Te Tāhū Hauora
Health Quality & Safety Commission

SSII Surgical Site Infection Improvement Programme

Surgical skin antisepsis | Patuero ā-kiri hāpara

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Preface | Kupu takamua

The Surgical Site Infection Improvement Programme (SSIIP) is one component of the infection prevention and control (IPC) programme of Te Tāhū Hauora Health Quality & Safety Commission (Te Tāhū Hauora). It aims to reduce healthcare-associated infections, including surgical site infections (SSIs). It provides a consistent, evidence-based approach for collecting and reporting high quality data about hip and knee arthroplasty and cardiac procedures.

SSIs can cause emotional and financial stress, serious illness, longer hospital stays and long-term disability, and may result in loss of life. The consequences for patients, as well as health services, mean that the prevention of SSIs is extremely important. To address this, Te Tāhū Hauora has implemented the SSIIP in collaboration with all Te Whatu Ora districts nationally.

Through its consultative process, the SSIIP promotes culture change and practice improvements that focus on preventing SSIs. This encourages performance improvement by highlighting practice that may require change. The programme also provides intervention guidance on how to drive improvements that result in safer patient care and improved outcomes.

Surgical skin antisepsis is a simple and effective measure that helps to reduce the risk of SSIs (Maiwald and Chan 2012).

Document purpose | Te whāinga

This document provides guidance for optimal pre-operative skin antisepsis for the national orthopaedic and cardiac SSIIP in Aotearoa New Zealand.

The guide encourages health care professionals to use surgical skin antisepsis more effectively to improve the safety and quality of care that patients receive. This guide should be used alongside the SSIIP orthopaedic and cardiac surgery implementation guides.

This document supersedes the document *Surgical Skin Antisepsis Preparation Intervention Guidelines V 0.7 10 February 2014*.

Surgical skin antiseptics | Ngā wai patuero

Antiseptics can be defined as biocidal products that destroy or inhibit growth of microorganisms in, or on, living tissue, for example, the skin. Antiseptics include a wide variety of formulations and preparations including hand hygiene products, pre-operative skin antisepsis agents, ointments, creams, tinctures, mouthwashes and toothpaste. Overall, they should have the following characteristics:

- a wide spectrum of activity against bacteria, fungi and viruses
- rapid biocidal activity
- little or no damage, irritation or toxicity to the tissue
- little or no absorption into the body
- if possible, some persistent biocidal activity.

Pre-operative skin preparation of the operative site involves use of an antiseptic agent with both rapid and long-acting antimicrobial activity. Alcohol, chlorhexidine gluconate (CHG) and iodine (iodine tinctures or iodophors) are the most-used antiseptic agents.

Pre-operative skin preparations that combine alcohol (which has an immediate and dramatic effect on skin bacteria) with long-acting antimicrobial agents are more effective at preventing SSIs (IHI 2012; Jalalzadeh et al 2022):

- CHG in alcohol (at least 70%)
- povidone-iodine (PVI) in alcohol (at least 70%).

CHG in alcohol or PVI in alcohol significantly reduce the bacterial flora at the surgical site and maximise the rapidity, potency and duration of bactericidal activity when compared with other agents.

There are no differences reported for the rate of adverse events between CHG and iodine preparations.

CHG

The properties that make CHG highly effective are a strong affinity for binding to the skin, high antibacterial activity and a prolonged residual effect delaying bacterial re-growth.

CHG exhibits excellent activity against Gram-positive and good activity against Gram-negative vegetative organisms and fungi (APIC 2010).

Compared with iodine preparations, CHG has a longer residual effect, is more effective at reducing bacterial skin counts and is less affected by body fluids.

CHG is typically used in concentrations of 2% to 4% for hospital scrubs and hand washes, however, when the formulation includes alcohol, the concentration of CHG is usually 0.5% to 2%.

Iodine

Iodine has been widely used as an antiseptic. Traditional solutions in water or alcohol include tincture of iodine or Lugol's solution.

Iodophors are preparations that contain iodine and a solubilising agent such as a surfactant or povidone. In this way, a small amount of iodine is slowly released in solution. The most common iodophor used in surgery is PVI. PVI is most commonly used as a 10% solution (which contains 0.001% free iodine).

Iodophors have allowed for greater flexibility in the use of iodine in antiseptics. Depending on the concentration of free iodine, iodophors can be used for routine and high-risk applications such as surgical scrubs and pre-operative skin antisepsis. They are generally associated with low toxicity and little irritation.

