Evaluation of National Healthcare Safety Network (NHSN) Data Available Through the Arizona Department of Health Services Data Use Agreement (DUA)

ARIZONA DEPARTMENT OF HEALTH SERVICES

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Abstract:

Background: The National Healthcare Safety Network (NHSN) is the most widely used healthcare-associated infection (HAI) tracking system in the U.S., and changes to Centers for Medicare and Medicaid Services incentive programs and rules have greatly increased healthcare facility participation in Arizona. However, the Arizona Department of Health Services (ADHS) has only recently gained direct access to NHSN data, through a data use agreement (DUA) with CDC. An evaluation of the data available to ADHS on key attributes, particularly data quality (completeness) and representativeness, will provide a reference for more accurate interpretation of future findings from NHSN infection and safety data.

Methods: The system was evaluated using the CDC's *Updated Guidelines for Evaluating Public Health Surveillance Systems*. Representativeness was assessed by identifying all Arizona acute care hospitals (ACH) and critical access hospitals (CAH) and comparing data available through NHSN; facilities without available data were identified and characterized. Completeness was assessed by comparing hospitals with NHSN data available to ADHS, by infection type, to those available to CDC. The sensitivity of NHSN for capturing invasive MRSA events reported to Arizona's communicable disease surveillance system (MEDSIS) was completed by matching all 2014 NHSN LabID MRSA data to 2014 MEDSIS MRSA cases. Additional surveillance system attributes were also considered in the evaluation.

Results: 72% (53/74) of Arizona ACH and 7% (1/14) of CAH reported 2014 data to NHSN that was accessible by ADHS staff. It was calculated that ADHS data include 79% of Arizona hospitals reporting data to CDC for MRSA and C. diff LabID, 90% for CLABSI and CAUTI, 95% for SSI COLO, and 100% for SSI HYST. Veterans Affairs and Indian Health Services hospitals make up a portion of missing facilities. The MRSA analysis revealed a sensitivity of 54% for NHSN capturing MRSA events reported to MEDSIS; 2277 additional NHSN records did not match MEDSIS cases.

Conclusion: As a result of identifying gaps in facility data completeness, ADHS worked with CDC and was granted access to 18 additional facilities in early December, and 11 more in February. Although the sensitivity of NHSN for capturing invasive laboratory-reported MRSA cases is rather low, NHSN LabID MRSA surveillance will represent a valuable source of information for monitoring MRSA trends in Arizona by capturing a substantively different group of events. By identifying the completeness and representativeness of the NHSN data available to ADHS, ADHS is better equipped to accurately interpret future findings and effectively use NHSN data for HAI control and prevention.

Task A. Engage the stakeholders in the evaluation.

The evaluation of the National Healthcare Safety Network (NHSN) and specifically, the Arizona NHSN data available to the Arizona Department of Health Services (ADHS), will serve as a resource for ADHS, particularly the Healthcare Associated Infection (HAI) Program. Because NHSN data has not previously been available to the department, the impact the system could have on the HAI Program and the program's leadership in statewide activities is not yet known. Therefore, the original stakeholders will only be those individuals in the Office of Infectious Disease Services (OIDS), in which the HAI Program is located. This report will provide background information on the surveillance system, describe the public health importance, and evaluate its performance on key attributes.

Task B. Describe the surveillance system to be evaluated

The NHSN is the most widely used HAI tracking system in the United States. Over 14,500 medical facilities participate in NHSN, including acute care hospitals, long-term acute care hospitals, psychiatric hospitals, rehabilitation hospitals, outpatient dialysis centers, ambulatory surgery centers, and nursing homes.[1] The data reported through NHSN allows users to conduct surveillance of HAIs, and gives them the ability to identify problematic areas that can be targeted for prevention activities. Additionally, the data can be used to track the progress of these infection prevention efforts over time, and ultimately lead to an elimination of HAIs.

Most acute care hospitals report data to NHSN as a requirement for reimbursement by the Centers for Medicare and Medicaid Services (CMS). However, all facilities that report data to NHSN receive the added value of being able to see their data in real-time and use it to make quality improvements and monitor progress.

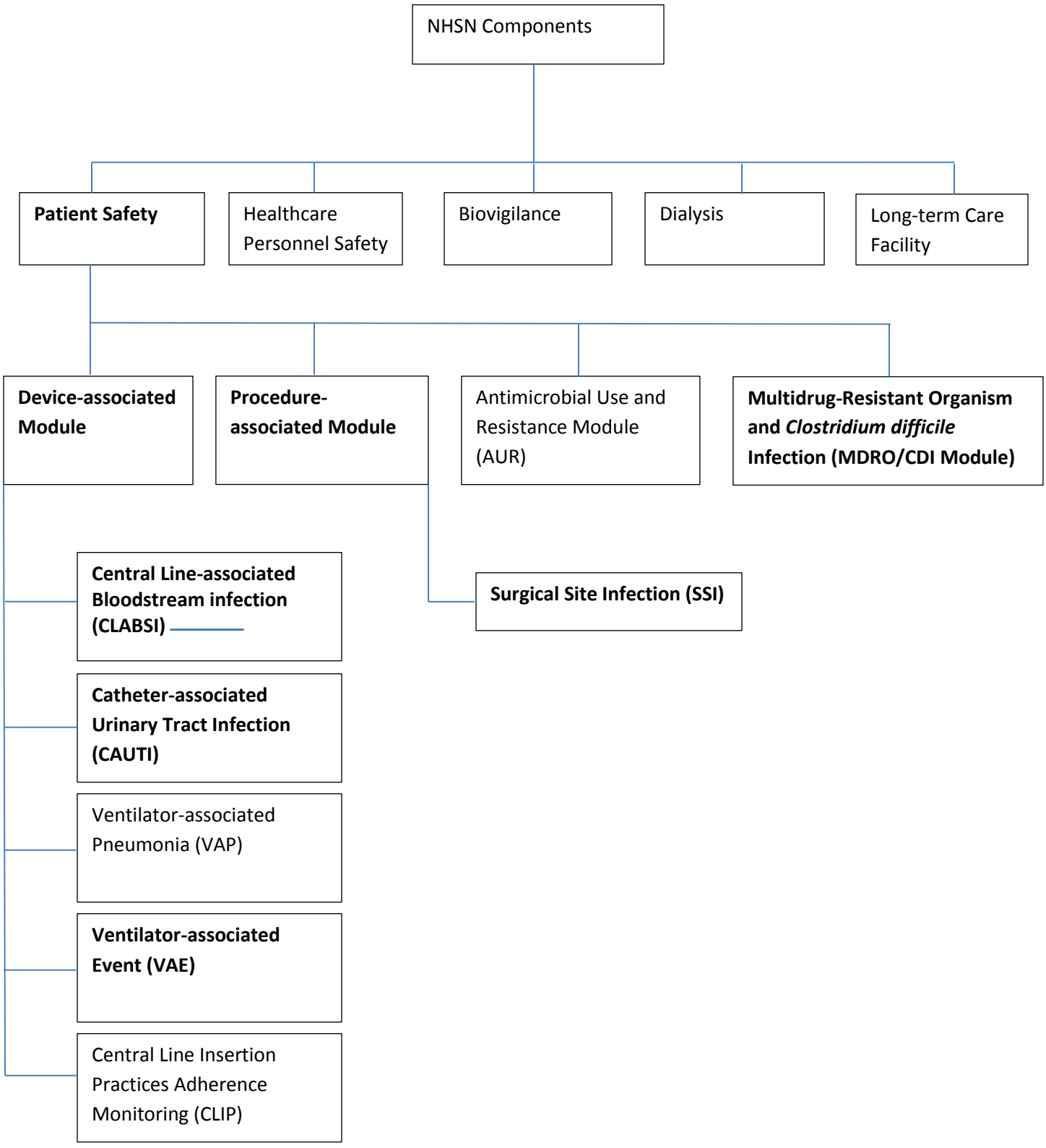
Some states have a mandatory HAI reporting requirement, which allows their state health departments to access the data reported by healthcare facilities from their jurisdiction. Currently, thirty-three states and the District of Columbia have a mandatory reporting requirement.[2] Those states that do not have a mandatory reporting requirement can still gain access to NHSN data for their jurisdiction through a Data Use Agreement (DUA). By entering into a DUA with the CDC's Division of Healthcare Quality Promotion (DHQP), these states can access NHSN data but only for the purpose of surveillance and prevention. They cannot use the data for regulatory or enforcement outcomes. Arizona does not have mandatory HAI reporting, and has entered into a DUA to provide the HAI Program with access to the NHSN data (Appendix I).

