PRE-OPERATIVE BATHING AND SHOWERING

WHAT ARE THE BENEFITS?

Martin Kiernan @emrsa15
Clinical Director, GAMA Healthcare
Visiting Clinical Fellow, Richard Wells Research Centre, University of West London

Chlorhexidine gluconate

- Long acting topical antiseptic in use since 1954
  - Developed from a search for new antimalarials
  - Water soluble, active for hours after application
- Binds to negatively charged bacterial cell wall, causing osmotic changes, destroying the organism
  - Cationic so sticks to the skin
- Activity against Gram positive, Gram negative bacteria, Yeasts
  - No sporicidal activity

Milstone AM, et al. Clin Infec Dis 2008; 46:274-81
Lio PA, Kaye E. Inf Dis Clin North Ame;

Evidence Review

Cochrane Review (Webster and Osborne, 2015 5th update)

- Evaluated a total of seven clinical studies conducted between 1983 and 1992 involving 10,157 patients that analysed pre-op bathing or showering with 4% CHG compared with placebo, bar soap, or no bathing before hospital admission
  - preoperative bathing with CHG does not result in a significant reduction in SSIs involving clean surgical procedures

Evidence Review

Cochrane Review (Webster and Osborne, 2015 5th update)

- Authors clearly pointed out that one of the limitations they faced in conducting a systematic review was the quality of some of the studies
  - Search terms
    - #29 shower* or bath* or wash* or cleans* 2611
  - Wipes studies not included or excluded

Murray 2011

2% chlorhexidine gluconate cloths were used to wipe over the entire body one hour after showering.

Let's look at the studies

- Inconsistent
  - In four studies patients showered once, in two they showered or bathed twice, in one three times
  - Inadequate surveillance in five of the seven; only two used a standardised method for assessing SSI
  - Either no written or inadequate showering instructions in five of the seven studies
- Other issues
  - One took six years – unlikely this was the only practice change
  - Importantly no study reported patient compliance

Methodology is critical

- Studies pre-2009 that used 4% CHG liquid did not use a standard process
  - Researchers have only recently appreciated the importance of process that includes a consistent application of CHG to the surface of the skin (eg, leaving lather on the skin for one to two minutes before rinsing)
- Recent studies have generally focused on two standardised methods of using CHG preoperatively:
  - Method 1: one hour after a regular bath or shower, apply CHG to the skin surface by cleansing with cloths impregnated with 500 mg CHG
  - Method 2: apply liquid CHG (4%) directly to the skin surface during a shower and then rinse with water

Dose & Contact Time

- Two factors must be considered when evaluating this low risk/cost intervention
  - CHG skin concentration accumulates with repetitive application; single application may not approach concentration sufficient to inhibit skin flor
    - Nicoletti, G., et al. J Hosp Infect, 1990. **15**(4): p. 323-37.
  - CHG binding to skin protein influenced by amount of CHG exposed to the skin and duration of exposure prior to rinsing
    - Edmiston CE, et al. (2008) Preoperative shower revisited: can high topical antiseptic levels be achieved on the skin surface before surgical admission. *J Am Coll Surg.* 207: 233-239

Compliance is Critical

- What chance of
  - applying the liquid in a shower and allowing 2 min contact time?
  - bathing normally and then undressing an hour later to use a CHG Wipe?
- 29% didn’t complete protocol in recent work
  - Edmiston CE et al. J Am Coll Surg. (2014)
  - apathy, lack of interest, or that the patient did not fully realize the importance of completing the task
  - Used text messages to improve compliance

Learning from Experience
WHO review (2016)

Author (year); Study type	Outcome
Johnson et al (2010) J. Arthroplasty Retrospective Cohort *	• Fourteen infections occurred in the group that was not compliant (1.6% infection rate); No infections occurred in the compliant population (p=0.231) • Hip arthroplasty 157/897 (13.8%) completely complied with pre-op CHG protocol
Johnson et al (2013) J. Knee Surgery Retrospective Cohort *	• Lower incidence of SSI in knee arthroplasty found in patients using CHG cloths (0.6%) compared with patients undergoing only in-hospital perioperative skin preparation (2.2%) p=0.021 • Better compliance; only 38/1735 did not

