Patients' Bath Basins as Potential Sources of Infection: A Multicenter Sampling Study

ARTICLE *in* AMERICAN JOURNAL OF CRITICAL CARE · FEBRUARY 2009

Impact Factor: 2.12 · DOI: 10.4037/ajcc2009968 · Source: PubMed

3 AUTHORS, INCLUDING:

Lauri Lineweaver
Presbyterian Healthcare Services
3 PUBLICATIONS **25** CITATIONS
SEE PROFILE

Lenora M Maze
Eskenazi Health
2 PUBLICATIONS **34** CITATIONS
SEE PROFILE

AJCC American Journal of Critical Care

Evidence-based interdisciplinary knowledge for high acuity and critical care

Patients' Bath Basins as Potential Sources of Infection: A Multicenter Sampling Study

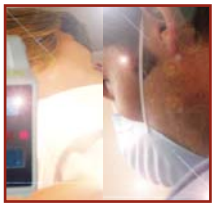
Debra Johnson, Lauri Lineweaver and Lenora M. Maze

Am J Crit Care. 2009;18: 31-40 doi: 10.4037/ajcc2009968

Published online http://www.ajcconline.org

AJCC, the American Journal of Critical Care, is the official peer-reviewed research journal of the American Association of Critical-Care Nurses (AACN), published bimonthly by The InnoVision Group, 101 Columbia, Aliso Viejo, CA 92656. Telephone: (800) 899-1712, (949) 362-2050, ext. 532. Fax: (949) 362-2049.

AMERICAN ASSOCIATION of CRITICAL-CARE NURSES



Patients' Bath Basins as Potential Sources of Infection: A Multicenter Sampling Study

By Debra Johnson, RN, BSN, OCN, CIC, Lauri Lineweaver, RN, BSN, CCRN, and Lenora M. Maze, RN, MSN, CNRN

Background Nosocomial infections are a marked burden on the US health care system and are linked to a high number of patient deaths.
Objective To identify and quantify bacteria in patients' bath basins and evaluate the basins as a possible reservoir for bacterial colonization and a risk factor for subsequent hospital-acquired infection.
Methods In a prospective study at 3 acute care hospitals, 92 bath basins, including basins from 3 intensive care units, were evaluated. Sterile culture sponges were used to obtain samples from the basins. The culture sponges were sent to an outside laboratory, and qualitative and quantitative microbial tests were conducted and the results reported.
Results Some form of bacteria grew in 98% of the samples (90 sponges), either by plating or on enrichment (95% confidence interval, 92%-99.7%). The organisms with the highest positive rates of growth on enrichment were enterococci (54%), gram-negative organisms (32%), *Staphylococcus aureus* (23%), vancomycin-resistant enterococci (13%), methicillin-resistant *S aureus* (8%), *Pseudomonas aeruginosa* (5%), *Candida albicans* (3%), and *Escherichia coli* (2%). Mean plate counts, in colony-forming units, were 10 187 for gram-negative organisms, 99 for *E coli*, 30 for *P aeruginosa*, 86 for *S aureus*, 207 for enterococci, and 31 for vancomycin-resistant enterococci.
Conclusions Bath basins are a reservoir for bacteria and may be a source of transmission of hospital-acquired infections. Increased awareness of bath basins as a possible source of transmission of hospital-acquired infections is needed, particularly for high-risk patients. (*American Journal of Critical Care.* 2009;18:31-40)

This article is followed by an *AJCC* Patient Care Page on page 41.

doi: 10.4037/ajcc2009968

Each year, an estimated 1.75 to 3.5 million patients in the United States, 5% to 10% of all patients admitted to US hospitals annually, contract nosocomial infections.[1] Health care–associated infection (HAI) is linked to nearly 90 000 deaths annually,[2] is ranked as the fifth leading cause of death in acute care hospitals, and results in an annual financial burden thought to exceed $6.5 billion.[2] Multiple studies[3-6] have shown that the cost of care is even higher in hospitalized patients in whom methicillin-resistant *Staphylococcus aureus* (MRSA) infections develop.

Nobel laureate Robert Koch first correlated high heterotrophic counts of bacteria with tap water hygiene in 1883 in Berlin.[1] Since then, researchers around the globe have substantiated his findings and have, more recently, discovered that in health care facilities such as hospitals, hospices, and residential care centers, contaminated water supplies can spread infection among patients whose health is already compromised.[1,7,8] Infection control measures such as water chlorination, filtration, thermal disinfection, and UV irradiation can decrease microbial counts in hospital water.[1,9-12]

However, water often is merely a conduit. Pathogens, such as *Enterobacter cloacae,* can create highly potent biofilms that lodge in hospital pipes, hot water tanks, air conditioning cooling towers, sinks, and even touchless faucets and then contaminate the water upon contact.[1,13,14] Without proper education and hygienic practice, hospital staff can transmit pathogens both into and via water that has become contaminated after contacting a contaminated surface.[15,16]

A review of the evidence suggests a link between waterborne pathogens in the health care setting and the development of biofilm (multiple colonies of microorganisms attached to a surface). The ability of organisms to form a biofilm, combined with transmission of organisms through contact with contaminated items or unwashed hands, can create a reservoir of bacteria that can be transferred to and maintained in a patient's bath basin (defined as a container in which water is placed for use in bathing a patient).