Arizona gained access to NHSN data in the fall of 2015. Therefore, an evaluation of NHSN data available to ADHS through the DUA is an important first step prior to utilizing the system for surveillance and prevention purposes. This evaluation will help ADHS better understand and interpret findings and trends in the state's HAI data.

NHSN contains five different components (Figure 1): Patient Safety, Healthcare Personnel Safety, Biovigilance, Dialysis, and Long-term Care Facility.[3]

Figure 1. NHSN Components

***Bolded Components will be the primary focus of the evaluation**



The Patient Safety Component is separated into four modules: Device-associated Module, Procedure-associated Module, Antimicrobial Use and Resistance Module (AUR), and Multidrug-Resistant Organism and *Clostridium difficile* Infection (MDRO/CDI) Module. The Device-associated Module includes central line-associated bloodstream infection (CLABSI), catheter-associated urinary tract infection (CAUTI), ventilator-associated events (VAE), ventilator-associated pneumonia (VAP), and central line insertion practices adherence (CLIP). The Procedure-associated Module includes surgical site infection (SSI).

The Healthcare Personnel Safety Component contains two modules: Healthcare Personnel (HCP) Exposure Module and HCP Vaccination Module. The HCP Exposure Module consists of blood and bodily fluid exposure with and without exposure management and also influenza exposure management. The HCP Vaccination Module consists of an influenza vaccination summary.

The Biovigilance Component consists of the Hemovigilance Module which performs surveillance on blood products beginning with receipt from the supplier and ending with the administration to the patient.

The Dialysis Component consists of Dialysis Event Surveillance. Under Dialysis Event Surveillance, there are three reportable dialysis event types: IV antimicrobial start, positive blood culture, and pus, redness or increased swelling at the vascular access site.

The Long-term Care Facility (LTCF) Component was adapted from the Patient Safety Component for Long-term Care Facilities to report infections. Thus, the LTCF Component contains three different modules: Healthcare-Associated Infection Module, Laboratory Identified (LabID) Event Module, and Preventions Process Measures Module.

ADHS does not currently have access to any facilities enrolled in the Biovigilance, Dialysis, or Long-term Care Facility Components. Additionally, the Healthcare Personnel Safety Component only contains the annual HCW summary flu vaccination data. Therefore, the Patient Safety Component will be the focus of this evaluation, as it contains the bulk of the data available to ADHS. Each monitored infection is described in the sections below.

CLABSI:

The number of central line-associated bloodstream infections (CLABSI) in the United States is estimated to be over 30,000 each year.[4] This number has been decreasing in recent years due to increased adherence to proper insertion techniques and management of central lines as outlined in CDC's Healthcare Infection Control Practices Advisory Committee (CDC/HICPAC) *Guidelines for the Prevention of Intravascular Catheter-Related Infections*, 2011. Between 2008 and 2013, there was a 46% decrease in CLABSI in the United States.[4] NHSN surveillance is fundamental in tracking prevention efforts and in identifying the burden of CLABSI in hospitals. In order to accurately portray this picture, facilities must follow the NHSN protocol and consistently apply the NHSN criteria for identifying an infection. There are situations when the surveillance definitions for NHSN do not match the clinical diagnosis for the patient; however, it is essential that facilities apply constant surveillance definitions for successful surveillance. Some key terms for CLABSI surveillance through NHSN are:

Primary bloodstream infections (BSI): Laboratory-confirmed bloodstream infections (LCBI) that are not secondary to an infection at another body site.

Date of event (DOE) or Infection date: The date when the first element used to meet the laboratory-confirmed bloodstream infection (LCBI) criterion occurred.

Healthcare-associated infections (HAI): The date of event must occur on or after the 3rd calendar day of admission.

Present on Admission (POA): The date of event occurs on the day of admission, the day after admission, or the 2 days before admission. These infections are not reported to NHSN.

Infection Window Period: A 7 day period during which all site-specific infection criterions must be met. This includes the 3 calendar days before and 3 calendar days after the date of the first positive diagnostic test.

Repeat Infection Timeframe (RIT): A 14-day timeframe during which no new infections of the same type are reported. The date of event is Day 1 of the 14-day RIT. Additional pathogens recovered during the RIT from the same type of infection is added to the event.

Central Line (CL): An intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring. The following are considered great vessels for the purpose of reporting central-line BSI and counting central-line days in the NHSN system: aorta, pulmonary arteries, superior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, common iliac veins, femoral veins, umbilical artery and vein (in neonates)

Central line-associated BSI (CLABSI): A laboratory-confirmed bloodstream infection (LCBI) where central line (CL) or umbilical catheter (UC) was in place for >2 calendar days on the date of event, with day of device placement being Day 1,

AND

A CL or UC was in place on the date of event or the day before. If a CL or UC was in place for >2 calendar days and then removed, the date of event of the LCBI must be the day of discontinuation or the next day. If the patient is admitted or transferred into a facility with an implanted central line (port) in place, and that is the patient's only central line, day of first access in an inpatient location is considered Day1. "Access" is defined as line placement, infusion or withdrawal through the line. Such lines continue to be eligible for CLABSI once they are accessed until they are either discontinued or the day after patient discharged (as per the Transfer Rule). Note that the "de-access" of a port does not result in the patient's removal from CLABSI surveillance.

Transfer Rule: If the date of event is on the date of transfer or discharge, or the next day, the infection is attributed to the transferring/discharging location.

Appendices II and III contains detailed criteria for defining and classifying a Laboratory-Confirmed Bloodstream Infection (LCBI) and a Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI).

Denominator data for CLABSI includes device days and patient days. These can be collected from different locations where the patients are monitored and by one of the following methods:

- Manual, Daily - collected at the same time every day of the month
- Manual, sampled once/week - collected at the same time on the same designated day, once per week
- Electronic - can be collected from available electronic sources if 3 months have been validated from manually-collected daily counts, and do not differ by more than 5 %.

CAUTI:

Urinary tract infections (UTIs) account for more than 15% of infections reported in acute care hospitals, ranking 2nd, behind only SSIs and tied with pneumonia.[5] Furthermore, over 13,000 deaths each year are associated with UTIs. From 2009 to 2013 there was a 6% increase in CAUTI, although 2014 data indicates rates are beginning to decline. NHSN surveillance of CAUTI includes many of the same key terms as CLABSI. The key terms for CAUTI are:

Urinary tract infections (UTI): are defined using Symptomatic Urinary Tract Infection (SUTI) criteria, Asymptomatic Bacteremic UTI (ABUTI), or Urinary System Infection (USI) criteria (Appendix IV).

Date of event (DOE) or Infection date: The date when the first element used to meet the UTI infection criterion occurred for the first time within the 7-day Infection Window Period.

Healthcare-associated infections (HAI): The date of event must occur on or after the 3rd calendar day of admission.

Present on Admission (POA): The date of event occurs on the day of admission, the day after admission, or the 2 days before admission. These infections are not reported to NHSN.

Infection Window Period: A 7-day period during which all site-specific infection criterions must be met. This includes the 3 calendar days before and 3 calendar days after the date of the first positive diagnostic test.

Repeat Infection Timeframe (RIT): A 14-day timeframe during which no new infections of the same type are reported. The date of event is Day 1 of the 14-day RIT. Additional pathogens recovered during the RIT from the same type of infection is added to the event.

Indwelling catheter: A drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a drainage bag (including leg bags). These devices are also called Foley catheters. Condom or straight in-and-out catheters are not included nor are nephrostomy tubes,

ileoconduits, or suprapubic catheters unless a Foley catheter is also present. Indwelling urethral catheters that are used for intermittent or continuous irrigation are included in CAUTI surveillance.

Catheter-associated UTI (CAUTI): A UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1,

AND

An indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for > 2 calendar days and then removed, the date of event for the UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated.

Transfer Rule: If the date of event is on the date of transfer or discharge, or the next day, the infection is attributed to the transferring/discharging location.

Appendix IV contains detailed criteria for defining and classifying a Urinary Tract Infection (UTI).

