



衛生防護中心
Centre for Health Protection

Recommendations on Prevention of Surgical Site Infection

2nd Edition

**Scientific Committee on Infection Control, and
Infection Control Branch, Centre for Health Protection,
Department of Health**

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I. Background

The Scientific Committee on Infection Control (SCIC) endeavours to prevent surgical site infection. In this connection, the SCIC has developed the Recommendations on Prevention of Surgical Site Infection with the joint effort by *the Infection Control Branch, Centre for Health Protection, Department of Health* and *the Central Committee on Infectious Diseases and Emergency Response, Hospital Authority*. The recommendations provided by SCIC serve as guidance for the hospital colleagues in the formulation of strategies, programmes and plans for the prevention of surgical site infection.

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The 1st edition was dedicated to the late

Dr. Rosie Fan

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I. Introduction

Surgical site infection (SSI) remains the second most frequent type of HAI in high-income areas. (1) It accounts for 14% to 16% of hospital-acquired infections with reported rates ranged from 0.5% to 13%, depending on the type of surgery and patient characteristics. (2, 3) Applying strategies for the prevention of surgical site infection help to reduce surgical patients' morbidity, mortality and length of stay, and save cost for the healthcare institutions. (4)

2. All SSI prevention measures effective in adult surgical care are also applied to pediatric surgical care. (4)

3. Nowadays, more and more open surgeries are replaced by laparoscopic surgeries in Hong Kong and evidence shows that the risk of surgical site infection of laparoscopic surgery is comparatively lower. SSI prevention measures which are applied in open surgery (e.g. open cholecystectomy) in the recommendations are also indicated for their laparoscopic counterparts (e.g. laparoscopic cholecystectomy) unless indicated otherwise. (4)

4. It is widely accepted that patient risk factors, operative and environmental characteristics increase the risk of surgical site infection and few have been proven to independently influence the risk of surgical site infection. Some of the patient factors are not alterable, such as extremes of age. Cessation of smoking requires patient initiative and is appropriate for elective surgery only. Obesity may be associated with increased risk of surgical site infection.

5. Among the well accepted measures to prevent surgical site infection, the Institute for Healthcare Improvement highlights several imperatives for reducing surgical site infection. It is called bundle of care and although consists of four evidence-based components, is grouped as a single intervention and standard of care for patients undergoing surgical procedures. These components include appropriate use of antibiotics, appropriate hair removal, postoperative glucose control in patients undergoing major cardiac

surgery and postoperative normothermia in colorectal surgery patients. (5)

6. A multidisciplinary team work approach is necessary to successfully implement the preventive measures and improvement in surgical site infection. The team may include anyone who has a role in the surgical care process, e.g. surgical staff, anaesthesiologists, operating room assistants, infection control personnel, pharmacists, supporting staff, quality control officers, engineers, etc. All direct care healthcare workers should be educated of the risks of surgical site infection and preventive measures.

II. Recommendations on Prevention of Surgical Site Infection

A. Preparation of Surgical Patients

- (a) Eradicate or treat all infections remote to the surgical site before surgery whenever possible. (6, 7)
- (b) Screen patients for presence of hyperglycaemia and implement protocol to adequately control the serum blood glucose level perioperatively and during the first 48 hours postoperatively for both diabetic and non-diabetic patients undergoing cardiac and other major operations.(1, 8-11)
- (c) Minimize the preoperative length of stay of the patients in the hospital, such as completing pre-surgical assessments and correcting underlying conditions before admission to hospital for operation and performing elective surgery, where possible, in ambulatory day centres. (1, 4, 12)
- (d) Educate the patients about the increased risk of smoking on postoperative surgical site infection and encourage patients to stop smoking or taking any tobacco consumption at least 30 days before the operation. (4, 13-16)
- (e) Maintain normothermia (above 36°C) in the operating room and during the surgical procedure. The supportive measures include a combination of warmed blankets, warming devices, and warmed intravenous fluids, increase ambient temperature in the operating room, and a consistent method and equipment for monitoring patients' temperature. (1, 5, 16-19)
- (f) Optimize tissue oxygenation in adult patients undergoing general anaesthesia with endotracheal intubation for surgical procedures by administering an 80% fraction of inspired oxygen (FiO₂) intraoperatively and, if feasible, in the immediate postoperative period for 2-6 hours to reduce the risk of SSI. (1, 16)

B. Preoperative Care of the Operation Site

- (a) Remove hair if needed and when it interferes with the operation.