On the basis of ample, documented evidence for microbial colonization of patients' skin, health care facility water supplies, and environmental surfaces such as dry disposable bath basins, we asked the following question: Can patients' bath basins harbor microorganisms that are potential sources of HAI, even after the removal of the possibly contaminated water? A prospective, multicenter study was done to identify and quantify bacteria in patients' bath basins to evaluate bath basins as a possible reservoir for bacterial colonization and as a risk factor for subsequent HAI.

Methods

Setting and Sample

A total of 92 bath basins in 3 acute care hospitals were evaluated; these included basins from 3 intensive care units (cardiac care, surgical intensive care, and medical intensive care) and a rehabilitation unit. The hospitals were Presbyterian Hospital, Albuquerque, New Mexico, a large acute care hospital and state tertiary medical center (453 licensed beds); Wishard Health Services, Indianapolis, Indiana, a teaching hospital and level I trauma center (319 licensed beds); and Westerly Hospital, Westerly, Rhode Island, a smaller acute care community hospital (125 licensed beds). Sampling was limited to basins used at least twice for whole-body bathing of patients hospitalized for 48 hours or longer. Bath basins were not cleaned with any substance after patients were bathed. The study had no inclusion or exclusion criteria for patients because the focus of the research was the bath basin. One registered nurse from each hospital was assigned to carry out all study activities and to record data, including collecting data on patients' demographics, length of stay, and bathing regimen.

Health care–associated infections are the 5th leading cause of death in acute care hospitals.

About the Authors
Debra Johnson is the infection control coordinator at Westerly Hospital, Westerly, Rhode Island, **Lauri Lineweaver** is an education resource nurse in cardiac critical care at Presbyterian Hospital, Albuquerque, New Mexico. **Lenora M. Maze** is a clinical nurse specialist in critical care and neuroscience at Wishard Health Services, Indianapolis, Indiana.

Corresponding author: Debra Johnson, RN, OCN, IC Solutions Consulting, 9 Fawn Circle, Charlestown, RI 02813 (e-mail: Debrn78@msn.com).

The method used for bathing was not observed or reported. In general, nonlicensed and licensed staff of all facilities bathed patients or assisted the patients in bathing and followed universal precautions and accepted bathing practices. These practices included taping a bag or some type of protector around a wound before the bath to avoid contamination. No antiseptic soaps were used during the bathing process. Patients' caregivers were not told of the study to ensure that the caregivers continued with usual practices. All nurses who conducted basin sampling were trained to maintain consistency in the sampling technique. One liaison trained by the outside testing laboratory ensured that data collectors used standardized and appropriate data collection techniques.

Biofilm-forming pathogens create potent biofilms that lodge on hospital equipment and structures.

Sampling Procedures

The designated nurse from each hospital sampled the bath basins during the course of a single day. For each basin sampled, 1 culture sponge, which was prewetted with 10 mL of neutralizer, was used to swab the entire interior of the basin, including the walls and base. The neutralizer provided the moisture necessary to remove potential organisms from the basin surface; the neutralizer is not a nutrient and should not encourage growth of organisms. Culturing of the samples included an enrichment step to increase the numbers of organisms to allow qualitative detection of bacterial growth. Testing was based on the qualitative, rather than quantitative, presence of bacteria, and so the results would not be affected if any growth occurred during transport.

Ninety-eight percent of all cultures grew some form of bacteria after either plating or enrichment.

Swabbing of basins was performed at least 2 hours after patient bathing, after the bath water had been emptied and the basins were allowed to air dry. All basins were disposable and were used for only 1 patient admission. After swabbing the basin, using aseptic technique, the nurse who obtained the sample placed each sponge into a separate sterile bag and sealed the bag with a Whirl-Pak–style tie (Nasco, Fort Atkinson, Wisconsin). The bags were then packaged and mailed in bulk by express mail on the same day the samples were gathered to a predetermined off-site microbiological testing laboratory.

Culture Procedures

Once the samples were received in the laboratory, 20 mL of trypticase soy broth was introduced into each bag for a 1:30 dilution, and each sponge was thoroughly manipulated for 1 minute to release organisms. This step was to allow enough bacterial growth to allow detection of the different species present on the sponge. Direct plating was used for an aerobic plate count; yeast and mold count; and counts of gram-negative organisms, *Escherichia coli*, *S aureus*, *Pseudomonas aeruginosa*, and enterococci. Immediately after plating, the remainder of the sponge and diluent were incubated for 48 hours (±4 hours) at 35°C (±2°C) for enrichment. After incubation, samples were streaked onto selective or differential agars for the isolation of gram-negative organisms, *E coli*, *S aureus*, *P aeruginosa*, enterococci, MRSA, and *Candida albicans*.

If plates that were streaked with enrichment samples had growth of enterococci, samples from the enterococcal colonies were streaked onto brain-heart infusion agar with 6 µg/mL vancomycin to evaluate vancomycin resistance.