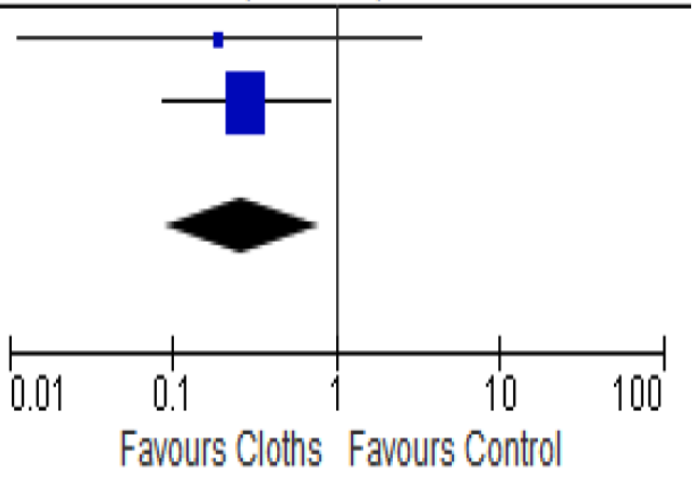
Listed in WHO review as prospective cohort but retrospective record review

Improving compliance
WHO SSI Guidelines (2016) Appx 2

Study or Subgroup	CHX Cloths Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Johnson 2010	0	157	14	897	14.9%	0.19 [0.01, 3.26]
Johnson 2013	3	478	38	1735	85.1%	0.28 [0.09, 0.92]
Total (95% CI)		**635**		**2632**	**100.0%**	**0.27 [0.09, 0.79]**
Total events	3		52			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.06$, df = 1 (P = 0.81); $I^2 = 0\%$

Test for overall effect: Z = 2.38 (P = 0.02)



Systematic review

Karki, S. and A.C. Cheng J Hosp Infect, 2012. **82**(2): p. 71-84

- 1 RCT, 2 before/after, 2 Cohort
  - Majority were Orthopaedic, one LSCS
  - Two site-specific, three whole-body
- Pooled analysis (ex-RCT) suggests that CHG 2% impregnated washcloths are associated with a significant reduction in the risk of surgical site infections (pooled RR: 0.29; 95% CI: 0.17-0.49)
  - Again, quality of studies was an issue
    - Not free from potential bias

Cloths reduce SSI

Graling et al. AORN J (2013) 97(5) 547-51

- Prospective Cohort Study, not RCT
  - Control group was retrospective (before/after?) Ortho/cardiac only, 4% liquid, compliance??
  - Intervention was all patients, compliance checked, superficial infection of dermis excluded

Infection	No-bath group 2007 (N = 284) Mean (95% CI)	CHG bath group 2008 (N = 335) Mean (95% CI)	Odds ratio (95% confidence interval)
Overall	18 (6.3)	7 (2.1)	3.17 (1.24, 9.10), $P = .01$
Postoperative deep	1 (0.35)	2 (0.60)	0.58 (0.001, 11.4), $P = 1.00$
Postoperative superficial	8 (2.8)	4 (1.2)	2.40 (0.63, 11.0), $P = .24$
Postoperative open space	4 (1.4)	0 (0)	†

