

# EPIC Guidelines for Preventing Healthcare Associated Infections



*Journal of Hospital Infection* (2001) 47(Supplement):S1 doi:10.1053/jhin.2000.0921, available online at <http://www.idealibrary.com> on IDEAL

## Foreword

Improved patient care is at the very heart of the NHS Plan and modernisation process. More robust arrangements for the control of infection in hospitals are a fundamental part of the agenda of modernisation. Not all hospital-acquired infection is avoidable but a significant proportion is preventable. Better application of existing knowledge and adherence to good practice can make a major contribution to that end.

These multi-professional guidelines, commissioned by the Department of Health, have been developed after a systematic and expert review of all of the available scientific evidence. They cover many elements of clinical practice that are an essential part of action to prevent the spread of hospital-acquired infection, including multi-drug resistant organisms.

I very much welcome and commend these guidelines. They provide sound and clear statements of evidence-based good practice which can be adapted for use locally by all health care practitioners. They also provide a useful tool for clinical governance and audit purposes.

**John Denham MP**

Minister of State (Health)

*Journal of Hospital Infection* (2001) 47(Supplement): S3-S4 doi:10.1053/jhin.2000.0886, available online at <http://www.idealibrary.com> on

## The *epic* Project: Developing National Evidence-based Guidelines for Preventing Healthcare associated Infections

### Phase 1: Guidelines for Preventing Hospital-acquired Infections

#### Authors

Pratt RJ,<sup>a</sup> Pellowe C,<sup>a</sup> Loveday HP,<sup>a</sup> Robinson N,<sup>a</sup> Smith GW,<sup>b</sup> and the *epic* guideline development team: Barrett S,<sup>c</sup> Davey P,<sup>d</sup> Harper P,<sup>a</sup> Loveday C,<sup>e</sup> McDougall C,<sup>f</sup> Mulhall A,<sup>g</sup> Privett S,<sup>h</sup> Smales C,<sup>a</sup> Taylor L,<sup>i</sup> Weller B,<sup>g</sup> and Wilcox M<sup>j</sup>

*Correspondence to:* Professor Robert J. Pratt, Director, Richard Wells Research Centre, Wolfson Institute of Health Sciences, Thames Valley University, 32-38 Uxbridge Road, London W5 2BS. Telephone: 44 (0)20 8280 5142. e-mail: [robert.pratt@tvu.ac.uk](mailto:robert.pratt@tvu.ac.uk)

- a: Richard Wells Research Centre, Wolfson Institute of Health Sciences, Thames Valley University
- b: Department of Medical Microbiology, Royal Liverpool University Hospital and the University of Liverpool
- c: Department of Microbiology, Guy's Hospital and Imperial College, University of London
- d: Department of Clinical Pharmacology (Medicines Monitoring Unit), Ninewells Hospital Medical School, University of Dundee
- e: Department of Retrovirology, The Royal Free and University College Medical School, University of London
- f: Department for Risk Management, St. Mary's Hospital NHS Trust
- g: Independent Consultant
- h: Department of Microbiology, South Warwickshire General Hospitals NHS Trust
- i: Laboratory of Hospital Infections, Central Public Health Laboratory
- j: Department of Microbiology, Leeds Infirmary and the University of Leeds

## Contents

1. Preface
2. Executive Summary
3. Acknowledgements
4. Introduction
5. Standard Principles for Preventing Hospital-acquired Infections
6. Guidelines for Preventing Infections Associated with Short-term Indwelling Urethral Catheters
7. Guidelines for Preventing Infections Associated with Central Venous Catheters
8. Issues relating to Clinical Governance
9. Appendices
  - A. Systematic Review: MeSH Terms
  - B. Systematic Review
    - i. Acquiring and appraising evidence
    - ii. Guideline authoring process
  - C. Guideline Authoring Group
  - D. Project Advisory Group
  - E. Consultation Strategy
  - F. External Review

The guidelines are available on the Department of Health website at: [www.doh.gov.uk/HAI](http://www.doh.gov.uk/HAI) and the Hospital Infection Society website at: [www.his.org.uk](http://www.his.org.uk)

*Journal of Hospital Infection* (2001) 47(Supplement): S5-S9 doi:10.1053/jhin.2000.0887, available online at <http://www.idealibrary.com> on

## Executive summary

In 1998, the Department of Health (England) commissioned the first phase of national evidence-based guidelines for preventing healthcare associated infections. These focused on developing a set of *standard principles for preventing infections in hospitals together with guidelines for preventing hospital-acquired infections (HAI) associated with the use of short-term indwelling urethral catheters in acute care and with central venous catheters in acute care.*

These guidelines are systematically developed broad statements (principles) of good practice that all practitioners can use and which can be incorporated into local protocols. A nurse-led, multiprofessional team composed of infection prevention practitioners, clinical microbiologists/retrovirologist, epidemiologists, and researchers developed the guidelines. A rigorous guideline development process was used to inform the systematic reviews, the clinical and critical appraisal of relevant evidence, and linking that evidence to evolving guidelines. Both general and specialist clinical practitioners were involved in all stages of developing these guidelines, as were representatives from relevant Royal Colleges, learned societies, other professional organisations and key stakeholders.

The introduction to these guidelines describes a robust and validated guideline development model that can be used by others to develop future guidelines. This model is described in more detail in the associated technical reports that can be found on the project web site <http://www.epic.tvu.ac.uk>. Locating and appropriately using good quality evidence to inform guideline development in this field is challenging. Evidence from rigorously conducted experimental studies was frequently limited and consequently a range of other types of evidence were systematically retrieved and carefully appraised.

The concluding discussion on implementation highlights potential issues for clinical governance and areas for future research and suggests issues that need to be addressed to allow practitioners to successfully incorporate these guidelines into routine clinical practice.

## Summary of guidelines

The type and grade of supporting evidence explicitly linked to each recommendation is described within the full guideline document. *All recommendations are endorsed equally and none is regarded as optional.*

### Standard principles for preventing hospital-acquired infections

#### *Intervention 1: Hospital environmental hygiene*

- 1 The hospital environment must be visibly clean, free from dust and soilage, and acceptable to patients, their visitors and staff.
- 2 Where a piece of equipment is used for more than one patient, e.g., commode, bath hoist, it must be cleaned following each and every episode of use.
- 3 Statutory requirements must be met in relation to the safe disposal of clinical waste, laundry arrangements for used and infected linen, food hygiene and pest control.
- 4 All staff involved in hospital hygiene activities must be included in education and training related to the prevention of hospital-acquired infection.

#### *Intervention 2: Hand hygiene*

- 5 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.
- 6 Hands that are visibly soiled or potentially grossly contaminated with dirt or organic material must be washed with liquid soap and water.
- 7 Apply an alcohol-based hand rub or wash hands with liquid soap and water to decontaminate hands between caring for different patients, or between different caring activities for the same patient.
- 8 Remove all wrist and ideally hand jewellery at the beginning of each clinical shift before regular hand decontamination begins. Cuts and abrasions must be covered with waterproof dressings.
- 9 Effective handwashing technique involves three stages: preparation, washing and rinsing, and drying. Preparation requires wetting hands under tepid running water before applying liquid soap or an antimicrobial preparation. The handwash solution must come into contact with all the surfaces of the hand. The hands must be rubbed together vigorously for a minimum of 10-15 seconds paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers. Hands should be rinsed thoroughly prior to drying with good quality paper towels.
- 10 When decontaminating hands using an alcohol 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.
- 11 Apply an emollient hand cream regularly to protect skin from the drying effects of regular hand decontamination. If a particular soap, antimicrobial handwash or alcohol product causes skin irritation, seek occupational health advice.

#### *Intervention 3: The use of personal protective equipment*

- 12 Select protective equipment on the basis of an assessment of the risk of transmission of microorganisms to the patient, and the risk of contamination of health care practitioners clothing and skin by patients' blood, body fluids, secretions, and excretions.
- 13 Gloves must be worn for invasive procedures, contact with sterile sites, and non-intact skin, 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.
- 14 Gloves should be worn as single use items. Put gloves on immediately before an episode of patient contact or treatment and remove them as soon as the activity is completed. Change gloves between caring for different patients, or between different care/treatment activities for the same patient.
- 15 Gloves must be disposed of as clinical waste and hands should be decontaminated following the removal of gloves.

16 Gloves conforming to European Community (CE) standards and of an acceptable quality must be available in all clinical areas.

17 Alternatives to natural rubber latex (NRL) gloves must be available for use by practitioners and patients with NRL sensitivity.

18 Powdered and polythene gloves should not be used in health care activities.

19 Disposable plastic aprons should be worn when there is a risk that clothing or uniform may become exposed to blood, body fluids, secretions and excretions, with the exception of sweat.

20 Full body, fluid repellent gowns should be worn where there is a risk of extensive splashing of blood, body fluids, secretions and excretions, with the exception of sweat, onto the skin of health care practitioners.

21 Plastic aprons should be worn as single use items for one procedure or episode of patient care and then discarded and disposed of as clinical waste.

22 Face masks and eye protection should be worn where there is a risk of blood, body fluids, secretions and excretions splashing into the face and eyes.

23 Respiratory protective equipment should be used when clinically indicated. Intervention 4: The safe use and disposal of sharps

24 Sharps must not be passed directly from hand to hand and handling should be kept to a minimum.

25 Needles must not be bent or broken prior to use or disposal.

26 Needles and syringes must not be disassembled by hand prior to disposal.

27 Needles should not be recapped.

28 Used sharps must be discarded into a sharps container (conforming to UN3291 and BS 7320 standards) at the point of use. These must not be filled above the mark indicating that they are full. Containers in public areas must not be placed on the floor and should be located in a safe position.

29 Consider the use of needlestick-prevention devices where there are clear indications that they will provide safe systems of working for healthcare practitioners.

30 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.

## **Guidelines for preventing infections associated with the use of short-term indwelling urethral catheters in acute care**

### **Intervention 1:**

#### ***Assessing the need for catheterisation***

1 Only use indwelling urethral catheters after considering alternative methods of management.

2 Review regularly the patient's clinical need for continuing urinary catheterisation and remove the catheter as soon as possible.

3 Document catheter insertion and care. Intervention 2: Selection of catheter type

4 Choice of catheter material will depend on clinical experience, patient assessment and anticipated duration of catheterisation.

5 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.

### **Intervention 3:**

#### ***Aseptic catheter insertion***

6 Catheterisation is an aseptic procedure. Ensure that health care personnel are trained and competent to carry out urethral catheterisation.

7 Clean the urethral meatus prior to the insertion of the catheter.

8 Use an appropriate lubricant from a single use container to minimise urethral trauma and infection.

**Intervention 4:**  
**Catheter maintenance**

- 9 Connect indwelling urethral catheters to a sterile closed urinary drainage system.
- 10 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 the manufacturer's recommendations.
- 11 Decontaminate hands and wear a new pair of clean, non-sterile gloves before manipulating a patient's catheter and decontaminate hands after removing gloves.
- 12 Obtain urine samples from a sampling port using an aseptic technique.
- 13 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.
- 14 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.
- 15 Do not add antiseptic or antimicrobial solutions into urinary drainage bags.
- 16 Do not change catheters unnecessarily or as part of routine practice.
- 17 Routine personal hygiene is all that is needed to maintain meatal hygiene.
- 18 Bladder irrigation, instillation and washout do not prevent catheter-associated infection.

**Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters****Intervention 1:**  
**Selection of catheter type**

- 1 Use a single-lumen catheter unless multiple ports are essential for the management of the patient.
- 2 If total parenteral nutrition is being administered, use one central venous catheter or lumen exclusively for that purpose.
- 3 Use a tunnelled catheter or an implantable vascular access device for patients in whom long-term (>30 days) vascular access is anticipated.
- 4 Consider the use of an antimicrobial impregnated central venous catheter for adult patients who require short-term (>10 days) central venous catheterisation and who are at high risk for CR-BSI.

**Intervention 2:**  
**Selection of catheter insertion site**

- 5 In selecting an appropriate insertion site, assess the risks for infection against the risks of mechanical complications.
- 6 Unless medically contraindicated, use the subclavian site in preference to the jugular or femoral sites for nontunnelled catheter placement.
- 7 Consider the use of peripherally inserted catheters as an alternative to subclavian or jugular vein catheterisation.

**Intervention 3:**  
**Optimum aseptic technique during catheter insertion**

- 8 Use optimum aseptic technique, including a sterile gown, gloves, and a large sterile drape, for the insertion of central venous catheters.

**Intervention 4:**  
***Cutaneous antisepsis***

9 Clean the skin site with an alcoholic chlorhexidine gluconate solution 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.

10 Do not apply organic solvents, e.g., acetone, ether, to the skin before catheter insertion.

11 Do not routinely apply antimicrobial ointment to the catheter placement site prior to insertion.

**Intervention 5:*****Catheter and catheter site care***

12 Before accessing the system, disinfect the external surfaces of the catheter hub and connection ports with an aqueous solution of chlorhexidine gluconate or povidone-iodine, unless contraindicated by the manufacturer's recommendations.

13 Use either a sterile gauze or transparent dressing to cover the catheter site.

14 If a gauze and tape catheter site dressing is used, it must be replaced when the dressing becomes damp, loosened, or soiled, or when inspection of the insertion site is necessary.

15 Do not apply antimicrobial ointment to CVC insertion sites as part of routine catheter site care.

16 Routinely flush indwelling central venous catheters with an anticoagulant unless advised otherwise by the manufacturer.

**Intervention 6:*****Replacement strategies***

17 Do not routinely replace non-tunnelled CVC as a method to prevent catheter-related infections.

18 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 CR-BSI.

19 If CR-infection is suspected, but there is no evidence of infection at the catheter site, remove the existing catheter and 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.

20 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.

21 Replace all tubing when the vascular device is replaced.

22 Replace intravenous tubing and stopcocks no more frequently than at 72-hour intervals, unless clinically indicated.

23 Replace intravenous tubing used to administer blood, blood products, or lipid emulsions at the end of the infusion or within 24 hours of initiating the infusion.

**Intervention 7:*****Antibiotic prophylaxis***

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

*Journal of Hospital Infection* (2001) 47(Supplement): S11 doi:10.1053/jhin.2000.0926, available online at <http://www.idealibrary.com> on

## Acknowledgements

We are grateful to all the practitioners in different parts of England who participated in critically reviewing the guidelines during various stages of their development. This includes all those who were members of our Project Advisory Group, Panel of Practitioners and focus groups. We are also indebted to the Royal Colleges, learned societies and other professional organisations and patient groups who took an active role in the external review of the guidelines. We appreciated web-based comments from colleagues in many different parts of the world on various drafts of the guidelines posted on the project's web page on the Internet. We are indebted to Betsy Anagnostelis, Medical Librarian at The Royal Free and University Hospital Medical School for her assistance in conducting systematic reviews. We would like to especially thank Jennifer Russell, Carole Fry and Gill Stephens at the Department of Health for their ongoing advice and support, Professors Christine Beasley and Michael Orme for so ably chairing the Project Advisory Group, all of our colleagues in the Wolfson Institute of Health Sciences at Thames Valley University for their continuous support and encouragement, especially Lois Croke, Director of the Institute, and Professor Kenneth Barker, our Vice Chancellor.

## Introduction

### What is a national evidence-based guideline?

These are systematically developed broad statements (principles) of good practice.<sup>1</sup> 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 hospital-acquired infections.

### Why do we need a national guideline for preventing hospital-acquired infections?

At any one time 9 percent of hospital in-patients are suffering from an infection acquired following their admission to hospital.<sup>2,3</sup> A study conducted between August 1994 and September 1995 on the control of hospital-acquired infection (HAI) in nineteen hospitals in England and Wales suggested that there may be at least 100,000 HAI each year.<sup>4</sup> The emergence of micro-organisms that are resistant to antimicrobial treatment increases the threat to patients who acquire such infections.<sup>5</sup> A recent study into the socio-economic burden of hospital-acquired infection suggests that the additional costs to one health care trust of meeting the care of patients with hospital-acquired infection was £3.6 million.<sup>6</sup> While it is unlikely that hospital-acquired infection can be completely eradicated, there is considerable scope for preventing those that are preventable. Department of Health guidance suggests that approximately 30 percent of current HAI are preventable.<sup>7</sup>

### What is the focus of these guidelines?

Three key areas were chosen for guideline development; standard principles, short-term indwelling urethral catheters and central venous catheters. Standard principles are core recommendations for preventing HAI. Additional guidelines for preventing HAI associated with the use of short-term indwelling urethral catheters and central venous catheters were developed because these devices frequently cause serious infection in patients. These recommendations should be used in conjunction with the standard principles for preventing HAI.

### Standard principles

These guidelines focus on providing evidence-based recommendations for the prevention of HAI in general care settings. They provide guidance on infection control precautions that can be applied as standard principles by all health care practitioners to the care of all hospital in-patients all the time. The guidelines are grouped as 'sets' of recommendations within the following potential intervention categories:

1. hospital environmental hygiene;
2. hand hygiene;
3. the use of personal protective equipment;
4. the use and disposal of sharps.

These guidelines do not address the additional infection control requirements of specialist settings, such as the operating department. Short-term indwelling urethral catheters

These guidelines focus on providing evidence-based recommendations for preventing hospital-acquired infections associated with the use of short-to-medium term indwelling urethral catheters in acute care

settings. The guidelines are grouped as 'sets' of recommendations within the following intervention categories:

1. Assessing the need for catheterisation;
2. Selection of catheter type;
3. Aseptic catheter insertion;
4. Catheter maintenance.

### Central venous catheters

These guidelines focus on providing evidence-based recommendations for preventing hospital-acquired infections associated with the use of central venous catheters in patients who are four years of age or older. The guidelines are grouped as 'sets' of recommendations within the following intervention categories:

1. selection of catheter type;
2. selection of catheter insertion site;
3. aseptic technique during catheter insertion;
4. cutaneous antisepsis;
5. catheter and catheter site care;
6. catheter replacement strategies;
7. antibiotic prophylaxis.

### 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. The recommendations for these guidelines have been derived from systematic review of the literature and expert opinion derived from systematically retrieved and appraised professional, national and international guidelines in the areas of standard principles and indwelling urethral catheters; and an expert review of evidence-linked guidelines for preventing intravascular device-related infections developed at the Centers for Disease Control by the Hospital Infection Control Practices Advisory Committee (HICPAC).<sup>8</sup> A summary of each of these processes is described below.

Detailed descriptions of the processes and evidence tables for each section of the guidelines can be found in the technical reports,<sup>9</sup> - which can be found on epic web site at <http://www.epic.tvu.ac.uk/>

### Experimental and non-experimental evidence

The first type of evidence was obtained from a systematic review. Electronic databases were used for these comprehensive and systematic searches of the literature. Databases included Medline, the Cochrane Database of Systematic Reviews (CDSR), the Database of Abstracts of Reviews of Effectiveness (DARE), the Cochrane Controlled Trials Register (CCTR), Embase, Paradigm and the Cumulative Index of Nursing and Allied Health Literature (CINAHL). Our strategy involved a comprehensive subject search, employing thesaurus and free text terms, and methodological filters for randomised controlled trials (RCTs) from 1966 up to March 1999.<sup>12</sup> Because there is limited evidence from RCTs in the field of infection prevention, additional studies, using acceptable non-experimental designs, were also included. MeSH terms for each of the guideline development areas can be found in Appendix a. Hand searching and grey literature retrieval was not undertaken.

Retrieved evidence was reviewed by infection prevention specialists for its relevance to practice and critically appraised by experts in study design, methodology and statistical analysis for quality and generalisability. An illustration of the systematic review process is shown in Appendix b.

### Expert opinion

Because the systematic review revealed limited evidence to inform all the necessary recommendations additional evidence was sought for standard principles and indwelling urethral catheters. This evidence was in the form of expert opinion derived from systematically retrieved professional, national and international guideline recommendations. The retrieved guidelines were appraised using a validated appraisal instrument currently used to assess guideline development processes.<sup>13</sup> In addition, some recommendations are based on health and safety legislation and common sense.<sup>14,15</sup>

### Expert review

Recommendations for preventing infections associated with the use of central venous catheters are based upon an 'expert review' of evidence-linked guidelines for preventing intravascular device related infections, developed in the mid-1990s at the Centers for Disease Control and Prevention (CDC) by the Hospital (now Healthcare) Infection Control Practices Advisory Committee (HICPAC).<sup>8</sup> These guidelines are available on the Internet (<http://www.cdc.gov/ncidod/hip/Guide/guide.htm>). We used a two-stage appraisal process to formally review these guidelines.

### *Expert review (stage 1): formal appraisal of the HICPAC guidelines*

The first stage of our review consisted of a structured appraisal of the methods used to develop these guidelines. Three dimensions of guideline development (Table 1) were assessed. An appraisal process and associated instrument, developed in England 13 and based on guideline appraisal recommendations published by the CDC,<sup>16</sup> was used for the review.

Although the HICPAC guidelines were developed just prior to an emerging emphasis on the use of rigorous systematic review and subsequent evidence appraisal to inform guideline development, a consensus of members of our review panel concluded that the development processes were valid and that the guidelines are:

- evidence-linked;
- categorised to the strength of the evidence examined;
- reflective of current concepts of best practice; and
- acknowledged as the most authoritative current reference guidelines in use by clinicians.

Consequently, they were accepted as the basis for the development of new national guidelines in England for preventing hospital-acquired infections associated with the use of central venous catheters.

Table 1 Guideline assessment dimensions	
• Dimension 1	<b>-Rigour of development</b> appraising guideline development processes. Identification and interpretation of evidence, formulation of recommendations, link between evidence and main recommendations, peer review and updating
• Dimension 2	<b>-Context and content.</b> assessing the aims and objectives of the guidelines target group circumstances for applying the recommendations presentation and formation of the guidelines and the estimated outcomes, benefits, harms and costs
• Dimension 2	<b>-Application</b> addressing implementation and dissemination strategies and monitoring

### *Expert review (stage 2): examining and updating the evidence base*

During the second stage of the review, we examined the detailed content and evidence base of those recommendations in the HICPAC guidelines that were specifically relevant to preventing HAI associated with the insertion and maintenance of CVCs. To update the evidence base, we also systematically searched, retrieved and appraised additional supporting evidence produced since the HICPAC guidelines were developed in 1994-95. This search was confined to elements of infection prevention where expert advisers indicated new developments or changes in technology had occurred, or where pertinent new experimental trials or systematic reviews had been published.

This additional evidence was identified by searching MEDLINE 1997 (Week 3, 2000), the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effectiveness, and the Cochrane Controlled Trials Register for trials published in English and related to the prevention of central venous catheter-related complications. The MeSH terms used for a subject search can be found in Appendix a.

The strength of additional supporting evidence varies. The highest quality evidence cited is derived from well-conducted systematic reviews and meta-analyses.

### *Evidence from systemic reviews and meta-analyses*

Although an increasing body of evidence has accumulated in relation to interventions focused on preventing infections related to the use of CVCs since 1994, many trials have contradictory results.<sup>17</sup> Because of this, systematic reviews and meta-analyses have been conducted by others since the publication of the HICPAC guidelines in an attempt to identify reported outcomes clearly linked to evidence.<sup>17-23</sup>

### Other (non-systematic review) evidence

In addition to good quality systematic reviews in this field, other relevant evidence that influences best practice in preventing infections associated with the use of central venous catheters is described. This includes evidence obtained from other experimental studies, consensus papers, expert opinion, other national and international guideline recommendations and obvious practical common sense.<sup>15</sup>

### How is the evidence graded?

Following critical appraisal, evidence was synthesised and graded as:

- **Category 1:** generally consistent findings in a range of evidence derived from a majority of acceptable studies.
- **Category 2:** evidence based on a single acceptable study, or a weak or inconsistent finding in multiple acceptable studies
- **Category 3:** limited scientific evidence that does not meet all the criteria of 'acceptable studies,' or an absence of directly applicable studies of good quality. This includes published expert opinion derived from systematically retrieved and appraised professional, national and international guidelines.

This is an adaptation of a grading system devised by other guideline developers in England and which is commonly used to describe the strength, quality and direction of evidence that underpins a guideline recommendation. 24-26 The difficulties of designing and conducting ethical intervention studies in the field of infection prevention suggested that this categorisation model was more appropriate, as most other approaches are based upon treatment intervention studies. This grading system provides guideline developers with a uniform method of weighting evidence from a range of sources, including expert opinion.

