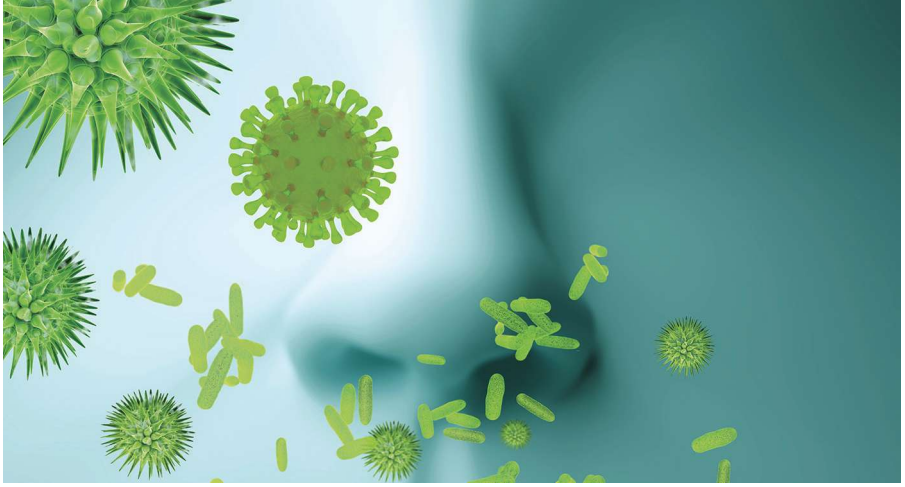

Nasal Decolonization and HAI Prevention: Applications and Evidence

By Sue Barnes, RN, CIC

Healthcare-associated infections (HAIs) affect more than 2 million patients annually and cost over $4.5 billion.[1] Infection prevention bundles are increasingly being used that include nasal decolonization, and evidence supporting its effectiveness is growing.[2] Although mupirocin (trade names including Bactroban, Centany) is commonly used for nasal decolonization, it may be prudent to consider new nasal antiseptics with which antimicrobial resistance is not an issue [trade names including Nozin (alcohol) and 3M and Clorox (iodine)].

The rapid action and convenience of these alternatives to antibiotic use may also provide a wider range of opportunities to reduce the infection risk that nasal carriage brings to the healthcare environment.

The role of nasal bacteria in HAI development and transmission and the efficacy of nasal decolonization to reduce infection has been established.[3] Mupirocin is the agent used most frequently for nasal decolonization, and the most widely studied.[4] However, strains of Staphylococcus aureus resistant to mupirocin continue to increase.[5] Thus, in the face of widespread antimicrobial resistance, judicious use of antibiotics has never been more important. Other concerns with mupirocin include that it is slow to reach full effect, generally requiring a five-day, twice-daily application. Patient compliance with this self-application protocol is a common challenge. Furthermore, despite correct application and full course of treatment, eradication of MRSA (methicillin resistant Staphylococcus aureus) and MSSA (methicillin sensitive Staphylococcus aureus) is not complete.[6] And finally, although not commonly considered, an FDA warning on the Bactroban product insert indicates that as with any antibiotic, there is a risk of developing Clostridium difficile infection (CDI).[7] The newer nasal decolonizing antiseptics are not associated with these risks and concerns.[8-9] These antiseptic products permit just-in-time application by healthcare providers rather than patients, fast broad spectrum effect, and little or no resistance potential.

