded contradictory

alcoholic povidone-iodine solution for patients with a history of chlorhexidine sensitivity. Allow the antiseptic to dry before inserting the catheter.

CVC17 Do not apply organic solvents, e.g., acetone, ether, to the skin before catheter insertion. Category D/GPP

CVC18 Do not routinely apply antimicrobial ointment to the catheter placement site prior to insertion. Category D/GPP

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4.9. Catheter and Catheter Site Care

Infections can be minimised by good catheter and catheter site care

The safe maintenance of a central venous catheter and relevant care of the catheter site are essential components of a comprehensive strategy for preventing CR-infections in patients. This includes good practice in caring for the patient's catheter hub and connection port, the use of an appropriate catheter site dressing regimens, and using flush solutions to maintain the patency of the catheter.

Choose the right dressing for CVC sites to minimise infection

Following CVC placement, a dressing is used to protect the catheter site. Because occlusive dressings trap moisture on the skin, and provide an ideal environment for the rapid growth of local microflora, dressings for CVC sites must be permeable to water vapour.¹ The two most common types of dressings used for CVC 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, e.g., Opsite® IV3000, Tegaderm®, are permeable to water vapour and oxygen, and impermeable to microorganisms.

HICPAC reviewed the evidence (up to 2000) related to which type of dressing provided the greatest protection against infection and found little difference.² They 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 CVC. Sterile transparent, semi-permeable polyurethane dressings have become a popular means of dressing catheter insertion sites. They reliably secure the CVC, permit continuous visual inspection of the catheter site, allow patients to bathe and shower without saturating the dressing, and require less frequent change than that required for standard gauze and tape dressings, thus saving personnel time.

Systematic Review Evidence

A Cochrane Review³ of gauze and tape vs. transparent polyurethane dressings for CVC concluded that there was no evidence demonstrating any difference in the incidence of CR-related infections between any of the dressing types compared in this review. Each of these comparisons was based on no more than 2 studies and all of these studies reported data from a small patient sample. Therefore it is probable that the findings of no difference between dressing types is due to the lack of adequate data. They further concluded that because there is a high level of uncertainty regarding the risk of infection associated with the central venous catheter dressings included in this review, at this stage it appears that the choice of dressing for CVC can be based on patient preference.

CVC19	Preferably, a sterile, transparent, semi-permeable polyurethane dressing should be used to cover the catheter site.	Category A
CVC20	Transparent dressings should be changed every 7 days, or sooner if they are no longer intact or moisture collects under the dressing.	Category A

CVC21	If a patient has profuse perspiration or if the insertion site is bleeding or oozing, sterile gauze dressing is preferable to a transparent, semi-permeable dressing.	<i>Category D/GPP</i>
CVC22	Gauze dressings should be changed when inspection of the insertion site is necessary or when they become damp, loosened or soiled, and the need for a gauze dressing should be assessed daily. A gauze dressing should be replaced by a transparent dressing as soon as possible.	<i>Category D</i>
CVC23	Dressings used on tunnelled or implanted CVC sites should be replaced every 7 days until the insertion site has healed, unless there is an indication to change them sooner.	<i>Category A</i>

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Use an appropriate antiseptic agent for disinfecting the catheter insertion site during dressing changes

HICPAC described compelling evidence that aqueous chlorhexidine 2% was superior to either 10% povidone iodine or 70% alcohol in lowering CR-BSI rates when used for skin antiseptics prior to CVC insertion. They made no recommendation for the use of any disinfectant agent for cleaning the insertion site during dressing changes.^{1,2}

Studies focused on the use of antimicrobial ointment applied under the dressing to the catheter insertion site to prevent CVC-related infection do not clearly demonstrate efficacy.^{3,4}

Systematic Review Evidence

A recent meta-analysis assessed studies that compared the risk for CR-BSI following insertion-site skin care with either any type of chlorhexidine gluconate (CHG) solution vs. povidone iodine (PI) solution.⁵ This analysis indicated that the use of CHG rather than PI can reduce the risk for CR-BSI by approximately 49% (risk ratio, 0.51 [CI, 0.27 to 0.97]) in hospitalised patients who require short-term catheterisation, i.e., for every 1000 catheter sites disinfected with CHG rather than PI, 71 episodes of catheter colonization and 11 episodes of CR-BSI would be prevented. In this analysis, several types of CHG solutions were used in the individual trials, including 0.5 percent or 1 percent CHG alcohol solution and 0.5 percent or 2 percent CHG aqueous solution. All of these solutions provided a concentration of CHG that is higher than the minimal inhibitory concentration (MIC) for most nosocomial bacteria and yeasts. Subset analysis of aqueous and non-aqueous solutions showed similar effect sizes, but only the subset analysis of the five studies that used alcoholic CHG solution produced a statistically significant reduction in CR-BSI. Because few studies used CHG aqueous solution, the lack of a significant difference seen for this solution compared with PI solution may be a result of inadequate statistical power.