The concentration of iodine varies depends on the formulation used. For example, 1% tincture of iodine, one formulation contains iodine poyacrylex (0.7% available iodine) and 74% weight to weight (w/w) isopropyl alcohol.

Recommended agents for surgical site skin antisepsis | Ngā momo patuero e tika ana

Surgical skin antisepsis is a simple and effective measure to reduce the risk of SSI (Maiwald and Chan 2012). The primary source of organisms contributing to infection following surgery is the bacteria on a patient's skin. The aim of skin antisepsis is to eliminate and rapidly kill skin flora at the site of a planned incision (Safer Healthcare Now 2011). Evidence supports the use of surgical skin antisepsis preparation for all classes of surgery.

Several recent reviews have examined the efficacy of different skin antisepsis agents in reducing SSIs (Ayoub et al 2015; Privitera et al 2017; Chen et al 2020; Peel et al 2021; Wade et al 2021; Jalalzadeh et al 2022). There is increasing evidence suggesting CHG in alcohol is associated with lower rates of SSI than PVI in alcohol (Kesani et al 2109; Chen et al 2020; Wade et al 2021; Seidelman et al 2023, Appendix 1).

Based on recent literature reviews, the preferred agent is CHG in alcohol.

PVI in alcohol is a suitable substitute if CHG in alcohol is not used.

Patients that are allergic to CHG should receive PVI in alcohol (at least 70%) as an alternative.

Alternative pre-operative surgical antisepsis preparations may be required when the availability and supply of preferred antisepsis agents are interrupted.

Alternative regimes should consider the following important points:

- Alcohol-based preparations are more effective at reducing SSIs than aqueous preparations.
- Tincture of iodine 1% contains iodine in alcohol.
- CHG 2.0–2.5% is recommended but if unavailable 0.5% or 4% concentrations are alternative choices.
- Sequential use of alcohol (70%) followed by either aqueous CHG or PVI can be considered.
- In the absence of either CHG or iodine products, alcohol (70%) should be used as a last resort.

Safe application of flammable skin antiseptics | He pani haumaru i ngā patuero ā-kiri

While fires in the operative theatre are extremely rare, alcohol-based antiseptics are flammable. The use of diathermy increases the risk of fire associated with these products. The following precautions are recommended for the use of alcohol based antiseptic skin preparations.

- Educate staff before using an alcohol-based preparation on how to be safe and effective in their application.
- Avoid dripping or pooling of alcohol-based solutions on sheets, padding, positioning equipment and adhesive tape, and on or under the patient.
- Ensure the liquid has completely dried by evaporation – three minutes is usually sufficient. Areas with excess hair may take longer to dry. Note that drying is essential for the biocidal activity of alcohol.
- Develop protocols that ensure the applied solution is completely dry before draping the patient.
- Use single-use applicators to apply flammable antiseptic agents.
- Cleanse the incision area for 30 seconds and then paint the rest of the area.
- Consider use of a tinted CHG in alcohol product for greater visibility.

Key points for surgical skin antisepsis | Ngā tino tohutohu

- Alcohol has an immediate bactericidal effect due to its evaporation; this must be given time to occur (around 3 minutes).
- CHG and iodine products have a residual antibacterial effect hours after their application.
- CHG is the preferred agent for skin antisepsis because:
  - CHG has a longer residual effect than PVI
  - CHG is more effective at reducing bacterial skin counts than iodine preparations
  - the activity of CHG is less affected by body fluids than iodine preparations (Appendix 1)
  - systematic reviews favour better outcomes compared with iodine preparations.
- Alcohol-based preparations are more effective at reducing SSIs than aqueous preparations.
- Alcohol skin preparations must be applied safely.
- There are no differences reported for the rate of adverse events between CHG and iodine preparations.

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Institute for Healthcare Improvement. 2012. *A how to guide: prevent surgical site infection for hip and knee arthroplasty*. Boston, MA: IHI. URL: http://www.ihi.org/knowledge/Pages/Tools/HowtoGuidePreventSSIforHipKneeArthroplasty.aspx.

Jalalzadeh H, Groenen H, Buis DR, et al. 2022. Efficacy of different preoperative skin antiseptics on the incidence of surgical site infections: a systematic review, GRADE assessment, and network meta-analysis. *The Lancet Microbe* 3(10): e762–e771. DOI: https://doi.org/10.1016/S2666-5247(22)00187-2.

Kesani VP, Talasila S, Sheela SR. 2019. Chlorhexidine-alcohol versus povidone-iodine-alcohol for surgical site antisepsis in caesarean section. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology* 8(4): 1359–63.

