

Nasal Decolonization for HAI Prevention and Control

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Disclosure

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Learning Objectives

At the end of the presentation, participants will be able to:

1. Discuss efficacy and action of nasal decolonizing agents
2. List 3 applications for nasal decolonization to prevent and control HAI
3. Share two gaps in current evidence related to nasal decolonization for prevention of HAI

Overview



- The Problem
- The Nose!
- Nasal Decolonizing Agents: Efficacy and Action
 - Mupirocin
 - Povidone-Iodine
 - Alcohol
- Nasal Decolonization to prevent and control HAI
- Universal vs Targeted Decolonization
- Looking Ahead: Nasal Decolonization

The Problem!



- HAIs account for an estimated 1.7 million infections, 99,000 associated deaths each year and are the 5th leading cause of death in the US. ^{1,44}
- The total annual cost for HAI = \$9.8 billion, with surgical site infections contributing the most to overall costs (33.7% of the total), followed by ventilator-associated pneumonia (31.6%), central line-associated bloodstream infections (18.9%), *C difficile* infections (15.4%), and catheter-associated urinary tract infections (<1%).¹
- One healthcare associated infection can cost \$60K.²

The Problem!



- *Staph aureus* causes 50% of central line associated bloodstream infections, 30% of surgical site infections, 24% of ventilator associated pneumonia.³
- Mortality rate for invasive MRSA alone is 20%.³
- Approximately 15 to 25 % of MRSA-colonized inpatients developed a MRSA infection during their hospitalization or within 18 months.⁴

The Problem!



- Experts are predicting that the continuing emergence of antimicrobial resistance will soon lead to the end of antibiotic efficacy and a 'post-antibiotic' era. ⁵
- A comprehensive national response is therefore urgently needed. ⁵
- Use of antiseptics in place of antibiotics (including mupirocin) where equally effective may be one aspect of a comprehensive response to antimicrobial resistance.

The Nose!



- *Staphylococcus aureus* (SA) is a bacterium commonly found in the anterior nares of about 30% of individuals. Other pathogens found in the nose include such as *Haemophilus influenzae*, *S. pneumonia*, *Nisseria meningitides*, *Moraxella catarrhalis*.¹¹
- *Staph aureus* bacterial colonization can be categorized as persistent carriage, intermittent carriage, or non-carriage.
- Nasal carriers of SA are 7X more likely to have contaminated hands than non-carriers.¹²

The Nose!



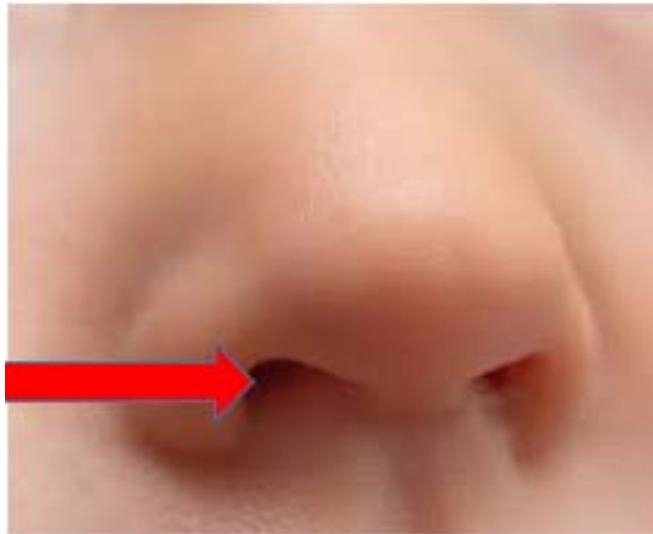
- 80% of wound infections can be traced to the patient's own nasal bacteria.³⁸
- Nose (anterior nares) touching can occur 250x/day leading to contaminated hands, environment and bacterial transmission.¹⁴
- Antibiotic surgical prophylaxis increases the nasal carriage of *S. aureus* and coag negative *S. aureus*, and the incidence of antibiotic resistant *S. epidermidis*.¹⁵

