

Chi-square and discriminate function analysis tests were performed to evaluate the possible contribution of the following factors to the incidence of carriage: age, gender, chronic health conditions, frequency of antibiotic use, total number of calls, and number of nursing home calls responded to per year. Neither analysis indicated any significant relationship between *S. aureus* nasal carriage and the surveyed factors ($P > .05$). Statistical analyses were not performed on the MRSA data because the sample size was too small to provide reliable interpretation.

Epidemiologic studies are important because of the increasing number of both MSSA and MRSA infections, their multiple drug resistance, their increasing reservoirs, and their ability to cause community outbreaks. Our results indicate that the incidence of nasal carriage of *S. aureus* among the paramedics of the Sedgwick County EMS is approximately 50%; 10% of these strains are MRSA. This incidence remained high during the course of this study, and is higher than the 30% to 35% incidence cited for most other groups of healthcare workers.¹ Paramedics are unique in that they have brief but uncontrolled exposures to patients. In addition, they frequently transport patients to and from hospitals and nursing facilities, where MRSA is often endemic. The increased frequency of carriage in the paramedic population implies that it is not random and that there is a discrete, yet unknown, cause for this phenomenon. Results of the observations described here are provocative and suggest the need for more comprehensive studies, including identification of the point source of the MRSA strains. Also, similar studies of paramedics in communities that are demographically similar to Sedgwick County would help to determine whether our findings are unique to the paramedics of Sedgwick County or whether they reflect a higher incidence of carriage among EMS personnel in general. In addition, regular continuing medical education programs should be encouraged to reinforce the need for strict adherence to transmission-based precautions and to increase knowledge of pathogenic microorganisms.

REFERENCES

1. Kluytmans J, Van Belkum A, Verbrugh H. Nasal carriage of *Staphylococcus aureus*: epidemiology, underlying mechanisms, and associated risks. *Clin Microbiol Rev* 1997;10:505-520.
2. Jevons MP. Celbenin-resistant staphylococci. *BMJ* 1961;1:124-125.
3. Centers for Disease Control and Prevention. National Nosocomial Infections Surveillance Report. *Am J Infect Control* 2000;28:429-448.
4. Al-Barrak A, McLeod AJ, Embil J, Thompson G, Ashe F, Nicolle L. Putting out the fire: extinguishing an outbreak of methicillin-resistant *Staphylococcus aureus* (MRSA) on a burn unit. *Am J Infect Control* 1998;26:189.
5. Centers for Disease Control and Prevention. Four pediatric deaths from community acquired methicillin-resistant *Staphylococcus aureus*—Minnesota and North Dakota, 1997-1999. *MMWR* 1999;48:707-710.
6. Jakob HG, Borneff-Lipp M, Bach A, et al. The endogenous pathway is a major route for deep sternal wound infections. *Eur J Cardiothorac Surg* 2000;17:154-160.
7. Martin JN, Perdreau-Remington F, Kartalija M, et al. A randomized clinical trial of mupirocin in the eradication of *Staphylococcus aureus* nasal carriage in human immunodeficiency virus disease. *J Infect Dis* 1999;80:896-899.
8. Mylotte JM, Kahler L, Jackson E. "Pulse" nasal mupirocin maintenance regimen in patients undergoing continuous ambulatory peritoneal dialysis. *Infect Control Hosp Epidemiol* 1999;20:741-745.
9. Kloos WE, Bannerman TL. *Staphylococcus and Micrococcus*. In: Murray PR, Baron EJ, Pfaller MA, Tenover FC, Tenover FC, eds. *Manual of Clinical Microbiology*, 7th ed. Washington, DC: ASM Press; 1999:264-282.
10. Tenover FC, Arebit RD, Goering RV, et al. Interpreting chromosomal DNA restriction patterns produced by pulsed-field gel electrophoresis: criteria for bacterial strain typing. *J Clin Microbiol* 1995;33:2233-2239.