Perform hair removal immediately before surgery and preferably with a clipper. (16, 20, 21) Shaving is not recommended as it increases the risk for surgical site infection. (1)

- (b) Educate and assist patients in taking shower wash or bath at least the night before the operation. Either plain soap or an antimicrobial soap can be used. Preoperative showers reduce the skin's microbial colony counts but studies did not show reduction in SSI rates. (1, 4, 11, 22-25)
- (c) Chlorhexidine is a more effective skin disinfectant (26, 27) and repeated applications with this agent may be indicated for cardiac thoracic and orthopaedic surgical patients with known MRSA in hospitals and units where there is a high incidence of postoperative wound infections by MRSA or MRSE. (28-30)
- (d) Use alcohol-based antiseptic solutions containing chlorhexidine for surgical site skin preparation in patients undergoing surgical procedures (1)
- (e) Colonic preparation and lavage perioperatively is unnecessary in colorectal surgery for preventing anastomotic leaks and wound infections. (31, 32)
- (f) Inspect and clean gross contamination of skin at and around the incision site before performing preoperative antiseptic skin preparation in the operating theatre. (4)
- (g) Do not perform preoperative antiseptic skin preparation of the incision site in the clinical areas, such as in the ward or patient's bedside. (4)
- (h) Antiseptic skin preparation should include surgical incision and drain sites.(4)

C. Preoperative Surgical Hand Preparation of Surgical Team

- (a) Nails should be kept short. Artificial fingernails are prohibited. Rings, wrist-watch and bracelets should be removed before surgical hand preparation. (33)
- (b) On arrival in the operating theatre and after having donned theatre

clothing, or if hands are visibly soiled, wash hands with plain soap and water. This step should be done before surgical hand preparation. Remove debris from underneath fingernails using a nail cleaner, preferably under running water. Brushes are not recommended for surgical hand preparation. (33)

- (c) The surgical hand antiseptic product should be either an antimicrobial soap (e.g. 4% chlorhexidine or 7.5% povidone-iodine) or an alcohol-based handrub. (1, 33), Alcoholic Chlorhexidine was found to have greater residual antimicrobial activity. However, no clinical trials have evaluated the impact of scrub agent choice on SSI risk. (34-39)
- (d) When performing surgical hand antisepsis using an antimicrobial soap, scrub hands and forearms for the length of time recommended by the manufacturer, typically 2 to 5 minutes. Long scrub times (e.g. 10 minutes) are not necessary. (33, 40)
- (e) When using alcohol-based surgical handrub product with sustained activity, follow the manufacturer's instructions for application times and observe the following guidance: (33)
 - (i) Apply the product on dry hands only.
 - (ii) Do not combine surgical hand scrub and surgical handrub with alcohol-based products sequentially.
 - (iii) When using an alcohol-based handrub, use sufficient product to keep hands and forearms wet with the handrub throughout the surgical hand preparation procedure.
 - (iv) After application of alcohol-based handrub as recommended, allow hands and forearms to dry thoroughly before donning sterile gloves.
 - (v) The proper sequence for surgical hand scrub with a medicated soap and surgical hand rub with an alcohol-based technique is included in Appendix 2.

