

# Preventing Surgical Site Infections

## Key Recommendations for Practice

Developed by the Joint Royal College of Surgeons in Ireland/Royal College of Physicians of Ireland Working Group on Prevention of Surgical Site Infection (2012)

Healthcare-associated infection (HCAI) affects around one in twenty hospitalised patients in Ireland. Surgical site infection (SSI) is one of the commonest HCAI and results in significant morbidity and increased hospital costs.

This document has been drafted by the members of the joint RCSI and RCPI working group for the prevention of SSI. (Appendix 1)

It outlines a number of evidence-based recommendations to optimise practice and proposes a number of audit measures for the prevention of SSI. The key recommendations outlined in this document are not intended to be full policies and procedures but rather they should be incorporated into local policies and daily practice. The elements of the key recommendations are based on a recent literature review performed by Health Protection Scotland (see: <http://www.hps.scot.nhs.uk/haic/ic/publicationsdetail.aspx?id=50987>)

The Health Protection Scotland review graded the evidence using the Healthcare Infection Control Practices Advisory Committee (HICPAC) method as follows:

- Category 1A – strong recommendation based on high to moderate quality evidence
- Category 1B – strong recommendation based on low quality of evidence which suggest net clinical benefits harms or an accepted practice (e.g. aseptic technique)
- Category 1C – a mandatory recommendation
- Category II – a weak recommendation which shows evidence of clinical benefit over harm
- No recommendation – not sufficient evidence to recommend one way or another

In addition to the overall assessment of the evidence underpinning the recommendation, other factors such as the health impact and expert opinion on the potential critical outcomes were considered.

In the development of these measures adherence to accepted standard operating procedures regarding instrument sterility, theatre attire and conduct and operative technique have been assumed. These recommendations focus on the generality of surgery and so have not taken account of speciality specific recommendations eg. laminar flow theatres in orthopaedics, wound protectors in general surgery.

The key measures to prevent SSI outlined in this document should be considered by all healthcare staff that care for surgical patients and be applied into routine practice for the care of all patients. Auditing single dose surgical prophylaxis should be performed on a regular basis and incorporated into surgical audit and review.

The recommendations in this document lend themselves directly to a locally instituted, multidisciplinary quality improvement initiative. A multifaceted project-based approach may best promote reliable implementation. This approach could be based on the concept of a Surgical Care Bundle where a series of measures are developed by a multi-disciplinary team. These measures are then consistently and correctly performed on all patients with this performance being audited until complete compliance is achieved and maintained. This process has been demonstrated to be very effective in the reduction of a number of significant infections, notably central line infections and surgical site infections. (Cima et al, Pronovost et al)

This approach should include both ongoing education and training, and the careful examination of the structures and processes which underpin performance.

The measures suggested in this document are evidence based, and may be used as a baseline dataset for audit and improvement. Such audit with improvement is well aligned with professional regulatory body ongoing continued professional development (CPD) requirements.

## A: Key Recommendations for Practice

### 1. Pre-operative

- a. Avoid hair removal at the surgical site. If hair must be removed use single-patient use clippers and not razors. (1A)
- b. Wash the patient / ensure that the patient has showered (or bathed/washed if unable to shower) on day of or day before surgery (1B)
- c. Use the right drug at the right time for the right duration for antibiotic prophylaxis (1A)
  - i. Right drug: Prescribe antibiotic prophylaxis according to local antimicrobial prescribing guidelines
  - ii. Right time: Ensure that the antibiotic is given AT INDUCTION (WITHIN 60 MINUTES BEFORE SKIN INCISION). In surgery where a tourniquet is to be applied, a 15 minute period is required between the end of antibiotic administration, and tourniquet application.
  - iii. Right duration: SINGLE DOSE only unless otherwise indicated