Organism Identification and Confirmation

Identifications of organisms were confirmed by using various techniques, including but not limited to latex test and coagulase test. Methicillin resistance of coagulase-positive, gram-positive cocci was determined by streaking samples onto oxacillin-resistance screening agar. No quantitative measures were conducted. No genotypic identification was done, and all results were based on the growth or reactions of organisms on selective plates.

Reporting

At the end of the study for each location, the laboratory provided a summary report of the microorganisms identified that included a comparison of microorganism recovery from the different centers.

Data Analysis

Standard biostatistical quantification methods were used. Semiquantitative data on plate counts were summarized with means, standard deviations, medians, and ranges after truncating text such as "est," "<," and ">." Qualitative data on enrichment results were summarized with counts, percentages, and exact 95% confidence intervals. All percentages have been rounded to whole numbers. Enrichment results were assessed by using an exact binomial test with the null hypothesis of a 5% positive rate.

Multivariable logistic regression modeling techniques were used to explore the difference between medical and surgical units with respect to 2 separate end points: enrichment MRSA and vancomycin-resistant enterococci (VRE) results. The following

potential covariates were explored in the model: age, sex, and length of stay. Significance was set at $P \leq .05$.

Results

Results Compiled From All Centers

A total of 92 basins were sampled. Samples were collected from basins of 49 men and 43 women 19 to 101 years old (mean, 64). Mean length of stay was 8.1 days; however, 1 outlier (a patient who stayed 122 days) skewed this mean. When data on the outlier was removed, the mean length of stay was 6.9 days. Some form of bacteria grew in 98% of the samples (90 sponges), either by plating or on enrichment (95% confidence interval, 92%-99.7%). Median plate counts were 30 for all but the aerobic plate counts, which had a median of 1150 (Table 1).

After the enrichment step, the highest positive growth rates, in order, were 54% for enterococci, 32% for gram-negative organisms, 23% for *S aureus*, and 13% for VRE (Table 2). Positive growth rates were less than 10% for all other enrichment cultures: MRSA, 8%; *P aeruginosa*, 5%; *C albicans*, 3%; and *E coli*, 2%. The positive growth rates were statistically significantly different from 5% for enterococci, gram-negative organisms, *S aureus*, and VRE.

Multivariable logistic regression modeling techniques clearly indicated that age, sex, and length of stay did not affect the findings (Table 3). In addition, no differences were found between the units for either MRSA ($P = .65$; Table 4) or VRE ($P = .25$; Table 5).

Of note, medical conditions of all patients were recorded; however, the diagnoses were numerous and varied, so it was not possible to report meaningful data. For instance, basin samples from patients with known critical illnesses had no bacterial growth, whereas samples from patients with less acute conditions had more bacterial growth. Analysis of data indicated no pattern or predictability.

Discussion and Recommendations

Clark and John[13] reviewed the literature on tap water contamination in health care facilities and suggested the need to keep contaminated water away from patients who are immunosuppressed, have fresh surgical wounds, or are at high risk for infection. Shannon et al[17] found that bath water specimens collected after a routine patient's bath contained bacterial counts of more than 105 colony-forming units/mL, a colony count similar to the number of bacteria found in urine samples from patients with urinary tract infections. In addition, they noted that most nurses disposed of used bath water in hand washing sinks, a practice that could contaminate the sink and surrounding areas.[17]

Table 1
Plate count results for 92 samples

Plate count, colony-forming units	Mean	SD	Median	Maximum
Aerobic plate count	94657	357 861	1150	2 200 000
Gram-negative organisms	10187	57 600	30	500 000
Escherichia coli	99	536	30	5 000
Pseudomonas aeruginosa	30	0	30	30
Staphylococcus aureus	86	357	30	2 700
Enterococci	207	1379	30	13 000
Vancomycin-resistant enterococci	31	6	30	90

[a] The minimum count for all samples was 30.

Table 2
Enrichment results

Growth	No. of samples	%	95% confidence interval for % positive	Exact binomial *P*[a]
Gram-negative organisms				
+	29	32	22.23-42.04	<.001
-	63	68		
Escherichia coli				
+	2	2	0.26-7.63	.31
-	90	93		
Pseudomonas aeruginosa				
+	5	5	1.79-12.23	0.98
-	87	95		
Staphylococcus aureus				
+	21	23	14.72-32.75	<.001
-	71	77		
Methicillin-resistant *S aureus*				
+	7	8	3.11-15.05	.35
-	85	92		
Enterococci				
+	50	54	43.63-64.78	<.001
-	42	46		
Vancomycin-resistant enterococci				
+	12	13	6.93-21.68	.004
-	80	87		
Candida albicans				
+	3	3	0.68-9.23	.64
-	89	97		

[a] Null hypothesis = 5% positive growth rate.

