



## Major article

# Effect of chlorhexidine bathing in preventing infections and reducing skin burden and environmental contamination: A review of the literature

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*Staphylococcus aureus*  
Vancomycin-resistant  
Enterococcus

Chlorhexidine bathing is effective in reducing levels of pathogens on skin. In this review, we examine the evidence that chlorhexidine bathing can prevent colonization and infection with health care-associated pathogens and reduce dissemination to the environment and the hands of personnel. The importance of education and monitoring of compliance with bathing procedures is emphasized in order to optimize chlorhexidine bathing in clinical practice.

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Patients colonized or infected with health care-associated pathogens often carry the organisms on their skin.<sup>1–3</sup> Such contamination may lead to infection when factors such as devices, catheters, and wounds provide a route for pathogens on skin to reach normally sterile sites. Skin contamination may also contribute to transmission due to environmental shedding and transfer to the hands of personnel.<sup>1–3</sup> Thus, there is a strong rationale for efforts to reduce the burden of pathogens on skin.

During the past decade, a number of studies have examined the use of chlorhexidine bathing as an infection prevention strategy. This review examines the evidence that chlorhexidine bathing can prevent colonization and infection with health care-associated pathogens and reduce dissemination to the environment and the hands of personnel. We also consider recent evidence that chlorhexidine bathing is often suboptimal in clinical practice. The

importance of education and monitoring and feedback on compliance with bathing procedures to optimize chlorhexidine bathing is emphasized. The review was not conducted as a systematic review, but the MEDLINE electronic database was searched using broad search terminologies and recent review articles and their references were searched.

## CHLORHEXIDINE SPECTRUM OF ACTIVITY AND USE FOR SKIN ANTISEPSIS

Chlorhexidine is a cationic bisbiguanide antiseptic that alters microbial membrane integrity.<sup>4</sup> A variety of formulations are available, with chlorhexidine gluconate being most commonly used in health care settings. Chlorhexidine has broad-spectrum activity against gram-positive and gram-negative bacteria, yeasts, and some lipid-enveloped viruses. Potent sporicidal activity can be induced in chlorhexidine under altered physical and chemical conditions (eg, elevated temperature, altered pH, and addition of ethanol).<sup>5</sup> However, chlorhexidine does not have activity against bacterial spores under the conditions present on skin.

Due to its broad-spectrum antimicrobial activity and excellent safety profile, chlorhexidine is used in a wide variety of disinfectant, antiseptic, and preservative applications.<sup>5</sup> In health care settings, chlorhexidine has been used for several decades for hand hygiene and for disinfection of the skin of patients before surgical procedures and catheter insertion.<sup>4</sup> Chlorhexidine significantly reduces levels of resident and transient skin microbiota and has persistent activity for several hours after application.<sup>6</sup> Chlorhexidine

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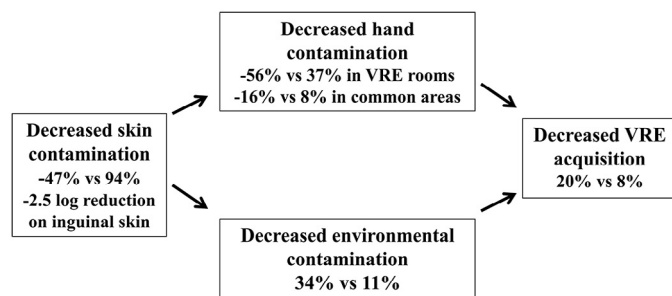
occasionally is associated with contact dermatitis, and rarely has been associated with anaphylaxis and hypersensitivity reactions.<sup>4</sup>

**EFFECT OF DAILY CHLORHEXIDINE BATHING ON SHEDDING OF PATHOGENS**

Skin contamination can be an important source of transmission of health care-associated pathogens through transfer to the hands of personnel and shedding into the environment.<sup>1-3</sup> To test the potential for skin decontamination to reduce transmission, Vernon et al<sup>7</sup> conducted a quasiexperimental study of daily chlorhexidine whole-body bathing in an intensive care unit (ICU). Vancomycin-resistant *Enterococcus* (VRE) was chosen for study as it is often present on the skin of colonized patients and it is a common cause of central line-associated bloodstream infections (CLABSIs). Patients were bathed daily with 2% chlorhexidine cloths during the intervention period and

standard soap-and-water baths or cloths cleansing without chlorhexidine was performed during control periods.