Surgical prophylaxis should be prescribed in the appropriate section of the drug Kardex. The aim of surgical prophylaxis is to have maximum tissue antibiotic levels at the time of first incision. For this reason, prophylaxis is administered AT INDUCTION (WITHIN 60 MINUTES BEFORE SKIN INCISION). With the exception of a small number of surgical indications (see below), the duration of surgical prophylaxis should be a SINGLE DOSE, except in two circumstances, these are:

- Blood loss – fluid replacement: Serum antibiotic concentrations are reduced by blood loss and fluid replacement, especially during the first hour of surgery when antibiotic levels are high. In the event of major intra-operative blood loss (>1.5 litres) additional doses of prophylactic antibiotic should be considered after fluid replacement
- Prolonged surgical procedures: Many antibiotics, such as cephalosporins like cefuroxime, are short acting and therefore an additional dose should be administered during the surgery if the procedure lasts longer than 4 hours.

There are a number of types of surgery where single dose antibiotic prophylaxis may not be appropriate based upon the current available evidence. These are listed in the National Antimicrobial Stewardship Guidelines, and are as follows.

- Duration of prophylaxis involving more than a single dose but not for more than 24 hours:
  - Open reduction and internal fixation of compound mandibular fractures
  - Orthognathic surgery
  - Complex septorhinoplasty (including grafts)
  - Head and neck surgery (contaminated or clean-contaminated wound class)
  - Arthroplasty
- Duration of prophylaxis for more than 24 hours but not for more than 48 hours:
  - Open heart surgery

## 2. Intra-operative

- a. Use 2% chlorhexidine gluconate in 70% isopropyl alcohol solution for skin preparation (if the patient is sensitive/allergic, use povidone-iodine) (1A)
- b. Ensure that
  - i. the patient's body temperature is maintained above 36°C during the perioperative period (excludes cardiac patients) (1A)
  - ii. the patient's haemoglobin saturation is maintained above 95% (or as high as possible if there is underlying respiratory insufficiency) (1B)
  - iii. if the patient is diabetic that the glucose level is kept at <11mmol/l throughout the operation (1B)
- c. Give an additional dose of antibiotic if the surgical procedure is prolonged<sup>2</sup> or there is major intra-operative blood loss (>1.5 litres in adults or 25ml/kg in children ) - otherwise the duration of surgical prophylaxis should be a SINGLE DOSE
- d. Cover the surgical site (wound) with a sterile wound dressing prior to removal of drapes at the end of surgery(1A)



The RCPI/RCSI joint Surgical Site infection Committee supports the introduction of 2% chlorhexidine and 70% isopropyl alcohol to reduce SSI. This will result in less surgical site infections, reduced length of stay, avoidance of potential litigation following acquisition of an SSI, and significant cost savings. There will be additional acquisition costs for this product. Darouiche R *et al* in 2010 showed that a chlorhexidine/alcohol solution for surgical skin preparation reduced surgical site infections in clean contaminated surgery by 41% compared with povidone iodine scrub and paint. When comparing specific types of infection, chlorhexidine/alcohol solution was significantly more protective than povidone iodine against both superficial incisional infections (52% reduction) and deep incisional infections (67% reduction) The number needed to treat with chlorhexidine/alcohol solution instead of povidone iodine in order to prevent one case of surgical site infection was approximately 17, which makes this intervention compared with many others cost effective.

Skin must be allowed to dry thoroughly, avoid pooling of the disinfectant and the patient draped after their skin is dry. This is essential to prevent surgical fires associated with the use of alcohol-based antiseptics. The presence of fuel (e.g., anaesthetic gases, alcohol-based antiseptic solutions, and drapes), ignition sources (e.g., diathermy, lasers) and oxygen in operating theatres provide all the elements for fires to occur. It has been estimated that 50-200 such fires occur annually in the United States. (Caplan RA *et al.*) Alcohol-based skin antiseptic has been reported as the primary cause for some of these fires. (Patel R *et al.*, Spigelman AD) Rocos and Donaldson reported that 11 of the 13 fires reported to the National Patient Safety Agency between 2004 and 2011, were associated with the use of alcohol-based skin solution. Three practices were identified as the cause of these fires;