Maiwald M, Chan E. 2012. The forgotten role of alcohol: a systematic review and meta-analysis of the clinical efficacy and perceived role of chlorhexidine gluconate in skin antisepsis. *PLoS One* 7: e44277. DOI: 10.1371/journal.pone.0044277.

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Privitera GP, Costa AL, Brusaferro S, et al. 2017. Skin antisepsis with chlorhexidine versus iodine for the prevention of surgical site infection: a systematic review and meta-analysis. *American journal of infection control*. 45(2): 180–9. DOI: https://doi.org/10.1016/j.ajic.2016.09.017.

Safer Healthcare Now, Canada. 2011. Prevent Surgical Site Infections, Get Started Kit. URL: www.saferhealthcarenow.ca.

Seidelman JL, Mantyh CR, Anderson DJ. 2023. Surgical Site Infection Prevention: A Review. *JAMA* 329(3): 244–52. DOI:10.1001/jama.2022.24075.

Wade RG, Burr NE, McCauley G, et al. 2021. The comparative efficacy of chlorhexidine gluconate and povidone-iodine antiseptics for the prevention of infection in clean surgery: a systematic review and network meta-analysis. *Annals of surgery* 274(6): e481–e488. DOI: https://doi.org/10.1097/SLA.0000000000004076.

Appendix 1: Review of the evidence for choice of surgical skin antisepsis | Āpitihanga 1: He arotakenga taunaki mō te kōwhiri patuero ā-kiri hāpara

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
Adams D, Quayum M, Worthington T, et al. 2005. Evaluation of a 2% chlorhexidine gluconate in 70% isopropyl alcohol skin disinfectant. *Journal of Hospital Infection* 61(4): 287–90. DOI: https://doi.org/10.1016/j.jhin.2005.05.015	In-vitro study comparing six commonly used skin disinfectants against *S. epidermidis.* The disinfectants tested were: • 2%CHG-A • 70% alcohol • aqueous 10% PVI • 0.5% aqueous CHG • 2% aqueous CHG • 0.5% CHG-A.	All disinfectants achieved a log_{10} reduction factor of 5 in suspension ± protein. However, when challenged with biofilm, effectiveness was reduced reflecting inhibition of in the presence of organic matter. Most effective agents tested against *S. epidermidis* were 2% CHG-A and 10% aqueous PVI.	Suggests that 2% CHG-A may offer advantages over other CHG products. No alcohol and PVI comparator.	Need in-vivo studies to assess effectiveness of this product in the clinical situation.
Alexander JW, Solomkin JS, Edwards MJ. 2011. Updated recommendations for control of surgical site infections. *Annals of surgery* 253(6): 1082–93. DOI:10.1097/SLA.0b013e31821175f8	Updated guidelines for the prevention of surgical wound infections based on review and interpretation of current and past literature.	Findings from literature review inconclusive. Suggests CHG-A lowers skin count better than iodophor/alcohol. Both better than aqueous PVI.	Use an alcohol containing skin preparation containing CHG although alcohol/iodophors are also acceptable.	Use alcohol containing skin preparation with an additional antiseptic property, ie, CHG or iodophor.
Ayoub F, Quirke M, Conroy R, et al. 2015. Chlorhexidine-alcohol versus povidone iodine for pre-operative skin preparation: A systematic review and meta-analysis. *International Journal of Surgery Open* 1: 41–6. DOI:	Comparative randomised control trials of pre-operative CHG-A versus PVI studying SSI in clean, clean-contaminated and contaminated surgery –	Six studies included. The overall rate of SSI was 6.8% in the CHG-A group versus 11.0% in the PVI group ($P < 0.0002$).	Pre-operative surgical skin preparation with CHG-A is more effective than PVI in preventing SSI across clean and clean-contaminated surgery.	