The type of supporting evidence is explicitly linked to each recommendation. The evidence category indicates the best evidence available for each of the recommendations, not the best evidence possible. In line with other UK guidelines, the evidence grade alerts the practitioner to the type of evidence that underpins each recommendation but does not indicate the strength of each recommendation or imply that one recommendation is more or less important than others.<sup>27</sup> **All the recommendations are endorsed equally and none is regarded as optional.**

All the stages of the systematic and subsequent clinical practice review and critical appraisals were undertaken following detailed protocols. An outline of the process can be found in the project's Technical Reports 9 -11 and on the *epic* web site at <http://www.epic.tvu.ac.uk/>

### Who developed these guidelines?

An illustration of the guideline authoring process is shown in Appendix b. The guidelines were developed by a multidisciplinary authoring group (Appendix c). The systematic review process was undertaken by a group of academic researchers, including a senior librarian with specialist expertise in developing search strategies and experienced critical appraisers. Clinical specialists in the field of infection prevention, medical microbiology and clinical virology provided in-depth subject and clinical expertise in the review process.

In addition, a Project Advisory Group with representation from relevant Royal Colleges, learned societies, and other professional organisations, advised and commented on the guidelines and subsequent recommendations throughout the drafting stages (Appendix d).

To ensure that the recommendations were acceptable, credible and practicable to all healthcare practitioners, an extensive consultation process was undertaken (Appendix e). General and specialist healthcare practitioners from medicine, nursing, the professions allied to medicine and healthcare management were involved in focus groups and specialist panels to discuss and comment on the draft guidelines. These groups included:

- infection control nurses;
- general nurses;
- clinical nurse specialists (intensive care, urological nursing);
- surgeons;

medical microbiologists;  
junior hospital doctors;  
intensive care physicians;  
anaesthetists;  
urologists;  
directors of clinical effectiveness;  
medical directors;  
physiotherapists.

In addition, web-based discussion groups provided access for a wide range of practitioners to contribute to the consultation exercise.

The final round of consultation incorporated formal comment from Royal Colleges, learned societies, professional organisations and patient interest groups. (Appendix f)

### **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 principals 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.

### **How are these guidelines structured?**

Interventions in each set of guideline recommendations are divided into four parts:

- a headline statement that describes the key issue being addressed;
- then a synthesis of the related evidence is described;
- next, the guideline recommendation(s) with a corresponding evidence grade is listed;
- a bibliography listing the evidence cited concludes each set of recommendations.

### **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.

The concluding section of these guidelines focuses on important issues for clinical governance and includes a discussion of:

- issues associated with implementation, audit and education;
- quality standards;<sup>28</sup>
- avenues for further research.

### 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 hospital acquired infection, the consequences associated with not implementing these guidelines would be unacceptable to both patients and health care professionals.

### When will these guidelines be updated?

Periodic searches will be undertaken for new evidence in this field and these guidelines will be reviewed during the summer of 2002.

### References

1. National Health Service Executive. Promoting Clinical Excellence: A framework for action in and through the NHS. Leeds: Department of Health; 1996; 44.
2. Meers PD, Ayliffe GA, Emmerson AM, Leigh DA, Mayton-White RT, Mackintosh CA, Stronge JL. Report on the national survey of infection in hospitals 1980. *Journal of Hospital Infection (Supplementary)* 1981; 2: 1-11.
3. Emmerson AM, Enstone JE, Griffin M, Kelsey MC, Smyth ETM. The second national prevalence survey of infection in hospitals - an overview of results. *Journal of Hospital Infection* 1996; 32: 175-190.
4. Glynn A, Ward V, Wilson J, Charlett A, Cookson B, Taylor L, Cole N. Hospital-Acquired Infection: Surveillance, Policies, and Practice. London: Public Health Laboratory Service; 1997; 100.
5. House of Lords Select Committee on Science and Technology. Resistance to antibiotics and other antimicrobial agents. (HL Paper 81-I, 7th Report Session, 1997-1998). London: Stationery Office; 1998; 56.
6. Plowman R, Graves N, Griffin M, Roberts JA, Swan AV, Cookson B, Taylor L. The Socio-economic Burden of Hospital-acquired Infection. London: Public Health Laboratory Service and The London School of Hygiene and Tropical Medicine; 1999; 12.
7. Hospital Infection Working Group of the Department of Health & Public Health Laboratory Service. Hospital Infection Control: Guidance on the control of infection in hospitals. London Department of Health 1995; 84.
8. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; 17(7): 438-473.
9. Pratt RJ, Pellowe C, Loveday HP, Robinson N. epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
10. Pratt RJ, Pellowe C, Loveday HP, Robinson N. epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England associated with the use of short-term indwelling urethral catheters in acute care: Technical Report. London: Thames Valley University; 2000; 86.
11. Pratt RJ, Wilcox M, Pellowe C, Loveday HP, Robinson N. epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England associated with the use of central venous catheters: Technical Report. London: Thames Valley University; 2000; 127.
12. Dickersin K, Larson K. Optimal search strategy for RCTs. From: Establishing and maintaining an international register of RCTs. In: The Cochrane Library. Oxford; Update Software, 1996.

13. Cluzeau F, Littlejohns P, Grimshaw J, Feder G. Appraisal instrument for clinical guidelines (Version 1). St. George's Hospital Medical School, London, May 1997.
14. Health and Safety Commission. Control of Substances Hazardous to Health Regulations 1999. Approved Codes of Practice. HSE Books. 1999; 75.
15. Asher R. Apriority, thoughts on treatment. *The Lancet* 1961; 2: 1403-1404.
16. Centers for Disease Control and Prevention. CDC Guidelines: Improving the Quality. Atlanta: Centers for Disease Control and Prevention. 1996; 179.
17. Randolph A. An evidence-based approach to central venous catheter management to prevent catheter-related infection in critically ill patients. *Critical Care Clinics* July 1998; 14(3): 411-421.
18. Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; 132(5): 391-402.
19. Randolph A, Cook D, Gonzales C, et al. Ultrasound guidance for placement of central venous catheters: A meta-analysis of the literature . *Critical Care Medicine* 1996; 24: 2053-2058.
20. Cook D, Randolph A, Kemerman P, Cupido C, King D, Soukup C, Brun-Buisson C. Central venous catheter replacement strategies: A systematic review of the literature. *Critical Care Medicine* 1997; 25(8): 1417-1424.
21. Randolph A, Cook D, Gonzales C, Brun-Buisson C. Tunneling short-term central venous catheters to prevent catheter-related infection: A meta-analysis of randomized controlled trials. *Critical Care Medicine* 1998; 26(8): 1452-1457.
22. Randolph A, Cook D, Gonzales C, et al. Benefit of heparin use in central venous and pulmonary artery catheters: A meta-analysis of randomized controlled trials . *Chest* 1998; 113: 165-171.
23. Veenstra DL, Saint S, Saha S, Lumley T, Sullivan S. Efficacy of antiseptic-impregnated central venous catheter in preventing catheter-related bloodstream infection: a meta-analysis . *Journal of the American Medical Association* 1999; 281(3): 261-267.
24. Waddell G, Feder G, McIntosh A, Lewis M, Hutchinson A. Clinical Guidelines for Management of Low Back Pain (Low Back Pain Evidence Review). London: Department of Health; 1996; 36.
25. Royal College of Nursing Institute, Centre of Evidence-based Nursing, University of York, School of Nursing, Midwifery and Health Visiting, University of Manchester. Clinical Practice Guidelines: the Management of Patients with Venous Leg Ulcers, Technical Report. London: Royal College of Nursing; 1998; 26. Available (Internet): <http://www.ahcpr.gov/>
26. AHCPR. Acute Low Back Pain in Adults: Clinical Practice Guideline No. 14. USA: Agency for Health Care Policy and Research; 1994.
27. The Royal College of Nursing Institute. The recognition and assessment of pain in children. London: Royal College of Nursing; 1999; 31.
28. National Health Service Executive. Controls Assurance Standard - Infection Control. Leeds: Department of Health; 1999. 21p

## Standard Principles for preventing hospital-acquired infections

**Standard Principles** provide guidance on infection control precautions that should be applied by all health care practitioners to the care of all hospital in-patients all the time. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines. The recommendations are divided into four distinct interventions:

1. hospital environmental hygiene;
2. hand hygiene;
3. the use of personal protective equipment;
4. the use and disposal of sharps.

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

### Intervention 1

#### **Standard Principles for Hospital Environmental Hygiene**

Good hospital hygiene is an integral and important component of a strategy for preventing hospital-acquired infections

This section discusses the evidence upon which recommendations for the maintenance of 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 hospital-acquired infection.<sup>1,2</sup> They include:

- cleaning and decontamination, laundry and housekeeping;
- safe collection and disposal of general and clinical waste;
- kitchen and food hygiene.

#### **Maintain a clean hospital environment**

Our systematic review revealed little research evidence of an acceptable quality upon which to base guidance related to the maintenance of hospital environmental hygiene.<sup>3</sup> However, there is a large body of clinical evidence, derived from case reports and outbreak investigations, which identifies links between poor environmental hygiene and the transmission of microorganisms causing hospital acquired infection.<sup>4,5</sup>

Attention has been drawn to falling standards in the cleanliness of hospitals since the introduction of compulsory comprehensive tendering and the internal market. This has been 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 standards concerning hospital cleanliness.<sup>6,7</sup> In addition, existing statutory regulations,<sup>8-10</sup> specialist advice <sup>11,12</sup> the Controls Assurance Standards <sup>13,14</sup> and Clinical Governance,<sup>15</sup> provide a framework within which hospital environmental hygiene can be improved and monitored. More recently the NHS Plan included action to be taken to improve hospital cleaning.

1. The hospital environment must be visibly clean, free from dust and soilage, and acceptable to patients, their visitors and staff. **Category 3**
2. Where a piece of equipment is used for more than one patient, e.g., commode, bath hoist, it must be cleaned following each and every episode of use. **Category 3**
3. Statutory requirements must be met in relation to the safe disposal of clinical waste, laundry arrangements for used and infected linen, food hygiene and pest control. **Category 3**  
0195-6701/01/0S0021\_ 17 \$35.00/0 © 2001 Crown copyright
4. All staff involved in hospital hygiene activities must be included in education and training related

to the prevention of hospital-acquired infection. **Category 3**

## References

1. Hempshall P, Thomson M. Grime watch. *Nursing Times* 1998; **16(94)** 37: 66-69.
2. National Audit Office. The Management and Control of Hospital-acquired Infection in Acute NHS Trusts in England. HC 230 Session 1999-00. London: The Stationery Office. 1999; 117.
3. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
4. Dancer SJ. Mopping up hospital infection. *Journal of Hospital Infection* 1999; **43**: 85-100.
5. Garner JS, Favero MS. CDC Guideline for Handwashing and Hospital Environmental Control, 1985. *Infection Control* 1986; **7**: 231-235.
6. Working Party for Standards for Environmental Cleanliness in Hospitals. *Standards for Environmental Cleanliness in Hospitals*. ICNA & Association of Domestic Management. 1999; 32.
7. NHS Estates. Standards for environmental cleanliness in hospitals. London: The Stationery Office. 2000; 35.
8. Health and Safety Executive. *Safe Disposal of Clinical Waste*. London: HSE. 1999; 68.
9. National Health Service Executive. *Hospital Laundry Arrangements for Used and Infected Linen*. HSG (95)18 Leeds: NHSE; 1995; 4.
10. National Health Service Executive. *Hospital Catering, Delivering a Quality Service*. London: HMSO; 1989; 113.
11. Expert Advisory group on AIDS and the Advisory group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with bloodborne viruses*. London: Department of Health 1998; 46.
12. Microbiology Advisory Committee. *Decontamination of equipment, linen or other surfaces contaminated with Hepatitis B and/or human immunodeficiency viruses*. HC(91) 33 London: Department of Health 1991; 6.
13. National Health Service Executive. *Controls Assurance Standard - Infection Control*. Leeds: Department of Health; 1999; 21.
14. National Health Service Executive. *Guidelines for Implementing Controls Assurance in the NHS (Guidance for Directors)*. Leeds: Department of Health 1999; 36.
15. National Health Service Executive. *A First Class Service: Quality in the new NHS*. Leeds: Department of Health; 1998; 86.

## Intervention 2

### Standard Principles for Hand Hygiene

The following section provides the evidence for recommendations concerning hand hygiene practice. The difficulty of designing and conducting ethical, randomised controlled trials in the field of hand hygiene means that recommendations in these areas are based on 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 to protect hands from the adverse effects of hand decontamination practice.

#### **Why is hand decontamination crucial to the prevention of hospital-acquired infection?**

Evidence from two previous reviews 1-2 clearly demonstrates that in outbreak situations contaminated hands are responsible for transmitting infections. Our systematic review 3 indicates that effective hand decontamination can significantly reduce infection rates in gastro-intestinal infections 4,5 and in high risk areas, such as intensive care units.6-8

Overviews of epidemiological evidence 9-11 conclude that hand mediated transmission is a major contributing factor in the current infection threats to hospital in-patients. These include both methicillin-sensitive and methicillin-resistant *Staphylococcus aureus*, and multi-resistant Gramnegative aerobes and enterococci. However, there is some contention as to the benefits of hand hygiene as a primary prevention measure in routine clinical practice as distinct from high-risk areas.

The transmission of microorganisms from one patient to another via the hands, or from hands that have become contaminated from the environment, can result in adverse outcomes. Primary exogenous infection is a direct clinical threat where microorganisms are introduced into susceptible sites, such as surgical wounds, intravascular cannulation sites or catheter drainage systems. Secondary endogenous infection creates an indirect clinical threat where potential pathogens transmitted by the hands establish themselves as temporary or permanent colonisers of the patient and subsequently causes infection at susceptible sites.

Expert consensus groups agree 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.12-16

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

Decontamination refers to the process for the physical removal of blood, body fluids, and transient microorganisms from the hands, i.e., handwashing, and/or the destruction of microorganisms, i.e., hand antisepsis.12

Our review of expert opinion suggests that, in deciding when it is necessary to decontaminate hands, four key factors need to be considered:12-15

- 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 potential risk of developing a hospital-acquired infection when a health care practitioner caring for them has 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 supports the rationale that hands need to be decontaminated after completing an episode of patient care to minimise cross contamination of the environment.12-15

5. 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 3

### References

1. Larson E. A causal link between handwashing and risk of infection? Examination of the evidence. *Infection Control and Hospital Epidemiology* 1988; **9**: 28-36.
2. Bryan JL, Cohran J, Larson EL. Hand washing. A ritual revisited. *Critical Care Nursing Clinics of North America* 1995; **4**: 617-625.
3. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
4. Black RE, Dykes AC, Anderson KE, Wells JG, Sinclair SP, Gary GW, Hatch MH, Gangarosa EJ. Handwashing to prevent diarrhea in day-care centres. *American Journal of Epidemiology* 1981; **113**(4): 445-451.
5. Manns AB, Larson E, Fosarelli P. Occurrence of infectious symptoms in children in day care homes. *American Journal of Infection Control* 1990; **18**(6): 347-353.
6. Simmons B, Bryant J, Neiman K, Spencer L, Arheart K. The role of handwashing in prevention of endemic intensive care unit infections. *Infection Control and Hospital Epidemiology* 1990; **11**(11): 589-594.
7. Webster J. Hand-washing in a neonatal intensive care unit: Comparative effectiveness of chlorhexidine gluconate 4 % w/v and triclosan 1% w/v. *Australian College of Midwives* 1991; **4**(2): 25-27.
8. Berg DE, Hershov RC, Ramirez CA, Weinstein RA. Control of nosocomial infections in an intensive care unit in Guatemala City. *Clinical Infectious Diseases* 1995; **21**: 588-593.
9. Gould D. Nurses' hands as vectors of hospital-acquired infection: a review. *Journal of Advanced Nursing* 1991; **16**: 1216-1225.
10. Reybrouk G. Role of the hands in the spread of nosocomial infections. *Journal of Hospital Infection* 1983; **4**: 103-110.
11. Reybrouk G. Handwashing and hand disinfection. *Journal of Hospital Infection* 1986; **8**(1): 5-23.
12. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *American Journal of Infection Control* 1995; **23**: 251-269.
13. Garner JS, Favero MS. CDC guideline for handwashing and hospital environmental control, 1985. *Infection Control* 1986; **7**: 231-235.
14. Infection Control Nurses Association. *Guidelines for Hand Hygiene*. ICNA & Deb Ltd; 1999; 13.
15. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 5-9.
16. Teare EL, Cookson B, French G, Jenner EA, Scott G, Pallett A. UK Handwashing Initiative. *Journal of Hospital Infection* 1999; **43**: 1-3

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

Our systematic review 1 revealed 25 acceptable studies concerning the effectiveness of various preparations for the decontamination of hands.<sup>2-26</sup> The preparations considered were: plain soap and water, antimicrobial handwashes, and alcohol handrubs. In general, the studies were complex in design, reliant upon laboratory conditions rather than 'in use' conditions for their findings and based on small samples. Antimicrobial preparations are those that kill or inhibit microorganisms, e.g., alcohol, chlorhexidine. Overall there was no compelling evidence to favour the general use of antimicrobial handwashing agents over soap, or one antimicrobial agent over another.

When deciding which hand decontamination preparation to use, the practitioner must consider the need to remove transient and/or resident hand flora. Preparations with a residual effect are not normally necessary for everyday clinical practice but may be used for some invasive procedures and in outbreak situations. Practitioners need to be aware that research suggests that:

- Soap and water is as effective as handwashing preparations containing antimicrobial agents for decontaminating hands and removing transient microorganisms.27,28
- Alcohol-based handrubs are not effective in removing physical dirt or soiling.27,28
- Alcohol-based handrubs are more effective in destroying transient microorganisms than antimicrobial handwashing agents or soap and water, and give a greater initial reduction in hand flora.8,9,21,24,26
- Handrubs containing alcohol alone as the active ingredient have no residual effect.9,17
- Preparations containing antimicrobial agents are more effective in removing resident microorganisms than those without an antimicrobial agent.2,3,11,13,14,22,23,26
- Preparations containing antimicrobial agents have different effects on specific microorganisms.8,22,23,26

What is important is that health care practitioners use an appropriate preparation to decontaminate their hands. Our review of expert opinion 27-30 suggests that the acceptability of agents and techniques is an essential criterion for the selection of preparations for hand hygiene. Acceptability of preparations is dependent upon the ease with which the preparation can be used in terms of time and access together with their dermatological effects.27-30

#### **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, what is practically possible, available resources 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. The use of an antimicrobial liquid soap preparation will reduce transient microorganisms and resident flora, and result in hand antisepsis.27-30 The effective use of alcohol-based handrubs on contaminated hands will also result in substantial reductions of transient microorganisms, although alcohol is not effective at removing dirt and organic material.27 However, alcohol handrubs offer a practical and acceptable alternative to handwashing when the hands are not grossly soiled and are increasingly being recommended for routine use.27,29,30

**6. Hands that are visibly soiled or potentially grossly contaminated with dirt or organic material must be washed with liquid soap and water. Category 3**

**7. Apply an alcohol-based hand rub or wash hands with liquid soap and water to decontaminate hands between caring for different patients, or between different caring activities for the same patient.**

**Category 3**

#### **References**

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
2. Bendig JW. Surgical hand disinfection; comparison of 4% chlorhexidine detergent solution and 2% triclosan detergent solution. *Journal of Hospital Infection* 1990; **15(2)**: 143-148.
3. Ayliffe G, Babb JR, Davies JG, Newsom S, Rowland C, Platt JH, Mason B. Hygienic hand disinfection tests in three laboratories. *Journal of Hospital Infection* 1990; **16(2)**: 141-149.
4. Webster J. Hand-washing in a neonatal intensive care unit: comparative effectiveness of chlorhexidine gluconate 4% w/v and triclosan 1% w/v. *Australian College of Midwives* 1991; **4(2)**: 25-27.
5. Larson E, Eke PI, Laughon BE. Efficacy of alcohol-based hand rinses under frequent-use conditions. *Antimicrobial Agents and Chemotherapy* 1986; **30(4)**: 542-544.
6. Larson E, Mayur K, Laughon BA. Influence of two handwashing frequencies on reduction in colonizing flora with three handwashing products used by health care personnel. *American Journal of Infection Control* 1989; **17(2)**: 83-88.
7. La Rocca. MAK, La Rocca PT, La Rocca R. Comparative study of three handwash preparations for efficacy against experimental bacterial contamination of human skin. *Advances in Therapy* 1985; **2(6)**: 269-274.

8. Ayliffe GA, Babb JR, Quoraishi AH. A test for 'hygienic' hand disinfection. *Journal of Clinical Pathology* 1978; **31(10)**: 923-928.
9. Ayliffe GA, Babb JR, Davies JG, Lilly HA. Hand disinfection: a comparison of various agents in laboratory and ward studies. *Journal of Hospital Infection* 1988; **11(3)**: 226-243.
10. Casewell M, Phillips I. Hands as route of transmission for Klebsiella species. *British Medical Journal* 1977; **2(6098)**: 1315-1317.
11. Ojajarvi J. Effectiveness of hand washing and disinfection methods in removing transient bacteria after patient nursing. *Journal of Hygiene* 1980; **85**: 193-203.
12. Doebbeling BN, Stanley GL, Sheetz CT, Pfaller MA, Houston AK, Annis L, Li N, Wenzel RP. Comparative efficacy of alternative hand-washing agents in reducing nosocomial infections in intensive care units. *New England Journal of Medicine* 1992; **327(2)**: 88-93.
13. Ehrenkranz NJ, Alfonso BC. Failure of bland soap handwash to prevent hand transfer of patient bacteria to urethral catheters. *Infection Control and Hospital Epidemiology* 1991; **12**: 654-662.
14. Larson EL, Laughon BE. Comparison of four antiseptic products containing chlorhexidine gluconate. *Antimicrobial Agents and Chemotherapy* 1987; **31(10)**: 1572-1574.
15. Larson EL, Eke PI, Wilder MP, Laughon BE. Quantity of soap as a variable in handwashing. *Infection Control* 1987; **8(9)**: 371-375.
16. Rotter ML, Koller W, Wewalka G, Werner HP, Ayliffe GA, Babb JR. Evaluation of procedures for hygienic hand-disinfection: controlled parallel experiments on the Vienna test model. *Journal of Hygiene* 1986; **96(1)**: 27-37.
17. Aly R, Maibach HI. A comparison of the antimicrobial effect of 0.5% chlorhexidine (Hibistat) and 70% isopropyl alcohol on hands contaminated with *Serratia marcescens*. *Clinical & Experimental Dermatology* 1980; **5(2)**: 197-201.
18. Bartzokas CA, Corkill JE, Makin T. Evaluation of the skin disinfecting activity and cumulative effect of chlorhexidine and triclosan handwash preparations on hands artificially contaminated with *Serratia marcescens*. *Infection Control* 1987; **8(4)**: 163-167.
19. Dineen P. Hand-washing degerming: a comparison of povidone-iodine and chlorhexidine. *Clinical Pharmacology and Therapeutics* 1978; **23(1)**: 63-67.
20. Faix RG. Comparative efficacy of handwashing agents against cytomegalovirus. *Infection Control* 1987; **8(4)**: 158-162.
21. Rotter M, Koller W, Wewalka G. Povidone-iodine and chlorhexidine gluconate-containing detergents for disinfection of hands. *Journal of Hospital Infection* 1980; **1(2)**: 149-158.
22. Wade JJ, Desai N, Caswell MW. Hygienic hand disinfection for the removal of epidemic vancomycin-resistant enterococcus faecium and gentamicin-resistant enterobacter cloacae. *Journal of Hospital Infection* 1991; **18(3)**: 211-218.
23. Nicoletti G, Boghossian V, Borland R. Hygienic hand disinfection: a comparative study with chlorhexidine detergents and soap. *Journal of Hospital Infection* 1990; **15(4)**: 323-337.
24. Larson E, Bobo L. Effective hand degerming in the presence of blood. *Journal of Emergency Medicine* 1992 **10(1)**: 7-11.
25. Ojajarvi J, Makela P, Rantasalo I. Failure of hand disinfection with frequent handwashing: a need for prolonged field studies. *Journal of Hygiene* 1977; **79**: 107-119.
26. Bellamy K, Alcock R, Babb JR, Davies JG, Ayliffe GA. A test for the assessment of 'hygienic' hand disinfection using rotavirus. *Journal of Hospital Infection* 1993; **24(3)**: 201-210.
27. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 5-9.
28. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *American Journal of Infection Control* 1995; **23**: 251-269.
29. Garner JS, Favero MS. CDC guideline for handwashing and hospital environmental control, 1985. *Infection Control* 1986; **7**: 231-235.
30. Infection Control Nurses Association. Guidelines for Hand Hygiene. ICNA & Deb Ltd; 1999; 13.

