Understanding secondary bacterial infections associated with COVID-19 and influenza

Evaluating how a nasal colonization risk mitigation strategy can help improve patient outcomes
CE Credits. Accreditation is provided by Terri Goodman & Associates (TG&A), an approved provider by the California Board of Registered Nursing, Provider Number CEP16550.

Within 2 days, you will receive an invitation from TG&A to complete an evaluation.

If you do not receive an email or have a question, please contact Terri Goodman at terri@terrigoodman.com or (214) 797-0345.
Introduction

Gwen Borlaug MPH, CIC, FAPIC

Consultant

Disclosure: Gwen Borlaug, member of the Global Life Technologies Corp. Speaker’s Bureau
Learning Objectives

• Describe how secondary bacterial infections impact patients with respiratory viral infections such as COVID-19 and influenza.

• Describe the interactions among influenza virus, the nasal microbiome and *Staphylococcus aureus*.

• Identify nasal and skin decolonization as a potential strategy to mitigate risk of MSSA and MRSA secondary infections associated with respiratory viral infections.

• List the benefits of universal, house-wide nasal and skin decolonization for hospital patients.
Topics

I. Secondary bacterial infection in viral respiratory disease
II. Bacterial colonization: A risk factor for secondary bacterial infection
III. Exploring risk mitigation strategies
IV. Universal nasal decolonization: A strategy to prevent healthcare-associated S. aureus infections
Secondary bacterial infections following viral respiratory disease

Section I
Secondary bacterial infections (SBI)

**Bacterial co-infection** – a bacterial infection occurring simultaneously with onset of respiratory viral infections

**Secondary bacterial infection** – most commonly presents as bacterial infection (e.g. pneumonia), occurring after onset or in recovery phase of respiratory viral infections

These infections are associated with:
- greater severity of illness
- greater use of healthcare resources
- increased risk of death
Secondary bacterial infection among COVID-19 patients

SBI in COVID-19 patients increase morbidity, mortality and antimicrobial resistance (AMR) threat

- Hospital acquired-infection in 13.5% patients (Yang et al.)
- 50% of non-survivor cases had SBI
- VAP in 31% of patients requiring invasive respiratory support (Zhou et al.)
- 57.9% of severely and critically ill patients developed secondary bacterial infections. (Zhang et al.)
- SBI developed at a median of 17 days after illness onset (Zhou et al.)

Most prevalent pathogens:
- S. aureus
- S. pneumoniae
- N. meningitides
- H. influenzae
- K. pneumoniae

Acute bacterial co-infections associated with COVID-19 illness

Acute Bacterial Co-Infection in COVID-19

A Rapid Living Review and Meta-analysis

24 Studies included
3338 COVID-19 Patients

3.5% Co-Infection
On presentation

14.3% Secondary Infection
After presentation

71.8% Antibiotic Prescribing

4.9% (2.6 to 7.1) Co-infection

16% (12.4 to 19.6) Secondary Infection

UPDATE: October 29, 2020
38 studies
Accessed February 22, 2021


www.tarrn.org/covid
Risk Factors and Outcomes of Hospitalized Patients with Severe COVID-19 and Secondary Bloodstream Infections: A Multicenter, Case-Control Study

- 34% (128/375) of COVID-19 patients developed secondary BSI
- 91% caused by bacterial pathogens
  - S. aureus
  - Enterococcus spp.
  - E. coli
- 51% were hospital-associated

- Sources
  - Unknown
  - CLABSI
- Increased hospital stays and worse clinical outcomes

- Conclusions
  - Antimicrobial measures in hospitals need to be improved
  - Further studies need to develop prevention and treatment protocols

Secondary bacterial infections among COVID-19 patients

Retrospective observational case series of patients with coronavirus disease 2019 (COVID-19) who developed secondary *S. aureus* bacteremia across 2 New York City hospitals.