1. The solution not being allowed to dry
2. Swabs soaked in the solution remained in the operating field
3. Drapes soaked in the solution

Prevention therefore includes the following measures;

- Increase awareness of and educate staff on the risk of fires within the operating theatres and review systems and processes to minimise the risk
- In relation to fires associated with alcohol-based antiseptics the following practices have been recommended:
  - Follow the manufacturer's instructions on the use of alcohol-based solutions (Rocos B *et al.*)
  - Use an applicator that allows the dissipation of vapor, reduces the risk of pooling and excess application by controlling the flow of solution (Center for Medicaid.)

- Avoid pooling of the solution e.g. underneath the drapes, in the patient's umbilicus etc and ensure that the skin is allowed to dry following application (Rocos B *et al.*, Center for Medicaid., NICE; 2008, Medicines and Healthcare Products Regulatory Agency. SN 2000(17), Zahiri HR *et al.*)
- Avoid draping the patient until the skin is dry (Retzial K.)
- Ensure swabs soaked with solution are removed from operating field
- Consider using aqueous-based skin antiseptic for emergency procedures, where waiting for the alcohol-based solution to dry may compromise patient safety

### 3. Post-operative

- a. Do not tamper with or remove the surgical site (wound) dressing for 48hours post-op unless clinically indicated (II)
- b. Use aseptic (no touch) technique for surgical site (wound) inspection and/or surgical site (wound) dressing changes (1B)
- c. Hand hygiene is mandatory before and after every time the surgical site (wound) is inspected or the dressing is changed (1A)

Aseptic (no touch) technique aims to prevent micro-organisms on hands, surfaces or equipment being introduced to a surgical site or wound. A no touch technique with clean or sterile gloves, where appropriate, should be used for any change or removal of surgical site (wound) dressings.

## B: Audit measures

While there are many aspects of the key recommendations that can potentially be audited, the Working Group recommends that in the first instance, process measures such as those outlined below are used. The four process measures outlined in section B1 should be audited in the first instance and should be relatively easy to obtain/audit. Audit results can then be used to target areas that need improvements. Thereafter additional measures as outlined in section B2 should be used.

### B1: Initial Recommended Audit (Process) Measures

Audit Measure	
1.	% of patients who receive single dose antibiotic prophylaxis, where local guidelines specify only one dose is required
2.	% of patients who receive an additional dose(s) of intra-operative antibiotics if surgery lasts more than 4 hours where local guidelines specify more than one dose is required
3.	% of patients who receive an additional dose(s) of intra-operative antibiotics if intra-operative blood loss exceeds 1.5 litres where local guidelines specify more than one dose is required.
4.	% patients at 48 hours postop where surgical site (wound) dressing has not been removed or tampered with unless clinically indicated

## B2: Additional Audit Measures

The following measures are also suitable to audit compliance;

### 1. Process measures

<b>Right drug:</b>	% agreement with antibiotic agent choice for procedure compared to local guidelines % agreement with dosing recommendations compared to local guidelines
<b>Right time:</b>	% of patients who receive antibiotics in the 60 minute window pre-incision % of patient undergoing surgery where a tourniquet is to be applied, where antibiotic administration ends at least 15 minutes before tourniquet application
<b>Right skin preparation:</b>	% patients where 2% chlorhexidine gluconate in 70% isopropyl alcohol solution was used for skin preparation (exclude patients sensitive/allergic)
<b>Right hand hygiene:</b>	Hand hygiene compliance score (%) with breakdown by World Health Organisations (WHO) 5 moments and by healthcare staff category (%)

Outcome Measures:

- Surgical site infection rate for that procedure
- Interval between surgical procedure and the diagnosis of surgical site infection, especially the proportion diagnosed as in-patient and out-patient.