### Is hand decontamination technique important?

Investigations into the technique of hand decontamination are limited. Those identified for possible inclusion in our systematic review were generally descriptive, with small samples and did not meet our inclusion criteria.<sup>1</sup> Recommendations are therefore 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.<sup>2-5</sup>

### Does hand decontamination damage skin?

Our systematic review <sup>1</sup> found no consistent evidence to suggest that any product currently in use caused more skin irritation and damage than another.<sup>6-18</sup> Skin damage is generally associated with the detergent base of the preparation and/or poor handwashing technique. However, the frequent use of hand preparation agents may cause damage to the skin. A recent study <sup>19</sup> suggests that the normal hand flora is altered when skin has been damaged and this may result in increase carriage of pathogens responsible for hospital-acquired infection. In addition, the irritant and drying effects of hand preparations have been identified as one of the reasons why health care practitioners fail to adhere to hand hygiene guidelines.<sup>20-24</sup> The introduction of preparations that contain emollients and moisturisers seeks to address this problem. Expert opinion agrees that hand care is an important factor in maintaining regular hand decontamination practices and assuring the health and safety of health care practitioners.<sup>2-5</sup>

8. Remove all wrist and ideally hand jewellery at the beginning of each clinical shift before regular hand decontamination begins. Cuts and abrasions must be covered with waterproof dressings.

Category 3

9. Effective handwashing technique involves three stages: preparation, washing and rinsing, and drying. Preparation requires wetting hands under tepid running water before applying liquid soap or an antimicrobial preparation. The handwash solution must come into contact with all the surfaces of the hand. The hands must be rubbed together vigorously for a minimum of 10-15 seconds, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers. Hands should be rinsed thoroughly prior to drying with good quality paper towels. Category 3

10. When decontaminating hands using an alcohol 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 3

11. Apply an emollient hand cream regularly to protect skin from the drying effects of regular hand decontamination. If a particular soap, antimicrobial handwash or alcohol product causes skin irritation, seek occupational health advice. Category 3

### References

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
2. Infection Control Nurses Association. *Guidelines for Hand Hygiene*. ICNA & Deb Ltd; 1999; 13.
3. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 5-9.
4. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *American Journal of Infection Control* 1995; **23**: 251-269.
5. Garner JS, Favero MS. CDC guideline for handwashing and hospital environmental control, 1985. *Infection Control* 1986; **7**: 231-235.
6. Tupker R, Schuur J, Coenraads P. Irritancy of antiseptics tested by repeated open exposures on the human skin, evaluated by non-invasive methods. *Contact Dermatitis* 1997; **37**(5): 213-217.
7. Bendig JW. Surgical hand disinfection; comparison of 4% chlorhexidine detergent solution and 2% triclosan detergent solution. *Journal of Hospital Infection* 1990; **15**(2): 143-148.
8. Webster J. Hand-washing in a neonatal intensive care unit: comparative effectiveness of chlorhexidine

- gluconate 4% w/v and triclosan 1% w/v. *Australian College of Midwives* 1991; **4(2)**: 25-27.
9. Lauharanta J, Ojajarvi J, Sarna S, Makela P. Prevention of dryness and eczema of the hands of hospital staff by emulsion cleansing instead of washing with soap. *Journal of Hospital Infection* 1991; **17(3)**: 207-215.
  10. Scott D, Barnes A, Lister M, Arkell P. An evaluation of the user acceptability of chlorhexidine handwash formula-tions. *Journal of Hospital Infection* 1991; **18(Suppl B)**: 51-55.
  11. Larson E, Eke PI, Laughon BE. Efficacy of alcohol-based hand rinses under frequent-use conditions. *Antimicrobial Agents and Chemotherapy* 1986; **30(4)**: 542-4.12.
  12. Ohlenschlaeger J, Friberg J, Ramsing D, Agner T. Temperature dependency of skin susceptibility to water and detergents. *Acta Dermato-Venereologica* 1996; **76(4)**: 274-276.
  13. Rotter ML, Koller W, Neumann R. The influence of cosmetic additives on the acceptability of alcohol-based disinfectants . *Journal of Hospital Infection* 1991; **18(Suppl B)**: 57-63.
  14. Dykes PJ, Marks R. An evaluation of the irritancy potential of povidone iodine solutions: comparison of subjective and objective assessment techniques. *Clinical & Experimental Dermatology* 1992; **17(4)**: 246-249.
  15. Wilhelm KP, Freitag G, Wolff HH. Surfactant-induced skin irritation and skin repair. Evaluation of irritation and skin repair. Evaluation of the acute human irritation model by non-invasive techniques. *Journal of the American Academy of Dermatology* 1994; **30(6)**: 944-949.
  16. Nicoletti G, Boghossian V, Borland R. Hygienic hand disinfection: a comparative study with chlorhexidine detergents and soap. *Journal of Hospital Infection* 1990; **15(4)**: 323-337.
  17. Grunewald AM, Gloor M, Gehring W, Kleesz P. Damage to the skin by repetitive washing. *Contact Dermatitis* 1995; **32(4)**: 225-232.
  18. Ojajarvi J, Makela P, Rantasalo I. Failure of hand disinfection with frequent handwashing: a need for prolonged field studies. *Journal of Hygiene* 1977; **79**: 107-19.
  19. Larson EL, Norton Hughes CA, Pyrek JD, Sparks SM, Cagatay EU, Bartkus JM. Changes in bacterial flora associated with skin damage on hand of health care personnel. *American Journal of Infection Control* 1998; **25(5)**: 513-521.
  20. Larson EL, Killen M. Factors influencing handwashing behaviour of patient care personnel. *American Journal of Infection Control* 1982; **10(3)**: 93-99.
  21. Rotter ML, Koller W, Neumann R. The influence of cosmetic additives on the acceptability of alcohol-based hand disinfectants. *Journal of Hospital Infection* 1991; **18(Suppl B)**: 57-63.
  22. Scott D, Barnes A, Lister M, Arkell P. An evaluation of the user acceptability of chlorhexidine handwash formulations. *Journal of Hospital Infection* 1991; **18(Suppl B)**: 51-55.
  23. Zimakoff J, Kjelsberg AB, Larse SO, Holstein B. A multicenter questionnaire investigation of the attitudes toward hand hygiene, assessed by staff in fifteen hospitals in Denmark and Norway. *American Journal of Infection Control* 1992; **20**: 58-64.
  24. Hand Hygiene, Hand Care and Hand Protection for Clinical Dental Practice: recommendations of the European Panel for Infection Control in Dentistry (Working Group on Clinical Practice) ed. EA Field, *British Dental Journal* 1994; **176**: 129-134.

### Intervention 3

#### **Standard Principles for the Use of Personal Protective Equipment**

This section discusses the evidence and associated recommendations for the use of personal protective equipment by health care practitioners in general care settings and includes the use of aprons, gowns, gloves, eye protection, 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 personal protective equipment are to protect staff and reduce opportunities for transmission of microorganisms in hospitals.<sup>1,2</sup> A trend to eliminate the unnecessary 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 HAI.<sup>1</sup>

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

12. *Select protective equipment on the basis of an assessment of the risk of transmission of microorganisms to the patient, and the risk of contamination of health care practitioners' clothing and skin by patients' blood, body fluids, secretions and excretions.* Category 3/H&S

## References

1. Garner JS. The Hospital Infection Control Practices Advisory Committee: Guidelines for Isolation Precautions in Hospitals. *Infection Control Hospital Epidemiology* 1996; **17**(1): 53-80.
2. Wilson J. *Infection Control in Clinical Practice*.
3. Expert Advisory Group on AIDS and the Advisory Group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood-borne viruses*. Department of Health; London, 1998; 46.
4. Department of Health. *Management of Health and Safety at Work Regulations*. London: HMSO. 1992; 25. 5. Health and Safety Executive. *Personal Protective Equipment at Work Regulations: Guidance on Regulations*. London: HMSO; 1992; 47.
6. Health and Safety Commission. *Control of Substances Hazardous to Health Regulations 1999. Approved Codes of Practice*. HSE Books. 1999; 75.

## Gloves: their uses and abuses

Since the mid-1980s the use of gloves as an element of personal protective equipment has become an every-day part of clinical practice for health care practitioners.1-5 Expert opinion agrees that there are two main indications for the use of gloves in preventing HAI:1-6

- to protect hands from contamination with organic matter and microorganisms;
- 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.7-15 As with all items of personal protective equipment 15 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. Risk assessment should include consideration of:

- who is at risk (whether it is the patient or the health care 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.16

### Gloves leak!

Our systematic review 17 identified six studies 18-23 that provided evidence that gloves used for clinical practice leak when apparently undamaged. In terms of leakage, gloves made from natural rubber latex (NRL) performed better than vinyl gloves in laboratory test conditions. No in-use studies other than those conducted in the operating theatre were found. However, there was no direct evidence that gloves that leaked resulted in the transmission of infection. In the period following this research, revised standards relating to the manufacture of medical gloves for single use have been devised and implemented.24-26

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.1-5 Therefore, the use of gloves as a method of barrier protection reduces the risk of contamination but does not eliminate it.

Hands are not necessarily clean because gloves have been worn.

13. *Gloves must be worn for invasive procedures, contact with sterile sites, and non-intact skin, 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.*

**Category 3/H&S**

14. *Gloves should be worn as single use items. Put gloves on immediately before an episode of patient contact or treatment and remove them as soon as the activity is completed. Change gloves between caring for different patients, or between different care/treatment activities for the same patient.*

**Category 3/H&S**

15. *Gloves must be disposed of as clinical waste and hands should be decontaminated following the removal of gloves.* **Category 3**

## References

1. Infection Control Nurses Association. *Glove Usage Guidelines*. London: ICNA & Regent Medical; 1999; 43.
2. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 42.
3. Expert Advisory Group on AIDS and the Advisory Group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood-borne viruses*. London: Department of Health; 1998; 46.
4. Centers for Disease Control Update. Recommendations for prevention of HIV transmission in health care settings. *Morbidity and Mortality Weekly Report* 1987; **37**: 24.
5. Garner JS. The Hospital Infection Control Practices Advisory Committee: Guidelines for Isolation Precautions in Hospitals. *Infection Control and Hospital Epidemiology* 1996; **17**(1): 53-80.
6. Department of Health. *Control of Substances Hazardous to Health*. London: HMSO; 1994; 27.
7. Yassin MS, Lierl MB, Fischer TJ. Latex allergy in hospital employees. *Annals of Allergy* 1994; **72**(3): 245-249.
8. Lagier F, Vervolet D, Lhermet I. Prevalence of latex allergy in operating room nurses. *Journal of Allergy and Clinical Immunology* 1992; **21**(90): 319.
9. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987; **17**: 270-275.
10. Turjanmaa K, Reunala T. Contact urticaria from rubber gloves. *Dermatologic Clinics* 1988; **6**: 47-51.
11. Johnson G. Latex allergy: reducing the risks. *Nursing Times* 1998; **94**: 69-73.
12. Burke FJT, Wilson NHF, Cheug SW. Factors associated with the skin irritation of hands experienced by dental practitioners. *Contact Dermatitis* 1995; **32**: 35-38.
13. Medical Devices Agency. *Latex sensitisation in the health care setting - the use of latex gloves* DB (96)01. London: HMSO; 1996; 20.
14. Medical Devices Agency. *Latex medical gloves (surgeons' and examination) powdered latex medical gloves (surgeons' and examination)*. SN(98)25 London: HMSO; 1998.
15. Health and Safety Executive. *Personal Protective Equipment at Work Regulations: Guidance on Regulations* London: HMSO; 1992; 47.
16. Centers for Disease Control. Update. Universal Precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other bloodborne pathogens in health care settings *Morbidity and Mortality Weekly Report* 1988; **37**: 24.
17. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
18. Korniewicz DM, Laughon B, Cyr W, Lytle C, Larson E. Leakage of virus through used vinyl and latex examination gloves. *Journal of Clinical Microbiology* 1990; **28**: 787-788.
19. Korniewicz DM, Laughon B, Butz A, Larson E. Integrity of vinyl and latex procedure gloves. *Nursing Research* 1990; **38**: 144-146.
20. Korniewicz DM, Kirwin M, Cresci K, Markut C, Larson E. In use comparison of latex gloves in two high risk units: surgical intensive care and acquired immune deficiency syndrome. *Heart and Lung* 1992; **21**: 81-84.
21. De-Groot Kosolchar J, Jones JM. Permeability of latex and vinyl gloves to water and blood. *American Journal*

of *Infection Control* 1989; **17**: 196-201.

22. Hamann CP, Nelson JR Permeability of latex and thermoplastic elastomer gloves to the bacteriophage  $\phi$ X174. *American Journal of Infection Control* 1993; **21**: 289-296.

23. Richmond PW, McCabe M, Davies JP, Thomas DM. Perforation of gloves in an accident and emergency department. *British Medical Journal (Clinical research Ed.)* 1992; **304**: 879-880.

24. British Standards Institution. *Medical Gloves for Single Use Part 1: Specification for freedom from holes* BSEN 455-1 London: BSI; 1994.

25. British Standards Institution. *Medical Gloves for Single Use Part 2: Specification for physical properties* BSEN 455-2 London: BSI; 1994.

26. British Standards Institution. *Medical Gloves for Single Use Part 3: Requirements and testing for biological evaluation* BS-EN 455-3 London: BSI; 2000.

### Making choices

Expert opinion is quite clear about when gloves must be used by health care practitioners in general clinical practice.1-6 Having decided that gloves should be used for a health care 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.7-14 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 15-18 and properties that enable the wearer to maintain dexterity. The problem of patient or health care practitioner sensitivity to NRL proteins must be considered when deciding on glove materials.

A considerable body of evidence suggests that cornstarch powder, used to assist in the donning of gloves, is harmful and is associated with adhesions, latex allergy, and increasing risks of infection associated with invasive devices contaminated with cornstarch powder.19 As a consequence, expert opinion strongly advises that powdered gloves should not be used in health care.1,14

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.20 Polythene gloves are not suitable for clinical use due to their permeability and tendency to damage easily.21,22

16. *Gloves conforming to European Community (CE) standards and of an acceptable quality must be available in all clinical areas. H&S*

17. *Alternatives to natural rubber latex (NRL) gloves must be available for use by practitioners and patients with NRL sensitivity. H&S*

18. *Powdered and polythene gloves should not be used in health care activities. Category 2/H&S*

### References

1. Infection Control Nurses Association. *Glove Usage Guidelines*. London: ICNA & Regent Medical; 1999; 43.
2. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 42.
3. Expert Advisory Group on AIDS and the Advisory Group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood-borne viruses*. London: Department of Health; 1998; 46.
4. Centers for Disease Control Update. Recommendations for prevention of HIV transmission in health care settings. *Morbidity and Mortality Weekly Report* 1987; **37**: 24.
5. Garner JS. The Hospital Infection Control Practices Advisory Committee: Guidelines for Isolation Precautions in Hospitals. *Infection Control and Hospital Epidemiology* 1996; **17**(1): 53-80.
6. Department of Health. *Control of Substances Hazardous to Health*. London: HMSO; 1994; 27.
7. Yassin MS, Lierl MB, Fischer TJ. Latex allergy in hospital employees. *Annals of Allergy* 1994; **72**(3): 245-249.
8. Lagier F, Vervolet D, Lhermet I. Prevalence of latex allergy in operating room nurses. *Journal of Allergy and*

*Clinical Immunology* 1992; **21(90)**: 319.

9. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987; **17**: 270-275.
10. Turjanmaa K, Reunala T. Contact urticaria from rubber gloves. *Dermatologic Clinics* 1988; **6**: 47-51.
11. Johnson G. Latex allergy: reducing the risks. *Nursing Times* 1998; **94**: 69-73.
12. Burke FJT, Wilson NHF, Cheug SW. Factors associated with the skin irritation of hands experienced by dental practitioners. *Contact Dermatitis* 1995; **32**: 35-38.
13. Medical Devices Agency. *Latex sensitisation in the health care setting - the use of latex gloves* DB (96)01. London: HMSO; 1996; 20.
14. Medical Devices Agency. *Latex medical gloves (surgeons' and examination) powdered latex medical gloves (surgeons and examination)*. SN(98)25 London: HMSO; 1998.
15. Health and Safety Executive. *Personal Protective Equipment at Work Regulations: Guidance on Regulations* London: HMSO; 1992; 47.
16. Centers for Disease Control. Update. Universal Precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other bloodborne pathogens in health care settings *Morbidity and Mortality Weekly Report* 1988; **37**: 24.
17. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
18. Korniewicz DM, Laughon B, Cyr W, Lytle C, Larson E. Leakage of virus through used vinyl and latex examination gloves. *Journal of Clinical Microbiology* 1990; **28**: 787-788.
19. Korniewicz DM, Laughon B, Butz A, Larson E. Integrity of vinyl and latex procedure gloves. *Nursing Research* 1990; **38**: 144-146.
20. Korniewicz DM, Kirwin M, Cresci K, Markut C, Larson E. In use comparison of latex gloves in two high risk units: surgical intensive care and acquired immune deficiency syndrome. *Heart and Lung* 1992; **21**: 81-84.
21. De-Groot Kosolchar J, Jones JM. Permeability of latex and vinyl gloves to water and blood. *American Journal of Infection Control* 1989; **17**: 196-201.
22. Hamann CP, Nelson JR Permeability of latex and thermoplastic elastomer gloves to the bacteriophage  $\phi$ X174. *American Journal of Infection Control* 1993; **21**: 289-296.
23. Richmond PW, McCabe M, Davies JP, Thomas DM. Perforation of gloves in an accident and emergency department. *British Medical Journal (Clinical research Ed.)* 1992; **304**: 879-880.
24. British Standards Institution. *Medical Gloves for Single Use Part 1: Specification for freedom from holes* BSEN 455-1 London: BSI; 1994.
25. British Standards Institution. *Medical Gloves for Single Use Part 2: Specification for physical properties* BSEN 455-2 London: BSI; 1994.
26. British Standards Institution. *Medical Gloves for Single Use Part 3: Requirements and testing for biological evaluation* BS-EN 455-3 London: BSI; 2000.

### Aprons or gowns?

Our systematic review 1 identified a variety of a studies, including two randomised controlled trials, that focused on the use of gowns in special care units.<sup>2-10</sup> None of the studies identified supported the routine use of gowns in general or specialist clinical settings. However, expert opinion suggests that protective clothing should be worn by all health care practitioners when contamination with blood, body fluids, secretions, and excretions (with the exception of sweat), or when close contact with the patient, materials or equipment may lead to contamination of the clothing with microorganisms.<sup>11-13</sup> Plastic aprons are recommended for general use.<sup>13</sup> 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.<sup>13</sup>

19. *Disposable plastic aprons should be worn when there is a risk that clothing or uniform may become exposed to blood, body fluids, secretions and excretions, with the exception of sweat. Category 3/ H&S*

20. *Full body, fluid repellent gowns should be worn where there is a risk of extensive splashing of*

blood, body fluids, secretions and excretions, with the exception of sweat, onto the skin of health care practitioners. **Category 3/H&S**

21. Plastic aprons should be worn as single use items for one procedure or episode of patient care and then discarded and disposed of as clinical waste. **Category 3/H&S**

## References

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
2. Rush J, Fiorino-Chiovitti R, Kaufman K, Mitchell A. A randomized controlled trial of a nursery ritual: Wearing cover gowns to care for healthy newborns. *Birth* 1990; **17(1)**: 25-30.
3. Birenbaum EJ, Glorioso L, Rosenburger C, Arshad C, Edwards K. Gowning on a postpartum ward fails to decrease colonisation in the newborn infant. *American Journal of Diseases in Children* 1990; **144**: 1031-1033.
4. Donowitz LG. Failure of the overgown to prevent nosocomial infection in a pediatric intensive care unit. *Pediatrics* 1986; **77(1)**: 35-38.
5. Agbayani M, Rosenfeld W, Evans H, Salazar D, Jhaveri R, Braun J. Evaluation of modified gowning procedures in a neonatal intensive care unit. *American Journal of Diseases in Children*. 1981; **135**: 650-652.
6. Pelke S, Ching D, Easa D, Melish ME. Gowning does not affect colonisation or infection rates in a neonatal intensive care unit. *Archives of Pediatric and Adolescent Medicine*. 1994; **148**: 1016-1020.
7. Silverman WA, Sinclair MD. Evaluation of precautions before entering a neonatal unit. *Pediatrics* 1967; **40(5)**: 900-901.
8. Haque KN, Chagla AH. Do gowns prevent infection in neonatal intensive care units? *Journal of Hospital Infection* 1989; **14**: 159-162.
9. Hall CB, Douglas RG. Nosocomial respiratory syncytial viral infections. Should gowns and masks be used? *American Journal of Diseases in Children* 1981; **135**: 512-515.
10. Lovitt SA, Nichols RL, Smith JW, Muzik AC, Pearce PF. Isolation gowns: A false sense of security. *American Journal of Infection Control* 1992; **20**: 185-191.
11. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 42.
12. Griffiths-Jones A, Ward K. eds. *Principles of Infection Control Practice*. Scutari Press; 1995; 27.
13. Expert Advisory Group on AIDS and the Advisory Group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood-borne viruses*. London: Department of Health; 1998; 46

## When are a face mask, eye protection or other facial protection necessary?

Our systematic review 1 failed to reveal any robust experimental studies that suggested any clinical benefit from wearing surgical masks to protect patients during routine ward procedures such as wound dressing or invasive medical procedures.2-6

Personal respiratory protection is required in certain respiratory diseases, e.g., TB 7 and where patients who are severely immunocompromised are at an increased risk of infection. In these instances, surgical masks are not effective protection and specialised respiratory protective equipment (RPE) should be worn.8,9

In our systematic review,1 one non-randomised crossover clinical trial 10 of different protective eyewear indicated that they offered protection against physical splashing of infected substances into the eyes (although not on 100 percent of occasions). Despite heightened awareness of the background incidence of eye splashing, there was no statistically significant difference in health care practitioners' use of eye protection on entry to the study and at its conclusion. Expert opinion recommends that face and eye protection reduce the risk of occupational exposure of health care practitioners to splashes of blood, body fluids, secretion or excretions.4,11-13

22. Face masks and eye protection should be worn where there is a risk of blood, body fluids, secretions and excretions splashing into the face and eyes. **Category 3/H&S**

23. Respiratory protective equipment should be used when clinically indicated. **Category 3/H&S**

## References

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
2. Ruthman JC, Hendricksen D, Miller RF, Quigg DL. Effect of cap and mask on infection rates. *Illinois Medical Journal* 1984; **165**: 397-399.
3. Tunevall TG. Post-operative wound infections and surgical face masks: A controlled study. *World Journal of Surgery* 1991; **15**: 383-388.
4. Garner JS. The Hospital Infection Control Practices Advisory Committee: Guidelines for Isolation Precautions in Hospitals. *Infection Control Hospital Epidemiology* 1996; **17**(1): 53-80.
5. Berger SA, Kramer M, Nagar H, Finkelstein A, Frimmerman A, Miller HI. Effect of surgical mask position on bacterial contamination of the operative field. *Journal of Hospital Infection* 1993; **23**: 51-54.
6. Hall CB, Douglas RG. Nosocomial respiratory syncytial viral infections. Should gowns and masks be used? *American Journal of Diseases in Childhood* 1981; **135**: 512-515.
7. The Interdepartmental Working Group on Tuberculosis. The Prevention and Control of Tuberculosis in the United Kingdom: UK Guidance on the prevention and control of transmission of 1. HIV-related tuberculosis 2. Drug-resistant, including multiple drug-resistant, tuberculosis. London: Department of Health; 1998; 94.
8. Wake D, Bowry AC, Crook B, Brown RC. Performance of respirator filters and surgical masks against bacterial aerosols. *Journal of Aerosol Science* 1997; **28**: 1311-29.
9. Health and Safety Commission. *Control of Substances Hazardous to Health Regulations 1999. Approved Codes of Practice*. HSE Books. 1999; 75.
10. Garrett SJ, Robinson JK. Disposable protective eyewear devices for health care providers. How important are they and will available designs be used? *Journal of Occupational Medicine* 1993; **35**(10): 1043-1047.
11. Expert Advisory Group on AIDS and the Advisory Group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood-borne viruses*. London: Department of Health; 1998; 46.
12. Centers for Disease Control. Update. Recommendations for prevention of HIV transmission in health care settings. *Morbidity and Mortality Weekly Report* 1987; **37**: 24.
13. Centers for Disease Control. Update. Universal Precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other bloodborne pathogens in health care settings. *Morbidity and Mortality Weekly Report* 1988; **37**: 24.
14. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 42

## Intervention 4

### Standard Principles for 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 should form part of an overall strategy of clinical waste disposal to protect staff, patients and visitors from exposure to blood borne pathogens.<sup>1</sup> The incidence of injuries caused by sharps varies across clinical settings and is difficult to compare due to different denominators for data collection. In the United States of America (USA) it is estimated that 600,000 to 800,000 injuries occur per year.<sup>2,3</sup> United Kingdom (UK) audit data suggests that of the occupational injuries that occur in hospitals, 16 percent are attributable to sharps injuries.<sup>4</sup> Furthermore, it is likely that these institutional reports provide an underestimate of actual injuries by 50 percent.<sup>3,5-11</sup> In general clinical settings, sharps injuries are predominantly caused by needle devices and associated with venepuncture, administration of medication via intravascular lines and recapping of needles during the disassembly of equipment.<sup>2,11-18</sup> All sharps injuries are considered to be potentially preventable.