42 hospital patients with secondary *S. aureus* bacteremia

55% and 67% died at 14 days and 30 days respectively following first positive blood culture

Independent risk factors for 14 day mortality included hospital onset bacteremia and age.
Secondary bacterial infections associated with COVID-19: Risk

Endogenous colonization with flora harboring antimicrobial resistance
Data is suggestive of nosocomial transmission of hospital organisms in critically ill ventilated patients

Colonization is a risk:
- COPD is comorbidity in severe COVID-19. COPD patients are colonized by bacterial pathogens even at the stable phase of the disease, making it likely that SBI infection occurs in patients already colonized with bacteria.

Nosocomial acquisition likely:
- The median LOS of COVID-19 patients: 7 days (can reach ≥14 days)
- Risk of a hospital-associated pneumonia increases significantly the longer the hospitalization period.
- More than 90% of hospital-associated pneumonias are associated with mechanical ventilation, one of the therapeutics used in COVID-19 patients admitted in the ICU.

*Docherty AB et al. medRxiv: 2020.*
The experts suggest closely monitoring the signs of secondary infection, especially in critically ill patients with COVID-19 who have been admitted to ICU > 48 h (expert opinion).

Rationale

- Both long course of the disease and immunosuppressive state place the severe and critical COVID-19 patients at a high risk of secondary infection (including bacteria and fungus).
- The data on the epidemiology of secondary infection in COVID-19 patients are lacking.
- Based on the evidence from H1N1, secondary infection is very common in patients admitted to ICU > 48 h.
- Strategies for preventing healthcare-acquired infections should be effectively implemented, and multiple site samples (blood, sputum, etc.) should be routinely collected to monitor the signs of secondary infection.
The national standard infection ratio for central line-associated bloodstream infections increased:

28% in 2020 Q2 vs. 2019 Q2

Secondary bacterial infections associated with influenza

Influenza virus infects 5%–20% of the US population yearly, with 23,000 to 61,000 deaths annually.

Up to 75% of those infected with influenza that go on to acquire pneumonia are confirmed to have SBI

USA: influenza and pneumonia currently rank 8th overall as a cause of death, annually.

In seasonal epidemics, SBI associated with influenza is associated with:

- increases in hospital admissions
- more severe symptoms
- increases in mortality (mortality rates ranging from 11- to 15-fold higher than those of influenza alone)

Most common causative pathogens

- *Streptococcus pneumoniae*
- *Staphylococcus aureus*
- *Haemophilus influenzae*

Secondary bacterial infections during influenza pandemics

>95% of deaths attributable to secondary bacterial pneumonia (est.)

Streptococcus pneumoniae most frequently recovered etiologic agents

1.5 million deaths worldwide

Staphylococci assumed a novel prominence as the leading etiologic agent

Secondary staphylococcal infections continued to be seen through the second wave of the “Asian flu” in 1960–1961

Secondary bacterial infections during influenza pandemics

1968-1969 PANDEMIC | HONG KONG FLU | H3N2 STRAIN

- Deaths Peaked: September 1968–March 1969
- 34K total deaths in the United States
- Mildest flu pandemic of the 20th Century
- Virus still circulates today

Higher risk age/group: children, teens and young adults
30-55% of case mortality associated with bacterial pneumonia

S. pneumoniae most common bacteria identified

Pediatric ICU studies:
- 33% with SBI, S. aureus/MRSA most common (26%)
- 51% with SBI, S. aureus most common (35%)

2009-2010 PANDEMIC | SWINE FLU | H1N1 STRAIN

- 4/15/09 first U.S. case detected
- 61MIL vaccines produced 4/09-11/09
- 8–18K CDC estimated H1N1 related deaths
- 74 countries affected
- 48 U.S. states with H1N1
- 80MIL people vaccinated in total

Higher risk age/group: elderly
A high correlation between pneumonia, especially staphylococcal pneumonia, and influenza infection was documented.