D. Antimicrobial Prophylaxis

- (a) Administer surgical antimicrobial prophylaxis as indicated, such as in some operations classified preoperatively as clean surgical wounds and clean-contaminated surgical wounds. Operations classified as contaminated or dirty surgical wounds are frequently receiving therapeutic antimicrobial agents preoperatively to treat related infections. They are not regarded as surgical antimicrobial prophylaxis.(41-44)
- (b) Select antimicrobial agents according to antimicrobial efficacy against the common pathogens most likely encountered in the specific surgical sites.
- (c) Antimicrobial dosage modification may be necessary for the elderly, the very obese individuals, those with renal failure and / or liver failure. New guidelines recommend weight-based dose adjustment. (16, 44)
- (d) Avoid using newer broad-spectrum antibiotics whenever possible. Relatively narrow spectrum antibiotics, such as Cefazolin and Cefuroxime are preferred.
- (e) Do not use Vancomycin as a routine surgical antimicrobial prophylaxis.
- (f) Use pre-operative Mupirocin nasal ointment 2 % and take shower wash or bath with Chlorhexidine gluconate 4% skin cleanser and shampoo in known carriers of Methicillin Resistant *Staphylococcus aureus* (MRSA) undergoing cardiothoracic and orthopaedic surgeries with implants where morbidity and mortality due to surgical infections are significant. (1, 16, 28, 44-46)
- (g) The duration of antimicrobial prophylaxis should not routinely exceed 24 hours. (41, 44)
- (h) For many prophylactic antimicrobial agents, the administration of an initial dose should be given within 30 minutes before surgical incision to achieve an adequate tissue concentration at the time of initial incision. Administer additional intraoperative doses if the operation time exceeds two serum half-lives of the antimicrobial agent, or massive intraoperative blood losses occur (>1500ml). Administration of vancomycin and fluoroquinolones should begin within 120 minutes

before surgical incision. (44)

- (i) Antimicrobial irrigation (e.g. intra-abdominal, deep, or subcutaneous tissues) for the prevention of SSI is of uncertain benefits and harms. (13)
- (j) Whenever a proximal tourniquet is required, complete the infusion of the prophylactic antimicrobial agents before the tourniquet is inflated.
- (k) For cesarean section, administering the initial dose of antimicrobial prophylaxis prior to skin incision is now considered more effective than after the umbilical cord is clamped. (43, 47)
- (l) Laparoscopic cholecystectomy carries a low rate of postoperative infection, attributable to the relative minor trauma, earlier patient mobilization and prompt resumption of nutrition. (48, 49) Antimicrobial prophylaxis does not seem to lower the incidence of postoperative infective complications, as demonstrated by several randomized controlled trials. (49-51) At present the use of antibiotic prophylaxis in elective laparoscopic cholecystectomy is still controversial.
- (m) For suggestions on indications and choice of prophylactic antimicrobial agents please refer to Appendix 1.

E. Ventilation and Environment in the Operating Theatre

- (a) Exert traffic control of operating room by restricting the number of people allowed in the operating room. Keep doors closed to prevent in and out traffic, and limiting unnecessary movement and talking once in the operating room. (4, 13, 52-55)
- (b) Maintain positive-pressure ventilation in operating rooms with respect to corridors and adjacent areas. (4, 13, 52) A programme for periodic checking and system maintenance assessment is important to ensure that the target pressure gradient is maintained and that out of range performance can be detected. (52-56) A device or a simple visual method which requires a minimum differential pressure to indicate airflow direction is desirable.
- (c) Maintain the ventilation at a minimum of 20 air changes per hour (ACH) of which at least 4 ACH should be fresh air (4, 13, 57). Airflow

monitoring device(s) with alerting feature for out of range performance should be in place. A program for periodic checking and system maintenance assessment is important to ensure that the target airflow is maintained. (52-54)