Most modern CVC 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 CVC tubing, e.g., some catheters used in haemodialysis. The manufacturer's recommendations for only using disinfectants that are compatible with specific catheter materials must be followed.

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| CVC24 | Preferably, an alcoholic chlorhexidine gluconate solution should be used to clean the catheter site during dressing changes, and allowed to air dry. An aqueous solution of chlorhexidine gluconate should be used if the manufacturer's recommendations prohibit the use of alcohol with their product. | <i>Category A</i> |
| CVC25 | Individual single use sachets of antiseptic solution or individual packages of single use antiseptic-impregnated swabs or wipes or sprays should be used to disinfect the dressing site. | <i>Category D/GPP</i> |
| CVC26 | Do not apply antimicrobial ointment to catheter insertion sites as part of routine catheter care. | <i>Category D/GPP</i> |
| CVC27 | Healthcare personnel should ensure that 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. | <i>Category D/GPP</i> |

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4.10 Catheter Replacement Strategies

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

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

Frequency

HICPAC noted that with short peripheral venous catheters, the risk of phlebitis and catheter colonisation, both associated with catheter-related infection, could be reduced by catheter replacement and site rotation every 48-72 hours.¹ However, decisions regarding the frequency of CVC replacement were more complicated. They

considered evidence that showed duration of catheterisation to be a risk factor for infection and which advocated routine replacement of CVC at specified intervals as a measure to reduce infection.²⁻⁵ 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.⁶⁻⁷ Conclusions from a systematic review agree that exchanging catheters by any method every 3 days was not beneficial in reducing infections, compared with catheter replacement on an as-needed basis.⁸

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.⁶ However, three prospective studies (two randomised) showed no significant difference in infection rates between catheters inserted percutaneously and those inserted over a guide wire.^{7,9-10} 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, guide wire 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.^{7,9-12} Several methods are available, including recently described techniques, which allow a diagnosis of CR-BSI to be made without the need for catheter removal.^{13,14} Such approaches could be used prior to the replacement of a new catheter over a guide wire in order to exclude the possibility of CR-BSI and thus the need to replace a newly inserted catheter.

A systemic review 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 associated with fewer mechanical complications relative to new-site replacement.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.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.

CVC28	Do not routinely replace non-tunnelled CVC as a method to prevent catheter-related infection.	<i>Category A</i>
CVC29	Use guide wire assisted catheter exchange to replace a malfunctioning catheter, or to exchange an existing catheter only if there is no evidence of infection at the catheter site or proven CR-BSI.	<i>Category A</i>
CVC30	If CR-infection is suspected, but there is no evidence of infection at the catheter site, remove the existing catheter and	<i>Category A</i>

insert a new catheter over a guide wire; if tests reveal CR-infection, the newly inserted catheter should be removed and, if still required, a new catheter inserted at a different site.

- CVC31 Do not use guide wire assisted catheter exchange for patients with CR-infection. If continued vascular access is required, remove the implicated catheter, and replace it with another catheter at a different insertion site. Category A**
- CVC32 Replace all fluid administration tubing and connectors when the vascular device is replaced. Category D/GPP**

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4.11 General Principles for Catheter Management

Aseptic technique is important when accessing the system

HICPAC considered evidence demonstrating that contamination of the catheter hub is an important contributor to intraluminal microbial colonisation of catheters, particularly long-term catheters.¹⁻⁷

In a relatively recent overview,⁸ additional evidence from a prospective cohort study suggested that frequent catheter hub manipulation increases the risk for microbial contamination.⁹ During prolonged catheterisation, catheter hubs are accessed more frequently, increasing the likelihood of a CR-BSI emanating from a colonised catheter hub rather than the insertion site.⁷ Consequently, the reviewer commented that hubs and sampling ports should be disinfected before they are accessed¹⁰ and noted that both povidone-iodine and chlorhexidine are effective.¹¹⁻¹²