Secondary bacterial infections during previous coronavirus outbreaks


SARS-CoV: up to 30% of patients diagnosed with secondary bacterial infections (positively associated with disease severity)

Common etiologic agents:
- SARS-CoV—MRSA, Klebsiella, P. aeruginosa and Streptococcus
- MERS—MRSA, others included carbapenem-resistant *Acinetobacter baumannii*, VRE and *S. pneumoniae*
Antibiotic-Resistant Pathogens in Hospitalized Patients: Hospital-onset

Rate of hospital-onset resistant organisms per 10,000 discharges

- **Influenza-Like Illness (2019)**
- **COVID-19 (2020)**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>ILI 2019</th>
<th>COVID-19 2020</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>+57%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESBL</td>
<td></td>
<td>+176%</td>
<td></td>
</tr>
<tr>
<td>CRE</td>
<td>+56%</td>
<td>-23%</td>
<td></td>
</tr>
<tr>
<td>VRE</td>
<td>-23%</td>
<td>+62%</td>
<td></td>
</tr>
<tr>
<td>CRAB</td>
<td></td>
<td>+42%</td>
<td></td>
</tr>
<tr>
<td>CRPA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Length of stay may contribute to the higher frequency of some pathogens in patients with COVID-19.

The Intersection of Antibiotic Resistance (AR), Antibiotic Use (AU), and COVID-19 (hhs.gov)
Of the six pathogens, MRSA and ESBL contribute the most to total costs nationally due to their high burden despite having lower healthcare costs per case. The paper was published in *Clinical Infectious Diseases* in early 2021.
Key Takeaways

- Healthcare infection control is critical to fighting AR and SARS-CoV-2 infections
  - No clear evidence that COVID-19 patients are more susceptible to bacterial/fungal infections—similar frequency as patients with influenza-like illness (ILI). However, we are seeing sporadic outbreaks of AR infections in COVID units & higher rates of hospital onset infections
  - COVID-19 creates perfect storm for AR infections in healthcare settings: length of stay, crowding, sick patients, antibiotic use, infection control issues

- Antibiotic use fluctuated, appears stable but remains too high
  - Hospitals: Spiked in early 2020 but flattened as pandemic continued
  - Outpatient, nursing homes: Significant drops from previous years

- Highlights continued importance of infection control and antibiotic stewardship—both are dependent on the resiliency of these programs
Bacterial colonization: a risk factor for secondary bacterial infection

Section II
Viral infections are associated with increased colonization by potentially pathogenic bacteria (known as “pathobionts” or opportunistic pathogens).

- Staphylococcus spp., Propionibacterium spp., Corynebacterium spp., Moraxella spp. and Streptococcus spp.
- Prevotella spp., Veillonella spp., Streptococcus spp. and Tropheryma whipplei
Bacterial colonization in upper respiratory tract

**Bacterial colonization** of the upper respiratory tract (URT) is generally considered as the first step in the development of invasive bacterial infections, including secondary bacterial infections following respiratory viral infection.

Possible **mechanisms** by which influenza and other viral infections might predispose infected hosts to secondary bacterial pneumonia is by:

- fostering enhanced growth of pathogens; increasing nasal colonization **S. aureus**
- facilitating the subsequent entry of large bacterial loads into the lower respiratory tract (LRT)

Influenza virus infection is believed to facilitate migration of bacteria from URT to LRT where pathogens can now cause serious disease.

Mechanisms responsible for SBI with viral respiratory infections

Viral infections promote bacterial colonization of the airway through a variety of mechanisms/detrimental changes:

- Altered mucus secretion
- Cell death
- Decreased mucosal clearance
- Reduced oxygen exchange
- Impaired surfactant secretion
- Inflammatory response

Damage to cells and lung infrastructure enables bacteria to increase adherence and invasion.
Nasal colonization: *Staph aureus* and influenza

Nasal carriage of *S. aureus* is a significant risk factor for secondary staphylococcal pneumonia in influenza A virus (IAV)-infected hosts.

Persistent nasal carriers of *S. aureus* are predisposed to invasive disease, including secondary staphylococcal respiratory infection.

*S. aureus* may be aspirated from the nose into the lung, with the potential to cause respiratory infection in a host made susceptible by presence of IAV.