As shown in Figure 1, chlorhexidine bathing was associated with a reduction in detection of VRE on skin. For inguinal skin, there was a 2.5-log reduction in VRE concentrations in the chlorhexidine bathing group that persisted for at least 6-8 hours. The reduction in VRE on skin was associated with significantly reduced VRE contamination in the environment and on the hands of personnel. Moreover, there was a significant reduction in VRE acquisition in the ICU. The findings of Vernon et al<sup>7</sup> provide strong support for the concept of source control as a strategy to reduce dissemination of health care-associated pathogens (ie, reducing the burden of pathogens on the skin as a means to reduce dissemination to the environment or hands). Given its broad spectrum of activity, chlorhexidine bathing represents a horizontal infection prevention approach that can potentially reduce dissemination of multiple pathogens. In addition, it is in theory a very simple and easy to implement intervention because it involves substitution of chlorhexidine bathing for standard soap-and-water bathing.



**Fig 1.** Effect of daily chlorhexidine bathing on skin and environmental contamination and acquisition of vancomycin-resistant enterococci (VRE).

**EFFECT OF DAILY CHLORHEXIDINE BATHING ON COLONIZATION AND INFECTION WITH PATHOGENS**

Table 1 provides an overview of 14 studies that have evaluated the effect of chlorhexidine bathing using quasiexperimental, ward-level crossover, or stepped wedge design.<sup>7-22</sup> Several of the studies demonstrated reductions in levels of pathogens, including gram-negative bacilli, on skin.<sup>7,11,18</sup> For example, Popovich et al<sup>18</sup> reported significant reductions in gram-positive and gram-negative bacteria and *Candida* spp on skin. In 12 of the 14 (86%) studies, chlorhexidine bathing was associated with a significant reduction

**Table 1**  
Effect of chlorhexidine gluconate (CHG) bathing on colonization and infection with pathogens

Study	Setting	Chlorhexidine formulation	Design	Outcomes
7	Medical intensive care unit	2% chlorhexidine gluconate (CHG)-impregnated cloths	Quasiexperimental	Decreased vancomycin-resistant enterococci on patients' skin, health care workers' hands, and environment Reduced acquisition of vancomycin-resistant enterococci colonization
11	Medical intensive care unit	4% CHG solution	Quasiexperimental	Decreased <i>Acinetobacter baumannii</i> skin colonization and bloodstream infections
10	2 Medical intensive care unit wards	2% CHG-impregnated cloths	2 arm crossover trial	Decreased primary bloodstream infections
6	Medical intensive care unit	2% CHG-impregnated cloths	Quasiexperimental	Decreased central line-associated bloodstream infections and blood culture contamination
12	6 Intensive care units in 4 hospitals	2% CHG-impregnated cloths	Quasiexperimental	Decreased acquisition of methicillin-resistant <i>Staphylococcus aureus</i> and vancomycin-resistant enterococci Decreased vancomycin-resistant enterococci bacteremia
17	Long-term acute care hospital	2% CHG solution	Quasiexperimental	Decreased central line-associated bloodstream infection No change in ventilator-associated pneumonia
9	2 Intensive care units	4% CHG solution plus chlorhexidine acetate powder to groin, axilla, and skin folds	Quasiexperimental	Decreased acquisition of methicillin-resistant <i>S aureus</i> (non-qacA/B strains)
14	Trauma intensive care unit	2% CHG-impregnated cloths	Quasiexperimental	Decreased methicillin-resistant <i>S aureus</i> and <i>Acinetobacter</i> spp colonization Decreased central line-associated bloodstream infection
19	Surgical intensive care unit	2% CHG-impregnated cloths	Quasiexperimental	No decrease in central line-associated bloodstream infection
13	Trauma center intensive care unit	2% CHG-impregnated cloths	Quasiexperimental	Decreased central line-associated bloodstream infection
16	4 Medical wards	2% CHG-impregnated cloths	Quasiexperimental	Decreased methicillin-resistant <i>S aureus</i> and vancomycin-resistant enterococci infections No change in <i>Clostridium difficile</i> infections
21	Hospital-wide	4% CHG solution applied as bed bath or shower daily or 3 times per week	Quasiexperimental	Decreased <i>C difficile</i> infections No change in other hospital-associated infections
8	Oncology patients	2% CHG-impregnated cloths	Quasiexperimental	Decreased acquisition of vancomycin-resistant enterococci colonization
15	4 Long-term acute care hospitals	2% CHG-impregnated cloths	Stepped wedge bundle	Decreased <i>Klebsiella pneumoniae</i> carbapenemase-producing enterobacteriaceae colonization and infection, all-cause bacteremia, and blood culture contamination

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