Table 3
Multivariable logistic regression

Characteristic	Category	Medical	Surgical	Total
Covariates				
Age	N	72	20	92
	Mean (SD)	66.7 (16.46)	54.6 (20.38)	64.1 (17.98)
	Range	29.0-91.0	19.0-101.0	19.0-101.0
	Median	71.5	53	68
Sex	Male, No. (%)	34 (47)	15 (75)	49 (53)
	Female, No. (%)	38 (5)	5 (25)	43 (47)
Length of stay	N	72	20	92
	Mean (SD)	6.7 (6.34)	14.2 (25.89)	8.3 (13.45)
	Range	2.0-37.0	3.0-122.0	2.0-122.0
	Median	4.5	6.5	5
End points				
Methicillin-resistant *Staphylococcus aureus*	Negative, No. (%)	67 (93)	18 (90)	85 (92)
	Positive, No. (%)	5 (7)	2 (10)	7 (8)
Vancomycin-resistant enterococci	Negative, No. (%)	61 (85)	19 (95)	80 (87)
	Positive, No. (%)	11 (15)	1 (5)	12 (13)

Biofilm Formation

In recently published correspondence, Cervia et al[18] noted the concurrent reemergence of gram-negative HAI and recent reports of gram-negative bacteria, including *Pseudomonas* and *Enterobacter* organisms, in hospital water supplies. Cervia et al also mentioned the problem of the formation of biofilms, which may occur despite efforts to prevent contamination of water supplies. In addition, they sampled the water of 9 metropolitan area hospitals and found as many as 14 bacterial species in samples from a single source. Disturbingly, about one-third of the bacterial species found were known to be responsible for HAIs. The authors[18] concluded that further investigation was warranted to determine whether or not water should be considered a potential source of HAI.

VRE and MRSA were cultured from bath basins of patients who were not carriers.

Cross-Contamination

It is a universally accepted practice for caregivers to wash their hands to reduce bacterial transmission between patients and themselves and objects in the environment. Cross-contamination can occur when a caregiver touches a patient who is colonized with a bacterial species and then touches an object in the environment. If MRSA or VRE resides on an object in the environment and the caregiver touches that object, he or she can transmit the organisms to the next object or person he or she touches. Additionally, bath basins are often left out in the patient's room and are often used as storage basins. Basins are often used to hold personal items and may be used to hold soiled cloths from incontinence cleanups or may even be used as emesis basins.[19]

Disinfection and Sterilization

A rational approach to disinfection and sterilization of objects in the patient environment to reduce bacterial spread was developed by Spaulding,[20] who divided the objects into 3 categories: critical items, semicritical items, and noncritical items. Critical items are those that enter sterile tissue or the vascular system and that can thus introduce infection; these items should be sterilized before use. Examples include surgical instruments and catheters.

Semicritical items are those that come into contact with mucous membranes or nonintact skin. The mucous membranes and nonintact skin are not sterile tissue but are susceptible to the introduction of certain pathogens. Respiratory therapy equipment and laryngoscopes are examples of these types of items. Bathing with contaminated supplies can potentially expose a patient's mucous membranes or nonintact skin to bacteria. Thus, it is reasonable to consider that although a bath basin is classified as a noncritical item, at times it is a semicritical item. The Spaulding classification suggests that these semicritical items should be free of all microorganisms.

At-Risk Patients

Exner et al[1] noted that control of waterborne pathogens must include reducing the number of harmful microbes and specifically protecting patients at high risk for infection. Attentiveness to identifying which patients are at high risk is a prerequisite for protecting them from potential pathogens. Patients at high risk are numerous and include both children and adults who are immunocompromised, have indwelling catheters or drains, undergo invasive procedures such as surgery, or have wounds or underlying disease. In addition, the elderly are at increased risk.[21-24] Environmental factors such as widespread microbial antibiotic resistance and a lack of infection control measures and environmental hygiene also play a role in determining risk for hospitalized patients.[21,24]

Hospitalized patients themselves can harbor potentially dangerous microorganisms. Increasing rates of colonization by antibiotic-resistant organisms,

Table 4
Enrichment methicillin-resistant *Staphylococcus aureus* end point

Variable	Coefficient	Standard error	Wald χ^2	*P*	Risk ratio	95% confidence interval
Intercept	-2.5953	0.4636	31.3381	<.001		
Unit	0.398	0.8778	0.2056	.65	1.489	0.267-8.318

Table 5
Enrichment vancomycin-resistant enterococci end point

Variable	Coefficient	Standard error	Wald χ^2	*P*	Risk ratio	95% confidence interval
Intercept	-1.713	0.3276	27.346	<.001		
Unit	-1.2315	1.077	1.3074	.25	0.292	0.035-2.41

such as MRSA, VRE, and *Acinetobacter* organisms, may present significant problems in patients who have indwelling catheters or in those who are immunocompromised.[17,25,26] Methicillin-resistant *Staphylococcus epidermidis* has also received attention recently for its role in purulent infection in soft tissues and skin.[27]

During bathing, mechanical friction releases skin flora into bath water.[28] Via inhalation, ingestion, or direct contact with excoriated skin, contaminated water in bath basins can become a source of cross-contamination of organisms from one body system to another and can be potential reservoirs for the transmission of HAI.[12,16] The bath basin itself often becomes contaminated with gram-negative bacteria from the environment and can be a source of bacterial exposure during future baths.[29,30]

Our results confirm that potentially harmful microorganisms are present in bath basins even after the bath water is removed; 98% of all cultures grew some form of bacteria, either on plating or after enrichment. All at-risk patients admitted to intensive care units and surgical and medical care units in 1 of the 3 hospitals in the study were screened for MRSA (nares) on admission and VRE, and all the patients so tested during the course of the study were negative for MRSA. Therefore, VRE and MRSA were present in the hospital environment and were cultured from patients who had not been previously identified as carriers of VRE or MRSA.