- (d) Filter for all incoming air through MERV 7 & MERV 14 filters (or equivalent) at a minimum (53, 54, 56, 57)
- (e) Introduce air at the ceiling and exhaust air near the floor. (4, 13, 52, 55)
- (f) Laminar airflow ventilation systems (ultraclean air) and ultraviolet irradiation are not necessary to decrease overall surgical site infection risk, even for orthopaedic implant operations, if appropriate antiseptic precautions and prophylactic antibiotic policy are implemented (4, 13, 52, 58-60).
- (g) Maintain relative humidity at 20-60% and temperature at 20-24°C. (53, 54)
- (h) Do not shut down the heating, ventilation and air conditioning systems for purposes other than required maintenance, filter changes and construction. (52-54)
- (i) The design of sinks should reduce risk of splashes. (33) If strainers are used in water taps, they should be inspected, cleaned, descaled and disinfected regularly or on a frequency defined by the proper risk evaluation, taking account of the manufacturer's recommendations. (61)
- (j) Do not use tacky mats at the entrance to the operating room suite or individual operating rooms for infection control. (4, 52)
- (k) Microbiologic air sampling
 - (i) Allow adequate time for commissioning including microbiological assessments by the hospital infection prevention and control team before an operating theatre is first used and after any substantial modifications that may affect airflow patterns in pre-existing theatres. (62) As microbiological sampling is time consuming, the use of particle counters may be of value. (63) However, air particle count does not reliably correlate with

microbiological sampling thus cannot be a replacement of the latter. (63-65)

- (ii) Do not perform microbiological air sampling routinely, provided that engineering parameters such as air distribution, air change rates, pressure differentials and airflow, etc. are satisfactory and regularly monitored. Such sampling should be done as part of an epidemiological investigation, validation of changes in products e.g. HEPA filters, maintenance of operating theatres or as advised by the hospital infection control team. (4, 13, 59, 60)
- (iii) For conventional operating rooms, aerobic cultures on nonselective media should not exceed ten bacterial and/or fungal colony forming units per cubic metre (CFU/m³). (56, 66)
Initiate an appropriate course of action e.g. re cleaning of the environment and re testing if results are outside the limits If repeat testing produces results above acceptable levels the HVAC systems should be reviewed by the appropriate personnel. (66)

F. Surgical Attire and Drapes

- (a) Wear surgical mask to fully cover mouth and nose. (4, 13)
- (b) Wear cap or hood to fully cover head and face hair. (4, 13)
- (c) Surgical gowns and drapes should be sterile and resistant to liquid penetration and remain effective barriers when get wetted. (4, 13)
- (d) Scrubbed surgical team members should wear masks, caps, sterile gowns and gloves. (4, 13) Wearing additional glove barriers, such as double latex gloves or orthopaedic gloves is recommended during procedures that have a high risk of glove perforation. (67, 68) Glove(s) should be changed when perforation is noted. (16)
- (e) Other personnel in the operating theatre must wear surgical masks if an operation is being performed or if sterile instruments are exposed. (4, 13)
- (f) Use sterile surgical drapes to create a barrier between the surgical field and the environment or potential source of bacteria. (4, 13)

- (g) Change surgical gowns and scrub suit if visibly soiled or penetrated by blood or body fluids. (4, 13)
- (h) Shoe covers are not necessary for prevention of surgical site infection. (4, 13)

G. Sterilization of Surgical Instruments

- (a) All surgical instruments, especially those with long and narrow lumens, hinges must be clean and decontaminated adequately before sterilization process. (69, 70)
- (b) Heat resistant surgical instruments should receive steam sterilization. Heat sensitive instruments can use low temperature sterilization technology, such as hydrogen peroxide plasma, peracetic acid and ethylene oxide sterilization. (71)
- (c) Laparoscopes, arthroscopes and other scopes that enter normally sterile tissue should be sterilized. When it is not feasible, they should at least be treated with high level disinfection after thorough cleansing. (70, 72, 73)
- (d) All endoscopes and accessories used in endoscopy should be reprocessed following every endoscopic procedure, using a uniform, standardized reprocessing protocol. (73)
- (e) Immediate-use steam sterilization (IUSS, formerly known as flash sterilization) of surgical instruments should only be used for emergency with no alternatives. IUSS of implant devices, prosthesis and power instruments or simply to save time should be avoided. (74-76)
- (f) Standard procedures and staff proficiency to carry out IUSS should be monitored. (76)
- (g) IUSS record (i.e. load identification, patient/ hospital's identifier, mechanical, chemical +/- biological result) should be maintained and updated for epidemiological tracking and for an assessment of the

reliability of the sterilization process. (70, 75, 76)