Nasal Decolonizing Agents Efficacy and Action

	Efficacy	Development of resistance ⁵	Time to full effect
Mupirocin	MRSA ^{8,9} Gram positive	Yes	50-78% effective after 5-14 days
PVI (povidone iodine)	MRSA ^{6,7} MSSA Gram-positive, Gram-negative bacteria, bacterial spores, fungi, protozoa and viruses	None	100% effective immediately
Alcohol	MRSA ¹⁰ MSSA Gram-positive, Gram-negative bacteria, bacterial spores, fungi, protozoa and viruses	None	100% effective immediately

Anterior Nares = nostrils

The nose (anterior nares) is the single greatest “hotzone” for MRSA.¹⁶



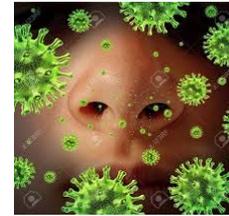
Nasal Decolonization

MRSA decolonization therapy can be defined as the administration of topical antimicrobial or antiseptic agents, with or without systemic antimicrobial therapy, for the purpose of eradicating or suppressing the carrier state. MRSA decolonization can be targeted to MRSA- colonized persons or applied universally to populations deemed to be at high risk for infection.⁴⁵

- Colonization can lead to infections in the colonized person and transmission from person to person via direct or indirect contact.
- Hospitals invest considerable efforts in prevention of direct patient-to-patient transmission or transmission via staff and the environment.
- The goal of decolonization is to reduce or eliminate the bacterial burden in order to reduce the risk of transmission and infection.²³

Nasal Decolonizing Agents: Mupirocin

- Mupirocin is the most frequently used and studied nasal decolonizing agent.
- Although mupirocin reduces, not eliminates pathogenic bacteria in the nose, it is reported in many studies to be an effective tool in reducing the risk of surgical site infections, device associated infections, infections in high risk categories, and in outbreaks.¹⁷⁻²⁷



Nasal Decolonizing Agents: Mupirocin

- Mupirocin is slow to reach full effect, generally requiring a 5 day twice daily application.⁸
- Patient compliance with self-application of mupirocin is a common challenge.
- An FDA warning on the package insert indicates that as with any antibiotic, there is a risk of developing *Clostridium difficile* infection (CDI).²⁸



Mupirocin - General Activity and Action

- ▶ Mupirocin is an antibiotic.
- ▶ Mupirocin has excellent in vitro activity against staphylococci and most streptococci but less activity against other gram-positive and gram-negative bacteria.
- ▶ Mupirocin exerts its antimicrobial activity by reversibly inhibiting isoleucyl-transfer RNA, thereby inhibiting bacterial protein and RNA synthesis.

Mupirocin resistance

- ▶ Mupirocin was introduced into clinical practice in the UK in 1985, and resistance was described shortly after its initial use.⁸
- ▶ Bacterial resistance to mupirocin including *Staphylococcus aureus* continues to increase, making it a less effective decolonizing agent.^{29, 31}
- ▶ Screening for mupirocin resistance is important before attempting decolonization.²⁹

Relapse and Treatment Failure with Mupirocin

- ▶ Mupirocin is effective at removing *S aureus* from the nose in the short term. Patients at risk require periodic retreatment.¹²
- ▶ One study concluded that after application of mupirocin for 5 days, 22% of patients remained colonized with MRSA.¹⁸
- ▶ Wide usage of mupirocin has resulted in resistance leading to treatment failure.³⁰

Evidence of Efficacy - Mupirocin Nasal



SSI PREVENTION: Systematic literature reviews and meta-analyses of published studies have found a protective effect of mupirocin decolonization against surgical site infections (SSIs), especially among non-general surgery such as cardiac surgery, orthopedic surgery, and neurosurgery.^{21,22}

Effectiveness of a bundled intervention of decolonization and prophylaxis to decrease Gram positive surgical site infections after cardiac or orthopedic surgery.⁴⁶

Perioperative intranasal mupirocin for the prevention of surgical-site infections: systematic review of the literature and meta-analysis.⁴⁷

Evidence of Efficacy - Mupirocin Nasal



ICU PATIENTS: Decolonization of ICU patients with CHG and mupirocin has been associated with declines in CLABSI.²³