The average risk of transmission of bloodborne pathogens following a single percutaneous exposure has been estimated to be:<sup>19</sup>

- 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.<sup>20-23</sup> 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.<sup>24</sup> Any health care 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 tested and offered vaccination or chemoprophylaxis if appropriate.<sup>25</sup>

**24. Sharps must not be passed directly from hand to hand and handling should be kept to a minimum.**  
*Category 3/H&S*

**25. Needles must not be bent or broken prior to use or disposal.** *Category 3/H&S*

**26. Needles and syringes must not be disassembled by hand prior to disposal.** *Category 3/H&S*

**27. Needles should not be recapped.** *Category 3/H&S*

**28. Used sharps must be discarded into a sharps container (conforming to UN3291 and BS 7320 standards) at the point of use. These must not be filled above the mark indicating that they are full. Containers in public areas must not be placed on the floor and should be located in a safe position.**  
*Category 3/H&S*

## References

1. Health Services Advisory Committee. *Safe Disposal of Clinical Waste*. Sheffield: HSE; 1999; 68.
2. Henry K, Campbell S. Needlestick/sharps injuries and HIV exposures among health care workers: national estimates based on a survey of US hospitals. *Minnesota Medicine* 1995; **78**: 1765-1768.
3. EPINet. *Exposure prevention information network data reports*. University of Virginia: International Health Care Worker Safety Center; 1999.
4. National Audit Office. *The Management of Medical Equipment in Acute NHS Trusts in England*. HCP 475 Session 1998-1999 London: Stationary Office. 1999; 117.
5. Roy E, Robillard P. Underreporting of accidental exposures to blood and other body fluids in health care settings: an alarming situation. *Adverse Exposure Prev* 1995; **1(4)**: 11.

6. 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 Report* 1997; **46(2)**: 21-25.
7. Osborn EHS, Papadakis MA, Gerberding GL. Occupational exposures to body fluids among medical students. A seven year longitudinal study. *Annals of Internal Medicine* 1999; **130(1)**: 45-51.
8. Patterson B. Sharps injuries - who is at risk? *Occupational Health* 1990; **42**: 195-197.
9. Choudury RP, Cleator SJ. An examination of needlestick injury rates, hepatitis B vaccination uptake and instruction on sharps technique among medical students. *Journal of Hospital Infection* 1992; **22**: 143-148.
10. Cato D, Mulhall BP. Needlestick injuries in health care workers: continuing risk and under-reporting. *Medical Journal of Australia* 1994; **161**: 285.
11. McCormick RD, Maki DG. Epidemiology of needlestick injuries in hospital personnel. *American Journal of Medicine* 1981; **70**: 928-932.
12. Chia HP, Koh D, Jeyaratnum J. A study of needlestick injuries among medical undergraduates. *Annals of the Academy of Medicine, Singapore* 1993; **22**: 338-341.
13. Jagger J, Hunt EH, Brand-Elnaggar J, Pearson RD. Rates of needlestick injury caused by various devices in a university hospital. *New England Journal of Medicine* 1988; **319**: 284-288.
14. McCormick RD, Meisch MG, Ircink FG, Maki DG. Epidemiology of hospital sharps injuries; a 14-year prospective study in the pre AIDS and AIDS eras. *American Journal of Medicine* 1991; **91**: 301S-307S.
15. Cardo DM, Culver DH, Ciesielski CA, Srivastava PU, Marcus R, Abiteboul D, Heptonstall J, Ippolito G, Lot F, McKibbern PS, Bell DM. A case control study of HIV seroconversion in health care workers after percutaneous exposure. Centres for Disease Control and Prevention Needlestick Surveillance Group. *New England Journal of Medicine* 1997; **337**: 1485-1490.
16. Marcus R. Surveillance of health care workers exposed to blood from patients infected with human immunodeficiency virus. *New England Journal of Medicine* 1988; **319**: 1118-1123.
17. Howanitz PJ, Schifman RB. Phlebotomists' safety practices. *Archives of Pathology and Laboratory Medicine* 1994; **118**: 957-962.
18. Thurn J, Willenbring K, Crossley K. Needlestick injuries and needle disposal in Minnesota physicians' offices. *American Journal of Medicine* 1989; **86**: 575-579.
19. Public Health Laboratory Service AIDS & STD Centre. *Occupational Transmission of HIV*. London: PHLS; 1999; 73.
20. Expert Advisory Group on AIDS and the Advisory group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with blood borne viruses*. London: Department of Health; 1998; 46.
21. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 11-16.
22. Centers for Disease Control. Update. Universal Precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other blood borne pathogens in health care settings. *Morbidity and Mortality Weekly Report* 1988; **37**: 24.
23. Occupational Safety and Health Administration. *Enforcement procedures for the occupational exposure to bloodborne pathogens*. Directive number CPL2-2.44D. 1999; 69.
24. Health and Safety Commission. *Control of Substances Hazardous to Health Regulations 1999. Approved Codes of Practice*. HSE Books. 1999; 75.
25. Expert Advisory Group on AIDS. *HIV Post-exposure Prophylaxis*. London. Department of Health; 2000; 34

### **Do needle protection devices reduce avoidable injuries?**

Expert advice encourages health care providers and their employees to pursue safer methods of working through considering the benefits of new safety devices. 1 The incidence of sharps injuries has led to the development of needlestick-prevention devices in eleven different product groups. 2 They are designed to minimise the risk of operator injury during venepuncture, intravenous therapy and injections, and so-called 'downstream' injuries occurring following the disposal of sharps and often involving housekeeping or portering staff responsible for the collection of sharps disposal units.

Our systematic review 3 failed to identify any convincing evidence that needlestick-prevention devices were responsible for any significant impact on injury rates.<sup>4-9</sup> This was primarily due to the lack of well-designed, controlled intervention studies.

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, these include staff resistance to new devices, complexity of device operation or improper use, and poor training.<sup>2,4</sup> A comprehensive report and product review conducted in the USA provides background information and guidance on the need for and use of needlestick-prevention devices in four clinical applications:<sup>2</sup>

- delivering intravenous (IV) medications;
- delivering intramuscular and subcutaneous medications;
- introducing IV catheters;
- collecting blood.

The report identifies that none of the devices evaluated are without limitations in relation to cost, applicability and effectiveness. Some of the devices available are more expensive, may not be compatible with existing equipment, and paradoxically, may be associated with an increase in bloodstream infection rates.<sup>10-12</sup>

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.<sup>13,14</sup> 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.

29. Consider the use of needlestick-prevention devices where there are clear indications that they will provide safe systems of working for healthcare practitioners. **Category 3/H&S**

30. 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 3**

## References

1. Expert Advisory group on AIDS and the Advisory group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with bloodborne viruses*. London: Department of Health 1998; 46.
2. Health Devices. *Needlestick-Prevention Device Selection Guide - Special Report*. ECRI: Plymouth. 2000.
3. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191.
4. Nixon AD, Law R, Officer JA, Cleland JF, Goldwater PN. Simple device to prevent accidental needle-prick injuries. *Lancet* 1986; **1(8486)**: 888-889.
5. Wright GD, Farrer J. Needle covers reduce needlestick injury . *Accident Analysis & Prevention* 1993; **25(2)**: 153-159.
6. L'Ecuyer PB, Schwab EO, Iademarco E, Barr N, Aton EA, Fraser VJ. Randomised prospective study of the impact of three needleless intravenous systems on needlestick injury rates. *Infection Control and Hospital Epidemiology* 1996; **17(12)**: 803-808.
7. Gartner K. Impact of a needleless intravenous system in a university hospital. *American Journal of Infection Control* 1992; **20(2)**: 75-79.
8. Pugliese G. Reducing the risk of infection during vascular access. *Journal of Intravenous Nursing* 1997; **20(65)**: S11-S23.
9. Centers for Disease Control. 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.
10. Do AN, Ray BJ, Banerjee SN, Illian AF, Barnett BJ, Pham MH, Hendricks KA, Jarvis WR. Bloodstream infection associated with needleless device use and the importance of infection control practices in the home health care setting. *Journal of Infectious Diseases* 1999; **179**: 442-448.

11. Cookson ST, Ihrig M, Omara EM, Denny M, Volk H, Banerjee SN, Hartstein AI, Jarvis WR. Increased bloodstream infection rates in surgical patients associated with variation from recommended use and care following implementation of a needleless device. *Infection Control and Hospital Epidemiology* 1998; **19(1)**: 23-27.
12. Danzig LE, Short LJ, Collins K, Mahoney M, Sepe S, Bland L, Jarvis WR. Bloodstream infections associated with a needleless intravenous infusion system in patients receiving home therapy. *Journal of the American Medical Association* 1995; **273(23)**: 1862-1864.
13. Occupational Safety and Health Administration. *Enforcement procedures for the occupational exposure to bloodborne pathogens*. Directive number CPL2-2.44D. 1999; 69.
14. National Institute for Occupational Safety and Health. *Preventing Needlestick Injuries in Health Care Settings*. Cincinnati: DHHS (NIOSH); 1999.

## Guidelines for preventing infections associated with the insertion and maintenance of short-term indwelling urethral catheters in acute care

These guidelines focus on providing evidence-based recommendations for preventing hospital-acquired infections associated with the use of short-to-medium term indwelling urethral catheters in acute care settings. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines. The recommendations are divided into four distinct interventions:

1. Assessing the need for catheterisation;
2. Selection of catheter type;
3. Aseptic catheter insertion;
4. Catheter maintenance.

### Intervention 1

#### *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 hospital-acquired infections are related to urinary catheterisation.<sup>1-4</sup> The risk of infection is associated with the method and duration of catheterisation, the quality of catheter care and host susceptibility. The prevalence of catheterised patients in hospitals in England is 12.6 percent.<sup>5</sup> The highest incidence of infection is associated with indwelling urethral catheterisation.<sup>6</sup> 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).<sup>6</sup> The risk of acquiring bacteriuria is approximately 5 percent for each day of catheterisation.<sup>7,8</sup> Of patients with a UTI, 1-4 percent develop bacteraemia and, of these, 13-30 percent die.<sup>1,2</sup> 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.<sup>6</sup>

Advice from best practice emphasises the importance of documenting all procedures involving the catheter or drainage system in the patient's records<sup>1</sup> and providing patients with adequate information in relation to the need, insertion, maintenance and removal of their catheter.<sup>1</sup>

1. *Only use indwelling urethral catheters after considering alternative methods of management.*

*Category 3*

2. *Review regularly the patient's clinical need for continuing urinary catheterisation and remove the catheter as soon as possible.*

*Category 3*

3. *Document catheter insertion and care.*

*Category 3*

## References

1. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. Preventing Hospital-Acquired Infection: Clinical Guidelines. London: Public Health Laboratory Service; 1997; 25-29.
2. Wong ES, Hooton TM. Guideline for prevention of catheter-associated urinary tract infections. *American Journal of Infection Control* 1983; 11(1); 28-36. 0195-6701/01/0S0039\_08 \$35.00/0 © 2001 Crown copyright
3. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 169-174.
4. Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management* 5th ed. Baltimore MD: Williams & Wilkins; 1997; 241-242.
5. Crow R, Mulhall A, Chapman R. Indwelling catheterisation and related nursing practice. *Journal of Advanced Nursing* 1988; 13: 489-495.
6. Stamm WE. Urinary Tract Infections. In: Bennett JV, Brachman PS (eds). *Hospital Infection* 4th ed. Philadelphia: Lippincott-Raven; 1998; 477-485.
7. Garibaldi RA, Burke JP, Britt MR, Miller WA, Smith CB. Meatal colonisation and catheter associated bacteriuria. *New England Journal of Medicine* 1980; 303: 316-318.
8. Garibaldi RA, Mooney BR, Epstein BJ, Britt MR. An evaluation of daily bacteriologic monitoring to identify preventable episodes of catheter-associated urinary tract infections. *Infection Control* 1982; 3: 466.

## Intervention 2

### Selection of Catheter Type

#### *Is one catheter better than another?*

Our systematic review 1 identified three experimental studies that compared the use of latex with silicone catheters.<sup>2-4</sup> 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.<sup>5-8</sup> 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.<sup>9,10</sup> However, silver alloy coated indwelling urethral catheters are not currently available in the UK.

Evidence from best practice indicates that the incidence of catheter-associated infection in the short term is not influenced by any particular type of catheter material.<sup>11,12</sup> 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.<sup>13</sup>

**4. Choice of catheter material will depend on clinical experience, patient assessment and anticipated duration of catheterisation. Category 3**

**5. 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 3**

#### References

- Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - associated with the use of short-term indwelling urethral catheters in acute care: Technical Report*. London: Thames Valley University; 2000; 86. Available from (Internet): <http://www.epic.tvu.ac.uk>
- Lopez-Lopez G, Pascual A, Martinez-Martinez L, Perea EJ. Effect of a siliconized latex urinary catheter on bacterial adherence and human neutrophil activity. *Diagnostic Microbiology and Infectious Disease* 1991; **14**: 1-6.
- Nickel JC, Feero P, Costerton JW, Wilson E. Incidence and importance of bacteriuria in postoperative shortterm urinary catheterisation. *Canadian Journal of Surgery* 1989; **32**: 131-132.
- Talja M, Korpela A, Jarvi K. Comparison of urethral reaction to full silicone, hydrogen-coated and siliconised latex catheters. *British Journal of Urology* 1990; **66**: 652-657.
- Riley DK, Classen DC, Stevens LE, Burke JP. A large randomised clinical trial of a silver-impregnated urinary catheter: lack of efficacy and staphylococcal superinfection. *American Journal of Medicine* 1995; **98**: 349-356.
- Johnson JR, Roberts PL, Olsen RJ, Moyer KA, Stamm WE. Prevention of catheter-associated urinary tract infection with a silver oxide-coated urinary catheter: clinical and microbiologic correlates. *Journal of Infectious Diseases* 1990; **162**: 1145-1150.
- Liedberg H, Lundeberg T, Ekman P. Refinements in the coating of urethral catheters reduces the incidence of catheter-associated bacteriuria. An experimental and clinical study. *European Urology* 1990; **17**: 236-240.
- Liedberg H, Lundeberg T. Silver alloy coated catheters reduce catheter-associated bacteriuria. *British Journal of Urology* 1990; **65**: 379-381.
- Saint S, Lipsky BA. Preventing catheter-related bacteriuria. Should we? Can we? How? *Archives of Internal Medicine* 1999; **159**: 800-808.
- Saint S, Elmore JG, Sullivan SD, Emerson SS, Koepsell TD. The efficacy of silver alloy-coated urinary catheters in preventing urinary tract infection: A meta-analysis. *American Journal of Medicine* 1998; **105**: 236-241.
- Pomfret IJ. Continence clinic. Catheters: design, selection and management. *British Journal of Nursing* 1996; **5**: 245-251.
- Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management* 5th ed. Baltimore MD: Williams & Wilkins; 1997; 260-261.

13. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 169-174.

### Intervention 3

#### Aseptic Catheter Insertion

##### *Catheterisation is a skilled aseptic procedure*

Principles of good practice, clinical guidance 1,2 and expert opinion 3-7 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.<sup>1,8</sup> 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.<sup>1,3,7,9</sup>

6. *Catheterisation is an aseptic procedure. Ensure that health care personnel are trained and competent to carry out urethral catheterisation. Category 3*

7. *Clean the urethral meatus prior to the insertion of the catheter. Category 3*

8. *Use an appropriate lubricant from a single use container to minimise urethral trauma and infection. Category 3*

#### References

1. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service 1997; 25-29.
2. Wong ES, Hooton TM. Guideline for prevention of catheter-associated urinary tract infections. *American Journal of Infection Control* 1983; **11**(1): 28-36.
3. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 169-174.
4. Stamm WE. Urinary Tract Infections. In: Bennett JV, Brachman PS (eds). *Hospital Infection* 4th ed. Philadelphia: Lippincott-Raven; 1998; 477-485.
5. Kass EH, Schneiderman LJ. Entry of bacteria into the urinary tract of patients with indwelling catheters. *New England Journal of Medicine* 1957; **256**: 556-557.
6. Desautels RF, Walter CW, Graves RC, Harrison JH. Technical advances in the prevention of urinary tract infection. *Journal of Urology* 1962; **87**: 487-490.
7. Kunin CM, McCormack RC. Prevention of catheter-induced urinary tract infections by sterile closed drainage. *New England Journal of Medicine* 1966; **274**: 1155-1162.
8. Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management* 5th ed. Baltimore MD: Williams & Wilkins; 1997; 249-250.
9. Garibaldi RA, Burke JP, Dickman ML, Smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterisation. *New England Journal of Medicine* 1974; **291**: 215-218.

## Intervention 4

### Catheter Maintenance

#### *Leave the closed system alone!*

Maintaining a sterile, continuously closed urinary drainage system is central to the prevention of catheter-associated infection.<sup>1-6</sup> The risk reduces from 97 percent with an open system to 8-15 percent when a sterile closed system is employed.<sup>7-9</sup> 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.<sup>4,9,10</sup> Hands must be decontaminated and clean, non-sterile gloves worn before manipulation.

There is no evidence as to how often catheters should be changed. Best practice suggests changing only when necessary, i.e., according to either the manufacturers recommendations or the patient's clinical need.<sup>4,6</sup> Reflux of urine is associated with infection and, consequently, drainage bags should be positioned in a way that prevents back-flow of urine.<sup>4,5</sup> It is also recommended that urinary drainage bags should be hung on an appropriate stand that prevents contact with the floor.<sup>9</sup>

A number of studies have investigated the addition of disinfectants and antimicrobials to drainage bags as a way of preventing catheter-associated infection.<sup>11</sup> Three acceptable studies 12-14 from our systematic review 15 demonstrated no reduction in the incidence of bacteriuria following the addition of hydrogen per-oxide or chlorhexidine to urinary drainage bags. Urinary drainage bags should be changed when clinically indicated and/or in line with the manufacturer's recommendations.

9. Connect indwelling urethral catheters to a sterile closed urinary drainage system. **Category 3**

10. 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 3**

11. 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 3**

12. Obtain urine samples from a sampling port using an aseptic technique. **Category 3**

13. 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 3**

14. 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 3**

15. Do not add antiseptic or antimicrobial solutions into urinary drainage bags. **Category 1**

16. Do not change catheters unnecessarily or as part of routine practice. **Category 3**

### References

1. Thornton GF, Andriole VT. Bacteriuria during indwelling catheter drainage: II. Effect of a closed sterilisedraining system. *Journal of the American Medical Association* 1970; **214**: 339.
2. Kunin CM, McCormack RC. Prevention of catheter-induced urinary-tract infections by sterile closed drainage. *New England Journal of Medicine* 1966; **274**: 1155-1161.
3. Gilliespie WA, Simpson RA, Jones JE, Nashef L, Teasdale C, Speller DC. Does the addition of disinfectant to urine drainage bags prevent infection in catheterised patients? *Lancet* 1983; **1**: 1037-1039.
4. Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service 1997; 25-29.
5. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 169-174.
6. Wong ES, Hooton TM. Guideline for prevention of catheter-associated urinary tract infections. *American Journal of Infection Control* 1983; **11**(1): 28-36.
7. Gillespie WA, Lennon GG, Linton KB, Slade N. Prevention of urinary infections in gynaecology. *British Medical Journal* 1964; **2**: 423-425.

8. Garibaldi RA, Burke JP, Dickman ML, Smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterisation. *New England Journal of Medicine* 1974; **291**: 215-218.
9. Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management*, 5th ed. Baltimore: Williams & Wilkins; 1997; 419.
10. Platt R, Murdock B, Polk BF, Rosner B. Reduction of mortality associated with nosocomial urinary tract infection. *Lancet* 1983; **1**: 893-897.
11. Saint S, Lipsky BA. Preventing catheter-related bacteriuria. Should we? Can we? How? *Archives of Internal Medicine* 1999; **159**: 800-808.
12. Maizels M, Shaeffer AJ. Decreased incidence of bacteriuria associated with periodic instillations of hydrogen peroxide into the urethral catheter drainage bag. *Journal of Urology* 1980; **123**: 841-845.
13. Sweet DE, Goodpasture HC, Holl K, Smart S, Alexander H, Hedari A. Evaluation of H<sub>2</sub>O<sub>2</sub> prophylaxis of bacteriuria inpatients with long-term indwelling Foley catheters: a randomised controlled study. *Infection Control* 1985; **6**: 263-266.
14. Thompson RL, Haley CE, Searcy MA, Guenther SM, Kaiser DL. Catheter-associated bacteriuria. Failure to reduce attack rates using periodic instillations of a disinfectant into urinary drainage systems. *Journal of the American Medical Association* 1984; **251**: 747-751.
15. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guideline for Preventing Hospital-acquired Infections in England associated with the use of short-term indwelling urethral catheters in acute care: Technical Report*. London: Thames Valley University; 2000; 86.

### Appropriate maintenance minimises infections

- *Meatal cleansing with antiseptic solutions is unnecessary.*

Our systematic review 1 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.<sup>2-7</sup>

Expert opinion 8-10 and another systematic review 11 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.

17. *Routine personal hygiene is all that is needed to maintain meatal hygiene.* **Category 1**

### References

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guide-lines for Preventing Hospital-acquired Infections in England associated with the use of short-term indwelling urethral catheters in acute care: Technical Report*. London: Thames Valley University; 2000. 86 p. Available from (Internet): <http://www.epic.tvu.ac.uk>
2. Cleland V, Cox F, Berggren H, MacInnis MR. Prevention of bacteriuria in female patients with indwelling catheters. *Nursing Research* 1971; **20**: 309-318.
3. Burke JP, Garibaldi RA, Britt MR. Prevention of catheter-associated urinary tract infections. Efficacy of daily meatal care regimens. *The American Journal of Medicine* 1981; **70**: 655-658.
4. Burke JP, Jacobson JA, Garibaldi RA, Conti MT, Alling DW. Evaluation of daily meatal care with polyantibiotic ointment in the prevention of urinary catheter-associated bacteriuria. *Journal of Urology* 1983; **129**: 331-334.
5. Classen DC, Larsen RA, Burke JP, Stevens LE. Prevention of catheter-associated bacteriuria: clinical trial of methods to block three known pathways of infection. *American Journal of Infection Control* 1991; **19**: 136-142.
6. Classen DC, Larsen RA, Burke JP, Alling DW, Stevens LE. Daily meatal care for the prevention of catheter-associated bacteriuria: results using frequent applications of poly-antibiotic cream. *Infection Control and Hospital Epidemiology* 1991; **12**: 157-162.
7. Huth TS, Burke JP, Larsen RA, Classen DC, Stevens LE. Randomized trial of meatal care with silver sulfadiazine cream for the prevention of catheter-associated bacteriuria. *Journal of Infectious Diseases* 1992; **165**: 14-18.

8. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 171.
9. Wong ES, Hooton TM. Guideline for prevention of catheter-associated urinary tract infections. *American Journal of Infection Control* 1983; **11**(1): 28-36.
10. Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management*, 5th ed. Baltimore: Williams & Wilkins; 1997; 249-250.
11. Saint S, Lipsky BA. Preventing catheter-related bacteriuria. Should we? Can we? How? *Archives of Internal Medicine* 1999; **159**: 800-808.