- (h) To assure sterility and proper handling of instruments, a quality control programme should be established and documented. (4, 75, 76)

H. Asepsis

- (a) The principle of aseptic technique should be complied during operations, when inserting intravascular devices, administration of admixture and medication, or placing anaesthetic devices. (4)
- (b) Sterile surgical instruments, medications and solutions should be assembled just prior to use. (4)

I. Surgical Technique

- (a) Maintain good operative techniques during the operation, such as, gentle tissue handling to minimize trauma, minimal use of cautery, careful haemostasis, adequate debridement and removal of dead, devitalized tissue and foreign bodies. (4, 13)
- (b) If the surgical site is heavily contaminated, leave the incision open to close later when it is clean. (4, 13, 77)
- (c) Use close suction drain and insert through a separate incision if surgical drainage is necessary. Remove the drain as soon as possible. (4, 13)

J. Postoperative Incision Site Care

- (a) Cover the primarily closed clean surgical wound with sterile dressing and keep it intact for 24-48 hours postoperatively (4, 13). If excess oozing is noted, the dressing should be replaced. (78-80)
- (b) Use normal saline to cleanse and remove surface bacteria and discharge from wound. (81)
- (c) Perform hand hygiene before and after touching the surgical site or changing dressing. (4, 13)

- (d) Teach the patients and their carers how to care and monitor the incision site, signs and symptoms of surgical site infection and to report if any problems occur. (4, 13)

K. Surgical Site Infection Surveillance

7. Surgical Site Infection Surveillance with feedback of surgical infection rates to surgeons is one of the successful strategies to help reduce surgical site infection. (82-84) All hospitals with surgical services are recommended to undertake surveillance of surgical site infection using trained infection prevention personnel. (85)

8. The main components include:

- (a) Select certain categories of operations in the scope of the surgical site infection surveillance based on risk and volume of procedures in local hospitals. (16, 84)
- (b) Use standardized methods and definitions, such as National Healthcare Safety Network (NHSN) for data collection and analysis. (4, 86)
- (c) Trained infection prevention personnel with knowledge and understanding of epidemiology, surveillance and plan of the programme should be responsible for case-finding and applying definitions. (85)
- (d) Perform consistent post discharge surveillance of surgical site infection to capture the infection incidence that occurs outside the hospitals, which was essential to make the surveillance data more accurate and complete. (84, 87, 88)
- (e) Stratify operations according to the surgical site infection risk index determined by wound class, ASA score and duration of operation. (89, 90)
- (f) Report the stratified, operation-specific surgical site infection rates periodically to the surgical team members and other stakeholders. (4)
- (g) Benchmark the surveillance data with local and international

benchmark data like the NHSN system. (84, 86, 90)

- (h) Periodically evaluate and validate the application of definition, data and process of the surgical site infection surveillance to ensure high quality and accuracy. (84, 85)
- (i) Investigate outbreak or abnormal clustering of surgical site infection ascribing to, such as clustering of organisms, healthcare personnel or airborne source and make recommendations to frontline staff. (4)

L. Quality Measures

9. Quality measures should be established to assess the effectiveness of implementing the recommendations. The following parameters can be used as performance indicators:

- (a) Surgical site infection rate (stratified by risk and use bench mark). (16, 87)
- (b) Process measures as appropriate e.g. percentage of surgical cases with appropriate timing, selection, dosage and duration of prophylactic antibiotic in accordance with item 4 above. (16, 85)
- (c) Ventilation and environmental parameters of the operating theatres as listed in item 5 above.