*S. aureus* biofilm dispersal from the nasal environment into the lung is another mechanism of potential inoculation.

Roles of endogenous danger signals during influenza A viral infection.

Michelle E. Mulcahy, and Rachel M. McLoughlin mBio 2016; doi:10.1128/mBio.02068-16
**Streptococcus pneumoniae**

- Most common bacteria found in SBIs
- High mortality and morbidity during influenza epidemics and pandemics.
- Most common cause of community-acquired pneumonia and invasive disease (sepsis and meningitis) worldwide. (30% lab-confirmed cases of CAP involve bacterial-viral co-infection)
- 4 million cases of infection and 22,000 deaths annually in USA (2011 data*)
- **Pneumococcal vaccination** has shown to reduce risk of secondary bacterial pneumonia.
- Vaccine implementation has successfully reduced pneumococcal disease, (*45% reduction in incidence* in those with influenza)

• *S. aureus* infection in the intensive care unit (ICU) most commonly manifests as sepsis, VAP, and infection of surgical sites and indwelling medical devices.

• *S. aureus* nasal colonization has been identified as a major risk factor for the development of nosocomial staphylococcal infection.

• 20–30% of the healthy population is persistently colonized by *S. aureus* and 60% are intermittently colonized.

• Although vaccine development has lowered the mortality of other bacterial infections, all vaccination attempts aimed at preventing *S. aureus* invasive infections have failed in human trials.
Staphylococcus aureus and influenza

- Complicates influenza infection, increasingly so in more recent years/pandemics.
- Common cause of pneumonia, specifically necrotizing pneumonia caused by MRSA (30% mortality rate)
- MRSA currently accounts for 20%–40% of hospital-acquired and ventilator-associated pneumonias and 9% of community-acquired pneumonias.
- Increased intensive care admission, mechanical ventilation, and mortality have been described in children and young adults with influenza A and concomitant S. aureus infection compared to those with either influenza or S. aureus infection alone.

Mitigating risk

Most effective risk mitigation strategies:

#1 Influenza vaccine !!!

Pneumococcal vaccine
Haemophilus influenzae vaccine
Prompt antiviral treatment/prophylaxis

Eventually: SARS-CoV-2 vaccine
Risk mitigation for staphylococcal SBI

Modifiable risk factors

Nasal colonization

Respiratory viral infection promotes nasal colonization. Preventive measures can be directed at reducing nasal colonization to mitigate the risk of subclinical aspiration of bacteria colonizing the nose.

Nasal carriage of *S. aureus* is a significant risk factor for secondary staphylococcal pneumonia.

Colonization—subsequent infection

Transmission/acquisition HAI

Secondary infections can be acquired from the patient's environment i.e., hospital-acquired or nosocomial infections.

Transmission—acquisition—subsequent infection
### S. aureus nasal colonization, a risk factor for infections

<table>
<thead>
<tr>
<th>S. aureus nasal colonization, a risk factor for</th>
<th>Reference</th>
</tr>
</thead>
</table>
| Surgical site infections after orthopedic surgeries | Kalmeijer et al., 2000; Yano et al., 2000;  
Weiser and Moucha, 2015 |
| Surgical site infections after cardiac surgeries | Kluytmans et al., 1995; Muñoz et al., 2008 |
| Bacteremia in nonsurgical patients | Wertheim et al., 2004 |
| Catheter-related infections in dialysis patients | Luzar et al., 1990; Katneni and Hedayati, 2007 |
| S. aureus infections in HIV-infected patients | Nguyen et al., 1999; Sissolak et al., 2002 |
| ICU-associated S. aureus infections | Honda et al., 2010 |
| Recurrent furunculosis and impetigo | Durupt et al., 2007; Demos et al., 2012 |
| Diabetic foot ulcer infections | Dunyach-Remy et al., 2017 |

Nasal carriage of *S. aureus* is a significant risk factor for secondary staphylococcal pneumonia in influenza A virus (IAV)-infected hosts.
Can nasal decolonization be considered a supplemental risk mitigation strategy to prevent secondary staphylococcal pneumonia?
Risk mitigation for staphylococcal SBI

Nasal decolonization as a risk mitigation strategy??