Melissa J. Elliott, BS

Department of Biological Sciences
Wichita State University
Wichita, Kansas

Molly T. Kellum, BS

Fred C. Tenover, PhD, ABMM
Division of Healthcare Quality Promotion
Centers for Disease Control and
Prevention
Atlanta, Georgia

Roberta L. Petriess, MS

Department of Biological Sciences
Wichita State University
Wichita, Kansas

Efficacy of Alcohol-Based Hand Sanitizers Against Fungi and Viruses

To the Editor:

The antimicrobial effectiveness of short-chain alcohols, mainly ethanol, against fungus and yeast has been well documented in the litera-

ture. In general, the most effective ethanol concentration range has been reported to be greater than 50%, acting in 1 minute.^{1,2} However, no data are available on the efficacy of alcohols at contact times of less than 1 minute or on alcohol-based sanitizers.¹ Regarding the antiviral activity of alcohols, it is well established that alcohols are effective against lipophilic, enveloped viruses. The data suggest that alcohols inactivate enveloped viruses more easily than "naked" viruses²; however, there is no general agreement in the literature on the activity of alcohols against naked viruses. The results published to date suggest that alcohol is effective, but that the antiviral efficacy depends on the specific virus. Sattar et al., using the fingerpad method, recently found that the level of reduction of several naked viruses by an alcohol-based sanitizer was statistically significantly higher than that seen with a water control.³

To assess the antifungal and antiviral activity of an alcohol-based sanitizer, we conducted in vitro time-exposure kill evaluations of PURELL Instant Hand Sanitizer (GOJO Industries, Inc., Akron, OH), which contains 62% ethanol and emollients. Fifteen- and 30-second exposures were used for the fungal species and 30-second exposures for the viruses. The 15- and 30-second exposure kill studies were performed using selected challenge fungi and viruses. The challenge inoculum was introduced to the test product at time 0; a portion of the sample was removed and placed in neutralizing media at the appropriate time (15 or 30 seconds). Standard plate-counting techniques were used to enumerate viable challenge microorganisms.

The efficacy of the alcohol-based sanitizer against 7 fungal species is detailed in Table 1. It is apparent from Table 1 that the alcohol-based sanitizer was highly effective in 15 seconds against all of the fungal species investigated.

The efficacy of the alcohol-based sanitizer against viruses in 30-second exposure kill evaluations is detailed in Table 2. It is apparent that the alcohol-based sanitizer is effective against viruses in 30 seconds; however, the data show considerable variation, depending on the viral species.

The efficacy of alcohol as a bac-

TABLE 1
EFFICACY OF THE ALCOHOL-BASED SANITIZER AGAINST FUNGI

Fungal Species	ATCC No.	Exposure		% Reduction
		Time	Log ₁₀ Reduction	
<i>Aspergillus flavus</i>	9643	15	5.02	99.9991
		30	> 5.57	> 99.9997
<i>A. niger</i>	9642	15	> 4.72	> 99.9981
		30	> 4.72	> 99.9981
<i>Candida albicans</i>	14053	15	> 6.32	> 99.9999
		30	> 6.32	> 99.9999
<i>C. tropicalis</i>	13803	15	> 6.42	> 99.9999
		30	> 6.42	> 99.9999
<i>Epidermophyton floccosum</i>	52063	15	> 3.92	> 99.9880
		30	> 3.92	> 99.9880
<i>Penicillium citrinum</i>	9849	15	5.82	99.9999
		30	5.05	99.9991
<i>Trichophyton mentagrophytes</i>	9533	15	5.93	99.9999
		30	> 5.93	> 99.9999

ATCC = American Type Culture Collection.