## C: Implementation

The key evidence-based recommendations outlined in this document should be adopted by all healthcare staff that care for surgical patients throughout all stages of that patient's surgical care. Surgical directorates should consider how these elements can be embedded into daily practice. A multidisciplinary team should be established to guide implementation. An initial audit should be performed to establish baseline compliance with the key recommendations. Thereafter the process should be defined and mapped (i.e., follow a surgical patient's journey with respect to these elements and map out all the relevant different healthcare workers involved in every aspect of these recommendations). Staff responsible for the various aspects of the recommendations will be identified by this process, and should be represented on the multidisciplinary team. The mapping process will likely identify key points in time/staff groups/factors that are critical for the implementation of the various recommendations. These factors may vary with the surgical procedure in question. The multidisciplinary group should then agree how improvements can be made with respect to these key factors including consideration of healthcare staff education, training, alerts and checklists. Subsequent audits of compliance using the suggested audit measures as outlined above should be used to track improvements and the results feed back to all relevant healthcare staff.



## Appendices – see separate document

- Appendix 1: Terms of Reference and Membership of RCSI and RCPI working group on SSI
- Appendix 2: Sample audit form for single dose surgical antibiotic prophylaxis
- Appendix 3: Suggested Measure to Improve the Appropriateness of Surgical Antibiotic Prophylaxis
- Appendix 4: Sources of Evidence and relevant links
- Appendix 5: Sample Business Case - Justification documentation for changing from Current Skin Antisepsis practice to 2% Chlorhexidine and 70% Isopropyl Alcohol Skin Antisepsis for use.

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## Key Recommendations for Practice - Appendices

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### Appendix 1:

## Terms of Reference and Membership of RCSI and RCPI working group on Surgical Site Infection

### Terms of Reference

1. To produce evidence based recommendations to prevent surgical site infection and to advise on their implementation and audit
2. To propose indicators (process and outcome) to prevent surgical site infection including consideration of surgical antibiotic prophylaxis indicators

### Membership

#### Joint chair:

- Dr Fidelma Fitzpatrick, Consultant Microbiologist, Beaumont Hospital and Health Protection Surveillance Centre, Dublin & RCPI and HSE Clinical lead - Prevention of Healthcare-associated Infection (RCPI)
- Mr. Paul McCormick, Colorectal & General Surgeon, St. James Hospital, Dublin (RCSI)

#### Members:

- Dr. Mary Browne, Consultant in Public Health Medicine, Quality and Patient Safety Directorate, HSE
- Dr. Robert Cunney, Consultant Microbiologist, Childrens Hospital Temple Street and Health Protection Surveillance Centre & Chair RCPI Hospital Antimicrobial Stewardship Subcommittee
- Mr. Sean Egan, Antimicrobial Pharmacist, Tallaght Hospital, Dublin
- Prof. Hilary Humphreys, Professor of Clinical Microbiology, RCSI and Consultant Microbiologist, Beaumont Hospital
- Mr. Seamas Mc Hugh, Surgical SpR
- Ms. Alison Mc Guinness, Infection Prevention and Control Nurse Specialist, St. Vincent's University Hospital, Dublin
- Ms. Fiona Murphy, Assistant Director of Nursing, ORIAN directorate, St. James Hospital, Dublin