Pathogenesis of HAP and HCAP in non-intubated patients
- Micro-aspiration of contaminated nasal/oropharyngeal secretions into the lung in persons with compromised defense mechanisms
  ~ MAYBE

Pathogenesis of VAP
- Aspiration of oropharyngeal or gastric contents that have been colonized by endogenous flora
  ~ MAYBE

Pathogens from the environment / Acquisition
- hands or attire of healthcare workers
- pathogens attached to respiratory equipment
  ~ YES, as source control

Should nasal and skin staphylococcal decolonization protocols be deployed in long-term care facility COVID-19 units as source control to mitigate transmission of MSSA and MRSA??
Universal nasal decolonization: A strategy to prevent hospital-onset S. aureus infections

Section IV
Universal Staphylococcal Decolonization

Huang et al 2013 -
Universal decolonization superior to screen and isolate/treat

- Fewer infections
- Lower costs

“In routine ICU practice, universal decolonization was more effective than targeted decolonization or screening and isolation in reducing rates of MRSA clinical isolates and bloodstream infection from any pathogen.”

Huang SS et al. Targeted vs. universal decolonization to prevent ICU infection. N Engl J Med 2013; 368 (24) 2255-65
Universal Staphylococcal Decolonization

Study Results:

Reduction of:
- 37% in MRSA clinical cultures
- 28% in MRSA BSI
- 44% in all-pathogen BSI

Prevention of:
- 9 BSI/1,000 ICU admissions
- Average of 23 BSI avoided annually in a 30 bed ICU costing $418K/yr. to treat
2013 Huang study: If this practice (universal decolonization) is widely implemented, vigilance for emerging resistance will be required.

2006 CDC Guidelines for Managing Patients with MDRO: Routine decolonization is not recommended, however, when decolonization does occur, mupirocin antibiotic susceptibility testing should be performed each time patients undergo mupirocin decolonization to avoid treatment failures.

2009 CID mupirocin resistance article: A strategy for monitoring the prevalence of resistance should be developed and implemented whenever mupirocin is to be routinely used.

2013 ASHP guidelines: When decolonization therapy (e.g., mupirocin) is used as an adjunctive measure to prevent *S. aureus* SSI, surveillance of susceptibility of *S. aureus* isolated from SSIs to mupirocin is recommended.
## Nasal Decolonization Agents

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Alcohol-based antiseptic</th>
<th>Antibiotic prophylactic (mupirocin)</th>
<th>Povidone iodine antiseptic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective vs. MRSA/MSSA – 99%</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Non-antibiotic--no reported resistance</td>
<td>✔</td>
<td>✖</td>
<td>✔</td>
</tr>
<tr>
<td>Effective day 1</td>
<td>✔</td>
<td>✖</td>
<td>✔</td>
</tr>
<tr>
<td>Easy to use</td>
<td>✔</td>
<td>✖</td>
<td>✔</td>
</tr>
<tr>
<td>Suitable for daily use (2x/day)</td>
<td>✔</td>
<td>✖</td>
<td>✖</td>
</tr>
<tr>
<td>Compliance assurance – pre-op</td>
<td>✔</td>
<td>✖</td>
<td>✔</td>
</tr>
</tbody>
</table>
In vitro Activity of Alcohol-Based Nasal Antiseptic

Evaluation of antimicrobial persistence of alcohol-based nasal antiseptic intended for use to decolonize the human anterior nares. A standard skin explant model was used to evaluate bacteriostatic effect of the product at 20 percent of recommended dose vs. MRSA-ATCC #33592. The baseline surface inoculation and post-treatment levels (cfu/cm²) in six replicates for each time point were confirmed by direct count and compared to negative controls.