M. Management of surgical patients suspected or confirmed of pulmonary tuberculosis (TB) or other airborne infections

- (a) A system of detection and communication should be established to evaluate surgical patients prior to surgery and communicate to relevant departments to facilitate arrangement of necessary infection control measures. (91, 92)
- (b) There is no recommendation for changing pressure in operating room from positive to negative or setting it to neutral. (50, 92)
- (c) Perform only emergency operations or diagnostic procedures as indicated. Postpone elective surgery until after the infectious period or

after effective therapy if delaying the operation does not cause increased risk to the patients. (92)

- (d) Schedule patient as the last case of the day to provide maximum time for adequate air changes if the delay of operations does not cause increased risk to the patients.
- (e) HEPA filters should be installed in the exhaust duct leading from the operating room into the general circulating system if air is to be re-circulated. This is allowed in existing facilities only. For new facilities, recirculation is not allowed. Exhaust air directly outdoor would be required in areas with potential contamination. (57, 92, 93)
- (f) Install high-efficiency filters between the anaesthesia breathing circuit and the patients. (50, 92) The entire breathing circuit should be changed and safely discarded after used (94, 95). Close suctioning system is preferred.
- (g) N95 respirators without exhalation valves should be worn for respiratory protection of surgical personnel in the operating theatre. (52, 92)
- (h) Perform aerosol generating procedures, such as intubation and extubation in an airborne isolation room if feasible. (52)

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III. Appendix 1: Suggested Guidelines for Surgical Antimicrobial Prophylaxis

IMPACT (5th Edition) Part VI: Guidelines for surgical prophylaxis

IMPACT Website



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IV. Appendix 2: Protocol for surgical scrub with medication and surgical hand preparation technique with an alcohol-based handrub formulation.

(Source: WHO guideline on hand hygiene in healthcare facilities 2009)

Table I.13.2

Protocol for surgical scrub with a medicated soap

Procedural steps
<ul style="list-style-type: none">• Start timing. Scrub each side of each finger, between the fingers, and the back and front of the hand for 2 minutes.• Proceed to scrub the arms, keeping the hand higher than the arm at all times. This helps to avoid recontamination of the hands by water from the elbows and prevents bacteria-laden soap and water from contaminating the hands.• Wash each side of the arm from wrist to the elbow for 1 minute.• Repeat the process on the other hand and arm, keeping hands above elbows at all times. If the hand touches anything at any time, the scrub must be lengthened by 1 minute for the area that has been contaminated.• Rinse hands and arms by passing them through the water in one direction only, from fingertips to elbow. Do not move the arm back and forth through the water.• Proceed to the operating theatre holding hands above elbows.• At all times during the scrub procedure, care should be taken not to splash water onto surgical attire.• Once in the operating theatre, hands and arms should be dried using a sterile towel and aseptic technique before donning gown and gloves.

Figure I.13.1

Surgical hand preparation technique with an alcohol-based handrub formulation

The handrubbing technique for surgical hand preparation must be performed on perfectly clean, dry hands. On arrival in the operating theatre and after having donned theatre clothing (cap/hat/bonnet and mask), hands must be washed with soap and water. After the operation when removing gloves, hands must be rubbed with an alcohol-based formulation or washed with soap and water if any residual talc or biological fluids are present (e.g. the glove is punctured).

Surgical procedures may be carried out one after the other without the need for handwashing, provided that the handrubbing technique for surgical hand preparation is followed (Images 1 to 17).