DIALYSIS PATIENTS: Patients on dialysis are particularly vulnerable to methicillin-resistant *Staph aureus* (MRSA) infections and MRSA colonization is associated with increased risk for severe infections in this population.³⁰

BURN PATIENTS: The prevalence of HA-MRSA at one institution's burn center was significantly decreased after the implementation of a universal decolonization protocol (2% chlorhexidine-impregnated wipes and nasal decolonization).¹⁹

Nasal Decolonizing Agents: Povidone-Iodine

- Designed for just in time application by healthcare providers rather than patients, fast broad spectrum effect, and little or no resistance potential.
- 2-minute application, effective in eliminating MRSA, MSSA, gram-positive, gram-negative bacteria, bacterial spores, fungi, protozoa and viruses.
- Reduces 99.4% of *S. aureus* at 1 hour and maintains persistence for 12 hours.



Povidone-Iodine - General Activity and Action

- ▶ The antimicrobial action of iodine is rapid, even at low concentrations. Iodine rapidly penetrates into microorganisms and attacks key groups of proteins.
- ▶ Aqueous or alcoholic (tincture) solutions of iodine have been used for 150 years as antiseptics, although they are associated with irritation and excessive staining.

Evidence of Efficacy - Povidone-Iodine Nasal

SSI PREVENTION: One study demonstrated that pre-operative MRSA decontamination with chlorhexidine washcloths and oral rinse and intranasal povidone-iodine decreased the SSI rate by more than 50% among patients undergoing elective orthopedic surgery with hardware implantation.⁶

Another study concluded that nasal povidone-iodine may be considered as an alternative to mupirocin in a multifaceted approach to reduce SSI.³³

Evidence of Efficacy - Povidone-Iodine Nasal continued

ICU: Nasal application of povidone-iodine cream is safe and effective for eradicating MRSA in the nasal cavity. ³⁶



Nasal Decolonizing Agents: Alcohol



- Designed for just in time application by healthcare providers rather than patients, fast broad spectrum effect, and little or no resistance potential.
- Effective at eliminating MRSA, MSSA, Gram-positive, Gram-negative bacteria, bacterial spores, fungi, protozoa and viruses
- Kills 99.99% of nasal microbial pathogens
- 8 hour persistence, moisturizing
- Pleasant, non-stinging, non-staining, easy to apply in less than 1 minute

Alcohol - General Activity and Action

- ▶ Alcohols exhibit rapid broad-spectrum antimicrobial activity against vegetative bacteria, viruses, and fungi but are not sporicidal. They are, however, known to inhibit sporulation and spore germination.
- ▶ It is generally believed that they cause bacterial cell membrane damage and rapid denaturation of proteins, with subsequent interference with metabolism and cell lysis.
- ▶ Alcohols are widely used for both hard-surface disinfection and skin antiseptics. Lower concentrations may also be used as preservatives and to potentiate the activity of other biocides.¹⁰

Evidence of Efficacy - Alcohol

HEALTHCARE WORKER COLONIZATION:

Nasal application of a non-antibiotic, alcohol-based antiseptic was effective in one study in reducing *S aureus* and total bacterial carriage in healthcare workers, suggesting the usefulness of this approach as a safe, effective, and convenient alternative to antibiotic treatment.⁴¹



Product Comparison

	Mupirocin	Iodine	Alcohol
HAI reduction	✓	✓	✓
Non-antibiotic/ broad spectrum	X	✓	✓
Same day use	X	✓	✓
Easy and pleasant to use	X	X	✓
8-12 hour sustained effect with 1 application	X	✓	✓
HCW/Patient satisfaction	X	X	✓

Nasal Decolonization to Prevent and Control HAI



1. Surgical site infection prevention
2. Device associated infection prevention (CRBSI, CAUTI, VAP)
3. High risk patient population infection prevention including ICU, dialysis, oncology, burn units
4. Isolation - Reducing the incidence of contact isolation
5. Controlling outbreaks
6. Reducing community onset MRDRO

