MRSA Nasal Swabs for De-escalation of Anti-MRSA Therapy in Pneumonia

Selection of empiric antibiotics in pneumonia remains a challenge, especially when sputum cultures are unable to be obtained. Current guidelines recommend covering methicillin-resistant *Staphylococcus aureus* (MRSA) empirically for patients with prior isolation of MRSA, recent hospitalization or exposure to parenteral antibiotics, or if they are admitted to a unit with high prevalence of MRSA (HAP/VAP). De-escalation of anti-MRSA coverage is usually guided by the results of sputum cultures (which can take >48 hours) or negative blood cultures at 48 hours. Nasal swab MRSA polymerase chain reaction (PCR) tests are widely utilized for the purposes of deescalating anti-MRSA therapy in the treatment of pneumonia.

Supporting evidence

Staphylococcus aureus is a common colonizer of the nares, throat, axillae, rectum, and groin. Studies have shown that if MRSA is not present in the nares, it is unlikely to be involved in pneumonia. This has led to the use of a negative MRSA nasal PCR to rule out MRSA involvement in pneumonia and therefore discontinue anti-MRSA therapy. Studies have shown a high negative predictive value (NPV) for this test, usually >96%; NPV refers to the percent chance that if the nasal PCR is negative for MRSA, the pathogens involved in pneumonia will not include MRSA. The calculation for NPV depends upon the overall prevalence of MRSA infection in the patient population evaluated, so will vary between studies. (See table 1 for summary of references).

Why de-escalation is important

Unnecessary use of antimicrobial therapy is associated with significant consequences including development of antimicrobial resistance, adverse drug effects such as nephrotoxicity, *C difficile* infection, and increased healthcare costs. The cost of vancomycin therapy not only includes the medication cost itself, but also includes the costs of serum levels, nursing resources, and pharmacist time for pharmacokinetic monitoring.

When to obtain swabs

The use of PCR technology detects bacteria regardless of viability, unlike traditional cultures, which allows for detection of bacteria even after covering antibiotics have been started. Most hospital protocols recommend collection of MRSA nasal swabs within 48 hours of starting targeted anti-MRSA therapy to ensure sensitivity of the nasal swab. As patient colonization can change during their hospital stay with ongoing exposures, it is also recommended to base de-escalation off of nasal swabs obtained within the previous 7 days. If starting anti-MRSA therapy for pneumonia and a swab was obtained >7 days prior, a new swab should be obtained.

Rate of MRSA infections

The rate of MRSA involvement in pneumonia varies widely between studies and will affect the NPV reported (see table 1 for more information). At Our Lady of the Lake, ~8% of nasal swabs obtained in 2019 were MRSA positive. Of all respiratory cultures obtained on inpatients in 2019, ~9% were positive for MRSA.

When to caution use

Lower negative predictive value has been seen in studies for patients with complicated lung pathology. This could be attributed to colonization of the lower respiratory tract in a non-contiguous fashion with the nares. In ventilator-associated pneumonia, pathogens may be introduced during intubation or through aspiration.

- Lower NPV: Ventilator-associated pneumonia, cystic fibrosis, chronic bronchiectasis
- High risk disease state: septic shock, febrile neutropenia
- Symptoms suggestive of MRSA pneumonia: high fever, chills, severe hypoxemia, hypotension, cyanosis, hemoptysis

These factors listed above are not absolute contraindications to use of MRSA nasal swabs for de-escalation, but should be included in the discussion when deciding the risk vs benefit of stopping anti-MRSA therapy. **At this time, MRSA nasal swabs are only recommended for use in de-escalation in respiratory infections.**

Contraindications

Use of MRSA nasal swabs are contraindicated in patients with a nasal obstruction, heavy nasal bleeding, open wounds of the nasal cavity, or other condition which inhibits safe collection of the specimen. Use of MRSA nasal swabs are also contraindicated in patients with prior administration of intranasal mupirocin for MRSA decolonization. **At this time, MRSA nasal swabs are only recommended for use in de-escalation in respiratory infections.**

Interacting Intranasal Medications		
Oxymetazoline (Afrin)	Phenylephrine (Neo-Synephrine)	Desmopressin nasal
Azelastine (Astelin)	Fluticasone (Flonase)	Mometasone (Nasonex)
0.65% Sodium chloride (Saline)	Calcitonin (Miacalcin)	Ipratropium (Atrovent)

*If patient is receiving intranasal medications, please separate timing of nasal swab and medication administration. Discuss with the patient's nurse to ensure appropriate timing.