## Appendix 2:

### Sample audit form for single dose surgical antibiotic prophylaxis

Pre-operative – at induction but before incision		
The patient received the correct antibiotic(s)	Was the prescribed antibiotic (s) recommended for this operation (i.e., in local surgical antibiotic prophylaxis guidelines)?	Yes/No
	Has a history of antibiotic allergy been recorded?	Yes/No
	Has the patient's recent microbiological history been considered/recorded when choosing the antibiotic (s) (e.g., history of MRSA or other multidrug resistant organism colonisation)?	Yes/No
The patient received the correct dose(s)	Has the patient received the correct dose for their weight, hepatic and renal function?	Yes/No
The antibiotic is given in the 60 minute window pre-incision (but 15 minutes before tourniquet application where one is applied)	Has the antibiotic been given within 60min of skin incision? If the procedure needs a tourniquet to be applied, check that it has not been inflated before beginning administration of the antibiotics	Yes/No
Intra-operative – post-incision, but pre-closure		
The patient should not receive an additional dose of antibiotic(s) unless indicated	Has the patient been re-dosed with antibiotics intra-operatively if they fall into one of the following pre-defined categories a. In longer surgery - the re-dosing time will vary depending upon the half-life of the drug in question, and the patients underlying renal and hepatic function. b. If blood loss of greater than 1.5 litres occurs intra-operatively	No additional dose given / additional dose given but indicated / additional dose given
Post-operative		
Post operative antibiotics are not prescribed unless otherwise indicated	Post-operative antibiotics should only be given if there is robust clinical evidence to support their use. For most patients pre-operative and intra-operative antibiotic prophylaxis will be sufficient. Note <b>- This does not apply to surgery where contamination has occurred and where infection has been diagnosed at surgery.</b> - Check local guidelines to identify if post-operative antibiotics are required.	Yes/No

## Appendix 3:

# Suggested Measure to Improve the Appropriateness of Surgical Antibiotic Prophylaxis

### Choosing the Right Agent

- Ensure processes and procedures are in place to alert prescribers in theatre to drug allergies. These procedures should be robust enough to identify allergy in patients who are unable to verbalise allergy in the operating room.
- Formulate local empiric antibiotic guidelines for surgical antibiotic prophylaxis which are evidence based, and take into consideration local microbiological epidemiology and patient factors.
- Ensure these guidelines provide recommendations for the treatment of patients with penicillin and cephalosporin allergy, and those with a history of MRSA colonisation or infection.
- Ensure that new staff members involved in the antibiotic selection process are fully educated on the agreed local policy and processes for antibiotic prophylaxis on entry to the institution.
- Ensure that these guidelines are readily accessible to view (online or hard copy) at the point of prescribing and administration in theatre.
- Ensure that there is clear designation of who is responsible in deciding which agent is to be given, who reconstitutes the drug, and who administers the drug. Consider how the agreed process fits in with other concurrent processes and procedures, and its amenability to timely antibiotic administration pre-incision (and pre-tourniquet application where this occurs).
- Ensure access is available to previous microbiological data on the patient undergoing surgery at the point of prescribing the antibiotic.
- Ensure access to the patient's past medical history is available at the point of antibiotic prescribing in theatre
- Ensure processes are agreed and in place to ensure the availability of timely expert advice if a patient falls outside agreed guidelines. This will be particularly important if a patient is known to be colonised with a less common potentially pathogenic organism.

### Choosing the Right Dose

- Ensure access to information on the patient's weight is available at the point of prescribing. This may require standardisation of the process of measuring and recording patient weight on the ward or in the outpatient's department before transfer to theatre.
- Ensure access to U&E and LFT results at the point of prescribing.
- Agree a local policy on dosing antibiotics which is evidence based. This will be of particular significance when dosing aminoglycosides, glycopeptides, or in patients at extremes of weight.
- Consider the application of specific dose calculators for drugs where multiple calculations are required – e.g. aminoglycosides.