Surgical Site Infection Prevention



- ▶ Nasal decolonization of patients pre-op has been shown to reduce SSI rates by as much as 50%, presumably because 80% of *Staphylococcus aureus* HAIs have been reported to be associated with self-inoculation by the patient. ^{20,21}
- ▶ In a controlled before-and-after study, patients who tested positive for *Staph aureus* were decolonized with nasal mupirocin ointment and chlorhexidine soap prior to deep brain stimulation surgery. There was a significant decrease in SSI from 10.9% to 1.6%. ⁴²

Surgical Site Infection Prevention continued

- ▶ In one study, pre-op nasal decolonization of surgical and nursing staff was performed with alcohol based antiseptic, and patient decolonization with alcohol-based nasal antiseptic in combination with existing chlorhexidine bathing. Mean infection rates were significantly decreased by 81% from 1.76 to 0.33 per 100 surgeries during the 15-month trial, when compared with the prior 9-month baseline.⁴⁰
- ▶ In another study nasal decolonization was successfully performed by healthcare workers.⁴¹ This was presumably done since masks are not 100% effective in preventing leakage of aerosolized bacteria in and out.

Device Associated Infections

- ▶ Patients contaminate their environment with their own bacteria including from the nose. Pathogenic organisms can be frequently detected on hands of acute care patients.³⁹
- ▶ Indwelling devices serve as a direct conduit into organ spaces, and when touched with contaminated hands can be implicated in CLABSI, CAUTI, VAP.



Device Associated Infections continued

- ▶ In one study, implementation of decolonization with mupirocin and CHG bathing was associated with a 23.5% decrease in CLABSI.¹⁵
- ▶ Nasal decolonization to prevent device associated infections has typically been paired with decolonization of the skin with CHG.²¹



High Risk Populations - Burn, Oncology, Transplant

- ▶ High risk = patients with co-morbidities and/or immunosuppression
- ▶ Nasal and skin decolonization in burn patients, has mainly been studied as a pair of interventions, resulting in successful reduction of *Staph aureus* and MRSA infections.⁴³
- ▶ In one study decolonization with mupirocin and CHG was effective in decreasing the rate of *Staph aureus* infection that was endemic in liver transplant recipients.²⁷

High risk populations - Intensive Care Units

- ▶ Infections in ICU are associated with significant morbidity, patient and family suffering and costs. One NICU MRSA infection could cost as much as \$27,540.¹
- ▶ Decolonization for patients admitted to the ICU has been found to reduce bloodstream infections and associated healthcare costs.²³



High risk populations - Dialysis

- ▶ ICU patients colonized with MRSA or *S. aureus* are at greater risk of developing a MRSA or *S. aureus* infection, even after adjusting for patient-specific risk factors.⁴
- ▶ In one facility, mupirocin was observed to reduce the risk for *S. aureus* infections by 59% in dialysis units and adult intensive care units.³⁰



Isolation - Reducing Contact Precautions

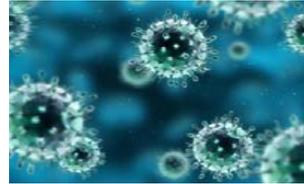


- ▶ Isolation is costly, with higher risk of adverse events, longer stays, delays in treatment, impact on work flow and and can reduce patient and staff satisfaction.
- ▶ Selective reduction of contact precautions/ isolation use can be achieved without risk of increased MRSA transmission or infection, by using universal skin decolonization bundled with antibiotic or antiseptic nasal decolonization.³⁷

Isolation - Reducing Contact Precautions

- ▶ At one medical center in California, an alcohol based nasal antiseptic was introduced in combination with daily CHG bathing to replace contact precautions for patients colonized with MRSA.³⁷
- ▶ This change resulted in the elimination of approximately 60-70 gowns and gloves per day/patient in isolation, and a total cost savings of \$73,000 in one year.³⁷
- ▶ Patients reported greater satisfaction with decolonization of nose and skin compared with contact precautions.³⁷

Controlling Outbreaks



- ▶ Patients contaminate their environment with their own bacteria including from the nose. Approximately 80% of *Staphylococcus aureus* HAIs have been reported to be associated with self-inoculation by the patient.³⁸
- ▶ Outbreaks of MRSA have been successfully controlled in a variety of healthcare settings including Emergency rooms, ICUs, dialysis centers and surgical services using a bundle of interventions including nasal decolonization.^{24,36}