Systematic Review Evidence

In a recent randomized prospective clinical trial¹³ conducted in England the microbial contamination rate of luers of CVC with either PosiFlow[®] needleless connectors or standard caps attached was investigated. The efficacy of: chlorhexidine gluconate 0.5% w/v in industrial methylated spirit (IMS) BP 70% w/w spray (*Hydrex DS*[®]); Sterile isopropyl alcohol (IPA) 70% w/w spray (*Spiriclens*[®]); and 10% (w/v) aqueous povidone-iodine (*Betadine*[®]) for the disinfection of intravenous connections. Patients were designated to receive chlorhexidine/alcohol, isopropyl alcohol or povidone-iodine for pre-CVC insertion skin preparation and disinfection of the connections. After 72 h in situ the microbial contamination rate of 580 luers, 306 with standard caps and 274 with needleless connectors attached, was determined. The microbial contamination rate of the external compression seals of 274 needleless connectors was also assessed to compare the efficacy of the three disinfectants. The internal surfaces of 55 out of 306 (18%) luers with standard caps were contaminated with micro-organisms, whilst only 18 out of 274 (6.6%) luers with needleless connectors were contaminated ($p < 0.0001$). Of those needleless connectors disinfected with isopropyl alcohol, 69.2% were externally contaminated with micro-organisms compared with 30.8% disinfected with chlorhexidine/alcohol ($p < 0.0001$) and 41.6% with povidone-iodine ($p < 0.0001$). These results suggest that the use of needleless connectors may reduce the microbial contamination rate of CVC luers compared with the standard cap. 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.

Although now generally alcohol-resistant, some CVC and catheter hub materials may be chemically incompatible with alcohol or iodine and the manufacturer's recommendations must be complied with.

CVC33	Preferably, an alcoholic chlorhexidine gluconate solution should be used to decontaminate the injection port or catheter hub before and after it has been used to access the system, unless contraindicated by the manufacturer's recommendations, in which case aqueous povidone iodine should be used.	Category A
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Inline filters do not help prevent infections

Although in-line filters reduce the incidence of infusion-related phlebitis, HICPAC could find no reliable evidence to support their efficacy in preventing infections associated with intravascular catheters and infusion systems. Infusate-related BSI is rare and HICPAC concluded that filtration of medications or infusates in the pharmacy is a more practical and less costly way to remove the majority of particulates. Furthermore, in-line filters might become blocked, especially with certain solutions, e.g., dextran, lipids, mannitol, thereby increasing the number of line manipulations and decreasing the availability of administered drugs.¹ In our systematic review we found no additional good quality evidence to support their use for preventing infusate-related CR-BSI. However, 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.

CVC34 In-line filters should not be used routinely for infection prevention purposes.

Category D

Reference

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of intravascular-catheter-related Infections. *Morbidity and Mortality Weekly Report* 2002;51(No.RR-10):1-29. Available from <http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf>

Antibiotic lock solutions have limited uses in preventing infection

Antibiotic lock prophylaxis, i.e., flushing and then filling the lumen of the CVC with an antibiotic solution and leaving it to dwell in the lumen of the catheter, is sometimes used in special circumstances to prevent CR-BSI, e.g., in 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 HICPAC¹ demonstrated the effectiveness of this type of prophylaxis in neutropenic patients with long-term CVC. However, they found no evidence that routinely using this procedure in all patients with CVC reduced the risk of CR-BSI and may lead to an increase in antimicrobial resistant microorganisms.

CVC35 Antibiotic lock solutions should not be used routinely to prevent catheter-related bloodstream infections.

Category D

Reference

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of intravascular-catheter-related Infections. *Morbidity and Mortality Weekly Report* 2002;51(No.RR-10):1-29. Available from <http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf>

Systemic antibiotic prophylaxis does not reliably prevent CR-BSI

No studies appraised by HICPAC demonstrated that oral or parenteral antibacterial or antifungal drugs might reduce the incidence of CR-BSI among adults. However, among low birth weight infants, two studies reviewed by HICPAC had assessed vancomycin prophylaxis; both demonstrated a reduction in CR-BSI but no reduction in mortality. They noted that because the prophylactic use of vancomycin is an independent risk factor for the acquisition of vancomycin-resistant *Enterococcus* (VRE), the risk for acquiring VRE probably outweighs the benefit of using prophylactic vancomycin.¹

Systematic Review Evidence

A Cochrane Review published in 2003 concluded that prophylactic antibiotics or catheter flushing with vancomycin and heparin may help cancer patients at high risk of catheter-related infections.² Patients with cancer often need to be given drugs and other treatments intravenously, so are frequently fitted with long-term tunnelled CVC. Infections sometimes occur. Clinical trial evidence shows it may be useful to give prophylactic antibiotics prior to inserting a tunnelled CVC or to flush the catheter with combined vancomycin and heparin, but microbial resistance may occur unless this practice is limited to high-risk patients.