In 1 patient whose basin sample was positive for MRSA, a sternal wound infection developed from which MRSA was cultured. The patient did not have colonization with MRSA at the time of admission, but did have MRSA in the nares at the time of discharge (on day 7 of admission). In another patient, a VRE infection developed after VRE was detected in the patient's wash basin. This patient initially had negative cultures for VRE/MRSA, but samples obtained when he was readmitted from a nursing home 10 days later were positive. In this patient, the first cultures possibly were false-negatives (ie, the patient was colonized during his stay in the nursing home) or the VRE exposure in the hospital led to the wound infection and to the colonization that was noted upon readmission. These temporal associations are not sufficient to establish a cause-and-effect relationship, but they raise the question of whether the infections were due to exposure to the contaminated wash basin. It is not surprising that bacteria were cultured from samples from patients' bath basins, because previously documented evidence has indicated that water in health care settings may harbor microorganisms. Our results suggest that the bath basins themselves may be an additional way that harmful bacteria are spread.

Most nurses disposed of used bath water in hand-washing sinks, which could then contaminate the sink and surrounding areas.

Of note, 100% of the basins sampled were positioned upright instead of upside down. Storing basins upright allows any remaining droplets of water to pool at the bottom, and the pooling allows biofilms to form. Additionally, multiple basins were stacked on top of each other, and items used for incontinence cleanup were stored inside (see Figure), a situation that creates another opportunity for contamination.

The finding of MRSA and VRE in the basins is not surprising, given the difficulty in eradicating microorganisms from the hospital environment, yet this finding underscores the need to identify and eliminate reservoirs where possible. Doing so is particularly important for bath basins because of

Figure Typical storage of bath basin. Note upright storage, sink, and used incontinence tubes.

the direct exposure to the bacteria that can occur if a contaminated basin is used for bathing. It is reasonable to anticipate that patients who are immunocompromised or who have open wounds would be at risk for infection after direct exposure to contaminated bathing materials. Any activity that potentially spreads antibiotic-resistant bacteria from a contaminated surface to the skin works directly against efforts to eradicate such bacteria from the hospital or health care environment.

Storing basins upright allows for any remaining droplets of water to pool at the bottom, which allows biofilms to form.

We recommend interventions or protocols that address bath basins as a potential source of bacterial exposure for patients. Sterilizing bath basins is not common practice and may not be cost-effective or provide the most efficient use of time for staff members. Alternative methods of bathing that are effective and cost- and time-efficient have been reviewed in the literature and deserve further evaluation and consideration.[29-31]

Alternative Bathing Methods and Research

Larson[29] and Vernon et al[31] found that microbial counts on patients' skin were lower after a prepackaged bath than after a bath given with a patient bath basin, although these differences were not significant. Larson concluded that the disposable bath is a desirable form of bathing, and possibly preferable to traditional basin baths, for patients in both critical care and long-term care settings who cannot bathe themselves.

Furthermore, McGuckin et al[32] investigated the rate of urinary tract infections after a hospital eliminated a prepackaged bath product and replaced it with standard basins, tap water, and paper towels. The study findings showed a significant increase in the rate of urinary tract infections after the elimination of the prepackaged bath product and an increase in cost of $107 741, which represented an increase in cost in a 14-bed intensive care unit during a 9-month period.

Although contaminated water within the health care environment and the development of biofilms on bath basins are important concerns, Lazzari et al[33] point out that HAIs are preventable. Multiple opportunities for intervention exist in the health care setting, many of which are related to the removal of potential etiologic factors.

Use of cleansing cloths can reduce microbial counts and avoids exposing patients to potentially contaminated bath basins[29,30] and potentially contaminated tap water and water conduits.[1] The use of a prepackaged bath product has other benefits as well. With a properly used bath pack, the same washcloth is not used to bathe the entire body, thus possibly reducing the potential for spread of bacteria from one area of the body to another.[29,30] The use of bath packs would also allow bathing methods to be standardized, thus reducing variability in technique between nurses. Such baths require less time to administer than do bed baths and appear to avoid the skin-drying effects associated with the use of soap, water, and towel drying.[29,30] More important, use of a product that contains a skin conditioner apparently is less damaging to the skin than are plain soap and water and towel drying.[29,30]

Of note, our study had a few weaknesses. Clean bath basins were not cultured because of cost restraints; however, a null hypothesis of 5% was used throughout data analysis to account for presumed contamination. Incontinence materials were found within basins, and these materials were not tested inside or outside of the basin. Basins were not sampled on the same day of use, and some may have been used more than others were. The presence of urinary catheters, drains, and/or wounds was not accounted for. A close examination of these variables in future studies may elicit additional valuable data.

Conclusion

We conclude that bath basins are a reservoir for bacteria and that further investigations into bath basins as a potential source of transmission of HAI are warranted. Increased awareness of bath basins as a possible source of bacterial cross-contamination is necessary, particularly in high-risk patients. In addition, alternative bathing methods should be investi-

gated. Our findings are a call to action to health care providers to develop and implement protocols for patients' bathing that address the potential for patients' exposure to pathogens. A system that uses prepackaged bathing supplies could be a useful adjunct to such a protocol.