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
https://doi.org/10.1016/j.ijso.2016.02.002	studies between 1980 and 2014.	CHG-A was superior to PVI in the prevention of SSI (RR 0.62; 95% CI 0.48–0.81).		
Carroll K, Dowsey M, Choong P, et al. 2014. Risk factors for superficial wound complications in hip and knee arthroplasty. *Clinical microbiology and infection* 20(2): 130–5. DOI: org/10.1111/1469-0691.12209	Retrospective cohort study of 964 patients undergoing primary or revision hip/knee procedures over an 18-month period. Multiple risk factors examined including skin antisepsis. Outcome measure: incidence and severity of superficial SSI.	Multivariable logistic regression analysis. Patients who received skin preparation with 0.5% CHG-A were at higher risk of superficial infection than those who received 1% iodine and alcohol, p = 0.012.	Authors acknowledge findings may reflect surgeon preference and experience and that skin preparation requires more evaluation/randomised control trials.	Limitations: single centre, retrospective, superficial SSI with 30-day follow-up only.
Chen S, Chen JW, Guo B, et al. 2020. Preoperative antisepsis with chlorhexidine versus povidone iodine for the prevention of surgical site infection: a systematic review and meta-analysis. *World Journal of Surgery* 44: 1412–24. DOI: https://doi.org/10.1007/s00268-020-05384-7	A meta-analysis aimed to evaluate the efficacy of CHG and PVI in the prevention of postoperative SSI and the incidence of corresponding skin adverse events. Thirty studies were included, including 29,006 participants.	CHG was superior to PVI in the prevention of postoperative SSI (RR 0.65; 95% CI 0.55–0.77; p < 0.00001). Further subgroup analysis showed that CHG was superior to PVI in the prevention of postoperative SSI in clean surgery (RR = 0.81; 95% CI 0.67–0.98; p = 0.03), and clean-contaminated surgery (RR = 0.58; 95% CI 0.47–0.73; p < 0.00001). However, there was no statistically significant difference in the incidence of	CHG was superior to PVI in preventing postoperative SSI, especially for the clean-contaminated surgery.	

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
		skin adverse events between CH and PVI groups.		
Darouiche RO, Wall Jr MJ, Itani KM, et al. 2010. Chlorhexidine–alcohol versus povidone–iodine for surgical-site antisepsis. *New England Journal of Medicine* 362(1): 18–26. DOI: 10.1056/NEJMoa0810988	Prospective randomised control trial involving 849 subjects over 4-year period in six hospitals in USA. Clean-contaminated surgery.	Overall rate of SSI was significantly lower in the CHG-alcohol group than in the PVI group.	Authors recommend use of 2% CHG with alcohol over aqueous povidone-iodine.	Comparison of CHG and alcohol versus aqueous povidone-iodine. Needed additional comparator arm with PVI and alcohol.
Dumville JC, McFarlane E, Edwards P, et al. 2013. Preoperative skin antiseptics for preventing surgical wound infections after clean surgery. *Cochrane Database of Syst Rev*. DOI:https://doi.org/10.1002/14651858.CD003949.pub4	Review of randomised control trials on pre-operative skin preparation. Multiple different formulations used.	Thirteen studies included. Only clean surgery included.	Majority under powered to show a difference. A single study from 1982 showed 0.5% CHG in methylated spirits reduced SSI compared to alcohol containing iodine paint.	Limited information provided. More research is required.
Hasegawa T, Tashiro S, Mihara T, et al. 2022. Efficacy of surgical skin preparation with chlorhexidine in alcohol according to the concentration required to prevent surgical site infection: meta-analysis. *BJS open* 6(5): zrac111. DOI: https://doi.org/10.1093/bjsopen/zrac111	Systematic review and meta-analysis was performed in 2020. SSI rates were compared between CHG–alcohol and PVI according to the concentration of CHG (0.5%, 2.0%, 2.5% and 4.0%).	The risk ratios of SSI for CHG–alcohol were significantly lower than those for PVI (RR = 0.71, 95% CI 0.52–0.97; RR = 0.52, 95% CI 0.31–0.86 respectively); however, no significant difference was observed in the compounds with a CHG concentration of more than 2.0%.	This study clarifies the usefulness of an alcohol-based CHG solution with a 0.5 per cent or higher CHG concentration for surgical skin preparation to prevent SSI.	
Jalalzadeh H, Groenen H, Buis DR, et al. 2022. Efficacy of different	Systematic review and network meta-analysis	Only 2.0–2.5% CHG-AI (RR = 0.75, 95% CI 0.61–0.92)	For adult patients undergoing a surgical procedure of any	Study used aqueous PVI.