CVC36 Do not routinely administer intranasal or systemic antimicrobials before insertion or during the use of a central venous catheter to prevent catheter colonisation or bloodstream infection.

Category A

Reference

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A dedicated catheter lumen is needed for parenteral nutrition

HICPAC reviewed evidence from a prospective epidemiologic study examining the risk for CR-BSI in patients receiving Total Parenteral Nutrition (TPN). They concluded

that either using a single lumen CVC or a dedicated port in a multilumen catheter for TPN would reduce the risk of infection.⁽¹⁾

CVC37 **Preferably, 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.** *Category D*

Reference

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of intravascular-catheter-related Infections. *Morbidity and Mortality Weekly Report* 2002;51(No.RR-10):1-29. Available from <http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf>

Maintaining catheter patency and preventing catheter thrombosis may help prevent infections

Indwelling central venous and pulmonary artery catheters are thrombogenic. Thrombus forms on these catheters in the first few hours following placement¹ and may serve as a nidus for microbial colonization of intravascular catheters.² Thrombosis of large vessels occurs after long-term catheterisation in 35 to 65% of patients.³⁻⁷ Prophylactic heparin and warfarin have been widely used to prevent catheter thrombus formation and catheter related complications, such as deep venous thrombosis (DVT).⁸⁻⁹

Two types of heparin can be used: unfractionated (standard) heparin and low molecular weight heparins. Although more expensive, low molecular weight heparins have a longer duration of action than unfractionated heparin and are generally administered by subcutaneous injection once daily. The standard prophylactic regimen of low molecular weight heparins are at least as effective and as safe as unfractionated heparin in preventing venous thrombo-embolism and does not require laboratory monitoring.⁽¹⁰⁾

Systemic Anticoagulation

A meta-analysis of randomised controlled trials⁹ evaluating the benefit of infused prophylactic heparin through the catheter, given subcutaneously or bonded to the catheter in patients with CVC found that prophylactic heparin:

- was associated with a strong trend for reducing catheter thrombus (RR, 0.66; 95% confidence interval [CI], 0.42,1.05). The test for heterogeneity of variance was not significant (p=0.681);
- significantly decreased central venous catheter-related venous thrombosis by 57% (RR, 0.43; 95% CI, 0.23,0.78). The test for heterogeneity of variance was not significant (p=0.526). Significant reduction of deep venous thrombosis was still present after excluding one trial of heparin-bonded catheters (RR, 0.44; 95% CI, 0.22,0.87);
- significantly decreased bacterial colonisation of the catheter (RR, 0.18; 95% CI, 0.06, 0.60). The test for heterogeneity of variance was not significant (p=0.719). The significant benefit for heparin remained after excluding one trial of heparin-bonded catheters (RR, 0.19; 95% CI, 0.04, 0.86).
- showed a strong trend for a reduction in CR-BSI (RR, 0.26; 95% CI, 0.07,1.03). The test for heterogeneity of variance was not significant (p=0.859); This trend decreased when one trial of heparin-bonded catheters

was excluded (RR,0.33; 95% CI, 0.07,1.56).

The authors of this meta-analysis concluded that heparin administration effectively reduces thrombus formation and may reduce catheter-related infections in patients who have central venous and pulmonary artery catheters in place. They suggest that various doses of subcutaneous and intravenous unfractionated and low molecular weight heparins and new methods of heparin bonding need further comparison to determine the most cost-effective strategy for reducing catheter-related thrombus and thrombosis.

There are many different preparations and routes of administration of heparin, and as yet there is no definite evidence that heparin reduces the incidence of CR-BSI, but this may reflect the heterogeneity of heparin and its administration.

Warfarin has also been evaluated as a means for reducing catheter-related thrombosis. A controlled trial of 82 patients with solid tumours randomised to receive or not to receive low-dose warfarin (1 mg a day) beginning 3 days prior to catheter insertion and continuing for 90 days, warfarin was shown to be effective in reducing catheter-related thrombosis.⁽¹¹⁾ The rates of venogram-proved thrombosis 4 of 42 in the treatment group versus 15 of 40 in the control group with 15 having symptomatic thromboses. In this study, warfarin was discontinued in 10% of patients due to prolongation of the prothrombin time.