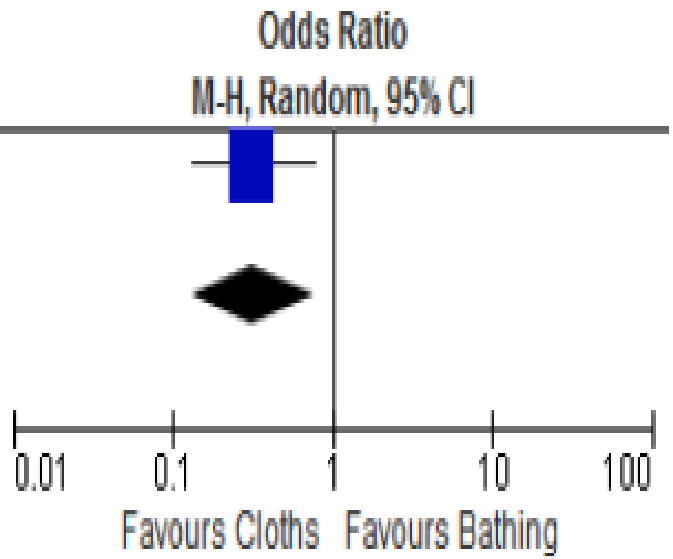
Cloths vs.bathing

WHO SSI Guidelines (2016) Appendix 2

Study or Subgroup	CHX Cloths Events	Total	CHX Solution Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Graling 2013	7	335	18	284	100.0%	0.32 [0.13, 0.77]
Total (95% CI)		**335**		**284**	**100.0%**	**0.32 [0.13, 0.77]**
Total events	7		18			

Heterogeneity: Not applicable

Test for overall effect: Z = 2.55 (P = 0.01)



Orthopaedic Opinion is quite strong

Bone Joint J 2013;95-B:1450–2

Use	Current evidence	International Consensus on Periprosthetic Joint Infection [49]
Preoperative skin cleansing	Evidence based on mostly observational studies. Clear reduction in skin bacterial load. Reduction in surgical site infection is less convincing. Multiple applications are required. Better compliance could be seen with cloths compared to showers.	Whole body cleansing with CHG starting at least the night before surgery (Strong Consensus)

Project JOINTS
IHI Initiative (USA)

- ‘New’ Practices in 2010
  - Use of an alcohol-containing antiseptic agent for pre-op skin prep
  - Instruct patients to bathe or shower with Chlorhexidine gluconate (CHG) soap for at least three days before surgery
  - Screen patients for Staphylococcus aureus (SA) and decolonize SA carriers with five days of intranasal mupirocin and bathing or showering with CHG soap for at least three days before surgery

Cost-effectiveness of CHG Cloths

Kapadia (2013) J Arthroplasty 28 1061-1065

- Economic evaluation of the cost in knee arthroplasty surgery
  - Single institution
  - Cost of treating 1,000 patients = $14,000
  - Assumption of reduction of infection rate from 1% to 0.6%
  - Net savings of >$0.5 million
    - Assuming cost of $130,000 per infection; average of two costed studies

Retrospective review

Kapadia (2013) J Arthroplasty 28 490-493

- Retrospective review
  - SSI significantly lower in patients using the 2% CHG protocol when compared to a cohort of patients who did not use the protocol (p=0.0428)
  - No real control group, just those that did not do it
- Did look at compliance
  - instructed to affix stickers from the packet upon use to the instruction sheet provided and to bring it with them on the day of surgery

Retrospective review

Kapadia (2013) J Arthroplasty 28 490-493

	Advance-Preparation Patients	No Advance Preparation Patients	*P*
Mean age [years] (range)	56 (14–84)	58 (12–106)	0.8140
Gender			
Men	235	836	0.4691
Women	322	1065	
Mean Body Mass Index [kg/m^2] (range)	29 (17–55)	38 (15–77)	0.7202
NHSN Risk Category			
Low (0)	349	1002	
Medium (1)	168	686	
High (2,3)	40	213	

Advance pre pre-op 2% CHG reduces incidence of SSI in knee arthroplasty

Zywiel et al. *International Orthopedics* 2010 Epub

Risk category	Compliance	Knees		
		Total joints operated	Number infected joints	Incidence (%)
Low	Non-compliant	256	4	1.6
	Compliant	52	0	0
Medium	Non-compliant	332	9	2.7
	Compliant	54	0	0
High	Non-compliant	123	9	7.3
	Compliant	30	0	0