References

1. Carr AL, Daley MJ, Givens Merkel K, et al. Clinical Utility of Methicillin-Resistant Staphylococcus aureus Nasal Screening for Antimicrobial Stewardship: A Review of Current Literature. Pharmacotherapy. 2018 Dec;38(12):1216-1228.
2. Giancola SE, Nguyen AT, Le B, et al. Clinical utility of a nasal swab methicillin-resistant Staphylococcus aureus polymerase chain reaction test in intensive and intermediate care unit patients with pneumonia. Diagn Microbiol Infect Dis. 2016 Nov;86(3):307-310.
3. Parente DM, Cunha CB, Mylonakis E, Timbrook TT. The Clinical Utility of Methicillin Resistant Staphylococcus aureus (MRSA) Nasal Screening to Rule Out MRSA Pneumonia: A Diagnostic Meta-analysis with Antimicrobial Stewardship Implications. Clin Infect Dis. 2018;67(1):1-7.
4. Baby N, Faust AC, Smith T, Sheperd LA, Knoll L, Goodman EL. Nasal Methicillin-Resistant Staphylococcus aureus (MRSA) PCR Testing Reduces the Duration of MRSA-Targeted Therapy in Patients with Suspected MRSA Pneumonia. Antimicrob Agents Chemother. 2017;61(4).
5. Jeffres MN. The Whole Price of Vancomycin: Toxicities, Troughs, and Time. Drugs. 2017;77(11):1143-54.
6. Darko W, Medicis JJ, Smith A, Guharoy R, Lehmann DE. Mississippi mud no more: cost-effectiveness of pharmacokinetic dosage adjustment of vancomycin to prevent nephrotoxicity. Pharmacotherapy. 2003;23(5):643-50.

MRSA Nasal Swabs for De-escalation of Anti-MRSA Therapy in Pneumonia- Workflow

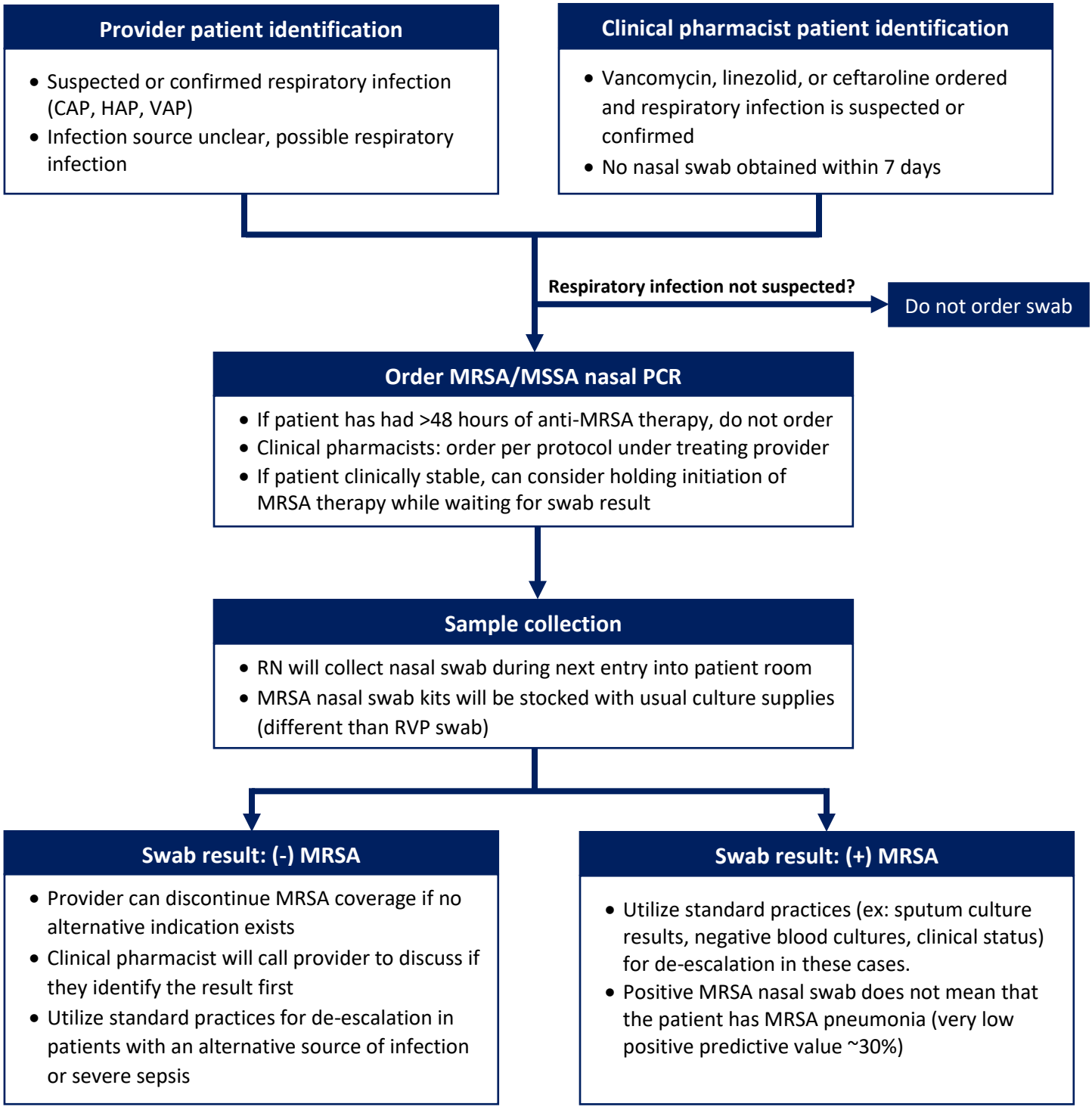

Table 1. Studies evaluating MRSA nasal PCR for antibiotic de-escalation in bacterial pneumonia