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
preoperative skin antiseptics on the incidence of surgical site infections: a systematic review, GRADE assessment, and network meta-analysis. *The Lancet Microbe* 3(10): e762–e771. DOI: https://doi.org/10.1016/S2666-5247(22)00187-2	comparing different pre-operative skin antiseptics in the prevention of SSIs in adult patients undergoing surgery of any wound classification. Randomised control trials that directly compared two or more antiseptic agents (ie, CHG, iodine, or olanexidine) or concentrations in aqueous and alcohol-based solutions.	and 1.5% olanexidine (0.49, 0.26–0.92) significantly reduced the rate of SSIs compared with aqueous iodine.	wound classification, skin preparation using either 2.0–2.5% CHG in alcohol or 1.5% olanexidine is most effective in the prevention of SSIs.	
Kesani VP, Talasila S, Sheela SR. 2019. Chlorhexidine-alcohol versus Povidone-Iodine-alcohol for surgical site antisepsis in caesarean section. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology* 8(4): 1359–63.	Randomised prospective study of 560 patients undergoing caesarean sections over a 6-month period. CHG-A vs 10% PVI followed by alcohol. Outcome measure – any SSI or endometritis within 30 days.	The number of SSI was significantly lower in the CHG group than in the iodine group (6.95% vs 14.28%; p = 0.005). CHG-A was significantly more protective than iodine-alcohol against both superficial incisional infections (5.49% vs 10.10%, p = 0.03) and deep incisional infections (1.46% vs 4.18%, p = 0.04).	CHG-A provided superior skin antisepsis in comparison to PVI-alcohol.	
Lee I, Agarwal RK, Lee BY, et al. 2010. Systematic review and cost analysis comparing use of chlorhexidine with use of iodine for preoperative skin antisepsis to prevent surgical site infection. *Infection Control & Hospital*	Literature review and meta-analysis. Eighteen articles underwent review of full text. Included	Moderate quality of evidence to use CHG over iodine for skin antisepsis to prevent SSI. Moderate quality evidence that use of CHG is	Five of the trials included compared CHG-A with PVI aqueous (hence not comparable) see Darouiche et al. 2010	

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
Epidemiology 31(12): 1219–29. DOI: https://doi.org/10.1086/657134	nine randomised control trials.	associated with fewer skin cultures after application.		
Maiwald M, Chan ES. 2012. The forgotten role of alcohol: a systematic review and meta-analysis of the clinical efficacy and perceived role of chlorhexidine in skin antisepsis. *Plos One*. e44277. DOI: https://doi.org/10.1371/journal.pone.0044277	Systematic literature review of clinical trials and systematic reviews investigating compounds for blood culture collection, vascular access and surgical skin preparation.	Perceived efficacy of CHG often based on the efficacy of CHG and alcohol. Rapid effect of alcohol effect skin antisepsis is often overlooked and comparative studies compare alcohol containing preparations with non-alcohol containing.	Alcohol is a key component of any skin preparation. Surgery requires both immediate skin activity (alcohol) plus persistent activity (CHG or PVI) hence the combination of both.	Skin antiseptics should contain alcohol of at least 70% for rapid action and another skin antiseptic, eg, CHG or PVI for more persistent effect.
Ostrander RV, Botte MJ, Brage ME. 2005. Efficacy of surgical preparation solutions in foot and ankle surgery. *The Journal of Bone & Joint Surgery* 87(5): 980–5. DOI*:* 10.2106/JBJS.D.01977	Prospective study comparing elimination of bacteria from sites disinfected using three different products. Cultures were undertaken on 125 consecutive patients undergoing surgery on the foot/ankle. Three randomly selected preps were used: 0.7% iodine/alcohol; 3% chloroxylenol and 2% CHG-A.	Limited study by numbers. Too small a study to link to fully evaluate SSI rates. Did not measure levels of microorganisms on the foot prior to skin preparation.	Suggestion that chloraprep (CHG-Al) was more effective at reducing counts of skin organisms pre-operatively.	Under powered as sample size too small.
Peel TN, Watson E, Lee SJ. 2021. Randomised controlled trials of alcohol-based surgical site skin preparation for the prevention of surgical site infections: systematic review and meta-analysis. *Journal of Clinical Medicine* 10(4): 663. DOI: https://doi.org/10.3390/jcm10040663	Randomised controlled trials comparing CHG-A and alcohol-based iodophor for surgical site skin preparation were included.	The use of CHG-A was associated with a reduction in risk of SSIs compared with iodophor-alcohol (RR 0.79; 95% CI 0.67, 0.93).	The use of CHG-A skin preparations was associated with a reduced risk of SSI compared to iodophor-alcohol agents. However, the efficacy of alcohol-based preparation agents may differ according	