## **Antibiotic Administration: Get it Right.**

- Examine the process in place for antibiotic administration. Examine at what stage in the pre-operative process antibiotics should be given. A balance needs to be struck between starting to administer antibiotics early enough to ensure adequate therapy, but not too late that incision time is delayed.
- Consider standardising the location of antibiotic administration e.g. induction room, on entry to the operating room etc. to ensure consistent practice.
- Consider the use of pre-agreed guidelines which allow for forward planning in drug and dose selection, and administration prior to the point of incision.
- Be aware of the time it takes to reconstitute and administer each required antibiotic and allow for this
- Ensure the procedure for tourniquet application includes a step to check if antibiotics have been administered before inflation of the tourniquet. Reliability may be improved by including a reminder to check about antibiotic administration on the tourniquet equipment.
- If a tourniquet is to be applied, set a countdown clock in theatre following the end of antibiotic administration to ensure a 15 minute time gap has elapsed before tourniquet inflation.
- Ensure the required antibiotics are readily available at the point of administration. Awareness of local guidelines and likely procedure throughput should guide stock levels.
- Ensure antibiotic vials and ancillary equipment are well ordered and clearly labelled in the theatre.
- Ensure guidance on antibiotic reconstitution and administration is readily available at the point of administration.
- Ensure that there is a standardised place to record antibiotic administration, drug, dose and time pre-incision and intra-operatively.
- Ensure that the initial incision cannot take place if antibiotics have not been administered at the pre-incision "time-out".

## **Additional Doses of Antibiotics**

**A patient is re-dosed with antibiotics intra-operatively if they fall into one of the following pre-defined categories**

- a. In longer surgery - the re-dosing time will vary depending upon the half-life of the drug in question, and the patient's underlying renal and hepatic function.**
  - b. If blood loss of greater than 1.5 litres in adults or 25ml/kg in children occurs intra-operatively**
- Provide robust reminder systems which prompt antibiotic re-administration in longer surgery, e.g. in-built alarms with local IT or anaesthetic equipment or a trigger at 4 hours post incision to highlight the need for re-administration?
  - Explore the option of providing alerts to prompt antibiotic re-dosing if blood loss has been above 1.5 litres in adults or 25ml/kg in children, e.g. a written reminder on stored blood, or on swab supplies.

**Post-operative antibiotics should only be given if there is robust clinical evidence to support their use. For most patients pre-operative and intra-operative antibiotic prophylaxis will be sufficient. Note - this does not apply to surgery where contamination has occurred or infection is diagnosed at surgery.**

- If antibiotics are required post-operatively, ensure processes are in place which enables clear communication to medical and nursing staff in the ward area with respect to indication/reason, name of drug (generic name), dose and duration.
- Post-operative antibiotics with a stop date should be prescribed on the patient's drug Kardex before the patient leaves theatre.

## Appendix 4:

### Sources of Evidence and relevant links

- Health Protection Scotland, targeted literature review, April 2012: What are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?  
<http://www.hps.scot.nhs.uk/haic/ic/publicationsdetail.aspx?id=50987>
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<http://www.who.int/patientsafety/safesurgery/en/index.html>
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- Hand Hygiene National Audit Tool. <http://www.hpsc.ie/hpsc/A-Z/Gastroenteric/Handwashing/HandHygieneAudit/>
- Aseptic Non Touch Technique. [http://www.antt.org.uk/ANTT\\_Site/Home.html](http://www.antt.org.uk/ANTT_Site/Home.html)
- Surgical site Infection – Protocol, Factsheets etc: <http://www.hpsc.ie/hpsc/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Surveillance/SurgicalSiteInfectionSurveillance/>
- Hand Hygiene e-learning tool on HSE Land:  
<http://hseland.aurionlearning.com/handhygiene/clinical/story.html>
- E-learning for surgeons: <http://www.surginfection.com/>

## Appendix 5:

### Sample Business Case - Justification documentation for changing from Current Skin Antisepsis practice to 2% Chlorhexidine and 70% Isopropyl Alcohol Skin Antisepsis for use.

**Summary:** 2% chlorhexidine and 70% isopropyl alcohol has been shown in randomised, double blind controlled trials to significantly reduce surgical site infections (SSI's). By reducing these preventable Hospital Acquired Infections (HAI's), by up to 41% (quoted results), 2% chlorhexidine and 70% isopropyl alcohol will generate significant savings in both bed days and hence costs as well as improving morbidity and patient outcomes.

#### Background: Evidence to support 2% Chlorhexidine and 70% Isopropyl Alcohol

Overall, there are 38 studies on 2% chlorhexidine and 70% isopropyl alcohol covering a broad range of applications across prevention of catheter related blood stream infections, surgical site infections and preventing false positive blood cultures. All show a significant improvement over every other type of skin preparation.