ACKNOWLEDGMENTS

We thank Michelle Secic, MS, for her expertise in biostatistical analysis of the results reported in this study, and Dr Rhonda Porterfield and Kersten Hammond for their expertise and assistance in the development of the manuscript.

FINANCIAL DISCLOSURES

Part of this study was supported by an unrestricted grant from Sage Products, Inc, Cary, Illinois.

REFERENCES

eLetters

Now that you've read the article, create or contribute to an online discussion on this topic. Visit **www.ajcconline.org** and click "Respond to This Article" in either the full-text or PDF view of the article.

SEE ALSO

For more about health care–associated infections, visit **www.ccnonline.org**, and read the article by Montefour et al, "*Acinetobacter baumannii:* An Emerging Multidrug-Resistant Pathogen in Critical Care" (*Critical Care Nurse*, February 2008).

1. Exner M, Kramer A, Lajoie L, Gebel J, Engelhart S, Hartemann P. Prevention and control of health care-associated waterborne infections in health care facilities. *Am J Infect Control.* 2005;33(5 suppl):S26-S40.
2. Stone PW, Braccia D, Larson E. Systematic review of economic analyses of health care-associated infections. *Am J Infect Control.* 2005;33:501-509.
3. Gavaldà L, Masuet C, Beltran J, et al. Comparative cost of selective screening to prevent transmission of methicillin-resistant *Staphylococcus aureus* (MRSA), compared with the attributable costs of MRSA infection. *Infect Control Hosp Epidemiol.* 2006;27(11):1264-1266.
4. Shorr AF, Tabak YP, Gupta V, Johannes RS, Liu LZ, Kollef MH. Morbidity and cost burden of methicillin-resistant *Staphylococcus aureus* in early onset ventilator-associated pneumonia. *Crit Care.* 2006;10(3):R97.
5. Nixon M, Jackson B, Varghese P, Jenkins D, Taylor G. Methicillin-resistant *Staphylococcus aureus* on orthopaedic wards: incidence, spread, mortality, cost and control. *J Bone Joint Surg Br.* 2006;88:812-817.
6. Pollard TC, Newman JE, Barlow NJ, Price JD, Willett KM. Deep wound infection after proximal femoral fracture: consequences and costs. *J Hosp Infect.* 2006;63:133-139.
7. Bartram J, Cotruvo J, Exner M, Fricker C, Glasmacher A, eds. *Heterotrophic Plate Counts and Drinking-Water Safety: The Significance of HPC's for Water Quality and Human Health.* London, England: IWA Publishing; 2003:1-271. http://www.who.int/water_sanitation_health/dwq/HPCFull.pdf. Accessed October 17, 2008.
8. World Health Organization. *Guidelines for Drinking-Water Quality: First Addendum to Third Edition.* Geneva, Switzerland: World Health Organization; 2006:1-595. Recommendations; vol 1. http://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf. Accessed October 17, 2008.
9. Trautmann M, Lepper PM, Haller M. Ecology of Pseudomonas aeruginosa in the intensive care unit and the evolving role of water outlets as a reservoir of the organism [published correction appears in *Am J Infect Control.* 2008;36(1):4]. *Am J Infect Control.* 2005;33(5 suppl 1):S41-S49.
10. Anaissie EJ, Penzak SR, Dignani MC. The hospital water supply as a source of nosocomial infections: a plea for action. *Arch Intern Med.* 2002;162:1483-1492.
11. Emmersen A. Emerging waterborne infections in health-care settings. *Emerg Infect Dis.* 2001;7:272-276.
12. Sheffer PJ, Stout JE, Wagener MM, Muder RR. Efficacy of new point-of-use water filter for preventing exposure to *Legionella* and waterborne bacteria. *Am J Infect Control.* 2005;33(5 suppl 1):S20-S25.
13. Clark AP, John LD. Nosocomial infections and bath water: any cause for concern? *Clin Nurse Spec.* 2006;20:119-123.
14. Leprat R, Denizot V, Bertrand X, Talon D. Non-touch fittings in hospitals: a possible source for *Pseudomonas aeruginosa* and *Legionella* spp. *J Hosp Infect.* 2003;53(1):77-82.
15. Assadian O, El-Madini N, Seper E, et al. Sensor-operated faucets: a possible source of nosocomial infection? *Infect Control Hosp Epidemiol.* 2002;23(1):44-46.
16. Sehulster L, Chinn RYW; CDC; HICPAC. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR Recomm Rep.* 2003;52(RR-10):1-42.
17. Shannon R, Allen M, Durbin A, Brecher S, Goodman R. Patient bath water as a source of nosocomial microbiological contamination: an intervention study using chlorhexidine. *J Healthc Safety Compliance Infect Control.* 1999;3(4):180-184.
18. Cervia JS, Canonica F, Ortolano G. Water as a source of health care-associated infections [letter]. *Arch Intern Med.* 2007;167:92.
19. Skewes SM. Skin care rituals that do more harm than good. *Am J Nurs.* 1996;96(10):33-35.
20. Spaulding EH. Chemical disinfection of medical and surgical materials. In: Lawrence C, Block SS, eds. *Disinfection, Sterilization, and Preservation.* Philadelphia, PA: Lea & Febiger; 1968:517-531.
21. Rutala WA, Weber DJ. Disinfection, sterilization, and control of hospital waste. In: Mandell GL, Bennett JE, Dolin R, eds. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases.* 4th ed. Philadelphia, PA: Elsevier/Churchill Livingstone; 2005:313-342.
22. Guinan JL, McGuckin M, Nowell PC. Management of health-care-associated infections in the oncology patient. *Oncology (Williston Park).* 2003;17(3):415-420.
23. Burgner D, Dalton D, Hanlon M, Wong M, Kakakios A, Isaacs D. Repeated prevalence surveys of paediatric hospital-acquired infection. *J Hosp Infect.* 1996;34(3):163-170.
24. Hussain M, Oppenheim BA, O'Neill P, Trembath C, Morris J, Horan MA. Prospective survey of the incidence, risk factors and outcome of hospital-acquired infections in the elderly. *J Hosp Infect.* 1996;32:117-126.
25. Larson EL, McGinley KJ, Foglia AR, Talbot GH, Leyden JJ. Composition and antimicrobic resistance of skin flora in hospitalized and healthy adults. *J Clin Microbiol.* 1986; 23:604-608.
26. Roth RR, James WD. Microbiology of the skin: resident flora, ecology, infection. *J Am Acad Dermatol.* 1989;20:367-390.
27. Hedin G. *Staphylococcus epidermidis*—hospital ecology and the detection of methicillin resistance. *Scand J Infect Dis Suppl.* 1993;90:1-59.
28. Moran GJ, Krishnadasan A, Gorwitz RJ, et al. Methicillin-resistant *S aureus* infections among patients in the emergency department. *N Engl J Med.* 2006;355(7):666-674.
29. Larson EL. Comparison of traditional and disposable bed baths in critically ill patients. *Am J Crit Care.* 2004;13:235-241.
30. Skewes SM. No more bed baths. *RN.* 1994;57(1):34-35.
31. Vernon MO, Hayden MK, Trick WE, Hayes RA, Blom DW, Weinstein RA; Chicago Antimicrobial Resistance Project (CARP). Chlorhexidine gluconate to cleanse patients in a medical intensive care unit: the effectiveness of source control to reduce the bioburden of vancomycin-resistant enterococci. *Arch Intern Med.* 2006;166:306-312.
32. McGuckin M, Shubin A, Hujcs M. Interventional patient hygiene model: infection control and nursing share responsibility for patient safety. *Am J Infect Control.* 2008;36(1):59-62.
33. Lazzari S, Allegranzi B, Concia E. Making hospitals safer: the need for a global strategy for infection control in health care settings. *World Hosp Health Serv.* 2004;40:32, 34, 36-42.