In recent years, incorporation of nasal decolonization into strategies for prevention and control of HAIs has expanded to include the following:

- Controlling outbreaks
- Device-associated infection prevention including catheter related bloodstream infection (CRBSI), catheter associated urinary tract infection (CAUTI) and ventilator associated pneumonia (VAP)
- High-risk patient population infection prevention including ICU (intensive care units), transplant, dialysis, oncology, burn units
- Reducing contact precautions/isolation
- Reduction of MDROs in the community
- Surgical site infection (SSI) prevention

Nasal decolonization has been demonstrated to be one of a number of effective HAI prevention and control measures. The applications for nasal decolonization in healthcare will be described and the evidence supporting each will be graded using the following method borrowed from the Society for Healthcare Epidemiology of America (SHEA) Compendium.[10-11]

Controlling Outbreaks: Outbreaks of MRSA have been successfully controlled in a variety of healthcare settings including emergency rooms, intensive care units (ICUs), dialysis centers and surgical services. Typically, there are a number of interventions applied, one being nasal decolonization of patients and or healthcare workers, with or without screening tests. Mupirocin is the nasal decolonizing agent studied most to date, and is Food and Drug Administration (FDA)-approved to eradicate MRSA nasal colonization in both patients and healthcare workers.[12] However, depending on the study, the degree to which mupirocin has been shown effective in eliminating target organisms is in the range of 50 percent to 78 percent, nowhere near "eradication."[13-14] Despite this limitation, mupirocin has been effective as one of a bundle of interventions to control outbreaks.[15] Mupirocin nasal decolonization = High; Antiseptic nasal decolonization = no data.

Device-Associated HAI Prevention: Patients can contaminate their environment with their own bacterial flora which reside on skin and in the anterior nares. This is especially a concern when patients have indwelling devices which can serve as direct conduits into vascular, urinary and respiratory systems, where bacteria can cause CRBSI, CAUTI and/or VAP, resulting in significant patient suffering, morbidity, mortality risk and cost. With most studies in which nasal decolonization was reported to be successful in reducing HAI, it was paired with decolonization of skin.[16] Given the growing incidence of antibiotic resistance, there has been a recent surge in study of antiseptics for nasal decolonization. A number of antiseptics and non-chemical technologies have been studied, though more and larger trials are still needed.

Universal versus screening and targeted decolonization is proposed by some studies in order to reduce environmental contamination with pathogens including vancomycin-resistant Enterococcus (VRE).[17] Antiseptic agents, as opposed to mupirocin, may be easier and more practical to implement for universal nasal decolonization. Despite limited published studies to date, nasal antiseptics are inexpensive, have a wider spectrum of bacterial efficacy than mupirocin without the resistance, pose little risk to patients, and are designed to be applied by staff vs. patients. These agents include povidone iodine (PVI) and alcohol-based products.[18] Most of the decolonization studies to date have focused on eliminating Staphylococcus aureus and MRSA, though other pathogens of concern in healthcare today include multidrug-resistant Gram-negative organisms. Studies in this application category would be rated as follows: Mupirocin nasal decolonization = Moderate; Antiseptic nasal decolonization = Moderate.

High-Risk Patient Populations: Patients

considered at high risk for HAIs are those with co-morbidities and/or immunosuppression including those in ICU, burn patients, oncology patients, transplant patients and those on peritoneal dialysis or hemodialysis. In these groups, skin and nasal decolonization have mostly been studied as paired interventions. Visitors, patients and healthcare workers can self-inoculate with pathogens present in the environment and subsequently be implicated in infection transmission to patients. Infections in these high-risk groups are associated with significant morbidity, patient and family suffering and costs. One NICU MRSA infection could cost as much as $27,540.[19] Studies of nasal and skin decolonization in burn patients conclude that decolonization reduces Staphylococcus aureus and MRSA infection risk.[20] Studies of nasal and skin decolonization in dialysis patients conclude that decolonization reduces infection risk, though repeated treatment is required.[21] Evidence ratings for this category: Mupirocin nasal decolonization = Moderate, Antiseptic nasal decolonization = no data.