Controlling Outbreaks continued

- ▶ Decolonization may decrease the risk of infection in colonized patients, and decrease the colonization prevalence in the unit to reduce the risk of transmission to non-colonized patients.²³
- ▶ *Staphylococcus aureus* (*S. aureus*) continues to be a leading cause of outbreaks and health-care-associated infections in neonatal intensive care units. Increasingly *S. aureus* colonized neonates are being decolonized with mupirocin in combination with an antiseptic such as chlorhexidine.²⁶

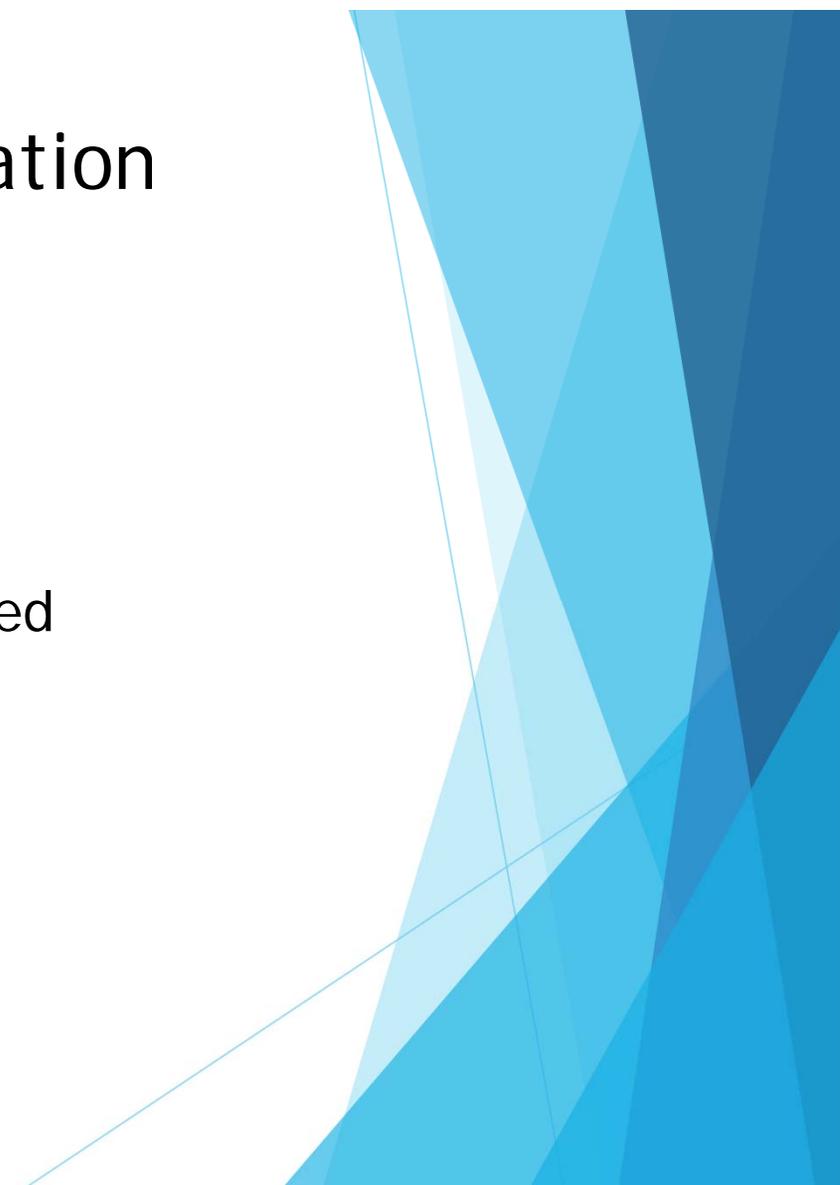
Reducing Community Onset MDRO



- ▶ Decolonization in ICUs has been described by one study to create a “spillover effect”, resulting in county-wide reduction in MRSA prevalence.
- ▶ This reduction was noted in community patients, as well as patients in LTCF, SNFs and inside hospitals in non ICU units even at one year.⁹