EBR Evidence-Based Review

Evidence-Based Review and Discussion Points

By Ruth Kleinpell, RN, PhD

Evidence-Based Review (EBR) is the journal club feature in the *American Journal of Critical Care*. In a journal club, attendees review and critique published research articles: an important first step toward integrating evidence-based practice into patient care. General and specific questions such as those outlined in the "Discussion Points" box aid journal club participants in probing the quality of the research study, the appropriateness of the study design and methods, the validity of the conclusions, and the implications of the article for clinical practice. When critically appraising this issue's EBR article, found on pp 31-38, consider the questions and discussion points outlined in the "Discussion Points" box. Visit **www.ajcconline.org** to discuss the article online.

The purpose of this prospective multicenter study was to identify and quantify bacteria in patient bath basins in intesive care units (ICUs) and to evaluate the potential for the bath basin as a source for bacterial colonization and risk for health care–associated infection. Three different hospitals were used and a total of 93 disposable bath basins from 3 ICUs were cultured using sterile techniques. The bath basins were tested at least 2 hours after patient bathing, after the bath water had been emptied, and after the basins had been allowed to dry. An off-site microbiological testing laboratory was used to conduct the culture analysis. The results revealed that the bath basins were a source for bacterial growth for a number of organisms, including *Enterococcus, Staphylococcus aureus,* vancomycin-resistant enterococcus, methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa*, *Candida albicans,* and *Escherichia coli*.

Information From the Authors

Debra Johnson, RN, BSN, OCN, CIC, lead author of this EBR article, reports that the idea for the study evolved from dialogue at a national infection control conference. "The study came about at an Association for Professionals in Infection Control and Epidemiology (APIC) conference in 2006. I had a conversation with the SAGE representative about my concerns regarding hospital bath basins. In a previous hospital that I worked at we had an outbreak of *Pseudomonas* on our oncology unit, which prompted me to remove the basins and use basinless bath cleaners instead to see if that was the source of the outbreak. The outbreak

Investigator Spotlight

This feature briefly describes the personal journey and background story of the EBR article's lead investigators, discussing the circumstances that led them to undertake the line of inquiry represented in the research article featured in this issue.

Debra Johnson

In her more than 25 years of health care experience, Debra Johnson has worked in 3 primary areas: acute care and outpatient oncology, HIV/AIDS care, and community mental health nursing. She told the *American Journal of Critical Care*, "My knowledge and extensive experience in oncology, HIV/AIDS, and mental health nursing has given me a global insight into being a passionate infection control preventionist."