- *Irrigation, instillation and washout do not prevent infection.*

Systematic review evidence failed to demonstrate any beneficial effect of bladder irrigation, instillation or washout with a variety of antiseptic or antimicrobial agents in preventing catheter-associated infection. 1-9

Evidence from best practice supports the above 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. 10-14

**18. Bladder irrigation, instillation and washout do not prevent catheter-associated infection. Category 2**

## References

1. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England associated with the use of short-term indwelling urethral catheters in acute care: Technical Report*. London: Thames Valley University; 2000; 86.
2. Davies AJ, Desai HN, Turton S, Dyas A. Does instillation of chlorhexidine into the bladder of catheterized geriatric patients help reduce bacteriuria? *Journal of Hospital Infection* 1987; **9**: 72-75.
3. Ball AJ, Carr TW, Gillespie WA, Kelly M, Simpson RA, Smith PJ. Bladder irrigation with chlorhexidine for the prevention of urinary infection after transurethral operations: a prospective controlled study. *Journal of Urology* 1987; **138**: 491-494.
4. Jones MA, Hasan A. Controlled trial of intravesical noxythiolin in the prevention of infection following outflow tract surgery. *British Journal of Urology* 1988; **62**: 311-314.
5. Schneeberger PM, Vreede RW, Bogdanowicz JF, van Dijk WC. A randomised study on the effect of bladder irrigation with povidone-iodine before removal of an indwelling catheter. *Journal of Hospital Infection* 1992; **21**: 223-229.
6. Warren JW, Platt R, Thomas RJ, Rosner B, Kass EH. Antibiotic irrigation and catheter-associated urinary-tract infections. *New England Journal of Medicine* 1978; **299**: 570-573.
7. Muncie HLJ, Hoopes JM, Damron DJ, Tenney JH, Warren JW. Once-daily irrigation of long-term urethral catheters with normal saline. Lack of benefit. *Archives of Internal Medicine* 1989; **149**(2): 441-443.
8. Kennedy AP, Brocklehurst JC, Robinson JM, Faragher EB. Assessment of the use of bladder washouts/instillations in patients with long-term indwelling catheters. *British Journal of Urology* 1992; **70**(6): 610-615.
9. Cox F, Smith RF, Elliott JP, Quinn EL. Neomycin-polymyxin prophylaxis of urinary-tract infection associated with indwelling catheters. *Antimicrobial Agents and Chemotherapy* 1966; **6**: 165-168.
10. Wong ES, Hooton TM. Guideline for prevention of catheter-associated urinary tract infections. *American Journal of Infection Control* 1983; **11**(1): 28-36.
11. Saint S, Lipsky BA. Preventing catheter-related bacteriuria. Should we? Can we? How? *Archives of Internal Medicine* 1999; **159**: 800-808.
12. Dieckhaus KD, Garibaldi RA. Prevention of Catheter-Associated Urinary Tract Infections. In: Abrutyn E, Goldmann DA, Scheckler WE (eds). *Saunders Infection Control Reference Service*. Philadelphia: W.B. Saunders Co.; 1998; 169-174.
13. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service 1997; 25-29.
14. Kunin CM. *Urinary Tract Infections: Detection, Prevention, and Management*, 5th ed. Baltimore: Williams & Wilkins; 1997; 251-253.

## Glossary

### Case-control study

Analytical observational study that aims to investigate the relationship between an exposure or risk factor, e.g., insertion of a CVC, and one or more outcomes, e.g., the occurrence of CR-BSI.

### CR-BSI

Catheter-related bloodstream infection; also *catheter-related sepsis* or *catheter-intravascular device-related bacteraemia*

Systemic infection (bacteraemia) *and* evidence implicating the central venous catheter as its source, i.e., the isolation of the referred to as same microorganism from blood cultures as that shown to be related (or significantly colonising the CVC of a patient with clinical features of bacteraemia).<sup>1-3</sup> (See CR-infection)

### CR-infection

Catheter-related infection

A significant growth of microorganisms ( $\geq 15$  colony-forming units (CFUs) by semiquantitative methods, or  $\geq 10^3$  CFUs by quantitative methods) on either the endoluminal or the external catheter surface beneath the skin in the *absence* of systemic bloodstream infection (bacteraemia).<sup>1</sup>

### Colonisation of the catheter

Similar to CR-infection but less growth of microorganisms, i.e.,  $<15$  CFUs (or  $<10^3$  CFUs).<sup>2</sup>

### CVC

Central venous catheter

Intravascular catheters inserted into a variety of sites to allow placement of the catheter tip in the superior vena cava above its junction with the right atrium, with the distal catheter parallel to the vessel wall. CVCs have several uses, e.g., giving multiple infusions of fluids, medication, or chemotherapy, temporary access for haemodialysis, monitoring central venous pressure, frequent blood sampling.

### 'High risk' patients

Refers to patients at increased risk for CR-infection, e.g., those patients in intensive care units, those receiving total parenteral nutrition, and immunocompromised patients.

### PICCs

Peripherally inserted central venous catheters

Used as an alternative to subclavian or jugular vein catheterisation; inserted into the superior vena cava by way of the cephalic and basilic veins of the antecubital space.

### 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.

### RCT

Randomised controlled trial

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.

*Journal of Hospital Infection* (2001) 47(Supplement): S3-S4 doi:10.1053/jhin.2000.0886, available online at <http://www.idealibrary.com> on

## Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters

### Background

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

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. Colonisation of the catheter, or catheter-related infection (CR-infection), 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.<sup>7-10</sup>

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.<sup>9</sup>

CR-BSI is caused either by cutaneous microorganisms that contaminate the catheter during insertion or migrate along the catheter track, or microorganisms from the hands of health care workers that contaminate and colonise the catheter hub during care interventions.<sup>7</sup>

### References

1. Arnow PM, Quimosing EM, Brech M. Consequences of intravascular catheter sepsis. *Clinical Infectious Diseases* 1993; 16: 778-784.
2. Emerson AM, Enstone JE, Griffin M, Kelsey MC, Smyth ETM. The second national prevalence survey of infection in hospital - overview of results. *Journal of Hospital Infection* 1996; 32: 175-190.
3. Martin MA, Pfaller MA, Wenzel RP. Coagulase-negative staphylococcal bacteraemia. Mortality and hospital stay. *Annals of Internal Medicine* 1989; 110: 9-16.
4. Smith RL, Meixler SM, Simberkoff MS. Excess mortality in critically ill patients with nosocomial bloodstream infections. *Chest* 1991; 100: 164-167.
5. Waghorn DJ. Intravascular device associated systemic infections: a 2-year analysis of cases in a district general hospital. *Journal of Hospital Infection* 1994; 28: 91-101.
6. Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients: excess length of stay, extra costs, and attributable mortality. *Journal of the American Medical Association* 1994; 271: 1598-1601.
7. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999; 9(2): 46-53.
8. Farr B. Nosocomial Infections Related to Use of Intravascular Devices Inserted for Short-Term Vascular Access. In: Mayhall CG, editor. *Hospital Epidemiology and Infection Control* 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1999; 157.
9. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of

Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; 17(7): 438-473.

10. Public Health Laboratory Service. *Protocol for Surveillance of Hospital-Acquired Bacteraemia*. Version 1.1. Internal policy document. London: Nosocomial Infection National Surveillance Scheme, Central Public Health Laboratory; March, 1998; 45

### **The guidelines**

These guidelines focus on providing evidence-based recommendations for preventing hospital-acquired infections associated with the use of central venous catheters in patients who are four years of age or older. These recommendations are not detailed procedural protocols and need to be incorporated into local guidelines. Additionally, various important specialist areas of patient management were beyond our remit and are not addressed in these guidelines, e.g., the diagnosis and treatment of CR-BSI.

The recommendations are divided into seven distinct interventions:

1. selection of catheter type;
2. selection of catheter insertion site;
3. aseptic technique during catheter insertion;
4. cutaneous antisepsis;
5. catheter and catheter site care;
6. catheter replacement strategies;
7. antibiotic prophylaxis.

### **Intervention 1**

#### **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;
- 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 may reduce the risk of subsequent CR-BSI.

#### **Catheter material**

Although catheter material may be an important determinant in the risk of infection associated with CVC,<sup>1</sup> evidence available to HICPAC when developing their guidelines in 1995/6 was inconclusive and they were unable to draw any appropriate conclusions about the contribution of catheter material to CR-infections.<sup>2</sup> There is no additional evidence that demonstrates conclusively that CR-infection rates vary with different materials.<sup>3</sup> In England, short-term CVC are almost always made of polyurethane and long-term tunnelled catheters are usually made of silicone.

## References

1. Tebbs SE, Sawyer A, Elliot TSJ. Influence of surface morphology on in vitro bacterial adherence to central venous catheters. *British Journal of Anaesthesia* 1994; **72**: 587-591.
2. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
3. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999;**9(2)**: 46-53.

### Number of catheter lumens

HICPAC states that clinicians often preferred multi-lumen CVC because they permitted the concurrent administration of various fluids and medications and haemodynamic monitoring among critically ill patients.<sup>1</sup> They 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.<sup>2-6</sup> However, other studies examined by HICPAC failed to demonstrate a difference in the rates of CR-BSI.<sup>7-8</sup>

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. <sup>4-5</sup> 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.<sup>6</sup>

1. Use a single-lumen catheter unless multiple ports are essential for the management of the patient. **Category 2**

2. If total parenteral nutrition is being administered, use one central venous catheter or lumen exclusively for that purpose. **Category 2**

## References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
2. Pemberton LB, Lyman B, Lander V, Covinsky J. Sepsis from triple- vs single-lumen catheters during total parenteral nutrition in surgical or critically ill patients. *Archives of Surgery* 1986; **121**: 591-594.
3. McCarthy MC, Shives JK, Robison RJ, Brodie TA. Prospective evaluation of single and triple lumen catheters in total parenteral nutrition. *Journal of Parenteral and Enteral Nutrition* 1987; **11**: 259-262.
4. Hilton E, Haslett TM, Borenstein MT, Tucci V, Isenberg HD, Singer C. Central catheter infections; single versus triple-lumen catheters. Influence of guide wires on infection rates when used for replacement of catheters. *American Journal of Medicine* 1988; **84**: 667-672.
5. Yeung C, May J, Hughes R. Infection rate for single-lumen vs triple-lumen subclavian catheters. *Infection Control and Hospital Epidemiology* 1988; **9**: 154-159.
6. Clark-Christoff N, Watters VA, Sparks W, Snyder P, Grant JP. Use of triple-lumen subclavian catheters for administration of total parenteral nutrition. *Journal of Parenteral and Enteral Nutrition* 1992; **16**: 403-407.
7. Farkas JC, Liu N, Bleriot JP, Chevret S, Goldstein FW, Carlet J. Single-versus triple-lumen central catheter-related sepsis: a prospective randomised study in a critically ill population. *American Journal of Medicine* 1992; **93**: 277-282.
8. Gil RT, Kruse JA, Thill-Baharozian MC, Carolson RW. Triple- vs single-lumen central venous catheters. A prospective study in a critically ill population. *Archives of Internal Medicine* 1989; **149**: 1139-1143.

### Tunnelled and totally implantable ports

Surgically implanted (tunnelled) CVC, e.g., Hickman<sup>®</sup> 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,<sup>®</sup> 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.

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 (nontunnelled) inserted CVC.<sup>1</sup> Although in general most studies reported a lower rate of infection in patients with tunnelled CVC,<sup>2-10</sup> some studies (including one randomised controlled trial) found no significant difference in the rate of infection between tunnelled and non-tunnelled catheters.<sup>11,12</sup> 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.<sup>13-23</sup>

Additional evidence examined 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.<sup>24</sup> 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.<sup>25</sup>

An additional meta-analysis of randomised controlled trials analysed data focused on the efficacy of tunnelling short-term central venous catheters to prevent CR-infections.<sup>26</sup> 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 at the internal jugular site. The reduction in risk was not significant when the data from five subclavian catheter trials were pooled. 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 until its efficacy is evaluated at different placement sites and relative to other interventions.

**3. Use a tunnelled catheter or an implantable vascular access device for patients in whom long-term (>30 days) vascular access is anticipated. Category 2**

### References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
2. Abraham JL, Mullen JL. A prospective study of prolonged central venous access in leukaemia. *Journal of the American Medical Association* 1982; **248**: 2868-2873.
3. Shapiro ED, Wald ER, Nelson KA, Spiegelman KN. Broviac catheter-related bacteremia in oncology patients. *American Journal of Diseases in Children* 1982; **136**: 679-681.
4. Press OW, Ramsey PG, Larson EB, Fefer A, Hickman RO. Hickman catheter infections in patients with malignancies. *Medicine* 1984; **63**: 189-200.
5. Darbyshire PJ, Weightman NC, Speller DC. Problems associated with indwelling central venous catheters. *Archives of Diseases in Childhood* 1985; **60**: 129-134.
6. Pessa ME, Howard RJ. Complications of Hickman-Broviac catheters. *Surgical Gynecology and Obstetrics* 1985; **161**: 257-260.
7. Schuman ES, Winters V, Gross GF, Hayes JF. Management of Hickman catheter sepsis. *American Journal of Surgery* 1985; **149**: 627-628.
8. Rannem T, Ladefoged K, Tvede M, Lorentzen JE, Jarnum S. Catheter-related septicemia in patients receiving home parenteral nutrition. *Scandinavian Journal of Gastroenterology* 1986; **21**: 455-460.
9. Shulman RJ, Smith EO, Rahman S, Gardner P, Reed T, Mahoney D. Single- vs double-lumen central venous catheters in pediatric oncology patients. *American Journal of Diseases in Children* 1988; **142**: 893-895.

10. Weightman NC, Simpson EM, Speller DC, Mott MG, Oakhill A. Bacteremia related to indwelling central venous catheters: prevention, diagnosis, and treatment. *European Journal of Clinical Microbiology and Infectious Diseases* 1988; **7**: 125-129.
11. Raad I, Davis S, Becker M *et al.* Low infection rate and long durability of nontunneled silastic catheters. A safe cost-effective alternative for long-term venous access. *Archives of Internal Medicine* 1993; **153**: 1791-1796.
12. Andrivet P, Bacquer A, Ngoc CV *et al.* Lack of clinical benefit from subcutaneous tunnel insertion of central venous catheters in immunocompromised patients. *Clinical Infectious Diseases* 1994; **18**: 199-206.
13. Gyves J, Ensminger W, Niederhuber J *et al.* A totally-implanted injection port system for blood sampling and chemotherapy administration. *Journal of the American Medical Association* 1984; **251**: 2538-2541.
14. Lokich JJ, Bothe AJ, Benotti P, Moore C. Complications and management of implanted venous access catheters. *Journal of Clinical Oncology* 1985; **3**: 710-717.
15. Khoury MD, Lloyd LR, Burrows J, Berg R, Yap J. A totally implanted venous access system for the delivery of chemotherapy. *Cancer* 1985; **56**: 1231-1234.
16. McDowell HP, Hart CA, Martin J. Implantable subcutaneous venous catheters. *Archives of Diseases in Childhood* 1986; **61**: 1037-1038.
17. Brickner H, Saeter G. Fifty-five patient years' experience with a totally implanted system for intravenous chemotherapy. *Cancer* 1986; **57**: 1124-1129.
18. Wurzel CL, Halom K, Feldman JG, Rubin LG. Infection rates of Broviac-Hickman catheters and implantable venous devices. *American Journal of Diseases in Children* 1988; **142**: 536-540.
19. Kappers-Klunne MC, Degener JE, Stijnen T, Abels J. Complications from long-term indwelling central venous catheters in hematologic malignancy patients with special reference to infection. *Cancer* 1989; **64**: 1747-1752.
20. Carde P, Cosset-Delaigue MF, Laplanche A, Chareau I. Classical external indwelling central venous catheter versus total implanted venous access systems for chemotherapy administration. A randomised trial in 100 patients with solid tumors. *European Journal of Cancer and Clinical Oncology* 1989; **25**: 939-944.
21. Pegues D, Axelrod P, McClarren C *et al.* Comparison of infections in Hickman and implanted port catheters in adult solid tumor patients. *Journal of Surgical Oncology* 1992; **49**: 156-162.
22. van der Pijl H, Frissen PH. Experience with a totally implantable venous access device (Port-A-Cath) in patients with AIDS. *AIDS* 1992; **6**: 709-713.
23. Groeger JS, Lucas AB, Thaler HT *et al.* Infectious morbidity associated with long-term use of venous access devices in patients with cancer. *Annals of Internal Medicine* 1993; **119**: 1168-1174.
24. Timsit JF, Sebille V, Farkas JC, Misset B, Martin JB, Chevret S *et al.* Effects of subcutaneous tunneling on internal jugular catheter-related sepsis in critically ill patient: a prospective randomised multicenter study. *Journal of the American Medical Association* 1996; **276**: 1416-1420.
25. Timsit JF, Bruneel F, Cheval C, Mamzer MF, Garrouster-Orgeas M, Wolff M *et al.* Use of tunneled femoral catheters to prevent catheter-related infection: a randomised controlled trial. *Annals of Internal Medicine* 1999; **130**: 729-735.
26. Randolph A, Cook D, Gonzales C, Brun-Buisson C. Tunneling short-term central venous catheters to prevent catheter-related infection: A meta-analysis of randomized controlled trials. *Critical Care Medicine* 1998; **26(8)**: 1452-1457.

### Antimicrobial impregnated CVC

Early studies demonstrating the efficacy of antimicrobial impregnated/coated CVC to reduce CR-BSIs were considered by HICPAC, especially a large randomised prospective trial among surgical intensive care unit patients conducted in 1991. 1 HICPAC concluded that the antimicrobial impregnated/coated catheters available at that time did not appear to pose any greater risk of adverse effects than did noncoated catheters but suggested additional randomised controlled trials to evaluate their efficacy, determine the appropriate situations for their use, and to assess the risk of toxicity and emergence of resistant bloodstream pathogens.<sup>2,3</sup>

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

- *Chlorhexidine/silver sulphadiazine impregnated catheters*

A large randomised controlled trial showed that catheters coated externally (extra-luminally) with chlorhexidine and silver sulfadiazine were associated with a 44 percent reduction in colonisation and a 79 percent reduction in CR-BSI.<sup>4</sup> However, other studies failed to confirm the efficacy of these catheters in reducing the incidence of CR-BSI.<sup>5,6</sup> A meta-analysis of these three studies concluded that the use of chlorhexidine/silver sulphadiazine impregnated catheters may decrease the frequency of CRBSI in those units with a high baseline incidence of CR-BSI (more than 3-4 per 1000 catheters days) but were not effective in reducing the incidence of CR-BSI when the infection rate was low for patients with long-duration treatment, e.g., parenteral nutrition, haematologic malignancy.<sup>7</sup> A larger metaanalysis of twelve randomised controlled trials demonstrated that this combination of antimicrobial agents was effective in reducing catheter colonisation and CR-BSI (by 40 percent) in patients at high risk. <sup>8</sup> A 'high-risk' patient in this analysis refers to patients in the intensive care unit and those receiving total parenteral nutrition. A later review of this meta-analysis also concluded that the short-term use of these catheters reduced the risk for CR-BSI.<sup>9</sup> This last review noted that microorganisms resistant to the antimicrobial agents used in this device had not been demonstrated in clinical studies and that reports of anaphylactic reactions to the chlorhexidine component were rare.<sup>10</sup>

A recent cost-effectiveness study, using data from meta-analyses, other randomised controlled trials, case-control studies, and safety data, estimated the incremental clinical and economic outcomes associated with the use of CVC coated with chlorhexidine and silver sulphadiazine compared with CVC that were not bonded with an antimicrobial agent.<sup>11</sup> This study concluded that the use of CVC coated with these agents in patients at high risk for CR-BSI reduces the incidence of CR-BSI and death and provides significant savings in costs. It recommended that the use of these catheters should be considered as part of a comprehensive nosocomial infection control programme.

- *Minocycline/rifampin coated catheters*

Another major randomised controlled trial, also published in 1997, examined catheters coated intra and extra-luminally with minocycline and rifampin (active in vitro against both Gram-positive and Gram-negative bacteria and *Candida* species) and demonstrated a reduction in colonisation and CRBSI, particularly in the first 10 days.<sup>12</sup>

A large, prospective, randomised controlled trial in twelve university-affiliated hospitals in the USA compared the efficacy of chlorhexidine/silver sulphadiazine-impregnated CVC with minocycline and rifampin coated CVC and showed the latter to be significantly superior at preventing catheter colonisation and CR-BSI in high-risk adult patients in whom CVC were in place for three days or more.<sup>13</sup>

Although resistance to minocycline/rifampin coated-catheters has not been demonstrated in clinical studies, population analysis has not yet been used to determine whether subpopulations of skin microorganisms develop resistance after prolonged exposure to this device.<sup>9</sup> One in vitro study does suggest that the use of these catheters may lead to drug resistance.<sup>14</sup> Conversely, this risk may be justified in that the use of these devices may reduce the need for systemic antimicrobials, e.g., vancomycin.<sup>9</sup>

### **Availability**

Two types of antimicrobial/antiseptic impregnated CVC are currently licensed for use in the European Community and are available in England. One (Vantex™ central venous catheter; Edwards Life Sciences Critical Care Division) uses a unique technology to bond the antiseptic agent (silver ions) with the polyurethane during the manufacture of the catheter. The other (ARROWgard Blue™; Arrow International, Inc.) incorporates two antimicrobial agents (chlorhexidine and silver sulphadiazine) molecularly bonded onto the surface of the polyurethane catheter material.

Others, including a catheter coated with a combination of minocycline and rifampin (Cook Spectrum™; Cook Incorporated), and a CVC with a chlorhexidine and silver sulphadiazine compound molecularly bonded onto the catheter surface and an internal lumen impregnation of chlorhexidine to the catheter body, extension lines and hubs (ARROWgard Plus™ Arrow International, Inc.), are likely to be licensed in the European Community within the next twelve months.<sup>15</sup>

**4. Consider the use of an antimicrobial impregnated central venous catheter for adult patients who require short-term (<10 days) central venous catheterisation and who are at high risk for CR-BSI.**

**Category 1**

## References

1. Kamal GD, Pfaller MA, Rempe LE, Jebson PJ. Reduced intravascular catheter infection by antibiotic bonding. A prospective, randomized controlled trial. *Journal of the American Medical Association* 1991; **265**: 2364-2368.
2. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17**(7): 438-473.
3. Pearson ML, Abrutyn E. Reducing the risk for catheter-related infections: a new strategy. *Annals of Internal Medicine*. 1997; **127**: 304-306.
4. Maki DG, Stolz SM, Wheeler S, Mermel LA. Prevention of central venous catheter-related bloodstream infection by use of an antiseptic-impregnated catheter. A randomized controlled trial. *Annals of Internal Medicine* 1997; **127**: 257-266.
5. Logghe C, Van Ossel Ch, D'Hoore W, Ezzedine H, Wauters G, Haxhe JJ. Evaluation of chlorhexidine and silver-sulfadiazine impregnated central venous catheters for the prevention of bloodstream infection in leukaemic patients: a randomized controlled trial. *Journal of Hospital Infection* 1997; **37**: 145-156.
6. Heard SO, Wagle M, Vijayakumar E, McLean S, Brueggemann A, Napolitano LM, Edwards LP, O'Connell FM, Puyana JC, Doern G. Influence of triple-lumen central venous catheters coated with chlorhexidine and silver sulfadiazine on the incidence of catheter-related bacteremia. *Archives of Internal Medicine* 1998; **158**(1): 81-87.
7. Haxhe JJ, D'Hoore W. A meta-analysis dealing with the effectiveness of chlorhexidine and silver-sulfadiazine impregnated central venous catheters. *Journal of Hospital Infection* 1998; **40**: 166-168.
8. Veenstra DL, Saint S, Saha S, Lumley T, Sullivan S. Efficacy of antiseptic-impregnated central venous catheters in preventing catheter-related bloodstream infection: a meta-analysis. *Journal of the American Medical Association* 1999; **281**(3): 261-267.
9. Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; **132**(5): 391-402.
10. Oda T, Hamasaki J, Kanda N, Mikami K. Anaphylactic shock induced by an antiseptic-coated central venous catheter. *Anesthesiology* 1997; **87**: 1242-1244.
11. Veenstra DL, Saint S, Sullivan S. Cost-effectiveness of antiseptic-impregnated central venous catheters for the prevention of catheter-related bloodstream infection. *Journal of the American Medical Association* 1999; **282**(6): 554-560.
12. Raad I, Darouiche R, Dupuis J, Abi-Said D, Gabrielli A, Hachem R, Harris R, Jones J, Buzaid A, Robertson C, Shenaq S, Curling P, Burke T, Ericsson C, the Texas Medical Center Catheter Study Group. Central venous catheters coated with minocycline and rifampin for the prevention of catheter-related colonization and bloodstream infections. A randomized, double-blind trial. *Annals of Internal Medicine*. 1997; **127**: 267-274.
13. Darouiche RO, Raad I, Heard S, Thornby JL, Wenker OC, Gabrielli A, Berg J, Khardori N, Hanna H, Henchem R, Harris R, Mayhall G. A comparison of two antimicrobial-impregnated central venous catheters. *New England Journal of Medicine* 1999; **340**: 1-8.
14. Sampath L, Tambe S, Modak S. Comparison of the efficacy of antiseptic and antibiotic catheters impregnated on both their luminal and outer surfaces [Abstract]. In: *Programs and Abstracts of the 39th Interscience Conference on Antimicrobial Agents and Chemotherapy*, 26-29 September 1999, San Francisco, California. Washington, DC: American Soc for Microbiology; [In press]. Cited in: Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; **132**(5): 391-402.
15. Pratt RJ, Wilcox M, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England associated with the use of central venous catheters: Technical Report*. London: Thames Valley University; 2000; 127. Available from (Internet): <http://www.epic.tvu.ac.uk>

## Intervention 2

### 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. 1 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 infection than those inserted in either jugular or femoral veins, but none of these were randomised controlled trials.<sup>2-7</sup> 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.