2% chlorhexidine and 70% isopropyl alcohol is *recommended* by or complies with the infection control guidelines of many organisations, including:

- UK Health Protection Agency Rapid Review Panel – **Recommendation 1 (A recommendation 1 means the NHS in England should include 2% chlorhexidine and 70% isopropyl alcohol in their pre operative skin preparation infection control protocols as appropriate)**
- Department of Health Saving Lives Delivery Programme 2005 Updated in 2010 for SSI's
- Epic2 Guidelines 2007
- Infectious Disease Society of America 2008
- DOH(2011) High Impact interventions-prevention of surgical site infections
- National Blood Service UK 2006
- National Kidney Foundation UK 2006
- Scottish Intensive Care Society Audit Group 2005
- American Association of Critical Care Nurses 2005

A study published in the New England Journal of Medicine by Darouiche R *et al* in 2010 showed that 2% chlorhexidine and 70% isopropyl alcohol reduced surgical site infections in clean contaminated surgery by 41% compared with povidone iodine scrub and paint. When comparing specific types of infection, 2% chlorhexidine and 70% isopropyl alcohol was significantly more protective than povidone iodine against both superficial incisional infections (52% reduction) and deep incisional infections (67% reduction)<sup>10</sup>. The number needed to treat with 2% Chlorhexidine and 70% Isopropyl Alcohol instead of povidone iodine in order to prevent one case of SSI was approximately 17<sup>10</sup>.

A study published in the Management of Infection Control showed that when 2% chlorhexidine and 70% isopropyl alcohol was introduced 25 months into a study investigating the effectiveness of HICPAC/CDC recommendations, the Central Venous Catheter related infection rate fell a further 62% from that obtained with earlier interventions<sup>12</sup>.

**How 2% Chlorhexidine and 70% Isopropyl Alcohol Works:** 2% chlorhexidine and 70% isopropyl alcohol works by rapidly killing microorganisms by the action of the alcohol denaturing cell protein. The chlorhexidine gluconate maintains persistent antimicrobial activity by disrupting the cell membrane and precipitating cell contents. Also as a sterile, single-use applicator, 2% chlorhexidine and 70% isopropyl alcohol promotes aseptic technique, as recommended in the SARI guidelines<sup>1</sup>. Applicators eliminate direct hand-to-patient contact, helping prevent cross-contamination. The sponge applicators' gentle-friction scrub helps the solution to penetrate the first five cell layers of the epidermis where microorganisms that can cause bloodstream infections and SSIs reside<sup>2</sup>. Applicators ensure a smooth flow of solution and prevent pooling on the patient's skin or the surrounding area.

The 70% isopropyl alcohol rapidly kills microorganisms versus free iodine, which requires two minutes to begin antimicrobial activity<sup>3</sup>. 2% chlorhexidine and 70% isopropyl alcohol maintains antimicrobial activity for at least 48 hours<sup>3,4</sup> compared to two hours for free iodine<sup>5</sup>. 2% Chlorhexidine and 70% Isopropyl Alcohol antimicrobial activity is effective against microorganisms including gram-positive and gram-negative bacteria, Methicillin-resistant *Staphylococcus aureus* (MRSA), Vancomycin-resistant Enterococci (VRE), *Clostridium difficile*, *Acineobacter* spp., and most viruses and fungi<sup>5,6,7</sup>. Remains active in the presence of blood, serum and other protein-rich biomaterials<sup>8</sup> unlike traditional iodophors, which are neutralized<sup>10</sup>. Chlorhexidine demonstrates low incidence of irritation<sup>9</sup>.

**Financial Implications:** By reducing preventable surgical site infection, based on the recent infection surveillance data and the 42% infection reduction rate postulated, a large hospital of 800 beds would annually save 1,771bed days and net financial savings of 789,420

## References

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