Hip/Knee Arthroplasty RCT

Kapadia BH, et al. J Arthroplasty (2016) 31(12) 2856-2861

- Single centre prospective RCT (?blinded)
  - CHG Cloths night before/morning of surgery
  - Infection rate in the CHG cohort (0.4%) compared to standard-of-care (2.9%)
    - OR 8.15 (95% CI 1.01- 65.6, P=0.049)
    - Early termination – 'ethical considerations', so smaller study than intended

Cohort (n)	Treatment N (%)	Standard-of-Care N (%)	*P* Value
Overall (554)	1 (0.4%)	8 (2.9%)	.049
Primary THA (208)	0 (0%)	1 (1%)	
Primary TKA (234)	0 (0%)	2 (1.7%)	
Revision THA (46)	0 (0%)	2 (6.9%)	
Revision TKA (66)	1 (4.3%)	3 (7%)	

New Systematic Review

George S, et al Dimensions of critical care nursing (2016) 35(4):204-22

- Experimental and non-experimental studies that evaluated the effect of CHG in combination with intranasal mupirocin for decolonization were included
  - 19 studies were included in this review
  - Not many were of ‘good’ quality
- Results of this review indicate the combination of topical CHG and intranasal mupirocin is effective in reducing S aureus-associated SSIs

WHO Recommendations (2016)

- No. 3 - Pre-op bathing
  - evidence was insufficient to formulate any recommendation on the use of chlorhexidine gluconate-impregnated cloths for the purpose of reducing SSIs
    - Studies examined ranged from 1983-2013
- PICO Question 1
  - **Preoperative bathing or showering with CHG antiseptic soap vs. plain soap**
    - Overall, a moderate quality of evidence shows that preoperative bathing with CHG soap has neither benefit nor harm in reducing the SSI rate when compared to plain soap

WHO Recommendations (2016)

- PICO Question 2
  - **Preoperative bathing with CHG-impregnated cloths**
    - 2% CHG-impregnated cloths may be beneficial in reducing the SSI rate when compared to either bathing with CHG soap or no preoperative bathing
    - Very low quality evidence
    - No RCTs were found on this topic (cutoff Dec 2014)

WHO Recommendations (2016)

- No. 4 – Decolonisation for *Staph. aureus*
  - known nasal carriers undergoing cardiothoracic or orthopaedic surgery should receive perioperative intranasal mupirocin 2% ointment +/- a combination of CHG body wash
    - strong recommendation, moderate quality evidence
  - consider use of the same treatment in patients with known nasal carriage undergoing other types of surgery
    - conditional recommendation, moderate quality evidence
  - Role of screening not considered

Using CHG as part of a bundle

Schweizer et al, JAMA (2015) 313(12)

- All patients screened for MRSA and MSSA
  - Positive patients applied mupirocin intra-nasally twice daily and bathed with CHG once daily for up to 5 days immediately before their operation
  - Patients with negative MRSA and MSSA nasal screens bathed with CHG the night before and on the morning of surgery

Using CHG as part of a bundle

Schweizer et al, JAMA (2015) 313(12)

- S. aureus SSI rates
  - decreased significantly among patients in the fully adherent group but did not in the partially adherent or non-adherent group
  - decreased significantly after operations performed by surgeons that implemented all or part of the bundle, but not after surgery by those that did not implement any bundle elements