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
			to the surgical procedure group.	
Privitera GP, Costa AL, Brusaferro S, et al. 2017. Skin antisepsis with chlorhexidine versus iodine for the prevention of surgical site infection: a systematic review and meta-analysis. *American journal of infection control* 45(2): 180–9. DOI: https://doi.org/10.1016/j.ajic.2016.09.017	A systematic review from 2000 to 2014 to determine if recent evidence supports the hypothesis that CHG in pre-operative antisepsis is more efficient than other antiseptics in reducing SSI rates. The primary endpoint was SSI incidence and secondary skin bacterial colonisation.	Nineteen studies were included. Meta-analysis were conducted for comparable studies for both outcomes. The results of the meta-analysis, including all of the studies in which CHG was compared with iodophor, were in favour of CHG for both SSI incidence (RR = 0.70; 95% CI 0.52–0.92) and bacterial skin colonisation (RR = 0.45; 95% CI 0.36–0.55).	Moderate-quality evidence supporting the use of CHG for pre-operative skin antisepsis and high-quality evidence that the use of CHG is associated with fewer positive skin cultures.	
Seidelman JL, Mantyh CR, Anderson DJ. 2023. Surgical Site Infection Prevention: A Review. *JAMA* 329(3): 244–52. DOI: 10.1001/jama.2022.24075	A review of general strategies are supported by randomised trials to prevent SSI.	Interventions that are associated with lower rates of infection include use of CHG-A skin preparation (4.0% with CHG-A vs 6.5% with PVI plus alcohol).	Use of CHG-A skin preparation agents among other interventions can reduce the rate of SSI.	
Swenson BR, Hedrick TL, Metzger R, et al. 2009. Effects of preoperative skin preparation on postoperative wound infection rates a prospective study of 3 skin preparation protocols. *Infection Control & Hospital Epidemiology* 30(10): 964–71. DOI: 10.1086/605926	Eighteen-month study comparing three different skin preparations on SSI rates. PVI/alcohol; CHG/alcohol and iodine povacrylex in alcohol.	Use of each agent for 6 months each on all general surgery cases. SSI tracked for 30 days postoperatively.	No difference in primary outcomes between traditional povidone/iodine/alcohol and iodine povacrylex in alcohol. SSI 3% higher with 2% CHG-A.	Study involved general surgery patients so a mix of clean/clean-contaminated and contaminated cases. Study not randomised.

Authors/journal, title of publication	Description	Findings	Conclusions	Comment
Tschudin-Sutter S, Frei R, Egli-Gany D, et al. 2012. No risk of surgical site infections from residual bacteria after disinfection with povidone-iodine-alcohol in 1014 cases: a prospective observational study. *Annals of surgery* 255(3): 565–9. DOI: 10.1097/SLA.0b013e3182468b2d	Prospective study looking at skin microbial counts taken after skin disinfection with PVI-alcohol in 1,005 patients. Counts compared with SSI rates.	A total 3.6% of skin cultures revealed significant colonisation and 41 (4%) SSI were detected. Residual bacteria before incision was unrelated to SSI even after adjusting for confounding variables.	PVI-alcohol is an effective skin antisepsis agent.	Supports findings of Swenson et al 2009.
Wade RG, Burr NE, McCauley G, et al. 2021. The comparative efficacy of CHG and PVI antiseptics for the prevention of infection in clean surgery: a systematic review and network meta-analysis. *Annals of surgery* 274(6): e481–e488. DOI: https://doi.org/10.1097/SLA.0000000000004076	Randomised or non-randomised studies comparing the effect of different preparations of CHG and PVI on the dichotomous outcome of SSI. Excluded studies concerning combination antiseptics or sequential applications of different antiseptics. A network meta-analysis to estimate the relative efficacy of interventions using relative risks (rate ratio [RR]).	Seventeen studies comparing five antiseptics in 14,593 individuals. The overall rate of surgical site infection was 3%. CHG-A 4%–5% was ranked as the most effective antiseptic as it halved the risk of surgical site infection when compared to aqueous PVI (RR = 0.49, 95% CI 0.24, 1.02). Also to alcoholic PVI, although uncertainty was larger (RR = 0.51, 95% CI 0.21, 1.27). Adverse events related to antiseptic application were only observed with patients exposed to PVI.	CHG-A formulations of 4%–5% seem to be safe and twice as effective as PVI (alcoholic or aqueous solutions) in preventing infection after clean surgery in adults. Findings concur with the literature on contaminated and clean-contaminated surgery, and endorse guidelines world-wide which advocate the use of CHG-A for pre-operative skin antisepsis.	

CHG-A – Chlorhexidine gluconate in 70% alcohol; CI – confidence intervals; PVI – povidone iodine; RR – risk ratio; SSI – surgical site infection.