Reducing Contact Precautions/Isolation: Contact precautions/isolation is utilized to reduce the likelihood that the healthcare worker will transmit pathogens to other patients in the facility; however, contact isolation is costly and can impact safety and satisfaction by reducing the amount of time healthcare workers spend with patients. Additionally, approximately 80 percent of Staphylococcus aureus HAIs have been reported to be associated with self-inoculation by the patient.[4] In concordance with these facts, there is growing evidence that the benefits of selective reduction of contact precaution/isolation use can be achieved without risk of increased MRSA transmission or infection by using universal skin decolonization bundled with antibiotic[22] or antiseptic[23] nasal decolonization. There is strong evidence that MRSA "colonization pressure" (the proportion of MRSA carriers in a facility) is a key driver of transmission rates. This would suggest universal decolonization vs. screening plus targeted decolonization might be prudent in facilities with high MRSA colonization pressure.[17]

Pathogens other than Staphylococcus aureus/MRSA have not been studied relative to nasal decolonization, possibly because mupirocin has limited antimicrobial activity. Since nasal antiseptics have broader spectrum efficacy they may be effective in reducing isolation and transmission of organisms other than MRSA.[18] Pathogenic organisms in addition to Staph aureus and MRSA, although typically not found to colonize nasal mucosa, can transiently colonize the nose. This can lead to patient self-inoculation and/or transmission from patient to patient or healthcare worker to patient.[4]

Evidence ratings for this category: Mupirocin nasal decolonization = Moderate, Antiseptic nasal decolonization = no data.

Reducing MDROs in the Community: An interesting consequence of patient decolonization in hospital ICUs has been described by one study using a computational model as a "spillover effect," resulting in a county-wide reduction in MRSA prevalence. This effect was noted within the county studied, not only in patients outside of hospitals, but also in patients in long-term care facilities, in nursing homes and inside of hospitals in non-ICU nursing units as well, even at one year.[24] Mupirocin nasal decolonization = Low, Antiseptic nasal decolonization patients = no data.

SSI Prevention: Until relatively recently, mupirocin was the only decolonizing agent for SSI prevention studied. This antibiotic ointment is commonly prescribed for application by the patient to the anterior nares for five days

pre-operatively. Although neither patient compliance nor elimination of bacteria is reported to be 100 percent with mupirocin, it has been used successfully to reduce the rate of SSI especially in high-risk procedures including orthopedic and cardiac.[25] More recently, PVI and alcohol-based nasal antiseptics have been introduced as alternatives to mupirocin due to concerns with mupirocin resistance, transference to of resistance, limited bacterial coverage, patient compliance and provider and patient and satisfaction.[6-7]

The normal flora residing in the nose is wide-ranging and includes Staphylococcus aureus, Corynebacterium diphtheriae, Streptococcus pneumoniae, Haemophilus influenza, Streptococcus, Neisseria, Haemophilus, and Micrococcus.[26] Mupirocin is effective active against streptococci and staphylococci, but not corynebacteria, micrococci, and the anaerobic propionibacterium spp. The newer nasal antiseptics containing PVI or alcohol are effective against all organisms found commonly and transiently in the nose including bacteria, virus and fungus.[27-28] Studies of nasal decolonization for SSI prevention would be rated as follows: Mupirocin nasal decolonization = High; Antiseptic nasal decolonization = Moderate.

Figure 1: Nasal Decolonization Products – mupirocin (antibiotic), povidone iodine and alcohol based nasal products (antiseptics)

	Efficacy	Development of resistance [5]	Cost	Risk of CDI 8	Patient Compliance[9,26]
Mupirocin (Bactroban, Centany)	MRSA[4,7] Gram positive	Yes	$10 (5 day course bid) for generic mupirocin; $40 for Bactroban brand	Yes	Variable
PVI (3M, Clorox)	MRSA [8,9] MSSA Gram-positive, Gram-negative bacteria, bacterial spores, fungi, protozoa and viruses	None	$8-16/ application x 3 (per day of treatment)	No	N/A applied by HCW only
Alcohol (Nozin)	MRSA [27] MSSA Gram-positive, Gram-negative bacteria, bacterial spores, fungi, protozoa and viruses	None	$3-6 (per day of treatment)	No	In hospital applied by HCW; if used for post op SSI prevention, can be applied easily by patient

As the quest for zero sustained healthcare associated infections of all types continues, it will be important to become familiar with all products designed to reduce the risk of developing and transmitting HAI. Alcohol and iodine based nasal antiseptics, may provide opportunities to reduce the environmental burden of nasal pathogens within healthcare settings in ways that have never before been accessible.