Heparin versus Normal Saline Intermittent Flushes

Although many clinicians use low dose intermittent heparin flushes to fill the lumens of CVC locked between use in an attempt to prevent thrombus formation and to prolong the duration of catheter patency, the efficacy of this practice is unproven. Despite its beneficial antithrombotic effects, decreasing unnecessary exposure to heparin is important to minimise adverse effects associated with heparin use, e.g., autoimmune-mediated heparin-induced thrombocytopenia, allergic reactions and the potential for bleeding complications following multiple, unmonitored heparin flushes.⁽¹²⁾ The risks of these adverse effects can be avoided by using 0.9 percent sodium chloride injection instead of heparin flushes. A systematic review and meta-analysis of randomised controlled trials 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.⁽¹³⁾ This finding was in agreement with two other meta-analyses.^(14,15) Manufacturers of implanted ports or opened-ended catheter lumens may recommend heparin flushes for maintaining catheter patency and many clinicians feel that heparin flushes are appropriate for flushing CVC that are infrequently accessed.

HICPAC reviewed all of the evidence ^(1-7,9,11-15) for intermittent heparin flushes and systemic heparin and warfarin prophylaxis and concluded that no data demonstrated that their use reduces the incidence of CR-BSI and did not recommend them.⁽⁸⁾ Although their use for preventing CR-BSI remains controversial, patients who have CVC may also have risk factors for DVT and systemic anticoagulants may be prescribed for DVT prophylaxis.

We did not identify and further new evidence when updating our systematic review.

CVC38 **Preferably, sterile 0.9 percent sodium chloride for injection should be used to flush and lock catheter lumens.** *Category A*

CVC39 **When recommended by the manufacturer, implanted ports or** *Category D*

opened-ended catheter lumens should be flushed and locked with heparin sodium flush solutions.

CVC40 Systemic anticoagulants should not be used routinely to prevent CR-BSI.

Category D

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Needleless devices require vigilance

Needleless infusion systems have been widely introduced into clinical practice to reduce the incidence of sharp injuries and the potential for the transmission of bloodborne pathogens to healthcare personnel. HICPAC examined evidence that these devices may increase the risk for CR-BSI and concluded that when they are used according to the manufacturers' recommendations, they do not substantially affect the incidence of CR-BSI.¹

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.²

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| CVC41 | The introduction of new intravascular devices that includes needle free devices, should be monitored for an increase in the occurrence of device associated infection. | <i>Category D</i> |
| CVC42 | If needleless devices are used, the manufacturer's recommendations for changing the needleless components should be followed. | <i>Category D/GPP</i> |
| CVC43 | When needleless devices are used, healthcare personnel should ensure that all components of the system are compatible and secured, to minimise leaks and breaks in the system. | <i>Category D/GPP</i> |
| CVC44 | When needleless devices are used, the risk of contamination should be minimised by decontaminating the access port with an alcoholic chlorhexidine gluconate solution unless contraindicated by the manufacturer's recommendations, in which case aqueous povidone iodine should be used. | <i>Category D</i> |

References

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of intravascular-catheter-related Infections. *Morbidity and Mortality Weekly Report* 2002;51(No.RR-10):1-29. Available from <http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf>
2. Centers for Disease Control and Prevention. Evaluation of safety devices for preventing percutaneous injuries among health care workers during phlebotomy procedures- Minneapolis-St Paul, New York City, and San Francisco, 1993-1995. *Morbidity and Mortality Weekly* 1997;46(2):21-25.

Change intravenous administration sets appropriately

The optimal interval for the routine replacement of intravenous (IV) administration sets has been examined in three well-controlled studies reviewed by HICPAC. Data from each of these studies reveal that replacing administration sets no more frequently than 72 hours after initiation of use is safe and cost-effective. When a fluid that enhances microbial growth is infused, e.g., lipid emulsions, blood products, more frequent changes of administration sets are indicated as these products have been identified as independent risk factors for CR-BSI.¹

- | | | |
|--------------|---|-------------------|
| CVC45 | In general, administration sets in continuous use need not be replaced more frequently than at 72 hour intervals unless they become disconnected or if a catheter-related infection is suspected or documented. | <i>Category A</i> |
| CVC46 | Administration sets for blood and blood components should be changed every 12 hours, or according to the manufacturer's recommendations. | <i>Category D</i> |
| CVC47 | Administration sets used for total parenteral nutrition (TPN) infusions should generally be changed every 24 hours. If the solution contains only glucose and amino acids, administration sets in continuous use do not need to be replaced more frequently than every 72 hours. | <i>Category D</i> |

Reference

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of intravascular-catheter-related Infections. *Morbidity and Mortality Weekly Report* 2002;51(No.RR-10):1-29. Available from <http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf>

4.12 Areas for Further Research

This is a well researched area and few realistic research needs were identified in developing these guidelines. The following investigations, along with a health economic assessment, may inform future clinical practice.