Denominator data for CAUTI includes device days and patient days. These can be collected from different locations where the patients are monitored and by one of the following methods:

- Manual, Daily - collected at the same time every day of the month
- Manual, sampled once/week - collected at the same time on the same designated day, once per week
- Electronic - Can be collected from available electronic sources if 3 months have been validated from manually-collected daily counts, and do not differ by more than 5%.

SSI:

Surgical Site Infections (SSIs) are the most common healthcare-associated infection, representing 31% of all HAIs in hospitalized patients. In 2011, there were over 157,000 surgical site infections associated with impatient surgeries.[6] Additionally, there is a 3% mortality rate with SSI, with 75% of SSI-associated deaths directly attributed to the SSI. From 2008 to 2013, there was a 19% decrease in SSIs among the top 10 tracked procedures in NHSN. Advances in infection control practices, combined with continued surveillance, can lead to strategies to reduce SSI even further. NHSN has made a large number of changes to SSI definitions in the past few years in an attempt to coordinate their definitions with those of other surgical professional organizations. Some of the key terms used in CLABSI and CAUTI surveillance do not apply for SSIs. Among these are Infection Window Period, Present on Admission, Healthcare-Associated Infection, and Repeat Infection Timeframe. Some of the key terms important for SSI surveillance are:

Date of event (DOE) or infection date: Is the date when the first element used to meet the SSI infection criterion occurs for the first time during the surveillance period.

ASA physical status: Assessment by the anesthesiologist of the patient's preoperative physical condition using the American Society of Anesthesiologists' (ASA) Classification of Physical Status.

Diabetes: The patient has a diagnosis of diabetes requiring management with insulin or a non-insulin anti-diabetic agent.

Duration of operative procedure: The interval in hours and minutes between the Procedure/Surgery Start Time, and the Procedure/Surgery Finish Time, as defined by the Association of Anesthesia Clinical Directors (AACD).

Emergency operative procedure: A nonelective, unscheduled operative procedure. Emergency operative procedures are those that do not allow for the standard immediate preoperative preparation normally done within the facility for a scheduled operation (e.g., stable vital signs, adequate antiseptic skin preparation, colon decontamination in advance of colon surgery, etc.).

General anesthesia: The administration of drugs or gases that enter the general circulation and affect the central nervous system to render the patient pain free, amnesic, unconscious, and often paralyzed with relaxed muscles.

Height: The patient's most recent height documented in the medical record in feet (ft.) and inches (in), or meters (m).

Weight: The patient's most recent weight documented in the medical record in pounds (lbs.) or kilograms (kg) prior to or otherwise closest to the procedure.

NHSN Inpatient Operative Procedure: An NHSN operative procedure performed on a patient whose date of admission to the healthcare facility and the date of discharge are different calendar days.

NHSN Outpatient Operative Procedure: An NHSN operative procedure performed on a patient whose date of admission to the healthcare facility and date of discharge are the same calendar day.

Primary Closure: Closure of the skin level during the original surgery, regardless of the presence of wires, wicks, drains, or other devices or objects extruding through the incision.

Non-primary Closure: Closure that is other than primary and includes surgeries in which the skin level is left completely open during the original surgery and therefore cannot be classified as having primary closure.

Scope: An instrument used to visualize the interior of a body cavity or organ.

Secondary BSI Attribution Period: The secondary BSI attribution period for SSI is a 17-day period that includes the date of event, 3 days prior and 13 days after.

Trauma: Blunt or penetrating injury occurring prior to the start of the procedure.

Wound class: An assessment of the degree of contamination of a surgical wound at the time of the operation. Wound class should be assigned by a person involved in the surgical procedure (e.g., surgeon, circulating nurse, etc.).

Denominator data: Every operation that meets the NHSN operative procedure definition must have a Denominator for Procedure record submitted. (See SSI manual for form)

Appendix V contains detailed criteria for defining and classifying a Surgical Site Infection (SSI).

VAE:

Estimates have shown that there are greater than 300,000 patients each year in the United States who receive mechanical ventilation. The outcomes for these patients is poor, as they are at an increased risk for complications including ventilator-associated pneumonia (VAP), sepsis, Acute Respiratory Distress Syndrome (ARDS), pulmonary embolism, barotrauma, and pulmonary edema. Furthermore, these complications lead to increased healthcare costs, as the patients endure longer stays in the ICU and hospital, and have an increased risk of disability and death.[7]

Prior to 2013, surveillance for ventilator-associated events in NHSN was limited to ventilator-associated pneumonia (VAP). However, current VAP definitions are not valid or reliable, and contain subjective elements resulting in very low sensitivity and specificity. Therefore, starting in 2013, a ventilator-associated event (VAE) was developed for ventilated patients 18 years or older. This focused on bringing objectivity, reliability, and the ability to automate event detection resulting in improved surveillance data to drive improvements in healthcare safety. It is important to note that this definition is not meant for clinical management of patients, and is designed only for surveillance use. A VAE algorithm was created with three definition tiers:[7]

1. Ventilator-Associated Condition (VAC)
2. Infection-related Ventilator-Associated Complication (IVAC)
3. Possible VAP (PVAP)

Appendix VI contains detailed criteria regarding the Ventilator-Associated Events Surveillance Algorithm. For more detailed information regarding ventilator-associated events, refer to the National Healthcare Safety Network VAE manual: http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf.

LABID MRSA and CDI events:

Surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* infection (CDI) are conducted in NHSN through the Multidrug Resistant Organism and *Clostridium difficile* infection (MDRO/CDI) module. MRSA, along with other MDROs such as vancomycin-resistant *Enterococcus* spp. (VRE), have risen greatly in hospitals over the past three decades, although in recent

years the trend has been reversing. This may be due in part to increased awareness and efforts to control MDROs. Among these efforts are the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines for the control of MDROs which provide a great resource to facilities for dealing with these organisms in their facilities.[8] A key reason these organisms are so dangerous is the difficulty in treating patients infected with these organisms. There are very few options for treatment, resulting in extended hospital stays, increased financial costs, and also high rates of mortality. The MDRO/CDI module allows facilities to report and analyze data on these threatening pathogens, which can inform infection prevention professionals of the impact of targeted prevention efforts.

There are two different reporting options for the MDRO/CDI module in NHSN. The first is Laboratory-identified (LabID) Events reporting while the second is Infection Surveillance reporting. In Arizona, all facilities with data available through our DUA report via the LabID module. Therefore, our focus will be on the LabID module. (For detailed information regarding Infection Surveillance, refer to the National Healthcare Safety Network MDRO and CDI manual: http://www.cdc.gov/nhsn/pdfs/pscmanual/12pscmdro_cdadcurrent.pdf). LabID reporting of MRSA and C. *difficile* provides a proxy measure of exposure burden, infection burden, and healthcare acquisition of these infections using limited admission data and relying primarily on laboratory reporting. By doing so, the burden of collecting clinical data is removed, creating a much less labor-intensive role for the infection prevention staff. It is important to note that laboratory specimens collected for active surveillance testing (AST) should not be included as LabID Events. Important terms for the MDRO module are:

MRSA: Includes *S. aureus* cultured from any specimen that tests oxacillin-resistant, cefoxitin-resistant, or methicillin-resistant by standard susceptibility testing methods, or by a laboratory test that is FDA-approved for MRSA detection from isolated colonies; these methods may also include a positive result by any FDA-approved test for MRSA detection from specific sources.

MDRO Isolate: Any specimen, obtained for clinical decision making, testing positive for an MDRO (MRSA defined above). NOTE: Excludes tests related to active surveillance testing.

Duplicate MDRO Isolate: If monitoring all specimens, any MDRO isolate from the same patient and location after an initial isolation of the specific MDRO during a calendar month, regardless of specimen source, except unique blood source (Appendix VII).

Unique Blood Source: For this organism and location, an MDRO isolate from blood in a patient with no prior positive blood culture for the same MDRO and location in ≤2 weeks, even across calendar months and different facility admissions (Appendix VIII) and, if following all specimens, the first MDRO for the patient, month, and location has already been reported.

Laboratory-Identified (LabID) Event: All non-duplicate MDRO isolates from any specimen source and unique blood source MDRO isolates.

- If a facility is participating in FacWideIN surveillance and reporting, the facility must also conduct separate location-specific surveillance in all outpatient emergency department and 24-hour

observation locations. This means LabID Events for the same organism and LabID Event type (i.e., all specimens or blood specimens only) must be reported from these locations even if the patient is not subsequently admitted to an inpatient location during the same encounter.