Although the above studies showed a higher risk of CR-infections associated with internal jugular site CVC insertion, evidence linking the site of catheter insertion to the risk of infection is often contradictory.<sup>8</sup> While one review<sup>9</sup> described four prospective, observational studies examined by HICPAC that found the risk for infection was significantly increased with insertion into the internal jugular vein compared with insertion into the subclavian vein,<sup>6,10-12</sup> another prospective study noted by HICPAC concluded that there was no significant difference in the risk for infection between subclavian, internal jugular and femoral placements, although colonisation of the catheter was more frequent in femoral placements.<sup>13</sup>

There is limited additional evidence in this area. A recent prospective observational study supports an association between catheter colonisation and femoral site colonisation,<sup>14</sup> and a prospective randomised trial found a higher risk of deep vein thrombosis with femoral placements compared with subclavian or internal jugular placements.<sup>15</sup>

Tunnelling may also influence the risk of CR-BSI. In a recent meta-analysis of randomised controlled trials focused on the efficacy of tunnelling short-term CVC to prevent CR-infection,<sup>16</sup> reviewers noted a large, multicentre prospective trial that demonstrated that internal jugular CR-related infections could be reduced by subcutaneous tunnelling.<sup>17</sup>

There is no additional evidence from randomised controlled trials that assessed the risk for infection associated with catheter insertion into the subclavian, internal jugular, or femoral vein.<sup>9,18</sup>

#### **Antecubital placement**

Peripherally inserted CVC (PICCs) 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.<sup>1</sup> Additionally, evidence examined by HICPAC suggests that PICCs are associated with a lower rate of infection than that associated with other non-tunnelled CVC,<sup>19,20</sup> perhaps because the antecubital fossa is less colonised by microorganisms, less oily, and less moist than the chest and neck.<sup>20,21</sup> HICPAC also noted that an antecubital placement removes the catheter away from endotracheal and nasal secretions. Finally, they discussed the mean duration of catheterisation for PICCs but noted that further studies were needed to adequately determine how long PICCs could be safely left in place and to determine whether routine replacement influenced the risk of associated infection.<sup>1</sup>

Studies examined by HICPAC also demonstrated that PICCs were associated with a substantially lower risk of CR-BSI compared to Hickman catheters. 19,23

5. In selecting an appropriate insertion site, assess the risks for infection against the risks of mechanical complications. **Category 3**

6. Unless medically contraindicated, use the subclavian site in preference to the jugular or femoral sites for nontunneled catheter placement. **Category 2**

7. Consider the use of peripherally inserted catheters as an alternative to subclavian or jugular vein catheterisation. **Category 2**

## References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
2. Prager RL, Silva J. Colonization of central venous catheters. *Southern Medical Journal* 1984; **77**: 458-461.
3. Brun-Buisson C, Abrouk F, Legrand P *et al*. Diagnosis of central venous catheter-related sepsis. Critical level of quantitative tip cultures. *Archives of Internal Medicine* 1987; **147**: 873-877.
4. Collignon PJ, Soni N, Pearson IY, Woods WP, Munro R, Sorrell TC. Is semiquantitative culture of central vein catheter tips useful in the diagnosis of catheter-associated bacteremia? *Journal of Clinical Microbiology* 1986; **24**: 532-535.
5. Richet H, Hubert B, Nitenberg G, *et al*. Prospective multicenter study of vascular catheter related complications and risk factors for positive central catheter cultures in intensive care unit patients. *Journal of Clinical Microbiology* 1990; **28**: 2520-2525.
6. Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *American Journal of Medicine* 1991; **91(suppl 3B)**: 197S-205S.
7. Snyderman DR, Gorbea HF, Pober BR, Majka JA, Murray SA, Perry SK. Predictive value of surveillance skin cultures in total parenteral nutrition. *Lancet* 1982; **2**: 1185-1188.
8. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999; **9(2)**: 46-53.
9. Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; **132(5)**: 391-402.
10. Heard SO, Wagle M, Vijayakumar E, McLean S, Brueggemann A, Napolitano LM *et al*. Influence of triple-lumen central venous catheters coated with chlorhexidine and silver sulphadiazine on the incidence of catheter-related bacteremia. *Archives of Internal Medicine* 1998; **158**: 81-87.
11. Viale P, Politi E, Sisti M, Confalonieri M, Alberici F. Impact of central venous catheters (CVC) management on infectious risk [Abstract]. *Journal of Hospital Infection* 1998; **40(Suppl A)**: 8.1.8.
12. Pittet D. Intravenous catheter-related infections: current understanding [Abstract]. In: *Program and Abstracts of the 32nd Interscience Conference on Antimicrobial Agents and Chemotherapy*, 11-14 October 1992, Anaheim, California. Washington, D.C.: American Society for Microbiology 1992; **411**.
13. Gil RT, Kruse JA, Thill-Baharozian MC, Carlson RW. Triple- vs single-lumen central venous catheters. A prospective study in a critically ill population. *Archives of Internal Medicine* 1989; **149**: 1139-1143.
14. Goetz A, Wagener M, Miller J, Muder R. Risk of infection due to central venous catheters: effect of site of placement and catheter type. *Infection Control and Hospital Epidemiology* 1998; **19(11)**: 842-845.
15. Trottier SJ, Veremakis C, O'Brien J, Auer AI. Femoral deep vein thrombosis associated with central venous catheterisation: results from a prospective, randomized trial. *Critical Care Medicine* 1995; **23**: 52-59.
16. Randolph A, Cook D, Gonzales C, Brun-Buisson C. Tunneling short-term central venous catheters to prevent catheter-related infection: A meta-analysis of randomized controlled trials. *Critical Care Medicine* 1998; **26(8)**: 1452-1455.
17. Timsit JF, Sebille V, Farkas JC, Misset B, Martin JB, Chevret S *et al*. Effects of subcutaneous tunneling on internal jugular catheter-related sepsis in critically ill patient: a prospective randomised multicenter study. *Journal of the American Medical Association* 1996; **276**: 1416-1420.
18. Reed CR, Sessler CN, Glauser FL, Phelan BA. Central venous catheter infections; concepts and controversies. *Intensive Care Medicine* 1995; **21**: 177-183.

19. Raad I, Davis S, Becker M *et al.* Low infection rate and long durability of nontunneled silastic catheters. A safe cost-effective alternative for long-term venous access. *Archives of Internal Medicine* 1993; **153**: 1791-1796.
20. Ryder MA. Peripheral access options. *Surgical Oncology Clinics of North America* 1995; **4**: 395-427.
21. Noble WC. Skin microbiology: coming of age. *Journal of Medical Microbiology* 1984; **17**: 1-12.
22. Roth RR, James WD. Microbial ecology of the skin. *Ann Rev Microbiol.* 1988; **42**: 441-446.
23. Pauley SY, Vallande NC, Riley EN *et al.* Catheter-related colonization associated with percutaneous inserted central catheters. *Journal of Intravenous Nursing* 1993; **16**: 50-54.

### Intervention 3

## Optimum Aseptic Technique During Catheter Insertion

*Using optimum aseptic technique 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-related infection is widely accepted. Although this alone seems 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.<sup>1</sup>

Studies examined by HICPAC concluded that if maximal barrier precautions were used during CVC insertion, catheter contamination and subsequent CR-related infections could be significantly minimised.<sup>2-5</sup>

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.<sup>5</sup> When maximal sterile barrier precautions were compared with routine procedures, they significantly decreased the risk of CR-BSI.<sup>5</sup>

Maximal sterile barrier precautions 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 evidence that wearing a facemask or cap is important in preventing CR-BSI during catheter insertion.

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.<sup>1</sup> However, data examined by HIC-PAC 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.<sup>3,5</sup>

Other 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.<sup>6-10</sup>

**8. Use optimum aseptic technique, including a sterile gown, gloves, and a large sterile drape, for the insertion of central venous catheters. Category 2**

### References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17**(7): 438-473.
2. Maki DG. Yes, Virginia, aseptic technique is very important: maximal barrier precautions during insertion reduce the risk of central venous catheter-related bacteremia. *Infection Control and Hospital Epidemiology* 1994; **15**: 227-230.
3. Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *American Journal of Medicine* 1991; **91**(suppl 3B): 197S-205S.
4. Bull DA, Neumayer LA, Hunter GC *et al*. Improved sterile technique diminishes the incidence of positive line cultures in cardiovascular patients. *Journal of Surgical Research* 1992; **52**: 106-110.
5. Raad I, Hohn DC, Gilbreath BJ *et al*. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infection Control and Hospital Epidemiology* 1994; **15**: 231-238.
6. Maki DG, Mermel LA. Infections due to Infusion Therapy. In: Bennett JV and Brachman PS, eds., *Hospital Infections* 4th ed. Philadelphia: Lippincott-Raven Publishers; 1998; 709-710.
7. Farr BM. Nosocomial Infections Related to Use of Intravascular Devices Inserted for Short-Term Vascular Access. In: Mayhall CG, editor. *Hospital Epidemiology and Infection Control* 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1999; 157-164.

8. Raad I, Umphrey J. Catheter-Related Bloodstream Infections: Evaluation of CDC Guidelines. In: Abrutyn EA, Goldman DA, Scheckler WE, editors. *Saunders Infection Control Reference Services*. Philadelphia: WB Saunders Co.; 1998; 191-194.

9. Ward V, Wilson J, Taylor L, Cookson B, Glynn A. Guidelines for the Prevention of Infection Associated with Central Intravascular Devices. In: *Preventing Hospital-Acquired Infection: Clinical Guidelines*. London: Public Health Laboratory Service; 1997; 41.

10. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 2. *British Journal of Intensive Care* 1999; **9(3)**: 74-80.

#### Intervention 4

### 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 HICPAC guideline developers regarded skin cleansing/antisepsis of the insertion site as 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.3

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.6

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 hyperalimination protocols. However, there was no evidence available to HICPAC to show that these agents appeared to either confer additional protection against skin colonisation or significantly decrease the incidence of CR-infection. Additionally, 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 findings.7-12 There was also concern that the use of polyantibiotic ointments that were not fungicidal could significantly increase the rate of colonisation of the catheter by *Candida* species.11,13

9. *Clean the skin site with an alcoholic chlorhexidine gluconate solution 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 3**

10. *Do not apply organic solvents, e.g., acetone, ether, to the skin before catheter insertion.* **Category 3**

11. *Do not routinely apply antimicrobial ointment to the catheter placement site prior to insertion.* **Category 2**

#### References

1. Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; **132(5)**: 391-402.

2. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999; **9(2)**: 46-53.

3. Mimos O, Pieroni L, Lawrence C, Edouard A, Costa Y, Samii K, Brun-Buisson C. Prospective, randomized trial of two antiseptic solutions for prevention of central venous or arterial catheter colonization and infection in intensive care unit patients. *Critical Care Medicine* 1996; **24(11)**: 1818-1823.

4. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.

5. Maki DG, Ringer M, Alvarado CJ. Prospective randomized trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *Lancet* 1991; **338**: 339-343.
6. Larsen E. Guideline for use of topical antimicrobial agents. *American Journal of Infection Control* 1988; **16**: 253-266.
7. Rannem T, Ladefoged K, Hegnhøj F, Hylander Møller E, Bruun B, Farnum S. Catheter-related sepsis in longterm parenteral nutrition with Broviac catheters. An evaluation of different disinfectants. *Clinical Nutrition* 1990; **9**: 131-136.
8. Prager RL, Silva J. Colonization of central venous catheters. *Southern Medical Journal* 1984; **77**: 458-461.
9. Moran JM, Atwood RP, Rowe MI. A clinical and bacteriologic study of infections associated with venous cutdowns. *New England Journal of Medicine* 1965; **272**: 554-560.
10. Norden CW. Application of antibiotic ointment to the site of venous catheterization: a controlled trial. *Journal of Infectious Diseases* 1969; **120**: 611-615.
11. Zinner SH, Denny-Brown BC, Braun P, Burke JP, Toala P, Kass EH. Risk of infection with indwelling intravenous catheters: effect of application of antibiotic ointment. *Journal of Infectious Diseases* 1969; **120**: 616-619.
12. Jarrad MM, Freeman JB. The effects of antibiotic ointments and antiseptics on the skin flora beneath subclavian catheter dressings during intravenous hyperalimentation. *Journal of Surgical Research* 1977; **22**: 520-526.
13. Maki DG, Band JD. A comparative study of polyantibiotic and iodophor ointment in prevention of vascular catheter-related infection. *American Journal of Medicine* 1981; **70**: 739-744

#### Intervention 5

### 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.

#### The catheter hub and connection port are common portals of infection

HICPAC considered evidence demonstrating that contamination of the catheter hub is an important contributor to intraluminal microbial colonisation of catheters, particularly long-term catheters.<sup>1-7</sup> In a recent overview,<sup>8</sup> additional evidence from a prospective cohort study suggested that frequent catheter hub manipulation increases the risk for microbial contamination.<sup>9</sup> 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.<sup>7</sup> Consequently, the reviewer commented that hubs and sampling ports should be disinfected before they are accessed<sup>10</sup> and noted that both povidoneiodine and chlorhexidine are effective.<sup>11-12</sup> It should be noted that some catheter and catheter hub materials, e.g., polyurethane, silicone, may be chemically incompatible with alcohol or iodine and the manufacturer's recommendations must be complied with.

12. *Before accessing the system, disinfect the external surfaces of the catheter hub and connection ports with an aqueous solution of chlorhexidine gluconate or povidone-iodine, unless contraindicated by the manufacturer's recommendations.* **Category 3**

#### References

1. deCicco M, Chiaradia V, Veronesi A *et al.* Source and route of microbial colonization of parenteral nutrition catheters. *Lancet* 1982; **2**: 1258-1261.
2. Capell S, Linares J, Sitges-Serra A. Catheter sepsis due to coagulase-negative staphylococci in patients on total parenteral nutrition. *European Journal of Clinical Microbiology and Infectious Diseases* 1986; **5**: 40-42.
3. Salzman MB, Isenberg HD, Shapiro JF, Lipsitz PJ, Rubin LG. A prospective study of the catheter hub as the portal of entry for microorganisms causing catheter-related sepsis in neonates. *Journal of Infectious Diseases* 1993; **167**: 487-490.

4. Peters G, Locci R, Pulverer G. Adherence and growth of coagulase-negative staphylococci on surfaces of intravenous catheters. *Journal of Infectious Diseases* 1982; **146**: 479-482.
5. Linares J, Sitges-Serra A, Garau J, Perez JL, Martin R. Pathogenesis of catheter sepsis: a prospective study with quantitative and semiquantitative cultures of catheter hub and segments. *Journal of Clinical Microbiology* 1985; **21**: 357-360.
6. Sitges-Serra A, Linares J, Perez JL, Jaurrieta E, Lorente L. A randomized trial on the effect of tubing changes on hub contamination and catheter sepsis during parenteral nutrition. *Journal of Parenteral and Enteral Nutrition* 1985; **9**: 322-325.
7. Raad I, Costerton W, Sabharwal U, Sacilowski M, Anaissie E, Bodey GP. Ultrastructural analysis of indwelling vascular catheters: a quantitative relationship between luminal colonization and duration of placement. *Journal of Infectious Diseases* 1993; **168**: 400-407.
8. Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine* 2000 March 7; **132(5)**: 391-402.
9. Weist K, Sperber A, Dietz E, Ruden H. Contamination of stopcocks mounted in administration sets for central venous catheters with replacement at 24 hrs versus 72 hrs: a prospective cohort study [Abstract]. *Infection Control and Hospital Epidemiology* 1997; **18(5 Pt 2)**: 24.
10. Maki DG, Stolz SM, Wheeler S, Mermel LA. Prevention of central venous catheter-related bloodstream infection by use of an antiseptic-impregnated catheter. A randomized controlled trial. *Annals of Internal Medicine* 1997; **127**: 257-266.
11. Salzman MB, Isenberg HD, Rubin LG. Use of disinfectants to reduce microbial contamination of hubs of vascular catheters. *Journal of Clinical Microbiology* 1993; **31**: 475-479.
12. Rushman KL, Fulton JS. Effectiveness of disinfectant techniques on intravenous tubing latex injection ports. *Journal of Intravenous Nursing* 1993; **16**: 304-308.

### Choose the right dressing for CVC sites to minimise infection

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.<sup>1</sup> The two most common types of dressings used for CVC sites are sterile, transparent, semi-permeable, polyurethane dressings ("transparent dressings"), and gauze and tape dressings. Transparent dressings, e.g., Opsite<sup>®</sup> IV3000, Tegaderm<sup>®</sup>, are popular because 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.

The potential risk of infection associated with transparent dressings is controversial and studies identified by HICPAC were contradictory.<sup>2</sup> Some suggested their use (for both peripheral venous catheters and CVC) increased both microbial colonisation of the catheter site and the risk of subsequent CR-related infection, while others, including a large controlled trial of peripheral venous catheter dressing regimens,<sup>3</sup> failed to demonstrate any difference in infection risk between transparent and gauze dressings. In one meta-analysis of catheter dressing regimens, CVC on which a transparent dressing was used had a significantly higher incidence of catheter-tip colonisation, but a nonsignificant increase in the incidence of CR-BSI.<sup>4</sup> HICPAC also noted preliminary data that suggested that newer transparent dressings that permit the escape of moisture from beneath the dressing could be associated with lower rates of skin colonisation and CR-related infection<sup>5</sup> but commented that the length of time that a transparent dressing could be safely left on a CVC site was unknown.

Another expert review<sup>6</sup> cites a variety of studies on the use of transparent dressings on short-term, noncuffed central venous and/or pulmonary artery catheters that yielded conflicting results, in part, reflecting differences in study protocols. Two randomised studies cited, focusing on the use of transparent dressings on surgically implanted, cuffed Hickman<sup>®</sup> or Broviac<sup>®</sup> catheters, suggested that either transparent or gauze and tape dressings could be safely used to cover the insertion sites of these devices. A third study compared the incidence of long-term CR-related infections in bone marrow transplant recipients associated with either dry sterile gauze dressings or transparent dressings, and found that there was no difference between them and concluded that either could be safely used.<sup>7</sup>

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.<sup>8-9</sup>

13. Use either a sterile gauze or transparent dressing to cover the catheter site. **Category 2**

14. If a gauze and tape catheter site dressing is used, it must be replaced when the dressing becomes damp, loosened, or soiled, or when inspection of the insertion site is necessary. **Category 3**

15. Do not apply antimicrobial ointment to CVC insertion sites as part of routine catheter site care. **Category 2**

## References

1. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999; **9(2)**: 46-53.
2. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
3. Maki DG, Ringer M. Evaluation of dressing regimens for prevention of infection with peripheral intravenous catheters. Gauze, a transparent polyurethane dressing, and an iodophor transparent dressing. *Journal of the American Medical Association* 1987; **258**: 2396-2403.
4. Hoffmann KK, Weber DJ, Samsa GP, Rutala WA. Transparent polyurethane film as an intravenous catheter dressing: a meta-analysis of the infection risks. *Journal of the American Medical Association* 1992; **267**: 2072-2076.
5. Maki DG, Stolz SM, Wheeler S. A prospective, randomised, three-way clinical comparison of a novel, highly permeable polyurethane dressing with 206 Swan Ganz pulmonary artery catheters: Op-Site IV 3000 vs Tegaderm vs gauze and Tape, I: cutaneous colonization under the dressing, catheter-related infection. In: Maki DG, ed. *Improving Catheter Site Care*. London, England: Royal Society of Medicine Services; 1991.
6. Maki DG, Mermel LA. Infections due to Infusion Therapy. In: Bennett JV and Brachman PS, eds., *Hospital Infections 4th* ed. Philadelphia: Lippincott-Raven Publishers; 1998; 711-712.
7. Brandt B, DePalma J, Irwin M, Shogan J, Lucke J. Comparison of central venous catheter dressings in bone marrow transplant recipients. *Oncology Nurses Forum* 1996; **23(5)**: 829-836.
8. Prager RL, Silva J. Colonization of central venous catheters. *Southern Medical Journal* 1984; **77**: 458-461.
9. Maki DG, Band JD. A comparative study of polyantibiotic and iodophor ointment in prevention of vascular catheter-related infection. *American Journal of Medicine* 1981; **70**: 739-744.

## Preventing catheter thrombosis and maintaining catheter patency will minimise opportunities for infection

The relationship between vascular thrombosis, microbial adherence and CR-related infection is well recognised. 1 Flushing CVC with a heparinised saline solution is designed to prevent thrombosis and associated microbial adherence to the catheter, and to prolong the duration of catheter patency. There are four elements involved in flushing CVC that need to be described in local protocols: the type, concentration, and volume of the flush solution and the flush frequency. Heparin diluted in 0.9% sodium chloride solution (heparinised saline) or normal saline solution alone are the two most common types of flush solution.

In considering the use of flush solutions incorporating heparin to discourage microbial adherence to the catheter and prevent CR-BSI, studies examined by HICPAC were contradictory.<sup>2-5</sup> Additionally, HICPAC noted that routine heparin administration, even at doses as low as 250 to 500 units per day, had been associated with bleeding disorders and complications.<sup>6-10</sup> Despite suggesting that clinical trials were needed to further assess the relative efficacy, risks, and benefits of the routine use of various anticoagulant flush solutions in preventing CR-related infection, HICPAC recommended their use.

A meta-analysis of the benefits of heparin in flushing peripheral intravascular catheters showed no advantage over normal saline.<sup>11</sup> However, a meta-analysis of randomised controlled trials focused on central intravascular catheters concluded that heparin significantly reduced bacterial colonisation and showed a strong but non-significant trend towards reduction of CR-related bacteraemia.<sup>12</sup>

Some types of tunneled CVC, e.g., Groshong™ catheters, may not require routine flushing with an anticoagulant.<sup>1</sup>

**16. Routinely flush indwelling central venous catheters with an anticoagulant unless advised otherwise by the manufacturer. Category 2**

## References

1. Fletcher SJ, Bodenham AR. Catheter-related sepsis: an overview - Part 1. *British Journal of Intensive Care* 1999; **9(2)**: 46-53.
2. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17(7)**: 438-473.
3. Maki DG, Ringer M. Evaluation of dressing regimens for prevention of infection with peripheral intravenous catheters. Gauze, a transparent polyurethane dressing, and an iodophor transparent dressing. *Journal of the American Medical Association* 1987; **258**: 2396-2403.
4. Hoffmann KK, Weber DJ, Samsa GP, Rutala WA. Transparent polyurethane film as an intravenous catheter dressing: a meta-analysis of the infection risks. *Journal of the American Medical Association* 1992; **267**: 2072-2076.
5. Maki DG, Stolz SM, Wheeler S. A prospective, randomised, three-way clinical comparison of a novel, highly permeable polyurethane dressing with 206 Swan Ganz pulmonary artery catheters: Op-Site IV 3000 vs Tegaderm vs gauze and Tape, I: cutaneous colonization under the dressing, catheter-related infection. In: Maki DG, ed. *Improving Catheter Site Care*. London, England: Royal Society of Medicine Services; 1991.
6. Maki DG, Mermel LA. Infections due to Infusion Therapy. In: Bennett JV and Brachman PS, eds., *Hospital Infections 4th ed*. Philadelphia: Lippincott-Raven Publishers; 1998; 711-712.
7. Brandt B, DePalma J, Irwin M, Shogan J, Lucke J. Comparison of central venous catheter dressings in bone marrow transplant recipients. *Oncology Nurses Forum* 1996; **23(5)**: 829-836.
8. Prager RL, Silva J. Colonization of central venous catheters. *Southern Medical Journal* 1984; **77**: 458-461.
9. Maki DG, Band JD. A comparative study of polyantibiotic and iodophor ointment in prevention of vascular
10. Silver D, Kapsch DN, Tsoi EK. Heparin-induced thrombocytopenia, thrombosis, and hemorrhage. *Annals of Surgery* 1983; **198**: 301-306.
11. Randolph AG, Cook DJ, Gonzales CA, Andrew M. Benefit of heparin in peripheral venous and arterial catheters: systematic review and meta-analysis of randomised controlled trials. *British Medical Journal* 1998; **316**: 969-975.
12. Randolph AG, Cook DJ, Gonzales CA, Andrew M. Benefit of heparin use in central venous and pulmonary artery catheters: A meta-analysis of randomized controlled trials. *Chest* 1998; **113**: 165-171. catheter-related infection. *American Journal of Medicine* 1981; **70**: 739-744.