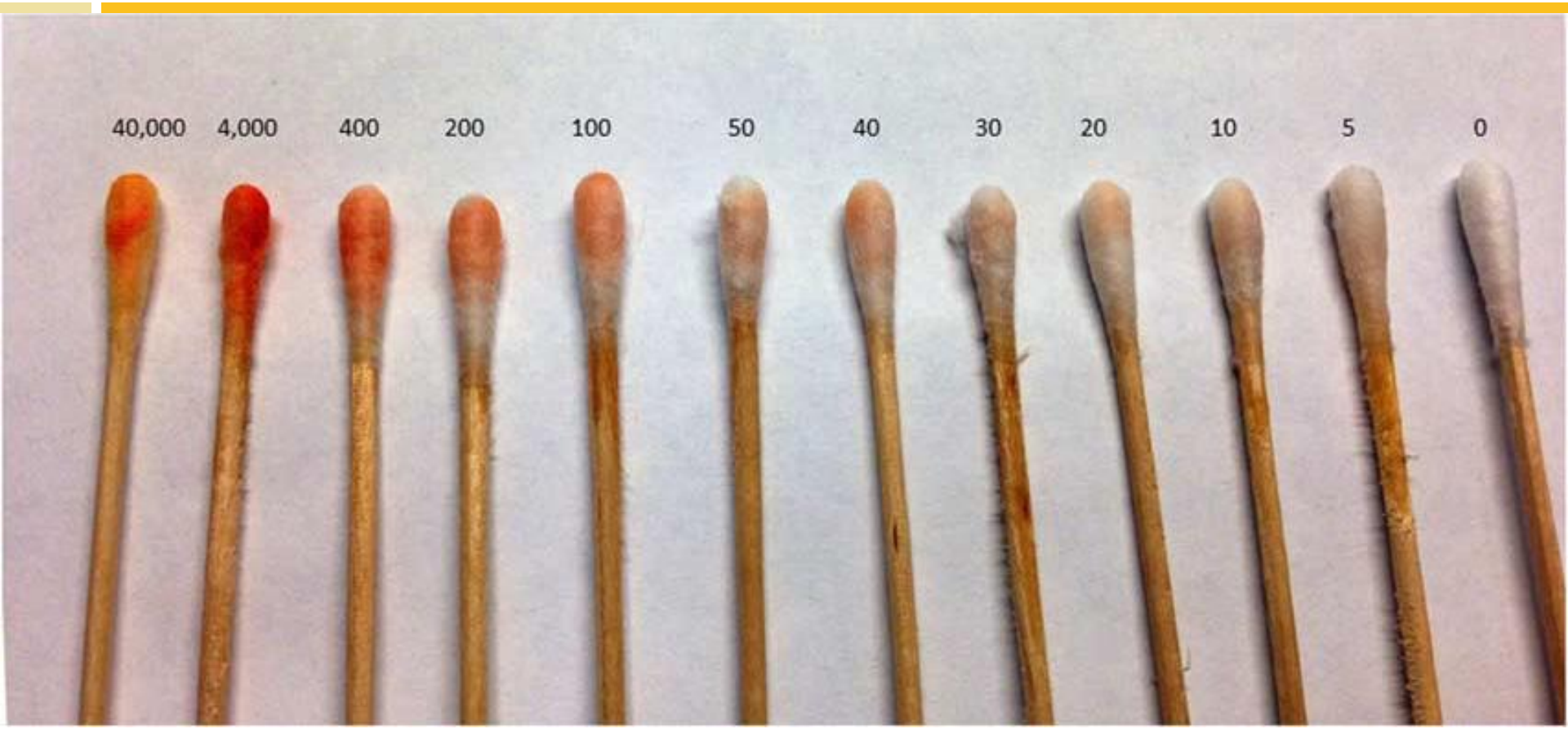
CHG Wipes and post-LSCS Morbidity

- Prospective RCT (? Blinded)
  - Ahmed, A et al (2016) J. Maternal-Fetal & Neonatal Medicine, DOI: 10.1080/14767058.2016.1219996
  - Intervention: 0.25% CHG wipes/1 min preoperative vaginal cleaning
  - Control: Standard prep, no pre-cleanse
- Infectious morbidity significantly reduced from 24.4% to 8.8% p=0.003
  - Endometritis 13.2% to 2.9% (p=0.008)
  - SSI 7.1% to 3.9% (p=0.05 NS)