TABLE 2
EFFICACY OF THE ALCOHOL-BASED SANITIZER AGAINST VIRUSES IN A 30-SECOND EVALUATION

Viral Species	ATCC No.	Log ₁₀ Reduction	% Reduction
Adenovirus type 2	VR-846	1.32	95.2
Parainfluenza virus type 2	VR-92	≥ 4.39	≥ 99.996
Parainfluenza virus type 3	VR-93	≥ 4.14	≥ 99.993
HIV type 1	HTLV-III _B	≥ 4.14	≥ 99.993
Hepatitis A virus	VR1073	1.25	94.4
Influenza virus type A ₂ *	VR-544	> 5.00	> 99.999
Rhinovirus type 16	VR-1126	≥ 4.25	> 99.994
Rhinovirus type 14	VR-284	2.25	99.94
Rhinovirus type 37	VR-1147	2.75	99.8
Coxsackievirus B ₃	VR-30	2.75	99.8
Herpes simplex virus type 1	VR-733	≥ 5.00	≥ 99.999

ATCC = American Type Culture Collection.

*Hong Kong strain.

tericidal agent has been recognized for more than 60 years.⁴ Recently, the recognition of low compliance with hand washing protocols and improper hand washing techniques has focused greater attention on the use of waterless, alcohol-based hand sanitizers as a primary tool for hand disinfection in the United States. The numerous advantages of alcohol-based sanitizers, such as rapid, broad-spectrum antibacterial activity, time savings, increased compliance with hand hygiene, and reduced infection rates, help to over-

come the obstacles to effective hand hygiene. These products may replace soap and water as the leading recommended tools for hand disinfection in the 2002 Guideline for Hand Hygiene of the Centers for Disease Control and Prevention's Healthcare Infection Control Practices Advisory Committee (HIC-PAC). The results presented here extend the data on the antimicrobial efficacy of alcohol-based sanitizers to fungi and viruses and indicate that the alcohol-based sanitizer evaluated in these tests is highly effective

in vitro against the fungal and viral species investigated.

REFERENCES

1. Ali Y, Dolan MJ, Fendler EJ, Larson EL. Alcohols. In: Block SS, ed. *Sanitization, Disinfection and Sterilization*. Philadelphia: Lippincott Williams and Wilkins; 2001:229-253.
2. Rotter ML. Alcohols for antiseptics of hands and skin. In: Ascenzi JM, ed. *Handbook of Disinfectants and Antiseptics*. New York: Marcel Dekker; 1996:177-233.
3. Sattar SA, Abehe M, Bueti AJ, Jampani H, Newman J, Hua S. Activity of an alcohol-based hand gel against human adeno-, rhino-, and rotaviruses using the fingerpad method. *Infect Control Hosp Epidemiol* 2000;21:516-519.
4. Price PB. Ethyl alcohol as a germicide. *Arch Surg* 1939;38:528-542.

Eleanor Fendler, PhD
Patricia Groziak, MS
GOJO Industries, Inc.
Akron, Ohio

Nosocomial Outbreak of *Kluyvera cryocrescens* Bacteremia

To the Editor:

Bacteremia caused by *Kluyvera cryocrescens* has been rarely reported. We report a nosocomial outbreak of *K. cryocrescens* bacteremia in four patients in a cardiovascular ward. Previous reports, as well as this study, suggest that *Kluyvera* is of clinical significance in humans.

To date, four different species, *Kluyvera ascorbata*, *Kluyvera cryocrescens*, *Kluyvera cochleae*, and *Kluyvera georgiana*, have been described and are classified in the family Enterobacteriaceae. In humans, sputum is the most common specimen yielding *Kluyvera*; the organism is rarely found in urine, stool, and blood or in the throat. Water, sewage, soil, milk, hospital sinks, and cows have been reported as environmental sources of *Kluyvera*.¹ Although a few reports have suggested that *Kluyvera* can cause severe disease, the clinical significance of the organism remains uncertain.^{2,3} All previously reported *Kluyvera* infections were isolated cases; there have been no reports of outbreaks of infection caused by *K. cryocrescens*.

In this study, we report 4 cases of nosocomial *K. cryocrescens* bacteremia in our hospital. All 4 patients had 2 consecutive sets of blood cultures with positive results for *K. cry-*