Future areas of evidence-building to strengthen the effectiveness of our infection

prevention efforts might potentially include:

- Patient nasal decolonization during post-op period with antiseptic bathing for continuing SSI prevention;
- Surgeon and perioperative staff nasal decolonization prior to high-risk surgical procedures for further SSI prevention;
- Healthcare provider nasal decolonization prior to high-risk non-surgical invasive procedures such as CVC insertion, cardiac catheterization for CRBSI and sepsis prevention;
- Healthcare worker nasal decolonization especially during flu season to help reduce presenteeism (working while sick) and absenteeism;
- Screening to identify asymptomatic carriage of MRSA among healthcare workers and the optimal management (e.g., decolonization therapy, follow-up monitoring) of MRSA-colonized healthcare workers;
- Epidemiology and prevention of MRSA among family members and other close contacts of patients colonized or infected with MRSA. ICT

Sue Barnes is currently the national program leader for infection prevention and control for Kaiser Permanente's eight regions, 38 hospitals and 630 medical offices. She plans to retire from Kaiser and begin the second chapter of her career in mid-October 2016, as an independent clinical consultant. She is board-certified in Infection Control and Prevention. She has been in the field of Infection Prevention since 1989. She has participated in the development of the APIC Guide to Elimination of CRBSI, APIC Guide to the Elimination of Infections in Hemodialysis, APIC Safe Injection Practices Position Paper and APIC Training Program for Infection Prevention in Ambulatory Care. She is a subject matter expert consultant and speaker for organizations including AORN and APIC. In addition Barnes has been published in journals including AORN Journal, American Journal of Infection Control, the Joint Commission Source for Compliance Strategies and The Permanente Journal. She served on the National APIC Board of Directors from 2010 to 2012, and was selected to represent APIC on the TAP (technical advisory panel) of the National Quality Forum (NQF) on Healthcare Associated Infections (HAI) and the NQF ESRD Steering Committee. She is the 2016 president of the SFBA APIC chapter and the 2016 president of the California APIC Coordinating Council.

References:

1. Goat GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008; 336(7650):924–926.
2. George S, Leasure AR, Horstmanshof D. Effectiveness of decolonization with chlorhexidine and mupirocin in reducing surgical site infections: A systematic review 2016 Dimensions of Critical Care Nursing 35 (4), pp 204-222.
3. Kalra L, Camacho F, Whitener CJ, Du P, Miller M, Zalonis C, Julian KG. Risk of methicillin-resistant Staphylococcus aureus surgical site infection in patients with nasal MRSA colonization. Am J Infect Control. 2013 Dec; 41(12):1253-7.
4. Coates T, Bax R, Coates A. Nasal decolonization of Staphylococcus aureus with mupirocin: Strengths, weaknesses and future prospects. 2009 Journal of Antimicrobial Chemotherapy 64 (1), pp 9-15.
5. Cookson BD (January 1998). "The emergence of mupirocin resistance: a challenge to infection control and antibiotic prescribing practice". J. Antimicrob. Chemother. 41 (1): 11–8.
6. Sai N, et al. Efficacy of the decolonization of methicillin-resistant Staphylococcus aureus carriers in clinical practice. Antimicrob Resist Infect Contr (2015) 4:56.
7. Bactroban Prescribing Information FDA: http://www.accessdata.fda.gov/drugsatfda_docs/label/2014/050591s032,050703s015,050746s018lbl.pdf
8. Bebko SP, Green DM, Awad SS. Effect of a preoperative decontamination protocol on surgical site infections in patients undergoing elective orthopedic surgery with hardware implantation 2015