Denominator Data: Patient days, admissions (for inpatient locations), and encounters for emergency department, observation units, and other affiliated outpatient locations are reported using the MDRO and CDI Prevention Process and Outcome Measures Monthly Monitoring form (CDC 57.127).

Community-Onset (CO): LabID Event specimen collected in an outpatient location or an inpatient location ≤3 days after admission to the facility (i.e., days 1, 2, or 3 of admission).

Healthcare Facility-Onset (HO): LabID Event specimen collected >3 days after admission to the facility (i.e., on or after day 4).

Important terms for the CDI module are:

CDI-positive laboratory assay: A positive laboratory test result for *C. difficile* toxin A and/or B, (includes molecular assays [PCR] and/or toxin assays) tested on an unformed stool specimen (must conform to the container)

OR

A toxin-producing *C. difficile* organism detected by culture or other laboratory means performed on an unformed stool sample (must conform to the container).

Duplicate C*. difficile*-positive test: Any *C. difficile* toxin-positive laboratory result from the same patient and location, following a previous *C. difficile* toxin-positive laboratory result within the past two weeks [14 days] (even across calendar months and readmissions to the same facility). There should be 14 days with no *C. difficile* toxin-positive laboratory result for the patient and location before another *C. difficile* LabID Event is entered into NHSN for the patient and location. The date of specimen collection is considered Day 1.

Laboratory-Identified (LabID) Event: All non-duplicate *C. difficile* toxin-positive laboratory results.

Incident CDI Assay: Any CDI LabID Event from a specimen obtained >8 weeks after the most recent CDI LabID Event (or with no previous CDI LabID Event documented) for that patient.

Recurrent CDI Assay: Any CDI LabID Event from a specimen obtained >2 weeks and ≤8 weeks after the most recent CDI LabID Event for that patient.

Community-Onset (CO): LabID Event collected in an outpatient location or an inpatient location ≤3 days after admission to the facility (i.e., days 1, 2, or 3 of admission).

Community-Onset Healthcare Facility-Associated (CO-HCFA): CO LabID Event collected from a patient who was discharged from the facility ≤4 weeks prior to current date of stool specimen collection. Data from outpatient locations (e.g., outpatient encounters) are not included in this definition.

Healthcare Facility-Onset (HO): LabID Event collected >3 days after admission to the facility (i.e., on or after day 4).

Denominator Data: Patient days, admissions (for inpatient locations), and encounters for emergency department, observation units, and other affiliated outpatient locations are reported using the MDRO and CDI Prevention Process and Outcome Measures Monthly Monitoring form (CDC 57.127).

Appendices VII-IX contains algorithms created by NHSN to assist facilities in whether LabID events should be reported or not.

Task C. Focus the evaluation design

Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health related event for use in public health action to reduce morbidity and mortality and to improve health.[9] While Arizona Administrative Code R9-6-204 requires laboratories to report invasive methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Staphylococcus aureus* (VRSA), vancomycin-intermediate *Staphylococcus aureus* (VISA), and invasive *Streptococcus pneumoniae* cases to ADHS, there is limited surveillance of HAIs in the state of Arizona. Even for MRSA and *S. pneumoniae* infections, the current surveillance system is unable to distinguish whether the infections are healthcare-associated, and where onset occurred. Thus, the NHSN has the ability to provide major improvements to the surveillance of HAIs for improved public health in Arizona. The ADHS HAI Program hopes to be able to utilize the NHSN to meet the following surveillance objectives:

1. Estimate the burden of selected HAIs in the state of Arizona
2. Monitor changes in the number of HAIs over time
3. Evaluate the impact of prevention strategies
4. Detect HAI-related outbreaks

This evaluation will place emphasis on how well the surveillance system functions along several key attributes. By answering these questions, the ADHS staff will be better equipped to analyze, interpret, and disseminate HAI data while understanding the strengths and limitations of our data. Using the CDC's *Updated Guidelines for Evaluating Public Health Surveillance Systems*, the system will be evaluated on simplicity, flexibility, data quality (completeness), acceptability, sensitivity, predicted value positive, representativeness, timeliness, and stability. The main areas of focus will be completeness and representativeness, by facility type and by component. Additionally, we will evaluate the sensitivity of NHSN for capturing invasive MRSA events reported to Arizona's communicable disease surveillance system (MEDSIS) by matching cases reported to both surveillance systems and assessing the proportion of MEDSIS cases that were not reported through NHSN.

Task D. Gather credible evidence regarding the performance of the surveillance system

Data Quality – Data quality reflects the completeness and validity of the data recorded in the public health surveillance system.

The completeness of the NHSN data available to ADHS was evaluated by collecting the monthly reporting plans, annual surveys, and patient-specific identifiers from NHSN, by module. During fall 2015, 54 acute care hospitals were in the ADHS NHSN DUA Super Group. These hospitals report data to the Patient Safety Component on CLABSI, CAUTI, VAE, SSI, and MRSA and C. difficile LabID events, all of which are available to ADHS as part of our DUA. The reporting plans of all 54 facilities in our DUA were observed for January 2015. The results are shown below in Table 1.

Table 1: NHSN Reporting Plans for Acute Care Hospitals, January 2015

Reporting Plan	Total # of Facilities with data available to ADHS	# of Facilities Reporting, per facility's reporting plan*	Percent Reporting*
CLABSI	54	54	100%
CAUTI	54	54	100%
VAE	54	26	48%
CLIP	54	1	2%
SSI COLO	54	53	98%
SSI HYST	54	53	98%
SSI HPRO	54	14	26%
SSI KPRO	54	13	24%
SSI CARD	54	3	6%
SSI CBGB	54	9	17%
SSI CBGC	54	9	17%
SSI CRAN	54	2	4%
SSI XLAP	54	2	4%
SSI CSEC	54	1	2%
SSI FUSN	54	7	13%
SSI GAST	54	4	7%
SSI LAM	54	6	11%
SSI REC	54	4	7%
SSI RFUSN	54	5	9%
SSI BRST	54	1	2%
SSI LTP	54	1	2%
SSI KTP	54	1	2%

Any SSI Beyond COLO & HYST	54	18	33%
MRSA LabID BLOOD	54	40	74%
MRSA LabID	54	15**	28%
MRSA (Any)	54	54**	100%
CDI LabID	54	54	100%
***Not all hospitals are required to report all infections; for example, some hospitals do not have ventilated patients or do not perform surgeries**			
**** One facility reported MRSA as both LabID Blood and LabID**			

The annual surveys were also reviewed for all 54 facilities with data available to ADHS during fall 2015. This included the 2014 facility survey, the 2014 flu survey, and the 2014/2015 flu season summary. The results are shown in Table 2.

Table 2: Annual Surveys for Acute Care Hospitals

Annual Survey	Total # of Facilities	# Complete	Percent Reporting
2014 Facility Survey	54	54*	100%
2014 Flu Survey	54	50	93%
2014/2015 Flu Season Summary	54	54	100%
* Plus 14 additional surveys for IRF within the acute care hospitals			

In recent years, the CDC has published an annual national and state HAI progress report. In this report, it identifies the number of hospitals providing data to CDC through NHSN for each module and each state. Table 3 shows the total number of Arizona hospitals reporting to NHSN in 2014, as listed in the CDC report, and also the number of hospitals for which ADHS has data available for 2014. While we have identified Veteran Affairs (VA) facilities and Indian Health Services (IHS) facilities as groups not available to ADHS, we are concerned that these facilities do not represent the full discrepancy.

Table 3. Arizona Acute Care Hospitals Reporting Data to NHSN

Module	# Hospitals Reporting to NHSN, per CDC report	# Hospitals with data available to ADHS Super Group	% Reporting Hospitals in ADHS Super Group
CLABSI	60	54	90%
CAUTI	60	54	90%
SSI HYST	53	53	100%
SSI COLO	56	53	95%
MRSA LabID	68	54	79%
CDI LabID	68	54	79%

The completeness of the reporting fields for individual records was observed by examining patient-specific identifiers for the events reported in each of four of the more widely used modules (CLABSI, CAUTI, VAE, and SSI). A line list of all events for each module was created for the first quarter of 2015, and date of birth (DOB), gender, race, and ethnicity variables were observed for completeness. The results are shown in Table 4.