Study	Design	Pt Population	Exclusions	Size	% (+) Nares	% (+) Culture	Sensitivity	Specificity	PPV	NPV[1]	Comments
Mergenhagen 2019	Retrospective, multi-center	All VA patients ≥18yo w/ MRSA nasal screen	none	561,325 (90,912 PNA)	22.9	8.3	67.4 (76.2)	81.2 (80.3)	24.6 (35.0)	96.5 (96.1)	~1/4 nasal culture (vs. PCR) ↓NPV with culture vs. PCR Didn't report nasal mupirocin
Parente 2018	Meta-analysis	NR	Non-nasal swab, lack of culture data	5,163	NR	10	70.9	90.3	44.8	96.5	NPV 98.1% for CAP/HCAP, 94.8% for VAP
Dunaway 2018	Pre-post implementation	CAP or HCAP	Swab obtained >24hrs after admit	121 pre 75 post	10.7	5.6	-	-	-	100	37/75 with swab and culture ~15% ICU
Smith 2017	Retrospective, single center	≥18yo, ICU, nasal PCR w/in 48hrs of ICU admit, resp cx	Nasal decolonization Recent MRSA infection	400	22.8	9.3	91.9	84.3	37.4	99.0	All patients had ≥1 resp culture All ICU patients Assessed NPV at different times from nasal swab to culture
Willis 2017	Retrospective, single center Pre-post implementation	Vancomycin, respiratory infection	Nasal decolonization ICU	150 pre 150 post	16.4	4	-	-	-	99.1	Do not report number of respiratory cultures No ICU patients
Dangerfield	Retrospective, single center	Respiratory or blood culture, nasal PCR	Alternative infection	435	14.3	5.7	88.0	90.1	35.4	99.2	~55% HCAP, 34% CAP. Only 11% HAP and <1% VAP NPV for HAP 97.7%
Johnson 2015	Retrospective, single center	Respiratory culture (+) S aureus	Nasal swab >48hrs after admit	72	41.7	42 MRSA 58 MSSA	93.9	95.2	93.3	95.2	All patients with Staph aureus respiratory infection

1 Negative predictive value is dependent upon the overall prevalence of an event and may account for difference in NPV between studies

NR: not reported; OLOL Hospital rates in 2019 : nasal swab ~7% (+) MRSA, respiratory cultures ~9% (+) MRSA

References

1. Mergenhagen KA, Starr KE, Wattengel BA, et al. Determining the utility of methicillin-resistant Staphylococcus aureus nares screening in antimicrobial stewardship. Clin Infect Dis. 2019 Oct 1;ciz974.
2. Parente DM, Cunha CB, Mylonakis E, Timbrook TT. The Clinical Utility of Methicillin Resistant Staphylococcus aureus (MRSA) Nasal Screening to Rule Out MRSA Pneumonia: A Diagnostic Meta-analysis with Antimicrobial Stewardship Implications. Clin Infect Dis. 2018;67(1):1-7.
3. Dunaway S, Orwig KW, Arbogast ZQ, et al. Evaluation of a pharmacy-driven methicillin-resistant Staphylococcus aureus surveillance protocol in pneumonia. Int J Clin Pharm. 2018 Jun;40(3):526-532.
4. Smith MN, Erdman MJ, Ferreira JA, et al. Clinical utility of methicillin-resistant Staphylococcus aureus nasal polymerase chain reaction assay in critically ill patients with nosocomial pneumonia. J Crit Care. 2017 Apr;38:168-171.
5. Willis C, Allen B, Tucker C, Rottman K, Epps K. Impact of a pharmacist-driven methicillin-resistant *Staphylococcus aureus* surveillance protocol. Am J Health Syst Pharm. 2017;74(21):1765-73.
6. Dangerfield B, Chung A, Webb B, et al. Predictive value of Methicillin-resistant Staphylococcus aureus (MRSA) nasal swab PCR assay for MRSA pneumonia.
7. Johnson JA, Wright ME, Sheperd LA, et al. Nasal methicillin-resistant Staphylococcus aureus polymerase chain reaction: A potential use in guiding antibiotic therapy for pneumonia. Perm J. 2015 Winter;19(1):34-36.