Universal vs. Targeted Decolonization

- ▶ Targeted = screening for carriage and decolonizing if positive screen
- ▶ Universal = all patients get decolonized regardless of carriage status



Universal vs. Targeted Decolonization continued

- ▶ Universal decolonization of skin and nose was reported in one study to achieve 44% reduction in ICU infections and \$171 cost savings per patient. Universal decolonization eliminated the cost and labor associated with lab screening.²⁰
- ▶ In one study, universal decolonization was more effective than targeted decolonization or screening and isolation in reducing rates of MRSA.²³

Universal vs. Targeted Decolonization continued

- ▶ 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.²³
- ▶ Legislative mandates in many states require targeted nares screening for MRSA. In combination with nasal and skin decolonization, this has been shown to reduce MRSA infections.

Evidence based Best Practice Guidelines Updated 2014

Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals

- Universal decolonization for ICU patients
- Intranasal *S. aureus* decolonization for high-risk procedures, including orthopedic and cardiothoracic procedures, as part of an effective strategy to prevent SSIs



Surgical Site Infections

Change Package

2016 UPDATE

PREVENTING SURGICAL SITE INFECTIONS



American Hospital Association

Secondary Driver > Identify *Staphylococcus aureus*-colonized patients and decolonize preoperatively

Patients who carry *Staphylococcus aureus* (SA) – both methicillin sensitive and methicillin resistant – in their nares or on their skin are more likely to develop SA surgical-site infections.^{43,44,45} Depending on the surgical procedure, such as joint and cardiac surgeries, baseline SSI rates, and available resources, implement a pre-screening program to identify and decolonize SA carriers prior to surgery.^{46,47,48}

Change Ideas

- + Educate the surgical staff to be aware that patients who carry SA in their nares/skin are more likely to develop SA surgical-site infections.
- + Recognize that decolonization efforts are not a “cure”, but a temporary reduction of SA from the nares and skin, the natural reservoirs where SA is most often carried.
- + Establish a pre-screening/decolonization program for designated elective surgeries (e.g., hip or knee replacements or coronary artery bypass surgery).
- + Integrate CHG bathing and either intranasal mupirocin or povidone-iodine nasal antiseptic into the decolonization protocol.
- + Establish clear pre-admission testing protocols for the screening, detection and reporting of SA. Clearly state who performs the diagnostic swab, who processes the swab to determine if SA is present, who receives the notification of SA presence, and who coordinates and implements follow-up treatment.

Consider pre-op patient nasal decolonization with Mupirocin, Nozin alcohol or 3M PVI nasal antiseptic¹

Hospital quality programs and HAIs

- Coordinated efforts of Federal agencies aimed at HAI prevention
- Public reporting of hospital-specific HAI rates
- Linking hospital-specific HAI performance measurements to financial reimbursement to stimulate HAI prevention efforts
- Report CLABSIs in ICU to qualify for annual payment updates
- CMS reporting requirements for SSIs, now also MRSA BSI hospital-wide
- Value-based purchasing includes these quality metrics to determine CMS reimbursement levels
- Hospitals now have strong financial incentives to implement prevention strategies to control HAIs. One such prevention strategy is decolonization.