1 Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the dispenser



2 Dip the fingertips of your right hand in the handrub to decontaminate under the nails (5 seconds)



3 Images 3-7: Smear the handrub on the right forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)



4 See legend for Image 3



5 See legend for Image 3



6 See legend for Image 3



7 See legend for Image 3



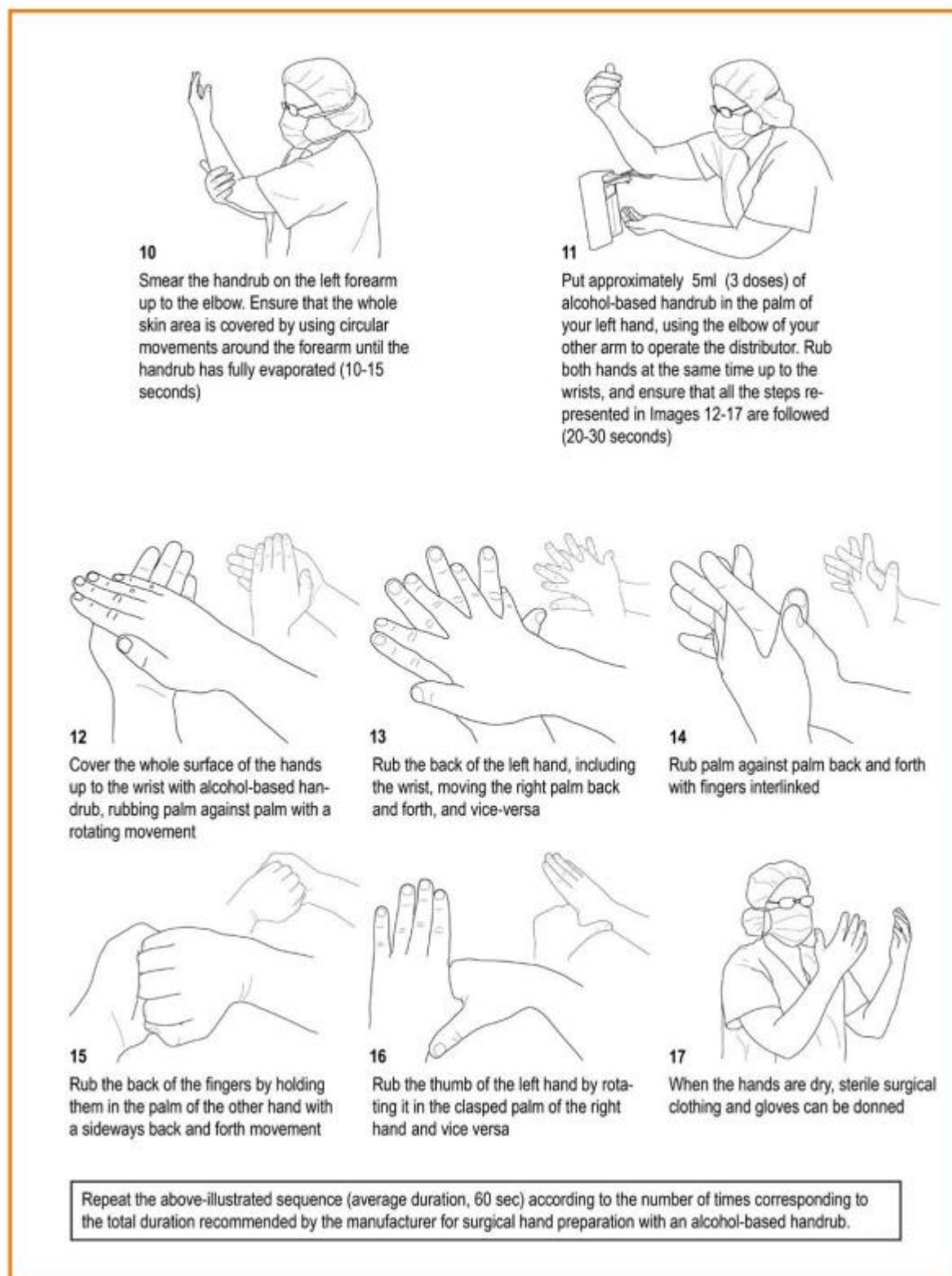
8 Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your right hand, using the elbow of your other arm to operate the dispenser



9 Dip the fingertips of your left hand in the handrub to decontaminate under the nails (5 seconds)

Figure 1.13.1

Surgical hand preparation technique with an alcohol-based handrub formulation (Cont.)



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Addendum 02/2019

Clause	Page	Amended clause
E(c)	13	Maintain the ventilation at a minimum of <u>20</u> air changes per hour (ACH) of which at least <u>4</u> ACH should be fresh air
M(a)	19	A system of detection and communication should be established to evaluate surgical patients prior to surgery and communicate to relevant departments <u>to facilitate arrangement of necessary infection control measures</u>
Reference 53, 54, 57	29	Updated reference
Reference 76	30	Updated reference