Table 4. Patient-Specific Identifiers, by Module (2015Q1)

		Included variables			
Module	**Total # of Events**	**DOB* (%)**	**Gender* (%)**	**Race** (%)**	**Ethnicity** (%)**
CLABSI	122	122 (100)	122 (100)	20 (16.4)	22 (18.0)
CAUTI	97	97 (100)	97 (100)	15 (15.5)	16 (16.5)
VAE	133	133 (100)	133 (100)	5 (3.8)	11 (8.3)
SSI	123	123 (100)	123 (100)	7 (5.7)	8 (6.5)
Total	475	475 (100)	475 (100)	47 (9.9)	57 (12)
*DOB and Gender are Required Fields					
**Race and Ethnicity are Optional Fields					

Beyond examining the completion of specific fields for the reported events, the quality of the data entered into NHSN by the hospitals is difficult to measure, particularly in the state of Arizona where no external validation efforts have been performed. Data validation is the process of making sure that HAI data reported to NHSN are complete and accurate. Some states have completed data validation efforts which can provide a point of reference for Arizona. In doing validation, the health department is able to assess the accuracy and quality of data submitted to NHSN, identify unreported HAIs, identify reported events that did not meet the NHSN case definitions, provide hospitals with information to help them correctly use NHSN, provide education to Infection Preventionists (IPs) and other hospital staff to improve data accuracy and quality, and make recommendations for improvements if data accuracy and/or quality issues are discovered.

In 2014, California conducted validation efforts on SSI, CLABSI, LabID CDI, LabID MRSA BSI, and LabID VRE BSI. The validation process differed for larger volume and smaller volume hospitals. For larger volume hospitals, an HAI Program Liaison IP conducted an onsite visit to independently validate the hospitals' HAI data. For smaller volume hospitals, the HAI Program developed a toolkit to be used by facilities for an internal review of their HAI data. The results of their findings are shown in Table 5.[10]

Table 5. California Validation Results, 2014

Module	Hospital Type	# Events Reported	# Events that should have been reported	Sensitivity (Case Finding %)
SSI (Colon)	Larger Volume	204	295	69%

SSI (Colon)	Smaller Volume	39	48	81%
SSI (Hyst/HIP)	Smaller Volume*	54	58	93%
CLABSI	Larger Volume	294	402	73%
CLABSI	Smaller Volume	67	72	93%
MRSA/VRE	Larger Volume	1267	1431	88%
MRSA/VRE	Smaller Volume	166	184	90%
CDI	Larger Volume	3460	3731	93%
CDI	Smaller Volume	578	629	92%

*SSI (Hyst/HIP) validation was only performed in smaller volume hospitals

The California results show us that the data quality, or sensitivity, can be different depending on the module and hospital size. As expected, SSI sensitivity is among the lowest, as it has some of the most complex case definitions to follow. Alternatively, LabID events (MRSA/VRE and CDI) have among the highest sensitivity which can be expected as they do not rely on clinical diagnosis.

While external validation has not been completed by ADHS, there are basic business rules and edit checks built into NHSN's web interface that are designed to reduce keystroke errors and provide a mechanism to assure logical integrity upon data entry. Examples of business rules and edit checks for CLABSI and CAUTI data entries are listed in Table 6.[11]

Table 6. NHSN Data Entry Checks for CLABSI and CAUTI

Topic	Data Entry Check
Dates	Date of birth must be ≥ 01/01/1890 and ≤ current date Date of birth must be ≤ event date Date of birth must be ≤ admission date Event date must be ≥ 3 days after admission date (admission date = day 1)
Dropdown menus	Location of attribution for CLABSI or CAUTI event Pathogen identity
Events	Logic to populate common commensal vs. recognized pathogen (CLABSI) Logic to populate uropathogen and common commensal lists (CAUTI) Required fields given monthly reporting plan Limit maximum number of feasible events per patient, per date (e.g., only one BSI or UTI can be reported per patient per date)
Summary Denominators	Format of denominator screen is driven by mapped locations Patient days must be ≥ device days for a given location

While these business checks provide some level of quality assurance, there are additional errors that can greatly affect the data quality. For CLABSI and CAUTI this can include errors in:

- assignment as healthcare-associated infections (HAIs)
- case-ascertainment of bloodstream infection (BSI) or urinary tract infection (UTI)
- case-classification (primary vs. secondary BSI, or type of UTI, e.g., asymptomatic bacteremic urinary tract infection (ABUTI), or types of symptomatic urinary tract infection (SUTI1a, SUTI2a, SUTI3, SUTI4 or other UTIs)

- location of attribution
- denominator reporting
- risk-adjustment variables

In order to limit these errors and maintain a high level of data quality, it expected that some level of internal validation is being done by facilities. Among these, NHSN suggests different data quality checks conducted daily to weekly, monthly, and annually. For CLABSI and CAUTI, it is suggested that daily or weekly spot checks are done for denominator counting and that positive blood and urine cultures are reviewed. It is suggested that the quality of the uploaded denominator data is reviewed monthly, and patient care location mapping and bed size, along with surveillance staff training updates, are conducted annually.

Similar to the business checks and edits for CLABSI and CAUTI, NHSN has business rules and edit checks to provide intrinsic SSI data quality as well. These business rules are shown below in Table 7.[11]

Table 7. NHSN Data Entry Checks for SSI

Topic	Data Entry Check
Procedure	Patient ID, procedure date, procedure code, inpatient/outpatient are verified for consistency between the SSI event and surgical procedure record already present in NHSN Procedure-specific variables Outpatient/Inpatient logic based on procedure
Drop-down menu	Specific events available for selection are procedure-specific Pathogen identity
Events	Criteria selected correctly meet the specific event definition Wound class selection limited by procedure Required fields given monthly reporting plan
Dates	Logic to verify when event was detected Date of birth must be ≥ 01/01/1890 and ≤ current date Date of birth must be ≤ event date Date of birth must be ≤ admission date Event date must be ≥ admission date

While these business checks provide some level of quality assurance, there are additional errors that can greatly affect the data quality. For SSI this can include errors in:

- completeness and accuracy of procedure denominator reporting
    - This includes NHSN procedures and associated risk-adjustment variables such as American Society of Anesthesiologists (ASA) score, procedure duration, use of general anesthesia, height, weight, and diabetes status
- quality of risk-adjustment variables
    - Variables mentioned above and also teaching hospital affiliation and bed size

- completeness of case-ascertainment (due to challenges and variation in post-discharge surveillance)
- correct case-classification

NHSN suggests internal validation of SSI data quality similar to that of CLABSI and CAUTI. This includes daily to weekly checks for active surveillance of events, monthly checks for the quality of uploaded or entered denominator data in addition to the completeness of risk-adjustment variables, and annual checks for surveillance staff training updates. Also, bed size should be reviewed annually, and procedure sources should be assessed to assure all in-plan surgical procedures are identified.

NHSN also has business rules and edit checks to provide intrinsic LabID Event data quality. These business rules are shown below in Table 8.[11]

Table 8. NHSN data entry checks for LABID Event

Topic	Data Entry Check
Dates	Date of birth must be ≥ 01/01/1890 and ≤ current date Date of birth must be ≤ specimen collection date Date of birth must be ≤ admission date Specimen collection date and location admission date must be ≥ facility admission date Specimen collection date must be ≥ and location admission date
Dropdown menus	Specimen source limited by body site Specimen source and body site choices limited by organism Location of attribution driven by mapped locations
Events	Previous event verified Required fields given monthly reporting plan
Summary Denominators	Facility-wide patient days ≥ any single location-specific patient days *C.difficile* patient days ≤ total facility-wide patient days

While these business checks provide some level of quality assurance, there are additional errors that can greatly affect the data quality. For LabID Event this can include errors in:

- incorrect assignment as hospital-onset (HO) or community-onset (CO)
- incorrect determination of duplicate vs reportable test results
- incorrect denominator data (observation patients in inpatient locations excluded from denominator counts)
- one error in classification can cause a series of downstream errors in case-classification because events are linked through patient location and time

NHSN provides suggestions for internal validation of NHSN LabID Event data quality. It is suggested that daily or weekly reviews of laboratory reports and data entry decisions be conducted. It is also suggested that monthly reviews be done on the quality of uploaded denominator data (patient days and admissions). Annual reviews should include surveillance staff training updates, and review of

patient care location mapping with patient demographics and location bed size during the NHSN annual survey.