## Intervention 6

### 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.<sup>1</sup> 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.<sup>2-5</sup> 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 CR-BSI.<sup>6-7</sup> Conclusions from a recent 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.<sup>8</sup>

## 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.<sup>6</sup> However, three prospective studies (two randomised) showed no significant difference in infection rates between catheters inserted percutaneously and those inserted over a guide wire.<sup>7,9-10</sup> 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.<sup>7,9-12</sup> Several methods are available, including recently described techniques, which allow a diagnosis of CR-BSI to be made without the need for catheter removal.<sup>13,14</sup> 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 recent systemic review concluded that, compared with new site replacement, guidewire exchange was associated with a trend toward a higher rate of catheter colonisation, regardless of whether patients had a suspected infection. 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.<sup>8</sup>

**17. Do not routinely replace non-tunnelled CVC as a method to prevent catheter-related infection. Category 2**

**18. 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 CR-BSI. Category 1**

**19. If CR-infection is suspected, but there is no evidence of infection at the catheter site, remove the existing catheter and 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. Category 1**

**20. 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 1**

## References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17**(7): 438-473.
2. Richet H, Hubert B, Nitenberg G *et al*. Prospective multicenter study of vascular catheter related complications and risk factors for positive central catheter cultures in intensive care unit patients. *Journal of Clinical Microbiology* 1990; **28**: 2520-2525.
3. Gil RT, Kruse JA, Thill-Baharozian MC, Carolson RW. Triple- vs single-lumen central venous catheters. A prospective study in a critically ill population. *Archives of Internal Medicine* 1989; **149**: 1139-1143.
4. Miller JJ, Venus B, Mathru M. Comparison of the sterility of long-term central venous catheterisation using single-lumen, triple-lumen, and pulmonary artery catheters. *Critical Care Medicine* 1984; **12**: 634-637.
5. Ullman RF, Gurevich I, Schoch PE, Cunha BA. Colonization and bacteremia related to duration of triple-lumen intravascular catheter placement. *American Journal of Infection Control* 1990; **18**: 201-207.
6. Cobb DK, High KP, Sawyer RG *et al*. A controlled trial of scheduled replacement of central venous and pulmonary artery catheters. *New England Journal of Medicine* 1992; **237**: 1062-1068.
7. Michel LA, Bradpiece HA, Randour P, Pouthier F. Safety of central venous catheter change over a guide wire for suspected catheter-related sepsis: a prospective randomised trial. *International Surgery* 1988; **73**: 180-186.

8. Cook D, Randolph A, Kemerman P, Cupido C, King D, Soukup C, Brun-Buisson C. Central venous catheter replacement strategies: A systematic review of the literature. *Critical Care Medicine* 1997; **25**(8): 1417-1424.
9. Armstrong CW, Mayhall CG, Miller KB *et al.* Prospective study of catheter replacement and other risk factors for infection of hyperalimentation catheters. *Journal of Infectious Diseases* 1986; **154**: 808-816.
10. Synder RH, Archer FJ, Endy T, *et al.* Catheter infection. A comparison of two catheter maintenance techniques. *Annals of Surgery* 1988; **208**: 651-653.
11. Pettigrew RA, Lang SDR, Haydock DA, Parry BR, Bremner DA, Hill GL. Catheter-related sepsis in patients on intravenous nutrition: a prospective study of quantitative catheter cultures and guide wire changes for suspected sepsis. *British Journal of Surgery* 1985; **72**: 52-55.
12. Newsome HH Jr, Armstrong CW, Mayhall CG *et al.* Mechanical complications from insertion of subclavian venous feeding catheters: comparison of de novo percutaneous venipuncture to change of catheter over guide wire. *Journal of Parenteral and Enteral Nutrition* 1984; **8**: 560-562.
13. Farr BM. Accuracy and cost-effectiveness of new tests for diagnosis of catheter-related bloodstream infections. *Lancet* 1999; **354**: 1487-1488.
14. Siegman-Igra Y, Anglim AM, Shapiro D, Adal KA, Strain B, Farr MB. Diagnosis of vascular catheter-related bloodstream infection: a meta-analysis. *Journal of Clinical Microbiology* 1997; **35**: 928-936.

### Change IV administration sets appropriately

The intravenous administration set includes the area from the spike of tubing entering the fluid container to the hub of the vascular device.<sup>1</sup> A short extension tube may be connected to the vascular device and may be considered a portion of the device to facilitate aseptic technique when changing administration sets.

HICPAC examined three well-controlled studies 2-4 that examined the optimal interval for the routine replacement of intravenous administration sets. Data from each of these studies show that replacing administration sets 72 hours or more after initiation of use is both safe and cost-beneficial. Other studies examined by HICPAC noted that certain intravenous fluids, e.g., blood, blood products, and lipid emulsions, were more likely than other parenteral fluids to support microbial growth if contaminated,<sup>5-8</sup> and suggested that more frequent replacement of intravenous tubing may be required when such fluids are given.

21. Replace all tubing when the vascular device is replaced. **Category 3**
22. Replace intravenous tubing and stopcocks no more frequently than at 72-hour intervals, unless clinically indicated. **Category 1**
23. Replace intravenous tubing used to administer blood, blood products, or lipid emulsions at the end of the infusion or within 24 hours of initiating the infusion. **Category 2**

### References

1. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17**(7): 438-473.
2. Snyderman DR, Donnelly-Reidy M, Perry LK, Martin WJ. Intravenous tubing containing burettes can be safely changed at 72-hour intervals. *Infection Control* 1985; **8**: 113-116.
3. Josephson A, Gombert ME, Sierra MF, Karanfil LV, Tansino GF. The relationship between intravenous fluid contamination and the frequency of tubing replacement. *Infection Control* 1985; **6**: 367-370.
4. Maki DG, Botticelli JT, LeRoy ML, Thielke TS. Prospective study of replacing administration sets for intravenous therapy at 48- vs 72-hour intervals. 72 hours is safe and cost effective. *Journal of the American Medical Association* 1987; **258**: 1777-1781.
5. Maki DG, Martin WT. Nationwide epidemic of septicemia caused by contaminated infusion products, IV: growth of microbial pathogens in fluids for intravenous infusion. *Journal of Infectious Disease* 1975; **131**: 267-272.
6. Melley MA, Meng HC, Schaffner W. Microbial growth in lipid emulsions used in parenteral nutrition. *Archives of Surgery* 1975; **110**: 1479-1481.
7. Jarvis WR, Highsmith AK. Bacterial growth and endotoxin production in lipid emulsion. *Journal of Clinical Microbiology* 1984; **19**: 17-20.
8. Crocker KS, Noga R, Filibeck DJ *et al.* Microbial growth comparisons of five commercial parenteral lipid emulsions. *Journal of Parenteral Nutrition* 1984; **8**: 391-395.

## Intervention 7

### Antibiotic Prophylaxis

#### *Antibiotic prophylaxis is unnecessary*

Prophylactic administration of systemic antimicrobials had previously been used to reduce the incidence of CR-BSI, but scientific studies examined by HICPAC on the efficacy of this practice were inconclusive. 1-7 HICPAC was also concerned that such prophylaxis may select for resistant microorganisms, particularly those resistant to vancomycin.

**24. Do not administer systemic antimicrobials routinely before insertion or during use of a central venous catheter to prevent catheter colonisation or bloodstream infection. Category 2**

#### References

1. Bock SN, Lee RE, Fisher B *et al.* A prospective randomised trial evaluating prophylactic antibiotics to prevent triple-lumen catheter-related sepsis in patients treated with immunotherapy. *Journal of Clinical Oncology* 1990; **8**: 161-169.
2. Al-Sibai MB. The value of prophylactic antibiotics during insertion of long-term indwelling silastic right atrial catheters in cancer patients. *Cancer* 1987; **60**: 1891-1895.
3. Ranson MR, Oppenheim BA, Jackson A, Kamthan AG, Scarffe JH. Double-blind placebo controlled study of van-comycin prophylaxis for central venous catheter insertion in cancer patients. *Journal of Hospital Infection* 1990; **15**: 95-102.
4. McKee R, Dunsmuir R, Whitby M, Garden OJ. Does antibiotic prophylaxis at the time of catheter insertion reduce the incidence of catheter-related sepsis in neonates. *Journal of Hospital Infection* 1985; **6**: 419-425.
5. Spafford PS, Sinkin RA, Cox C, Reubens L, Powell KR. Prevention of central venous catheter-related coagulase-negative staphylococcal sepsis in neonates. *Journal of Pediatrics* 1994; **125**: 259-263.
6. Kacica MA, Horgan MJ, Ochoa L, Sander R, Lepow ML, Venezia RA. Prevention of gram-positive sepsis in neonates weighing less than 1500 grams. *Journal of Pediatrics* 1994; **125**: 253-258.
7. Schwartz C, Henriskson KJ, Roghmann K, Powell K. Prevention of bacteremia attributed to luminal colonization of tunneled central venous catheters with vancomycin-susceptible organisms. *Journal of Clinical Oncology* 1990; **8**: 1591-1597.

## Glossary

<b>Case-control study</b>	Analytical observational study that aims to investigate the relationship between an exposure or risk factor, e.g., insertion of a CVC, and one or more outcomes, e.g., the occurrence of CR-BSI.
<b>CR-BSI</b> Catheter-related bloodstream infection; also <i>catheter-related sepsis</i> or <i>catheter-intravascular device-related bacteraemia</i>	Systemic infection (bacteraemia) <i>and</i> evidence implicating the central venous catheter as its source, i.e., the isolation of the referred to as same microorganism from blood cultures as that shown to be related (or significantly colonising the CVC of a patient with clinical features of bacteraemia). <sup>1-3</sup> (See CR-infection)
<b>CR-infection</b> Catheter-related infection	A significant growth of microorganisms ( $\geq 15$ colony-forming units (CFUs) by semi-quantitative methods, or $\geq 10^3$ CFUs by quantitative methods) on either the endoluminal or the external catheter surface beneath the skin in the <i>absence</i> of systemic bloodstream infection (bacteraemia). <sup>2</sup>
<b>Colonisation of the catheter</b>	Similar to CR-infection but less growth of microorganisms, i.e., $< 15$ CFUs (or $< 10^3$ CFUs). <sup>2</sup>
<b>CVC</b> Central venous catheter	Intravascular catheters inserted into a variety of sites to allow placement of the catheter tip in the superior vena cava above its junction with the right atrium, with the distal catheter parallel to the vessel wall. CVCs have several uses, e.g., giving multiple infusions of fluids, medication, or chemotherapy, temporary access for haemodialysis, monitoring central venous pressure, frequent blood sampling.
<b>'High risk' patients</b>	Refers to patients at increased risk for CR-infection, e.g., those patients in intensive care units, those receiving total parenteral nutrition, and immunocompromised patients.
<b>PICCs</b> Peripherally inserted central venous catheters	Used as an alternative to subclavian or jugular vein catheterisation; inserted into the superior vena cava by way of the cephalic and basilic veins of the antecubital space.
<b>Prospective clinical trial</b>	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.
<b>RCT</b> Randomised controlled trial	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.

## References

1. Public Health Laboratory Service. *Protocol for Surveillance of Hospital-Acquired Bacteraemia*. Version 1.1. Internal policy document. London: Nosocomial Infection National Surveillance Scheme, Central Public Health Laboratory; March, 1998; 45.
2. Pearson ML. Hospital Infection Control Practices Advisory Committee. Guideline for Prevention of Intravascular-device-related Infections. *Infection Control and Hospital Epidemiology* 1996 July; **17**(7): 438-473.
3. Reed CR, Sessler CN, Glauser FK, Phelan BA. Central venous catheter infections: concepts and controversies. *Intensive Care Medicine* 1995; **21**: 177-183.

## Agenda for clinical governance

Clinical governance is the 'framework through which NHS organisations are accountable for continually improving the quality of their services and safeguarding high standards of care'.<sup>1</sup> It focuses primarily on identifying and implementing services which are clinically and cost effective and instituting and maintaining systems to ensure clinical quality.

Guidelines can assist practitioners and managers to achieve sound clinical governance by asking the following questions.

### *Are we doing the right things?*

Guidelines provide statements of good practice based on systematic review of research and other evidence. These can be adapted locally to ensure best practice in any clinical area.

The prevention of hospital acquired infection is one of the major challenges facing the National Health Service. The economic and social costs associated with failure to prevent infections are significant.<sup>2</sup> In addition, the threats posed by antimicrobial resistance<sup>3</sup> require the stringent application of standard principles of infection prevention to all patient care situations. The use of standard principles will enable a consistent approach to be established and monitored.

Nationally produced guidelines need to be adapted for local use. It is vital that such adaptations follow a recognised protocol. In other words, practitioners must be sure of the evidence base that they use when altering the national guidance.

### *Are we doing things right?*

Guidelines enable clinical effectiveness and risk management teams to focus audit on appropriate infection prevention and control interventions. Special attention should be paid to relevant criteria in the Department of Health Guidance on Quality Standards.<sup>4</sup>

Clearly articulated sets of guidelines provide quality assurance teams with a framework to monitor whether best practice is being achieved. Use of guidelines by practitioners requires not only that they know of the guideline's existence and content, but also their willingness to recognise that change may be necessary. Audit can focus at several points to determine the effectiveness of:

- dissemination strategies including consultation;
- managerial and professional support; and
- adherence by individual practitioners/units to the guidance.

National guidelines are known to change clinical practice and may lead to improvements in patient outcome.<sup>5</sup> However, they need to be adapted at local level and their dissemination requires an implementation protocol that includes:

- being clear who is targeted;
- staging the implementation;
- managing supporters and detractors;
- setting achievable goals;
- building on existing audit systems; and
- careful preplanning.

These provide a focus for the audit of dissemination and implementation.

Auditing managerial and professional support is less easily achieved, but could be monitored through surveys of:

- clinicians' attitudes; and
- the provision of resources, such as equipment and training.

Adherence to specific guidance statements may be monitored by:

#### **Standard principles**

- auditing the frequency and appropriateness of hand decontamination on a regular basis and communicating the results to staff.
- evaluating hand decontamination technique through the use of clear criteria 6,7 that score the key elements of decontamination and may be helpful in providing feedback to health care practitioners on hand hygiene techniques.
- auditing standards of environmental hygiene.
- auditing the outcomes of education programmes.

#### **Short-term indwelling urethral catheters**

- identifying the population at risk by determining the prevalence of indwelling urethral catheters according to age, sex and underlying disease of patients on a range of units;
- documenting the indications for and duration of catheterisation;
- monitoring the care of the system, for example, reviewing documentation to identify whether unnecessary irrigation/washouts have been carried out;
- surveying the incidence of symptomatic bacteriuria.

#### **Central venous catheters**

- identifying the population at risk by determining the prevalence of patients with CVC;
- documenting the indications for and duration of central venous catheterisation;
- monitoring the care of patients with CVC;
- surveying the incidence of catheter colonisation and CR-BSI.

#### **Do the right people have the right knowledge, skills and attitude?**

These guidelines provide the foundation for evidence-based practice and identify areas where staff training and professional development are required. As the insertion of both indwelling urethral and central venous catheters are skilled, aseptic procedures, practitioners must receive appropriate training, supervision and support to adhere to guidelines.

As Standard Principles are the core recommendations, we examined evidence focused on the importance of adherence. It is evident from our systematic review that non-adherence to good practice in the areas of hand hygiene, use of personal protective equipment and sharps disposal is widespread. The following examples provide an illustration of some of the issues that need to be addressed in assisting health care professionals to maintain high quality practice.

#### **Adhering to guideline recommendations**

A number of studies describe health care practitioners' failure to follow guidelines that would ensure the safer use and disposal of sharps.<sup>8-11</sup> Two large surveys conducted in the USA report an association between rates of needle recapping and overfilling sharps containers with increased rates of injury.<sup>11,12</sup> Adherence is a complicated issue, related to both individual behaviour and wider organisational factors, such as the provision of appropriate resources. Nevertheless, practitioner education is generally considered as central to developing awareness and promoting safe practice.<sup>13</sup> However, the evidence supporting education initiatives as an effective means of changing practitioners' behaviour is mainly descriptive and lacks rigour.

Our systematic review 14 identified six acceptable studies 9,15-19 that explored the effectiveness of education, four of these 15,16,18,19 were intervention studies, and only one of these 19 considered education as a single intervention rather than as part of a wider strategy of measures designed to increase adherence. This study suggests that education programmes that actively involve staff and raise awareness of needlestick prevention strategies, may be effective in altering the behaviour of nurses who were resistant to changing their practice and in maintaining the change over a longer period.<sup>19</sup> Other studies provide weak evidence that education programmes, combined with sharps bin provision and feedback of surveillance data to staff, improved adherence to guidelines.<sup>15,18</sup>

However, education interventions may have the effect of increasing reports of injuries by staff. Two studies reported on the failure of education programmes to have any significant effect on rates of injury or recapping of needles.<sup>16,17</sup>

Expert opinion supports the need for the development of effective programmes of education that will increase both staff awareness and adherence to guidelines.<sup>13</sup>

### *How can adherence to hand decontamination practice be improved?*

A number of descriptive studies identify that although health care practitioners are aware of the principles of effective hand hygiene, on 50 percent of the occasions when hand decontamination is indicated, they either fail to apply the principles or, they perform the requirements to an inadequate standard.<sup>20-30</sup> Furthermore, staff were more likely not to decontaminate their hands prior to carrying out a care activity that carried a high risk of introducing infection, and were more likely to decontaminate them after a low risk activity.<sup>30</sup>

However, failure to follow hand decontamination principles is a complex problem and investigators have identified a wide range of factors that contribute to non-adherence. They include:

- the effect of handwashing preparations on skin;<sup>20,21,31,32</sup>
- insufficient time or inadequate numbers of staff;<sup>20,21,33,34</sup>
- high patient dependency;<sup>21,30</sup>
- lack of physical resources, such as appropriately sited sinks<sup>35</sup> and poor tap design;<sup>36</sup>
- and poor levels of knowledge and understanding of hand hygiene.<sup>25,37-39</sup>

Interventions to improve adherence to hand hygiene guidelines have included:

- in-service education programmes;
- audit and feedback to staff;
- changes in hand preparations and facilities;
- involvement of patients.<sup>29,40-47</sup>

The small scale and descriptive nature of these studies make it difficult to determine the true effect of the interventions. However the studies suggest that there may be short-term improvements in hand hygiene practice but that sustained change has not been observed.

Evidence from these studies, and expert opinion,<sup>48-50</sup> suggest that no single method of addressing the issue of adherence will solve the problem and that a multifaceted approach is required to establish and maintain high standards of hand hygiene.

This would include the provision of: adequate resources; acceptable preparations for hand decontamination; effective education programmes; audit and feedback.

Guidelines identify where staff training and professional development are required. Examples might include the provision of education programmes that:

- promote effective hand hygiene practice;
- use approaches to education and training that actively involve staff in preference to poster or leaflet information;

- are frequent and varied in their approach and targeted at specific groups of staff;
- provide staff with regular feedback on rates of hospital-acquired infection in their sphere of practice.

#### *What further evidence do we need?*

Guidelines highlight gaps in the available evidence base where national or more local research/data are required. Research is required in the following key areas:

#### *Standard principles*

##### *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.

##### *Short-term indwelling urethral catheters*

- randomised controlled trials comparing the effectiveness and patient acceptability of other methods of urinary drainage with the use of the indwelling urethral catheter.
- robust independent clinical trials to evaluate the efficacy and cost effectiveness of different catheter materials and emerging new technologies.
- descriptive studies on the decision making process around catheter insertion and removal.
- appropriate studies to determine the effectiveness of educational interventions to enhance adherence to guidelines by health care providers.
- studies on the spatial separation of catheter patients with bacteriuria.
- the relationship between the duration of urinary drainage bag use and the onset of bacteriuria.
- an exploration of methods for recording catheter care.
- an evaluation of the effectiveness of guideline dissemination and implementation.
- assessment of the effectiveness of guidelines in preventing bacteriuria and catheter-associated infection.

### Central venous catheters

- good quality randomised controlled trials to evaluate the efficacy and cost effectiveness of new and emerging technologies, e.g., antimicrobial/antiseptic impregnated CVC.
- a large, prospective randomised clinical trial to determine the risk of infection associated with various catheter insertion sites.
- studies to clarify the most appropriate anticoagulant flush solution for preventing intraluminal catheter thrombosis and catheter colonisation.
- studies to determine the frequency with which CVC tubing needs to be changed.
- an exploration of methods for recording catheter care.
- an evaluation of the effectiveness of guideline dissemination and implementation
- assessment of the effectiveness of national guidelines and local protocols in preventing infectious complications from the use of CVC.
- appropriate studies to determine the effectiveness of educational interventions to enhance adherence to guidelines by health care providers.

### References

1. National Health Service Executive. *Clinical governance: quality in the new NHS*. Leeds: Department of Health 1999; 25.
2. Plowman R, Graves N, Griffin M, Roberts JA, Swan AV, Cookson B, Taylor L. *The Socio-economic Burden of Hospital-acquired Infection*. London: Public Health Laboratory Service and The London School of Hygiene and Tropical Medicine; 1999; 12.
3. House of Lords Select Committee on Science and Technology. *Resistance to antibiotics and other antimicrobial agents*. (HL Paper 81-I, 7th Report Session, 1997-1998). London: Stationary Office; 1998; 56.
4. National Health Service Executive. *Guidelines for Implementing Controls Assurance in the NHS (Guidance for Directors)*. Leeds: Department of Health; 1999; 36.
5. Grimshaw J, Freemantle N, Wallace S, Russell I, Hurwitz B, Watt I, Long A, Sheldon T. Developing and implementing clinical practice guidelines. *Quality in Health Care* 1995; **4(1)**: 55-64.
6. Larson E, Lusk E. Evaluating handwashing technique. *Journal of Advanced Nursing* 1985; **10**: 547-552.
7. Feldman H. Learning transfer from programmed instruction to clinical performance. *Nursing Research* 1969; **18**: 51-54.
8. Roy E, Robillard P. Effectiveness of and compliance to preventative measures against the occupational transmission of human immunodeficiency virus. *Scandinavian Journal of Work, Environment and Health* 1994; **20**: 393-400.
9. Becker MH, Janz NK, Band J, Bartley J, Snyder MB, Gaynes RP. Noncompliance with universal precautions policy: Why do physicians and nurses recap needles? *American Journal of Infection Control* 1990; **18(4)**: 232-239.
10. Dalton M, Blondeau J, Dockerty E, Fanning C, Johnston L, LeFort-Jost S, Macdonald S. Compliance with a non-recapping needle policy. *Canadian Journal of Infection Control* 1992; **7(2)**: 41-44.
11. Hershey JC, Martin LS. Use of infection control guidelines by workers in healthcare facilities to prevent occupational transmission of HBV and HIV: Results from a national survey. *Infection Control and Hospital Epidemiology* 1994; **15(4)**: 143-152.
12. Aiken LH, Sloane DM, Klocinski JL. Hospital nurses' occupational exposure to blood. Prospective, retrospective and institutional reports. *American Journal of Public Health* 1997; **87(1)**: 103-107.
13. Expert Advisory group on AIDS and the Advisory group on Hepatitis. *Guidance for clinical health care workers: Protection against infection with bloodborne viruses*. London: Department of Health; 1998; 46.
14. Pratt RJ, Pellowe C, Loveday HP, Robinson N. *epic phase 1: The Development of National Evidence-based Guidelines for Preventing Hospital-acquired Infections in England - Standard Principles: Technical Report*. London: Thames Valley University; 2000; 191. Available from (Internet): <http://www.epic.tvu.ac.uk>
15. Haiduvan DJ, DeMaio TM, Stevens DA. A five-year study of needlestick injuries: significant reduction associated with communication, education and convenient placement of sharps containers. *Infection Control and Hospital Epidemiology* 1992; **13(5)**: 265-271.