Current issues

The effectiveness of subcutaneous low molecular weight heparins or low dose warfarin to prevent catheter thrombus, colonisation and CR-BSI.

Emerging Technologies

The efficacy of antimicrobial impregnated CVC to provide sustained protection against CRBSI in hospital patients with long term catheterisation.

The efficacy and cost-effectiveness of antimicrobial impregnated catheter site dressings in preventing catheter colonisation and CR-BSI.

The development and use of a closed system of vascular access for preventing endoluminal ingress of microorganisms.

4.13 Key Audit Criteria

Aim	Criteria
<p>Identify all patients with central venous catheters.</p>	<p>All patients should have a patient record that documents the reason for CVC placement, type of catheter, catheter insertion site, catheter replacements and care.</p> <p>Standard 100%</p> <p>Data collection: Review of patient notes</p>
<p>Ensure that all healthcare personnel are trained to implement these guidelines and assessed as competent.</p> <p>Support healthcare personnel to consistently adhere to guideline recommendations.</p>	<p>All healthcare personnel involved in the care of people with CVCs receive training and updates in the management of CVCs.</p> <p>Standard 100%</p> <p>Data collection: Review of staff education records/direct observation/self-audit</p>
<p>Assess the need for continuing venous access on a regular basis and remove a CVC as soon as clinically possible in order to reduce the risk for infection.</p>	<p>Evidence of regular and frequent assessment of the need for CVC and catheter discontinuation rates when the catheter is no longer essential for medical management.</p> <p>Standard 100%</p> <p>Data collection: Review of patient notes</p>
<p>Ensure that patients and carers are informed and educated about the management of their CVC.</p>	<p>All patients and carers are aware of the need to:</p> <ul style="list-style-type: none"> • Decontaminate their hands when manipulating the system; • Use aseptic technique when manipulating or accessing the system. <p>Standard 100%</p> <p>Data collection: direct patient questioning of patients and carers.</p>

4.14 Central Venous Catheters Systematic Review Process

Systematic Review Questions

Search questions:

1. What type of catheter is most effective at preventing catheter-related infections, including catheter-related bloodstream infection (CR-BSI), e.g., number of lumens, tunnelled and implanted devices, antimicrobial/antiseptic impregnated/coated catheters (N.B. HTA done by RIG University of Liverpool), peripherally-inserted central venous catheters
2. Which catheter insertion site provides the least risk of CR-infection?
3. Has placement of catheters using ultrasound affected infection rates?
4. Should the catheter insertion site be protected by a dressing and if so, which type of dressing should be used and how frequently should it be changed?
5. Which antiseptic/disinfectant is best for:
 - preparation of the insertion site?
 - cleansing the entry site once the catheter is in place?
 - disinfecting the catheter hub and/or injection ports?
6. Should the catheter be routinely flushed and if so which solution should be used and how often?
7. Will low-dose systemic anticoagulation reduce the risk of CR-BSI?
8. Do stopcocks, three-way taps, needleless devices increase the risk of catheter colonisation and /or blood stream infection?
9. Does the use of inline filters help prevent CR-BSI?
10. How frequently and by which method should catheters be changed?
11. How frequently should the intravenous catheter administration set be changed?
12. Does the prophylactic administration of systemic antimicrobials reduce the incidence of CR-BSI?
13. Is there any cost effectiveness evidence relating to the above?
14. What are the education and training implications for staff?

Databases and Search Terms Used

DATABASES

MEDLINE, CUMULATED INDEX OF NURSING AND ALLIED HEALTH LITERATURE (CINAHL), EMBASE, NELH GUIDELINE FINDER, NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, THE COCHRANE LIBRARY, US GUIDELINES CLEARING HOUSE