Can we see if it is being used?
Supple et al, ICHE (2015) 36(9) 1095-7

- Blinded technician applied 120 µ L of freshly prepared solution containing 5 parts cetyltrimethylammonium bromide and 1 part sodium hypobromite to a swab
  - Cotton-tipped moistened swabs of 5cm^2 areas of the neck, chest, abdomen, arm and leg
  - Color change assessed within 30s by comparison to a standard curve
    - The limit of detection was ~ 5 (ppm)

Assessing concentration



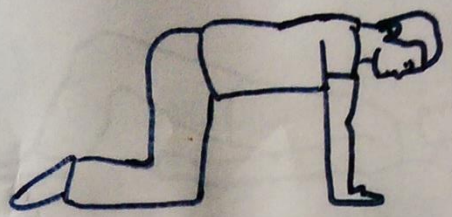
Results were ‘interesting’

- 6 of 45 patients (13%) using solution and 3 of 33 patients (9%) using cloths had no detectable CHG at any site
  - For positive sites, CHG concentration was higher with cloths vs solution (65.4 vs 20.8 ppm; $P < .01$)
- 20 of 78 patients (26%) indicated that they either did not receive application instructions or did not understand them
  - Those with undetectable levels on the neck said that their understanding was that cloths should be applied below the neck rather than from the neck down

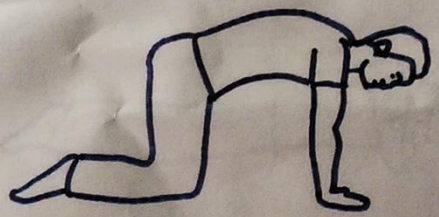
Information Booklets…

6. Pelvic Tilting and Kneeling

Kneel on all fours (knees under hips and hands under shoulders). Tense stomach muscles to prevent back from sagging.



Drop your head, round your shoulders, tip your pelvis backwards using your stomach and bottom muscles and release. Tighten, hold for a count of 2, then lower head and shoulders and release.



Start with 10 repetitions of each exercise twice a day. As you improve, gradually increase the number you do.

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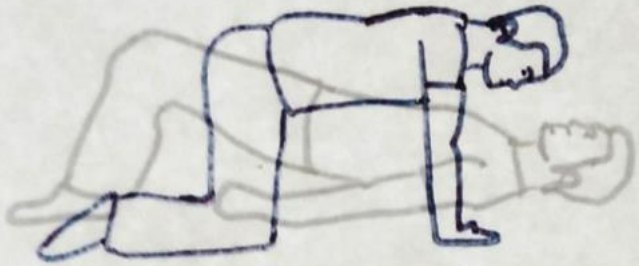

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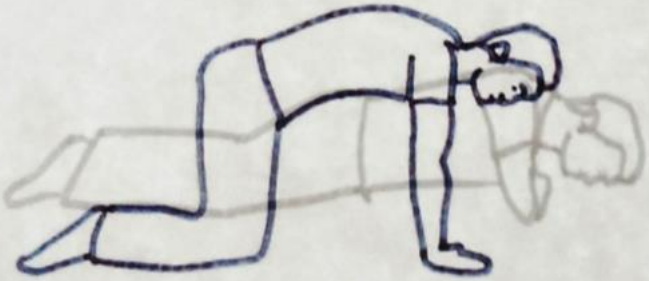

Start with 10 repetitions of each exercise twice

Should we worry about resistance?

Stephan Harbarth, ACIPC Conference 2015

- "The short answer is no"
  - Biocide resistance exists, but antibiotic resistance is clinically more important
  - Increase in antibiotic resistance in clinically important bacteria is not associated with increasing resistance to biocides
  - Resistance to disinfectants is not (yet) a major problem in healthcare

Conclusion?

- Interventions have the best chance of actually working if they are implemented
  - Reported compliance in studies is mostly terrible and not reported in early RCTs
- Would I use CHG preoperatively on
  - Myself or my mother?
    - Yes
  - My mother-in-law..
    - She can be the control