![Graph showing MRSA log population level over time after treatment application]
### Reduction of Staph Aureus Carriage by alcohol-based nasal antiseptic

<table>
<thead>
<tr>
<th>Arm/Group Title</th>
<th>Alcohol-Based Nasal Antiseptic</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm/Group Description: Participants known to exhibit Staph aureus carriage by previous nasal swab screening and randomly assigned received application by nasal swab of alcohol-based nasal antiseptic (Nozin® Nasal Sanitizer®) at 0, 4 and 8 hrs.</td>
<td>Participants known to exhibit Staph aureus carriage by previous nasal swab screening and randomly assigned received application of placebo treatment with phosphate-buffered saline at 0, 4 and 8 hrs.</td>
<td></td>
</tr>
</tbody>
</table>

| Overall Number of Participants Analyzed | 20 | 19 |
| Median (Inter-Quartile Range) | | |
| Unit of Measure: Percent change in colonization | -99.8 (-100 to -80.6) | -13.5 (-89.3 to 149.4) |
Can a nasal and skin decolonization protocol safely replace contact precautions for colonized MRSA patients?

Introduction:

Our current healthcare environment requires us to improve efficiency to meet an increasing demand for low-cost, highest quality health care.

Contact precautions (CP) are often at odds with these goals, and may not always be employed consistently throughout the enterprise.

Decolonization protocols using mupirocin can be ineffective due to antimicrobial resistance and run counter to stewardship programs.

A standardized, inpatient protocol that does not contribute to antimicrobial resistance is needed as an alternative to contact precautions to ensure patient safety and to meet efficiency goals.

Conclusions:

Replacing CP for MRSA-colonized patients with an alcohol-based nasal antiseptic and CHG bathing protocol significantly reduced isolation costs with no concurrent increase in MRSA transmission.

The majority of staff would recommend the alcohol-based nasal antiseptic to colleagues and preferred it to nasal mupirocin.

A standardized MRSA nasal and skin decolonization protocol is an effective way to reduce contact precaution days while ensuring patient safety and meeting efficiency goals.
Can a nasal and skin decolonization protocol safely replace contact precautions for MRSA-colonized patients?

“...mupirocin is unpleasant to use and must be consecutively dosed twice a day for 5 days to achieve a log kill indicative of nasal decolonization.”

“...patients find povidone iodine unpleasant due to its skin staining properties and odor.”

“...subsequent development of an alcohol-based nasal antiseptic offers enhanced effects when compared to PVI and mupirocin: it does not stain, is clean and well tolerated by patients, has a pleasant citrus odor, is suitable for self application and has no known mechanisms that contribute to microbial resistance...achieves a log kill consistent with decolonization after one application.”

Conclusion:

Replacing contact precautions for high-risk MRSA-colonized patients with an alcohol-based nasal antiseptic and CHG bathing significantly reduced isolation costs with no increase in MRSA bacteremia. In addition, the alcohol-based nasal antiseptic was preferred by staff when compared to nasal mupirocin.
Conclusion:

Incidence of MRSA bacteremia in a 61-bed adult ICU was reduced from 0.24 infections per 1000 for approximately 12,000 patient days (p < 0.001) by replacing mupirocin with a staphylococcal decolonization protocol of alcohol-based nasal decolonization in addition to CHG bathing.
Study

Does Universal Nasal Decolonization with an Alcohol-Based Nasal Antiseptic Reduce Infection Risk and Cost?

Results:

Compared with baseline, between April 2018 and March 2019, there was:

- a decrease in MRSA bacteremia from 3/1,000 patient-days to 0/1,000 patient-days

- a reduction in CP from 3.78 to 1.53/1,000 patient-days, a reduction in nasal screens from 3,874 to 605

- a reduction of all-cause (Gram-negative and Gram-positive) SSI after all surgical procedures from 3/4,313 procedures to 0/4,872 procedures.

- After accounting for the cost of the nasal antiseptic, the reduction in gowns, gloves and nasal screening tests resulted in $104,099.91 costs avoided.

Conclusion:

- House-wide application of alcohol-based nasal antiseptic in place of screening and contact precautions, resulted in a reduced incidence of both MRSA bacteremia and SSI for all types of surgical procedures, in addition to significant costs avoided.
Results:

The SIR decreased from 3.66 to 0.97 from baseline to post-intervention periods ($P = 0.003$).