16. Linnemann CC, Cannon C, DeRonde M, Lanphear B. Effect of educational programs, rigid sharps containers and universal precautions on reported needlestick injuries in healthcare workers. *Infection Control and Hospital Epidemiology* 1991; **12(2)**: 214-219.
17. Weltman AC, Short LJ, Mendelson MH, Lilienfeld DE, Rodriguez M. Disposal related sharps injuries at a New York city teaching hospital. *Infection Control and Hospital Epidemiology* 1995; **16(5)**: 268-274.
18. Ribner BS, Ribner BS. An effective education program to reduce the frequency of needle capping. *Infection Control and Hospital Epidemiology* 1990; **11(12)**: 635-638.
19. Seto WH, Ching PTY, Fung JPM, Fielding R. The role of communication in the alteration of patient-care practices in hospital - a prospective study. *Journal of Hospital Infection* 1989; **14**: 29-37.
20. Larson EL, Killen M. Factors influencing handwashing behaviour of patient care personnel. *American Journal of Infection Control* 1982; **10(3)**: 93-99.
21. Zimakoff J, Kjelsberg AB, Larsen SO, Holstein B. A multicentre questionnaire investigation of attitudes toward hand hygiene, assessed by the staff in fifteen hospitals in Denmark and Norway. *American Journal of Infection Control* 1992; **20**: 58-64.
22. Steere AC, Mallinson GF. Handwashing practices for the prevention of nosocomial infections. *Annals of Internal Medicine* 1975; **83**: 683-690.
23. Albert RK, Condie F. Handwashing practices for the prevention of nosocomial infections. *New England Journal of Medicine* 1981; **304**: 1465-1466.
24. Sneddon JG. A preventable cause of infection: carriage of gram-negative bacilli on hands. *Professional Nurse* 1990; 98-104.
25. Taylor L. An evaluation of handwashing techniques. *Nursing Times* 1978; **74(2)**: 54-55 and **74(3)**: 108-109.
26. Larson E, McGinley KJ, Grove GL. Physiologic, microbiologic, and seasonal effects of handwashing on the skin of healthcare personnel. *American Journal of Infection Control* 1986; **14**: 51-59.
27. Jarvis WR. Handwashing - the Semmelweis lesson forgotten? *Lancet* 1994; **344**: 1311-1312.
28. Sproat LJ, Inglis TJ. A multicentre survey of hand hygiene practice in intensive care units. *Journal of Hospital Infection* 1994; **26**: 137-148.
29. Simmons B, Bryant J, Neinman K, Spencer L, Arheat K. The role of handwashing in prevention of endemic intensive care unit infections. *Infection Control and Hospital Epidemiology* 1990; **11**: 589-594.
30. Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. *Annals of Internal Medicine* 1999; **130(2)**: 126-130.
31. Scott D, Barnes A, Lister M, Arkell P. An evaluation of the user acceptability of chlorhexidine handwash formulations. *Journal of Hospital Infection* 1991; **18(Suppl B)**: 51-55.
32. Rotter ML, Koller W, Neumann R. The influence of cosmetic additives on the acceptability of alcohol-based disinfectants. *Journal of Hospital Infection* 1991; **18(Suppl B)**: 57-63.
33. Haley RW, Bregmen DA. The role of understaffing and overcrowding in recurrent outbreaks of staphylococcal infection in a neonatal special-care unit. *Journal of Infectious Diseases* 1982; **145**: 875-885.
34. Pettinger A, Nettleman MD. Epidemiology of isolation precautions. *Infection Control and Hospital Epidemiology* 1991; **12**: 303-307. 35. Kaplan LM, McGuckin M. Increasing handwashing compliance with more accessible sinks. *Infection Control* 1986; **7**: 408-410.
36. Watts GT. Handwashing and horizontal spread of viruses. *Lancet* 1989; **2**: 218.
37. Gould D, Ream E. Nurses' views of infection control: an interview study. *Journal of Advanced Nursing* 1994; **19**: 1121-1131.
38. Elliot P. Handwashing practice in nurse education. *Professional Nurse* 1996; **11(6)**: 357-360.
39. Broughall J. An automatic monitoring system for measuring handwashing frequency in hospital wards. *Journal of Hospital Infection* 1984; **5**: 447-453.
40. Doebbeling BN, Stanley GL, Sheetz CT, Pfaller MA, Houston AK, Annis L, Li N, Wezel RP. Comparative efficacy of alternative handwashing agents in reducing nosocomial infections in intensive care units. *New England Journal of Medicine* 1992; **327**: 88-93.

41. Dubbert PM, Dolce J, Richter W, Miller M, Chapman SW. Increasing ICU staff handwashing: effects of education and group feedback. *Infection Control and Hospital Epidemiology* 1990; **11**: 191-193.
42. Graham M. Frequency and duration of handwashing in an intensive care unit. *American Journal of Infection Control* 1990; **18**: 77-80.
43. Conly JM, Hill S, Ross J, Lertzman J, Louie TJ. Handwashing practices in an intensive care unit: the effects of an educational program and its relationship to infection rates. *American Journal of Infection Control* 1989; **70**: 330-339.
44. Mayer JA, Dubbert PM, Miller M, Burkett PA, Chapman SW. Increasing handwashing in an intensive care unit. *Infection Control* 1986; **7**: 259-262.
45. Larson E, McGeer A, Quraishi ZA. Effect of an automated sink on handwashing practices and attitudes in high risk units. *Infection Control and Hospital Epidemiology* 1991; **12**: 422-428.
46. McGuckin M, Waterman R, Porten L, Bello S, Caruso M, Juzaitis B, Krug E, Mazer S, Ostrawski S. Patient education model for increasing handwashing compliance. *American Journal of Infection Control* 1999; **27(4)**: 309-314.
47. Nettleman MD, Trilla A, Fredrickson M, Pfaller M. Assigning responsibility: using feedback to achieve sustained control of methicillin resistant *Staphylococcus aureus*. *American Journal of Medicine* 1991; **91(Suppl 3B)**: B228S-B232S.
48. Infection Control Nurses Association. Guidelines for Hand Hygiene. ICNA & Deb Ltd; 1999; **13**.
49. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *American Journal of Infection Control* 1995; **23**: 251-269.
50. Garner JS, Favero MS. CDC guideline for handwashing and hospital environmental control, 1985. *Infection Control* 1986; **7**: 231-235.

*Journal of Hospital Infection* (2001) 47(Supplement): S3-S4 doi:10.1053/jhin.2000.0886, available online at <http://www.idealibrary.com> on

## Appendix A - Systematic review: MeSH terms

### Standard principles

The following MeSH terms were used for a subject search: handwashing: infection, handwashing, universal precautions, cross infection, disease transmission, horizontal/or disease transmission, professional-to-patient, disinfection, soaps, anti-infective agents, surface-active agents.

protective clothing: protective clothing, cross infection, disease transmission, disposable equipment.  
universal precautions: universal precautions, nursing staff.

sharps: wounds, needles cleaning and disinfection: disinfection, equipment contamination, cross infection, detergents.

### *Short-term indwelling urinary catheters*

The following MeSH terms were used for a subject search: urinary catheterization, catheters, indwelling, urinary tract infections, bacteriuria, pyuria, biocompatible materials, urinary tract infections.

### *Central venous catheters*

The following MeSH terms were used for a subject search: catheterisation, central venous or catheters, indwelling or catheters, indwelling or catheters, antimicrobial impregnated.

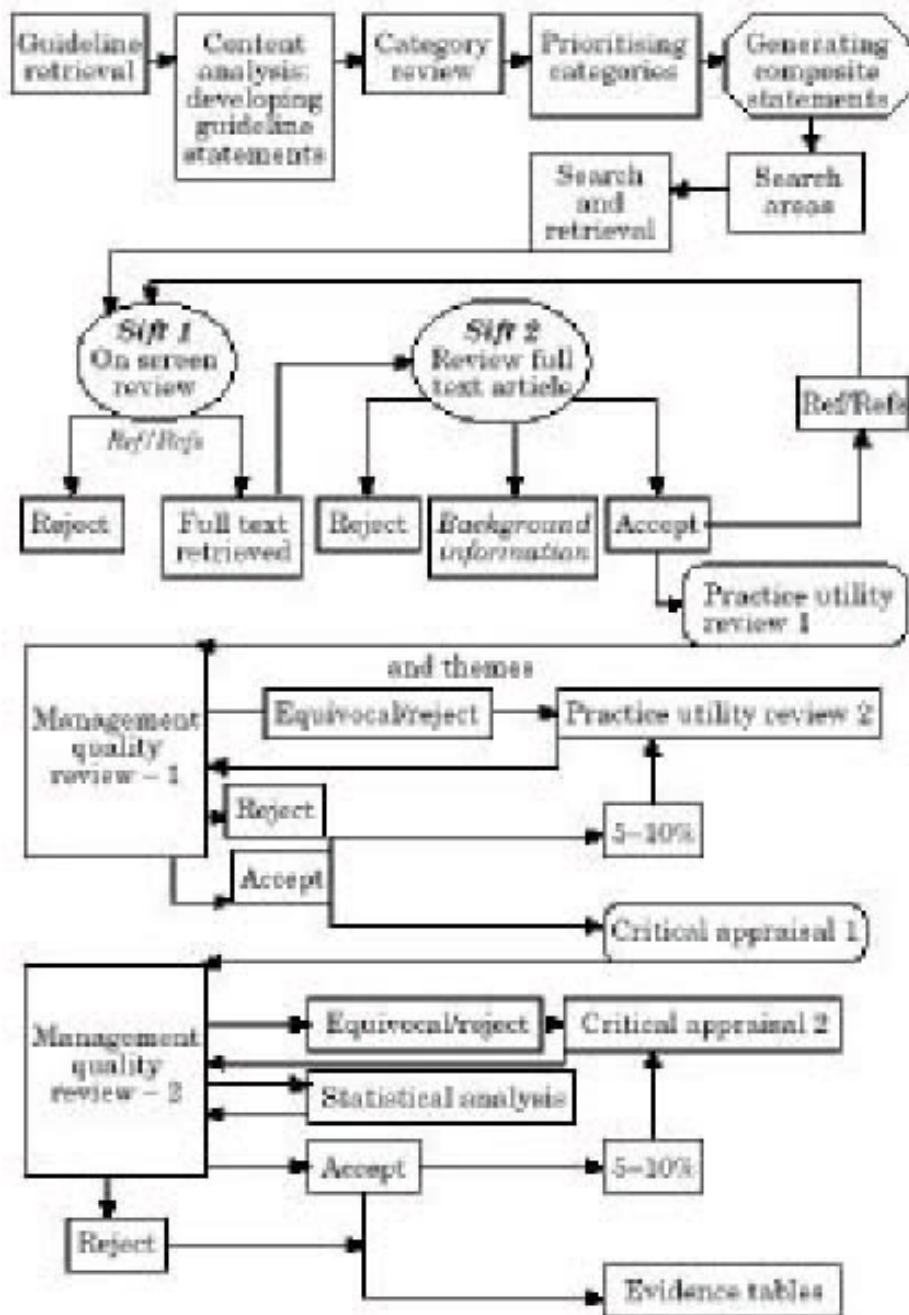
### *Methodological Factor*

A methodological filter to identify randomised controlled trials was then applied and the abstracts of all citations reviewed. The full manuscripts of those identified as potentially relevant were reviewed and the reference lists examined for any other potential randomised controlled trials.



Journal of Hospital Infection (2001) 47(Supplement): S3-S4 doi:10.1053/jhin.2000.0886, available online at <http://www.idealibrary.com> on B1 Evidence retrieval and construction

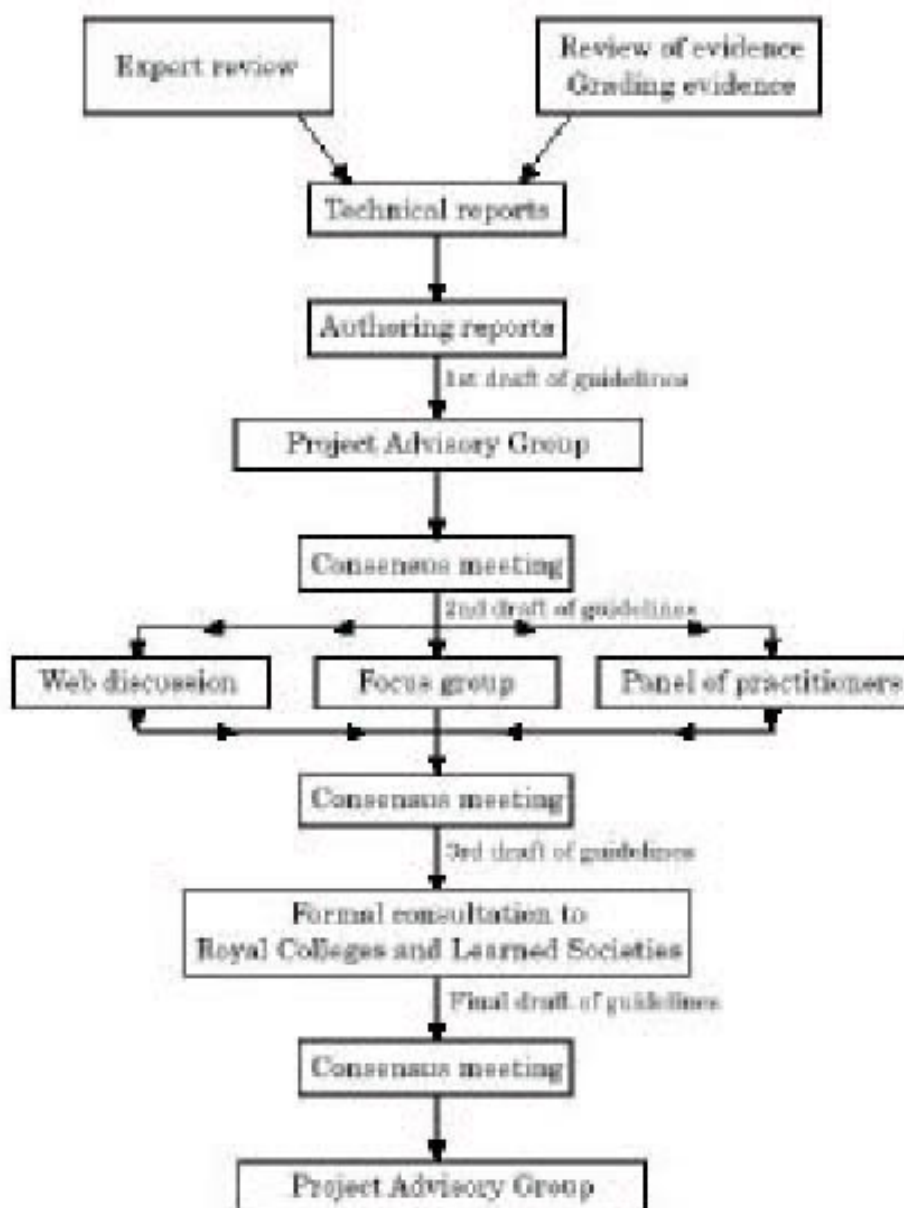
**Appendix B – Systematic review Flowchart**  
**B1 Evidence retrieval and Construction**





*Journal of Hospital Infection* (2001) 47(Supplement): S3-S4 doi:10.1053/jhin.2000.0886, available online at <http://www.idealibrary.com> on B1 Evidence retrieval and construction

**B2 Guideline authoring process**



## Appendix C - Guideline authoring group

The following were members of The Guideline Development Team:

*Professor Robert J. Pratt*, Professor of Nursing, Project Director, Wolfson Institute of Health Sciences, Thames Valley University

*Ms. Carol Pellowe*, Principal Lecturer, Deputy Project Director, Wolfson Institute of Health Sciences, Thames Valley University

*Mrs. Heather Loveday*, Principal Lecturer, Authoring Manager, Wolfson Institute of Health Sciences, Thames Valley University

*Dr. Nicky Robinson*, Reader, Research & Analysis Manager, Wolfson Institute of Health Sciences, Thames Valley University

*Dr. Godfrey W. Smith*, Consultant Medical Microbiologist and Honorary Senior Lecturer in Medical Microbiology and Genito-Urinary Medicine, Royal Liverpool University Hospital

*Dr. Steve Barrett*, Department of Microbiology, 4th Floor Tower Block, Guy's Hospital, London, SE1, 9RT

*Professor Peter G. Davey*, Professor of Pharmacoeconomics, Medicines Monitoring Unit, Department of Clinical Pharmacology, Ninewells Hospital Medical School, University of Dundee

*Mr. Peter Harper*, Senior Lecturer, Wolfson Institute of Health Sciences, Thames Valley University

*Professor Clive Loveday*, Professor of Retrovirology, The Royal Free & University College Medical School, University of London

*Mrs. Christine McDougall*, Senior Infection Control Nurse, St Mary's Hospital, London

*Dr. Anne Mulhall*, Research Consultant, Principal Project Officer

*Mrs. Sue Privett*, Clinical Nurse Specialist - Infection Control, Principal Project Officer

*Mrs. Caroline Smales*, Senior Lecturer, Wolfson Institute of Health Sciences, Thames Valley University

*Ms. Lynda J. Taylor*, Head of Nursing Unit, Laboratory of Hospital Infection, Central Public Health Laboratory

*Mrs. Barbara Weller*, Research Consultant, Principal Project Officer

*Dr. Mark H. Wilcox*, Senior Lecturer, Honorary Consultant in Medical Microbiology, Department of Microbiology, University of Leeds, The Leeds Teaching Hospitals NHS Trust.

## Appendix D - Project Advisory Group (PAG)

The following were members of the Project Advisory Group:

### Co-Chairpersons

*Professor Christine Beasley*, Director of Nursing, Human Resources & Organisational Development, NHS Executive (London Regional Office)

*Professor Michael Orme*, Director of Education and Training, NHS Executive (North West Department of Health)

### Members

*Mrs. Susan Macqueen*, Infection Control Nurses Association

*Ms. Lynda J. Taylor*, Central Public Health Laboratory

*Dr. Gill Harvey*, Royal College of Nursing Institute (Oxford)

*Ms. Rosaline Steele*, Royal College of Midwives

*Dr. Mary Cooke*, Specialist Adviser in Infection Control

*Dr. Mark Farrington*, Cambridge Public Health Laboratory

*Dr. Alison Holmes*, Royal College of Physicians

*Mr. Bernard Ribeiro*, Royal College of Surgeons of England

*Professor Gary French*, Hospital Infection Society

*Professor Hillary Humphreys*, Royal College of Surgeons of Ireland

*Professor Clive Loveday*, Royal College of Pathologists

*Professor Peter G. Davey*, British Society for Anti-microbial Chemotherapy

*Dr. Richard C.D. Slack*, Association of Medical Microbiologists

*Dr. Henry K. Fell*, British Medical Association

*Dr. Nita A. Mitchell-Heggs*, St. George's Healthcare NHS Trust

*Dr. Godfrey Smith*, Royal Liverpool University Hospital

*Dr. Steve Barrett*, Department of Microbiology, 4th Floor Tower Block, Guy's Hospital, London, SE1 9RT

*Dr. Mark H. Wilcox*, University of Leeds, The Leeds Teaching Hospitals NHS Trust

### Observers

*Ms. Carole Fry*, Nursing Officer, Department of Health

*Dr. Shirley Crawshaw*, Medical Officer, Department of Health

## Appendix E - Consultation strategy

An internal and external review process was used to ensure relevant consultation with all key stakeholders.

### Internal review

#### *Aim*

The aim of the internal review was to provide members of the Project Advisory Group with an opportunity to make preliminary comments on the draft guidelines.

#### *Process*

Draft guidelines were circulated to each member of the Project Advisory Group for comment and they were advised that detailed Technical Reports were available on the project's web site. Members were asked to address the following questions:

<i>Structure</i>	Is the format of the guidelines user friendly? Are the guidelines logically structured? Are the recommendations clearly stated?
<i>Content</i>	Do the guidelines cover the major issues associated with this area of practice? Are the recommendations credible? Is sufficient supporting evidence provided?
<i>Practice Applicability</i>	Can the guidelines be incorporated into clinical practice and local protocols?

#### *Outcome*

Following this review, collated comments were incorporated into management reports that were discussed by Project Officers and Advisers at a Consensus Meeting where relevant changes were agreed. At this, and subsequent Consensus Meetings, Project Directors and the Project's Scientific Adviser, arbitrated and resolved any outstanding issues of conflict.

### External Review

#### *Aim*

The aim of external review was to provide opportunities for critical input from parties likely to be affected by the guidelines and early independent peer review by key stakeholders prior to guideline approval/and publication.

#### *Process*

A two-stage process was used.

#### *Stage 1*

In this first stage, both general and relevant specialist practitioners were consulted and asked to comment on the context, content validity and practice applicability of the guidelines. Four mechanisms were simultaneously used in this stage.

*Members of the Panel of Specialist Practitioners* - Practitioners were recruited and assigned to one of three panels according to their clinical background and specialty (standard principles, central venous catheters, and short-term indwelling urethral catheters). These included specialist nurses, physicians and surgeons, microbiologists, and practitioners responsible for clinical effectiveness. In addition to general comment, the panel addressed specific clinical or technical issues identified by managers within each set of guidelines.

*Hospital-based Focus Groups* - relevant specialists were recruited and assembled in focus groups in different localities.

- The Focus Group for central venous catheters was conducted at the Leeds Infirmary NHS Trust and members included specialist nurses responsible for parenteral nutrition, infection control nurses, a senior microbiologist, intensive care nurses and medical and surgical specialist clinicians.
- The Focus Group for short-term indwelling urethral catheters was held at Chelsea and Westminster Hospital NHS Trust and members included specialist nurses (urology, continence), along with an experienced medical registrar, infection control nurse, senior microbiologist and a policy development nurse.
- Two Focus Groups were held to explore the draft guidelines on standard principles; one was held at St. Mary's Hospital NHS Trust in London and the other was held at Southport and Formby District General Hospital NHS Trust. As in previous focus groups, relevant practitioners, both medical and nursing, were recruited to the groups.

Appropriate focus group methodology was used to obtain and analyse comment from each group.

*Internet discourse on the www:* draft guidelines were posted on the project's web page and various practitioners, including those working in other countries, made contributions during the period of consultation.

*Methodology review* - During this stage, the rigour and appropriateness of the guideline development methodology was independently appraised by an expert Consultant. This included an appraisal of the processes used for the identification and interpretation of evidence, the formulation of the recommendations and the link between the evidence and the main recommendations.

### **Outcome**

Following the Stage 1 review, collated comments were incorporated into management reports that were discussed by Project Officers and Advisers at a Consensus Meeting where relevant changes were agreed. The final draft guidelines were then produced.

### **Stage 2**

During the second stage, final draft guidelines were distributed for formal consultation to appropriate Royal Colleges, learned societies, other relevant professional institutions and organisations, and association representing patients. The Technical Reports continued to be made available on the project's web and were sent to any organisation requesting hard copy. The response rate during this stage was very high.

### **Outcome**

Following the Stage 2 review, collated comments were incorporated into management reports that were discussed by Project Officers and Advisers at a final Consensus Meeting where relevant changes were agreed. The final guidelines were then produced for discussion and ratification by the Project Advisory Group and the Department of Health.

## Appendix F - External review

*The following were approached for formal comment:*

Association for Continence Advice  
Association for Professionals in Infection Control and Epidemiology  
Association of Medical Microbiologists  
Association of National Health Occupational Physicians  
British Association of Critical Care Nurses  
British Association of Urological Surgeons  
British Dental Association  
British Infection Society  
British Medical Association  
British Society for Antimicrobial Chemotherapy  
Chartered Society of Physiotherapy  
College of Occupational Therapists  
Community Practitioners & Health Visitors Association  
Handwashing Liaison Group & Hospital Infection Society  
Health & Safety Executive  
Incontact  
Infection Control Nurses Association  
Irish Society of Clinical Microbiology  
Medical Defence Union  
Medical Devices Agency  
Medical Protection Society  
National Association of Theatre Nurses  
Patient Concern  
Public Health Laboratory Service  
Public Health Medicine Environmental Group  
Royal College of Anaesthetists  
Royal College of Midwives  
Royal College of Nursing  
Royal College of Pathologists  
Royal College of Physicians  
Royal College of Surgeons in Ireland  
Royal College of Surgeons of England  
Society of Chiropodists & Podiatrists  
The Continence Foundation  
The Patients Association  
UNISON