MeSH TERMS

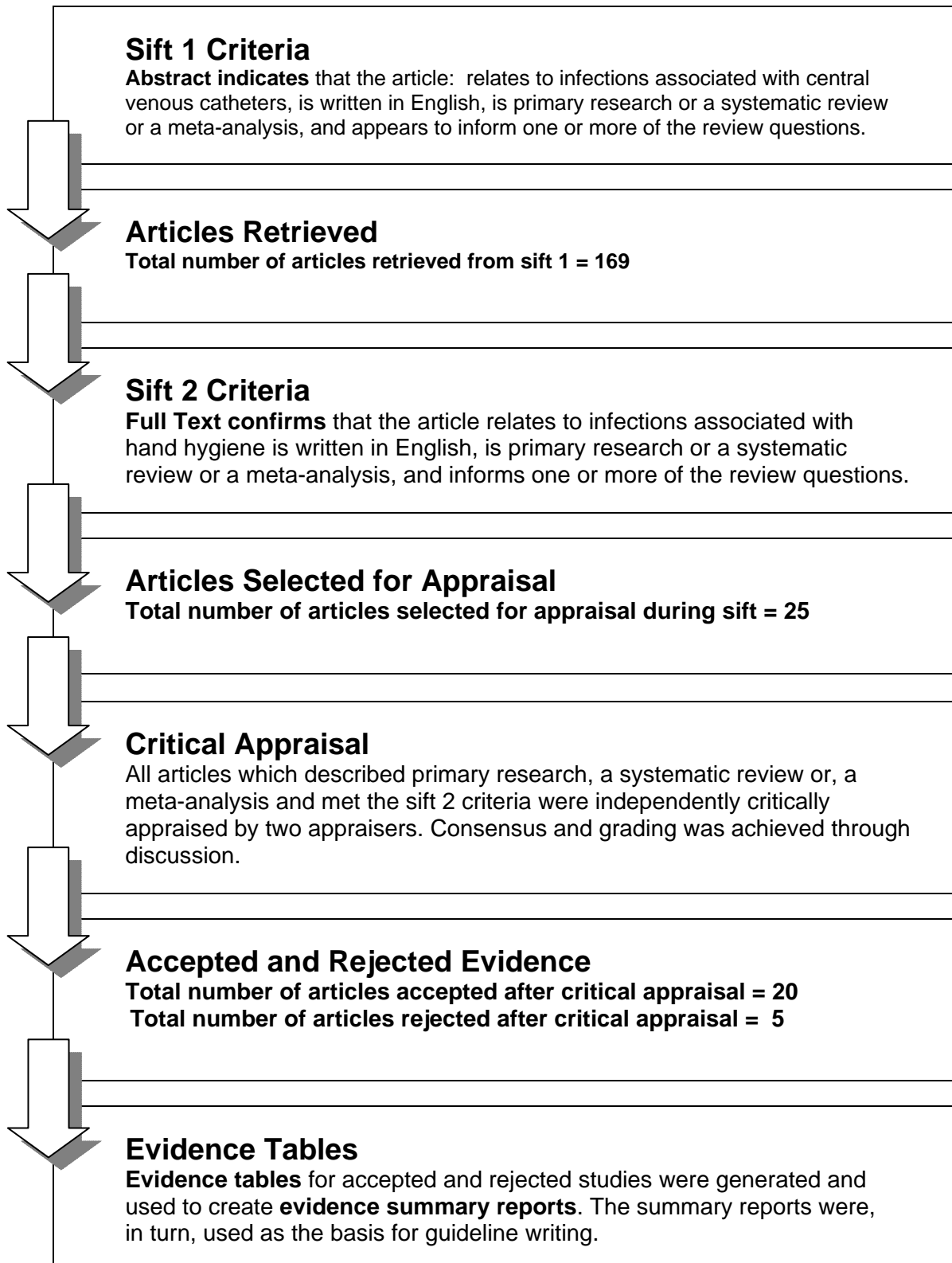
infection control; cross infection; disease transmission; universal precautions; central venous catheter; bacteremia; chlorhexidine; povidone-iodine; anticoagulants; sepsis; sterilisation; .