The largest decrease in cases and SIR was attained using combined hospital-wide daily CHG bathing, alcohol-based nasal sanitizer, and alcohol wipes for patient hand hygiene during Phase 4 (Table 1).

Our bundle of interventions for universal decolonization was successful in decreasing HO MRSA bacteremia.
<table>
<thead>
<tr>
<th>Reduction</th>
<th>Author (location)</th>
<th>ICU</th>
<th>Hospital-wide</th>
<th>CP/Isolation discontinued</th>
<th>Additional</th>
<th>Existing CHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Arden (Pinellas, FL)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>No CHG added</td>
<td></td>
</tr>
<tr>
<td>74%</td>
<td>Jimenez (Jackson, FL)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Bundled nasal decolonization, CHG bathing and patient hand hygiene</td>
<td>in ICU</td>
</tr>
<tr>
<td>100%</td>
<td>Reeves (Methodist, TN)</td>
<td>✔️</td>
<td></td>
<td></td>
<td>No CHG added</td>
<td></td>
</tr>
<tr>
<td>Cost Savings</td>
<td>Author (location)</td>
<td>Screening discontinued</td>
<td>Additional</td>
<td>Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------</td>
<td>------------------------</td>
<td>------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$104K</td>
<td>Arden (Pinellas, FL)</td>
<td>✓</td>
<td>Hospital wide.</td>
<td>12-month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$64K</td>
<td>Deatherage (Marshall, CA)</td>
<td>✓</td>
<td>Hospital wide.</td>
<td>12-month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1.4 mill</td>
<td>Whitaker (Tampa, FL)</td>
<td>✓</td>
<td>Hospital wide.</td>
<td>12-month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$223K</td>
<td>Landis (Frederick, MD)</td>
<td>✓</td>
<td>Hospital wide. Includes savings from CP replacement, screening and SSI cost avoidance.</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$200K</td>
<td>Steigmeier (Wesley Chapel, FL)</td>
<td>✓</td>
<td>High risk patient population.</td>
<td>12-month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$430K</td>
<td>Christie* (UHS, PA)</td>
<td>✓</td>
<td>MRSA colonized patients. Combined savings in 7 hospitals.</td>
<td>10-month</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Reduction in use of Contact Precautions for MRSA colonization

<table>
<thead>
<tr>
<th>Reduction</th>
<th>Author</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>88%</td>
<td>Christie*</td>
<td>(UHS, PA)</td>
</tr>
<tr>
<td>60%</td>
<td>Arden</td>
<td>(Pinellas, FL)</td>
</tr>
<tr>
<td>38%</td>
<td>Steigmeier</td>
<td>(Westley Chapel, FL)</td>
</tr>
<tr>
<td>42%</td>
<td>Whitaker</td>
<td>(Tampa, FL)</td>
</tr>
</tbody>
</table>
Key points

• The anterior nares are the primary sites of *S. aureus* carriage, which is a precursor to and the primary risk factor for development of *S. aureus* infections.

• Nasal and skin decolonization is a recognized strategy to reduce healthcare-associated *S. aureus* infections.

• Nasal colonization with *S. aureus* increases the risk of secondary staphylococcal infections among patients with influenza infection (and possibly COVID-19 patients?)

• Nasal and skin decolonization may have the potential to also reduce the risk of secondary staphylococcal pneumonia (currently no clinical evidence).
Recommendations for reducing hospital-onset *Staphylococcus aureus* infections

Centers for Disease Control and Prevention
Society for Healthcare Epidemiology of America
Strategies to Prevent Hospital-onset (HO) *Staphylococcus aureus* Bloodstream Infections in Acute Care Facilities

1. Prevent Healthcare-Associated Infections

   Central line-associated bloodstream infections (CLABSI)

   Surgical site infections (SSI)

   BSI among hemodialysis patients

   Ventilator-associated pneumonia (VAP)

https://www.cdc.gov/hai/prevent/staph-prevention-strategies.html
https://jamanetwork.com/journals/jamasurgery/fullarticle/2620725
2. Practice Source Control

**ICU patients**: Decolonize all patients with intranasal staphylococcal antibiotic/antiseptic plus topical CHG (core strategy).