Sensitivity – The sensitivity of a surveillance system can be considered on two levels. First, at the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system. Second, sensitivity can refer to the ability to detect outbreaks, including the ability to monitor changes in the number of cases over time.

The sensitivity of the NHSN data in Arizona is difficult to measure. Until data validation efforts have been completed, there is little that can be done to assess the sensitivity of the surveillance system. The results of California's validation efforts in 2014 are shown above and may provide insight to similar trends in Arizona facilities. Outside of NHSN, there is very little HAI data reported in Arizona that can be used to evaluate the sensitivity of case reporting to NSHN. The only comparable surveillance data in Arizona are for invasive methicillin-resistant *Staphylococcus aureus* (MRSA). Invasive MRSA is reportable by laboratories in the state under Arizona Administrative Code R9-6-204, and reports are entered into the Arizona communicable disease surveillance system (Medical Electronic Disease Surveillance Intelligence System, or MEDSIS). Although there are multiple limitations to using MEDSIS data as a comparison for NSHN (Table 9), we evaluated the sensitivity of NHSN for capturing MEDSIS MRSA events by matching all 2014 NHSN LabID MRSA data to 2014 MEDSIS MRSA cases, as described below.

Table 9. Summary of limitations to the use of MEDSIS data as a comparison for NHSN MRSA LabID events

MEDSIS	NHSN
All reports for a given patient are combined into a single MEDSIS case if the dates of specimen collection are within six months of each other.	Multiple NHSN records are available for a single infection if the patient moved between units or facilities or 14 days has passed since the last positive result in the same location; all records for a single patient cannot be easily combined.
Only specimens from normally sterile body sites, including but not limited to blood, are reported and counted	Can include any specimen site (including non-invasive sites) if reporting LabID "All Specimen" Includes only blood samples if reporting LabID "Blood Only"
Patient names are available	Patient name is not available
Patient DOB not a required field, although usually completed	Patient DOB a required field
No Onset classification	Community-Onset (CO) or Hospital-Onset (HO) based on admission and test date
Date of collection not required in MEDSIS	Date of specimen collection required in NHSN and very important in CO or HO determination
Population-level surveillance system	Hospital-based surveillance system

The 2014 final MEDSIS data contained 1178 invasive MRSA cases. The 2014 NHSN MRSA data contained 2966 events. A large number of NHSN events contained the "unspecified" sample type

(n=1427, 48%), followed by blood samples with 1086 (37%); all NHSN events were included in the matching, regardless of sample type. The process of matching cases involved four steps, each with multiple stages (see Figure 2). SAS 9.3 was used for all matching.

- Step one involved matching cases on date of birth (DOB), gender, and date of specimen collection. The first stage involved matching exactly on date of specimen collection, representing the highest quality matches. Any MEDSIS IDs matching multiple NHSN events were identified as having duplicates; all duplicates were documented and removed so that only one MEDSIS-NHSN pair remained. Next, cases were matched again on DOB and gender, but with a date of specimen collection difference of one to seven days. Again, duplicates were identified within this stage and removed. Also, any duplicates that had previously matched exactly on date of specimen collection in stage one were identified and removed from subsequent matching. All matches (including duplicates) were removed from the matching process prior to advancing to step two.
- Step two involved matching the remaining cases on DOB and date of specimen collection. This allowed us to capture those MEDSIS cases with unknown gender (n=63), and also to catch those in which gender was entered incorrectly in either system. Again it was broke down into two stages; first those that matched exactly on date of specimen collection, and second on those with a date of specimen collection that differed by one to seven days. Duplicates were identified and removed at each stage.
- Step three involved matching the remaining cases on age at onset and date of specimen collection. This stage allowed us to capture those MEDSIS cases in which date of birth was not entered (n=121), but an age was available. Only MEDSIS cases with no DOB available were used during this step. Due to the lack of precision by matching on age, only those cases that matched exactly on date of specimen collection were included in this step. Again, duplicates were identified and removed.
- The fourth and final step in matching cases involved bringing in additional NHSN data for December 2013. In MEDSIS, 2014 cases included all cases reported in 2014; however, some of the cases reported early in 2014 had specimen collection dates in December 2013 (n=31). Therefore, all cases from December 2013 in NHSN were added, and matched on DOB, gender, and date of specimen collection. Like in previous steps, it was broke down into two stages; first those that matched exactly on date of specimen collection, and second on those with a date of specimen collection that differed by one to seven days.

The number of matches from all four steps were combined giving us the total number of MEDSIS cases that correctly matched to at least one NHSN event (n=636). By taking this number and dividing it by the total number of MEDSIS cases for 2014 (n=1178), we are able to calculate the sensitivity of NHSN for identifying MRSA MEDSIS cases. The results are shown in Table 10.

Figure 2. Flow Chart of Sensitivity Matching Process

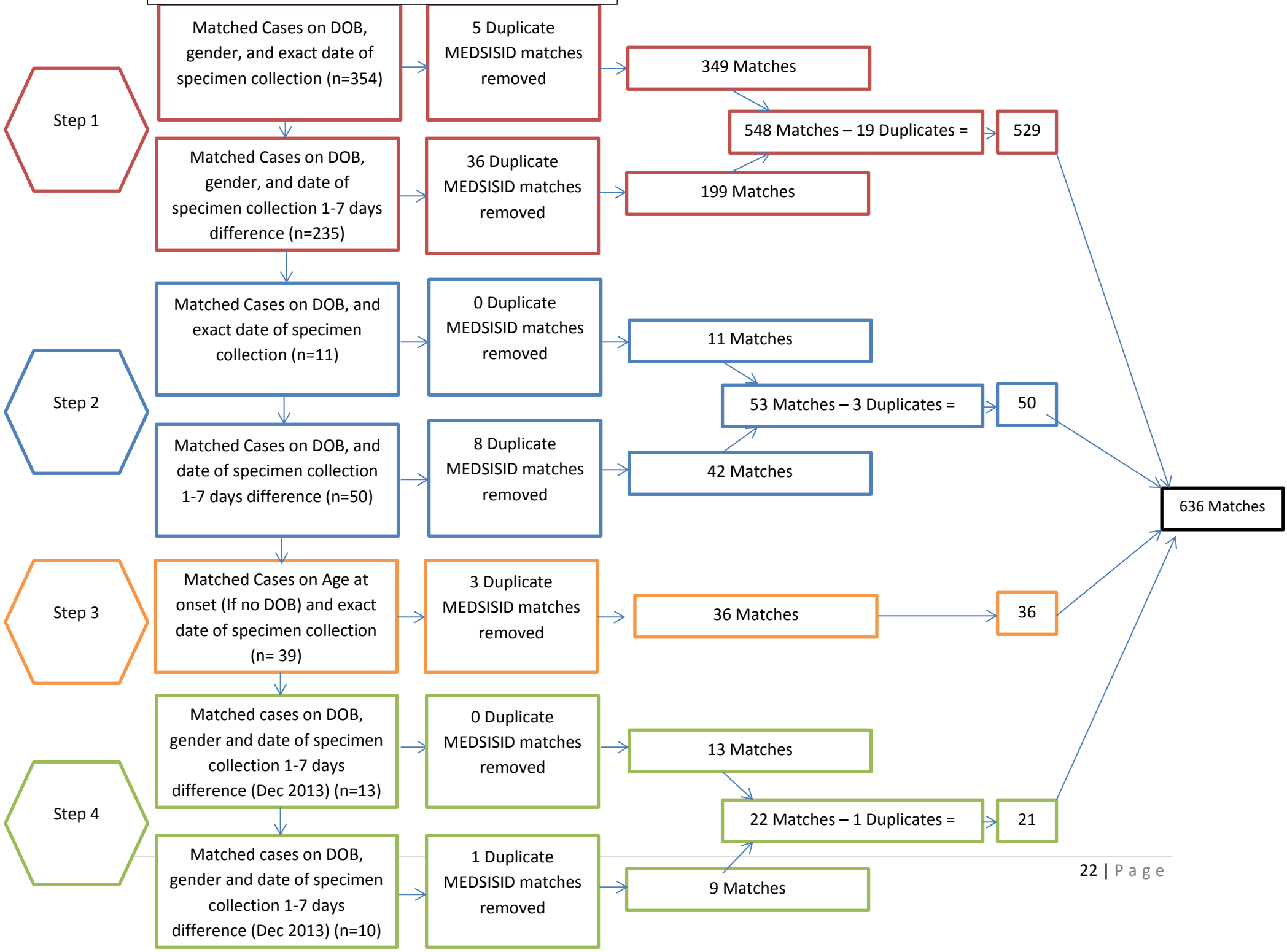


Table 10. NHSN Matching and Sensitivity for Capturing MEDSIS MRSA Cases

Matching Protocol	# of MEDSIS cases matched to NHSN records	% Matched (Sensitivity)
Matched exact date of specimen collection	409	35%
Matched date of specimen collection 1-7 days	227	19%
2014 MRSA MEDSIS Cases (n=1178)	**636**	**54%**

Of the 2966 NHSN events, 2277 did not match a MEDSIS case. However, due to the special rules for NHSN, it should be noted that this does not represent 2277 different people. It is not uncommon for multiple NHSN events to be linked to a single patient. The majority (1366, 60%) of these unmatched results were of "unspecified" sample type and 488 (21%) were blood.