Johnson's passion for infection control initially sprang from her alarm about how immune-compromised cancer patients on chemotherapy were treated. She said, "I verbalized it, complained about it, and fought to use basinless bath products." That experience convinced her that immune-compromised patients and patients in isolation should never be bathed from a bath basin. "All we do is reinfect them. We pick up that ugly, funky basin and just 'clean' them with the same bacteria we're trying to get off of them."

Regarding the present study, she said the research "justified and validated what I thought was going on already. These basins are basically cootie carriers."

Johnson said one of the surprises in this research was finding out how the basins were used. She said the investigators found that basins were being used to store items like toothbrushes and hairbrushes, and the investigators found them in a wide variety of places. They were left on the floor, tilted over, and leaned against things. Johnson and coauthors Lauri Lineweaver and Lenora Maze worked independently at 3 different hospitals and found that "all hospitals were exactly the same—everybody found the basins all over the place."

Another surprise, she said, were the psychological aspects of doing the research. "You discover all the little psychological nuances of people, what they're thinking and what they do or don't know." She found situations where people were "very curious and then very defensive." That concerned her because, as an infection control preventionist, she "didn't want to come off as punitive or critical. The point of the study was not to criticize, but to educate."

Offering advice to those who might want to delve into the research process, she said, "They just need to have a drive to want to fix something and change something."

doi: 10.4037/ajcc2009901

ceased. We kept the basinless bath cloths on the oncology unit after that."

Johnson highlights the fact that 3 different hospital sites in different cities were used for the study, and that there was consistency in data collection methods. She explains: "We divided up the sampling: one group did the ICU and the women's unit, the other did the medical and surgical units. We were trained in accordance with laboratory guidelines as to the process and use of the collection devices. This process was the same for all 3 sites, and all 3 sites sent collected specimens to the same lab the day of collection." Johnson notes that the study team is interested in conducting additional research on the topic. "We hope to replicate the study and to expand the study to include other specialty units," she said.

Implications for Practice

Infection prevention measures in the ICU are a priority area for nursing care. The results of the study indicate that bath basins can be a source of bacterial growth. The study confirmed that potentially harmful microorganisms are present in bath basins, even after the bath water is removed. "The implications for ICU nursing are significant in that all basins at all sites retained some type of bacterial organisms," said Johnson. "Many ICU patients are using a mechanical ventilator and have fomites that have a high potential for being contaminated with organisms such as *Pseudomonas*, MRSA, and *Acinetobacter*, all of which increase the bioburden in the environment and could potentially adversely affect the patient."

Part of the problem, Johnson said, is that, in the past, nursing students were taught always to rinse the basin out or wipe it with antiseptic, and hospitals still operate on the idea that this happens. "I don't believe that most nurses do this. I think it's a time thing in a hospital. No one has time to clean them appropriately.

"Most people want to do the right thing, but events happen fast—especially in an ICU—and you don't always have time to do the right thing." Johnson notes that it is more realistic to focus on doing the right things in nonemergency situations.

According to Johnson, the cleanliness of bath basins was actually better in the past. "When we had metal pans, they were sent to 'central' for cleaning," she explains. Her preference would be to use only basinless products in health care institutions. She understands that this is difficult because of the cost, but says, "There is a return on investment: patients get better quicker and you're not going to reinfect them."

Johnson says her day-to-day work as an infection control preventionist provides numerous occasions to commit to research. "I am always asking 'why' and exploring 'what' I can do when it comes to infections and infection prevention," she says. "The bath basin study was something that I instinctively knew would be significant and I felt validated when the study was completed."

Johnson concludes: "I believe readers of *AJCC* will review the study and see traditional bath basins as a source of infection. It is not traditional to clean bath basins, thus the contamination remains in the basin to be spread on the patient day after day."

About the Author
Ruth Kleinpell is contributing editor of the Evidence-Based Review section. She is a professor in the Rush University College of Nursing, a teacher-practitioner at the Rush University Medical Center, and a nurse practitioner with Our Lady of the Resurrection Medical Center, Chicago, Illinois.

eLetters
Now that you've read the EBR article and accompanying features, discuss them with colleagues. To begin an online discussion using eLetters, just visit **www.ajcconline.org**, select the article in its full-text or PDF form from the table of contents, and click "Respond to This Article" from the list on the right side of the screen. All eLetters must be approved by the journal's coeditors prior to publication.

Discussion Points

A. Description of the Study
- ❑ What was the purpose of the research?
- ❑ Why is the problem significant to clinical practice?

B. Literature Evaluation
- ❑ What previous research on the possible link between waterborne pathogens in health care settings and infection transmission risk has been conducted?

C. Sample
- ❑ What types of settings were used to collect the data?

D. Methods and Design
- ❑ How were the data collected?
- ❑ What types of quality control measures were used in data collection?

E. Results
- ❑ What were the findings of the research?
- ❑ What organisms were cultured from the bath basins?

F. Clinical Significance
- ❑ What are the implications of this study for clinical nursing?
- ❑ How does the study extend the evidence base on the risk of potential sources for health care–associated infection?