**Non-ICU patients**: Decolonize patients with CVC or midline catheter with intranasal staphylococcal antibiotic/antiseptic plus topical CHG (supplemental strategy).

**Surgical patients**: For all patients undergoing high risk surgeries (e.g. cardiothoracic, orthopedic, and neurosurgery), unless known to be *S. aureus* negative, use an intranasal anti-staphylococcal antibiotic/antiseptic and CHG wash or wipes prior to surgery (core strategy).

3. Prevent Transmission of MRSA

Place MRSA colonized or infected patients in private rooms and on contact precautions.

Use dedicated patient-care equipment (e.g. blood pressure cuffs, stethoscopes), and single use disposable items (e.g. single patient digital thermometer) whenever possible. If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient.

Provide regular competency-based training on use of PPE and monitor adherence.

Place patients with excessive wound drainage on contact precautions and in a private room regardless of MDRO status.

https://www.cdc.gov/hai/prevent/staph-prevention-strategies.html
ICU: MRSA decolonization can be targeted to MRSA-colonized persons or applied universally to populations deemed to be at high risk for infection.
(Level 1 Evidence: Provide universal decolonization to ICU patients when MRSA not effectively controlled).
Benefits of universal decolonization programs

- Mitigates risk of infection to the colonized patient.
- Mitigates risk of acquisition in the non-colonized patient.
- More effective than targeted (screening) decolonization in reducing healthcare-associated infections caused by staphylococcal organisms.
- Decolonizes patients with MSSA in addition to those with MRSA.
- Provides source control, reducing contamination of HCP hands, the patient environment and equipment and thus decreasing risk of transmission to other patients.
- Costs less to decolonize an entire patient population at risk than to screen and place in contact precautions.
- Eliminates the need for contact precautions, thus improving both patient and staff satisfaction.
Benefits of expanding to house-wide decolonization programs

- Eliminates the need to manage MSSA and MRSA colonized patients with contact precautions in all units.
- Inclusion of all patients facility-wide simplifies and improves compliance with the decolonization protocol and provides consistency across all units.
- Delivers cost savings when replacing "screen and isolate" protocols with universal decolonization.
- Improves patient flow and throughput.
- Increases patient and staff satisfaction throughout the facility.
- May be beneficial to general ward patients with respiratory viral illnesses as a strategy to prevent secondary bacterial infections.
Resources for staphylococcal decolonization


Society for Healthcare Epidemiology of America. Strategies to prevent methicillin-resistant *Staphylococcus aureus* transmission and infection in acute care hospitals: 2014 Update. 35(s2) Sept 2014:S108-S132. DOI: [https://doi.org/10.1017/S0899823X00193882](https://doi.org/10.1017/S0899823X00193882)


Huang SS et al. Chlorhexidine vs. routine bathing to prevent multidrug-resistant organisms and all-cause bloodstream infections in general medical and surgical units (ABATE infection trial): a cluster-randomized trial. *The Lancet* 2019; 393: 1205-1215.
In summary…

…universal staphylococcal decolonization using alcohol-based nasal antiseptics is an evidence-based, cost-effective strategy, that, when used in addition to current infection prevention practices (HAI prevention bundles, hand hygiene, environmental cleaning and disinfection), mitigates risk of hospital-acquired MSSA and MRSA infections.

Who benefits?

✓ ICU patients
✓ Surgical patients
✓ General ward patients with central/midline catheters
✓ Patients with respiratory viral infections who are at risk of acquiring SBI
✓ Healthcare personnel
✓ Chief financial officer
✓ Materials Management staff
THANK YOU

Questions?

Gwen Borlaug MPH, CIC, FAPIC
borlaug.gwen@gmail.com