THESAURUS AND FREE TEXT TERMS

PICC; TPN; catheter hub; implantable catheter; catheter port; needleless devices

Search Results

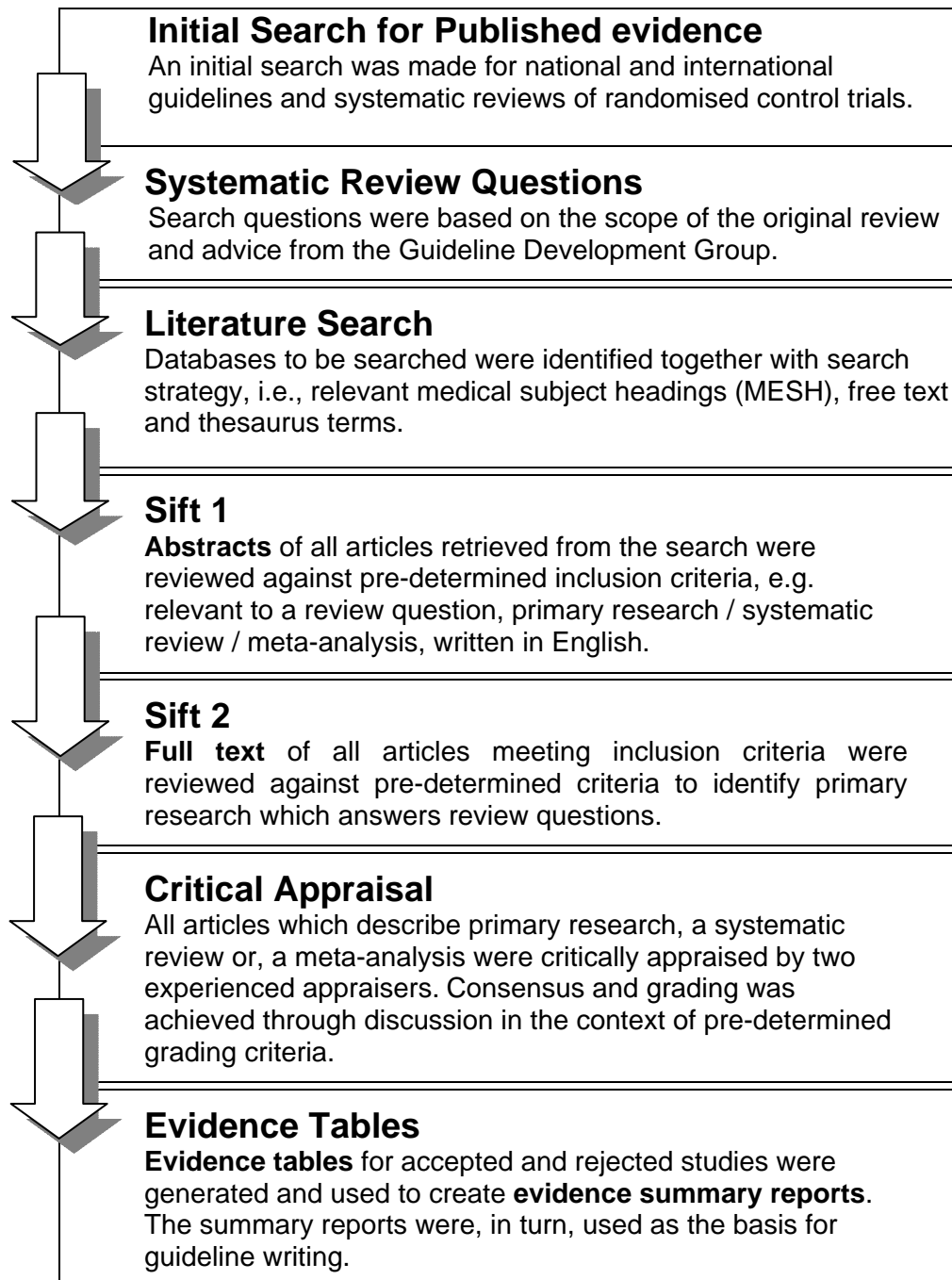
Total number of articles located = 5273



SECTION A

APPENDICES

A.1 Systematic Review Process



A.2 Stakeholders Consulted

The following organisations were approached for comment.

Association of Medical Microbiologists
Association of British Healthcare Industries
British Association of Critical Care Nurses
British Association Urological Nurses
British Association of Urological Surgeons
British Health Care Trades Association
British Medical Association
British National Formulary
British Society for Antimicrobial Chemotherapy
Carers UK
Department of Health (England)
General Medical Council
Hand Hygiene Liaison Group
Health Protection Agency
Health and Safety Executive
Hospital Infection Society
Infection Control Nurses' Association of the British Isles
Intensive Care Society
Medicines and Healthcare products Regulatory Agency
Nursing and Midwifery Council
Patient Concern
Royal College of Anaesthetists
Royal College of Midwives
Royal College of Nursing
Royal College of Pathologists
Royal College of Physicians
Royal College of Surgeons of England
Royal Pharmaceutical Society of Great Britain
Royal Society of Medicine
Safer Needles Network
Scottish Intercollegiate Guidelines Network
Specialist Advisory Committee on Antimicrobial Resistance (UK Departments of Health)
Unison (public services trade union)
Welsh Assembly Government