Representativeness – A public health surveillance system that is representative accurately describes the occurrence of a health-related event over time and its distribution in the population by place and person.

Determining the representativeness of the NHSN data is challenging as we do not know for sure what facilities we are missing, or which facilities are reporting data that we are unable to access. As of fall 2015, 54 hospitals were included in our NHSN DUA Super Group. Within NHSN they are all classified under the NHSN Facility Type "HOSP-GEN". Therefore, data available to ADHS is only being reported from general (acute care) hospitals, and ADHS does not have HAI data from other facilities. These other facility types include dialysis centers, ambulatory surgical centers (ASC), inpatient rehabilitation facilities (IRF), long-term acute care facilities (LTAC), and long term care facilities (nursing homes, assisted living, intermediate care). Anecdotally we have heard that a number of these facility types, including dialysis centers, LTACs, and IRFs, are reporting some data to NHSN. The full list of NHSN-defined Facility Types is shown in Table 11.

Table 11. NHSN Facility Types

NHSN Facility Type	Description
HOSP-GEN	General Hospital, including Acute, Trauma, and Teaching
HOSP-CAH	Critical Access Hospital
HOSP-MIL	Military Hospital
HOSP-VA	VA Hospital
HOSP-CHLD	Children's Hospital
HOSP-ONC	Oncology Hospital
HOSP-ORTHO	Orthopedic Hospital
HOSP-WOM	Women's Hospital
HOSP-WOMCHILD	Women and Children's Hospital
HOSP-PSYCH	Psychiatric Hospital

HOSP-REHAB	Rehabilitation Hospital
HOSP-SURG	Surgical Hospital
HOSP-LTAC	Long Term Acute Care Hospital
HOSP-PEDLTAC	Pediatric Long Term Acute Care Hospital
AMB-HEMO	Hemodialysis Center
AMB-SURG	Outpatient Surgery Facility
LTC-ASSIST	Assisted Living Residence
LTC-DEVDIS	Long-term Care Facility for the Developmentally Disabled
LTC-SKILLNURS	Skilled Nursing Facility

While the 54 hospitals contained in our NHSN DUA Super Group are all defined as HOSP-GEN in NHSN, an in-depth analysis found that one of the hospitals is designated a critical access hospital (CAH). According to the University of Arizona, Center for Rural Health, a CAH is a rural acute care hospital consisting of no more than 25 inpatient beds. A CAH also must not exceed a 96-hour length of stay and have agreements, contracts, or affiliations for transfer and services. It must be located at least a 35-mile drive from any other hospital or CAH. (In mountainous terrain or in areas with only secondary roads available, the mileage criterion is 15 miles).[12] The Center for Rural Health recognizes 14 CAH in the state, therefore only 7% of CAH are represented in our Super Group (Table 12).

Further, the remaining 53 acute care hospitals in our Super Group do not represent all of the acute care hospitals in Arizona. While the Center for Rural Health clearly identified the 14 CAH in Arizona, determining the appropriate denominator for ACH in Arizona was more challenging. By using the last four digits of each facility's CMS Certification Number (CCN), we identified 76 acute care hospitals in the state of Arizona through the American Hospital Directory. Two of the hospitals, Hu Hu Kam Memorial Hospital and Parker Indian Hospital were recognized as critical access hospitals by the University of Arizona, Center for Rural Health. Therefore, we will use the total of 74 rather than 76. The 53 acute care hospitals in our super group represent 72% of the acute care hospitals in the state of Arizona (Table 12).

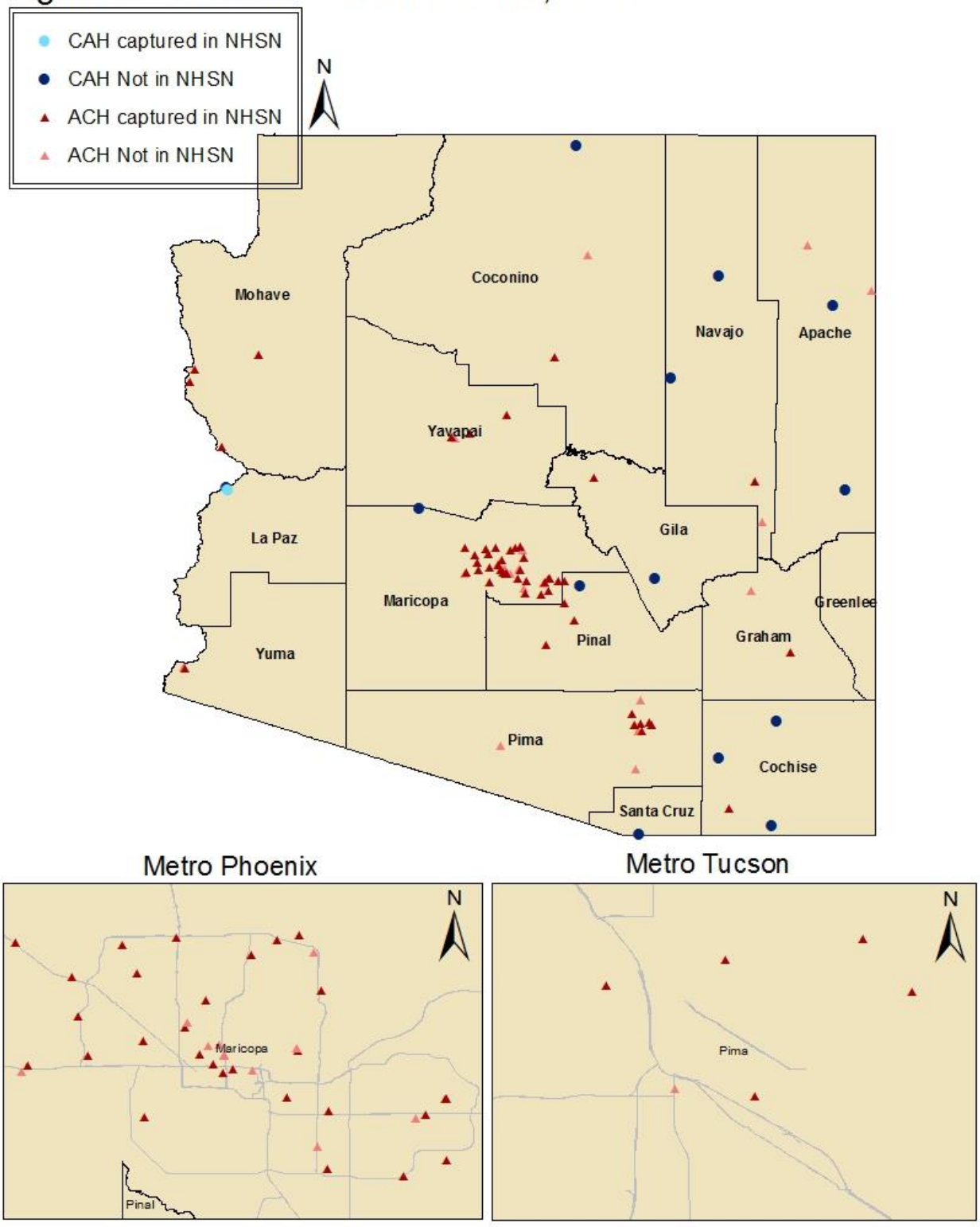
There are several subsets of ACH and CAH that we know will not be represented in the Arizona NHSN DUA Super Group, even if these facilities report data to NHSN. There are eight Indian Health Services (IHS) and tribal 638 facilities that are classified as ACH in the state of Arizona, but these facilities are not represented in the NHSN data available to ADHS, as expected. Further, there are four IHS/638 CAH in the state which are also not represented in the NHSN data. In addition to IHS/638 facilities, the three Veterans Affairs (VA) hospitals in the state, located in Maricopa, Yavapai, and Pima Counties, are not included in the NHSN data available to ADHS. Beyond the IHS/638 and VA hospitals, the remaining missing facilities have been identified from our complete hospital list, and further evaluation of their reporting status will be done.