Looking ahead: Nasal decolonization

Outcome measurements where research is needed

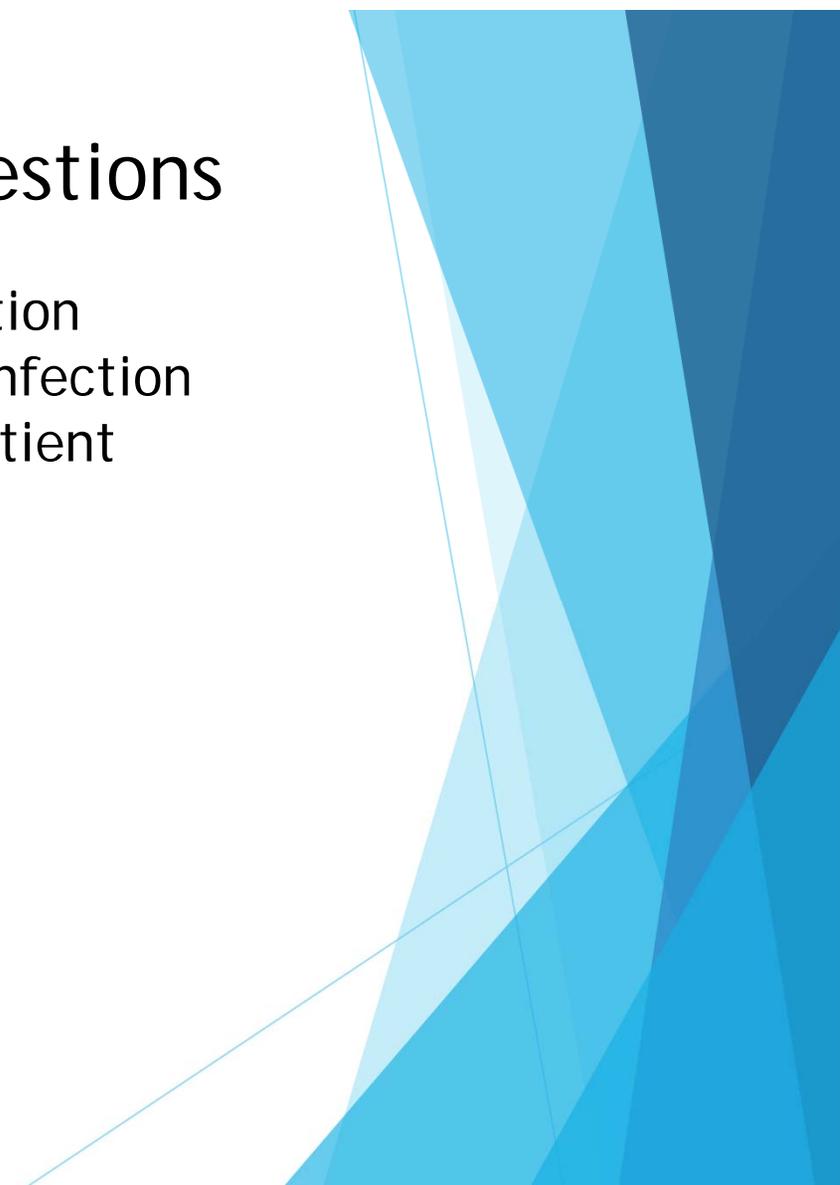
- MRSA acquisition rate
- MRSA infection rate
- Staff compliance with infection control procedures
- Patient flow (e.g., median time interval between ED arrival and hospital admission)
- Morbidity (e.g., complications of MRSA infection)
- MRSA-attributable mortality
- Harms (e.g., allergic reaction to treatment, satisfaction of patients in isolation)
- Resource use (e.g., length of stay)
- Cost-benefit analysis



Examples of future research questions

What is the most effective nasal decolonization strategy for reducing MRSA acquisition and infection rates and improving morbidity, mortality, patient flow and resource use for:

1. For surgical admissions
2. For intensive care populations
3. For general medical inpatients



More studies needed



- ✓ Efficacy of nasal alcohol vs. nasal iodine for SSI and device associated infection prevention and to replace contact isolation for colonized patients.
- ✓ Efficacy of other new products compared to alcohol, iodine and mupirocin.

New studies needed on expanded use of nasal decolonization for HAI prevention and control

- Patient nasal decolonization during post op period bundled with antiseptic bathing for continuing SSI prevention
- Surgeon and perioperative staff nasal decolonization prior to surgical procedures for adjunctive SSI prevention
- Provider nasal decolonization prior to non-surgical invasive procedures such as CVC insertion and cardiac catheterization for adjunctive CRBSI prevention.

New studies needed on expanded use of nasal decolonization for HAI prevention and control

- Healthcare worker nasal decolonization especially during flu season to help reduce presenteeism (working while sick) and absenteeism.
- Use of nasal antiseptics as a strategy to reduce patient infections, associated overall antibiotic treatment and emerging antibiotic resistance.



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