Table 12. Hospitals Represented in ADHS Super Group

Hospital Type	# Hospitals in Arizona	# IHS/638 Hospitals in Arizona	# VA Hospitals in Arizona	# Hospitals in Super Group	% Represented
ACH	74	8	3	53	72%
CAH	14	4	0	1	7%

The geographic breakdown of reporting and non-reporting acute care and critical access hospitals is shown in Figure 3.

Figure 3. ACH and CAH in Arizona, 2015



Although we did not perform additional data collection and analysis for the remaining surveillance system attributes, our assessment of these attributes is included here.

Simplicity – The simplicity of a public health surveillance system refers to both its structure and ease of operation. Surveillance systems should be as simple as possible while still meeting their objectives.

From the public health perspective, the NHSN surveillance system is very simple. There is virtually no work necessary by state or local public health officials to operate the system, as the burden falls on the hospitals and their infection prevention (IP) staff. For most hospitals, the NHSN system provides them with a method for complying with CMS' elective pay-for reporting program. For each different component within NHSN, there are standard definitions and reporting requirements outlined in the NHSN Patient Safety Component Protocol. Further, NHSN provides countless trainings and resources to facilities, as well as direct support including nine user support specialists, eight IPs, and nine analysts.[2] Despite the assistance, NHSN reporting remains challenging for the facilities. There are a number of case definitions to follow, and case definitions can be confusing, as they are often different than the clinical case definition. Further, the complexity of the requirements can involve tracking and linking information from multiple hospitals systems (e.g., laboratory, admissions, and clinical data), coordinating data collection, interpreting results, and data entry by multiple staff members. This places an enormous responsibility on the IP to correctly interpret and report the data following the NHSN definitions. This responsibility will continue to grow as NHSN methods evolve, reporting requirements are expanded, and electronic health records increase in use.[11]

The simplicity of the system also varies by module. The LabID component of the MDRO/CDI module provides the most simplicity. It relies entirely on laboratory results; therefore, it requires no clinical review or further evaluation of positive lab findings. This greatly reduces the burden on the IP to operate the MDRO/CDI module. This is a large contrast to the SSI module, which requires a lengthy list of definitions which must be followed precisely as well as post-discharge and ante-discharge surveillance methods to detect SSIs following operative procedures. This includes direct examination of patients' wounds during follow-up visits, review of medical records or surgery clinic patient records, surgeon surveys by mail or telephone, and patient surveys by mail or telephone.[6]

Flexibility – A flexible public health surveillance system can adapt to changing information needs or operating conditions with little additional time, personnel, or allocated funds. Flexible systems can accommodate, for example, new health-related events, changes in case definitions or technology, and variations in funding or reporting sources. In addition, systems that use standard data formats (e.g., in electronic data interchange) can be easily integrated with other systems and thus might be considered flexible.

For ADHS, the NHSN surveillance system offers very little flexibility. The data is granted to us by CDC through our Data Use Agreement, but we have no influence in adapting the system to fit our wants. The system as a whole has shown characteristics of being somewhat flexible over the years. It was launched in 2005, replacing the National Nosocomial Infection Surveillance (NNIS), as a voluntary, confidential HAI reporting system designed for hospitals performing internal surveillance,

benchmarking, and quality improvement for HAIs. It only contained two active components. There were zero states with mandatory reporting, and the first report included 211 hospitals. Currently, there are five components with the ability to add two components in the future. There are 33 states and D.C. that use NHSN for mandatory reporting, and the most recent report included data from 4,657 hospitals. Additionally, NHSN has made numerous changes to reporting requirements and definitions over the years to improve surveillance and adapt to changes in CMS reporting requirements. NHSN will continue to make updates which provide clarification and improve adherence to reporting, and also account for enrollment of additional facility types. Despite the changes that have been made to NHSN over the years, overall the system lacks flexibility. NHSN serves thousands of users, and involves extremely sophisticated terminology and case definitions. The process of making changes can take years before getting all users switched over to the new way of doing things.

Acceptability – Acceptability reflects the willingness of persons and organizations to participate in the surveillance system.

The acceptability of NHSN is unquestionable. It is the gold standard of HAI surveillance, and is used by over 16,000 healthcare facilities in the United States and adding new facilities steadily. Facilities report data to NHSN for one of three reasons: voluntarily, in response to state mandated reporting requirements, or to comply with CMS quality reporting programs. While NHSN has been accepted by its users as the primary HAI surveillance system, no evidence is available to ADHS on how satisfied or happy with the system the users are. As mentioned in discussing the simplicity of NHSN, the case definitions and reporting requirements can be quite difficult and burdensome on the reporting IPs. In Arizona, there is not a mandatory reporting requirement; therefore, facilities reporting in the state are most likely reporting to comply with CMS requirements. NHSN is the only accepted way for hospitals to report HAIs to the Hospital Inpatient Quality Reporting Program (HIQRP) for CMS Inpatient Prospective Payment System (IPPS) reimbursement. Thus, the facilities have very little choice in accepting NHSN if they want to receive CMS reimbursement.

Predicted Value Positive –Predictive value positive (PVP) is the proportion of reported cases that actually have the health-related event under surveillance.

Similar to sensitivity, the predictive value positive (PVP) cannot accurately be measured until data validation has been performed. Additionally, our MRSA comparison with MEDSIS data does not provide us with the necessary information to make a calculation. Therefore, until data validation is conducted, we can only allude to PPV generated by validation in other states. In 2009, Connecticut performed data validation of CLABSI events and determined the positive predictive value for the hospital reports was 85%.[13] While this validation result is old, and surveillance definitions and processes have changed considerably since then, it provides added evidence of the importance of validation work needed in Arizona. Additionally, it should be noted that PVP, as well as sensitivity, can vary greatly from module to module.

Timeliness – Timeliness reflects the speed between steps in a public health surveillance system.

States which have mandatory reporting to NHSN must submit their data to NHSN within 30 days of the end of the reporting month, according to NHSN rules. However, because Arizona is not a mandatory reporting state, facilities only need to comply with CMS reporting requirements. CMS requires that each facility's data is entered into NHSN no later than 4 ½ months after the end of the reporting quarter. Therefore, Q1 data (January, February, March) does not need to be entered until August 15th, Q2 data (April, May, June) does not need to be entered until November 15th, Q3 data (July, August, September) does not need to be entered until February 15th, and Q4 (October, November, December) does not need to be entered until May 15th.[14] Despite the lengthy reporting timeframe, it is recommended that facilities report their data sooner to allow for a greater impact on infection prevention activities. Nonetheless, the ultimate decision on how quickly to report rests in the hands of each individual facility. While it is not possible to definitively tell how quickly facilities are reporting, it is worth noting that not all reporting plans have been submitted for the previous two months, at the time that this report was compiled. Further studies could be done to more accurately describe the delay in reporting events by each facility.

Stability – Stability refers to the reliability (i.e., the ability to collect, manage, and provide data properly without failure) and availability (the ability to be operational when it is needed) of the public health surveillance system.

NHSN is the largest HAI surveillance system in the U.S., serving over 16,000 healthcare facilities, and more than 40,000 individual enrolled users. It has grown immensely in the last 10 years, and could not have established itself as the leader in HAI reporting without providing stability to all those who use it. The Division of Healthcare Quality Promotion (DHQP) at the CDC manages the secure, internet-based surveillance system. They provide training, support, and technical assistance to system users to ensure the data are entered into the system without error. By providing the highest level of stability and gaining the trust of its users, NHSN is the gold standard in HAI surveillance, providing an essential resource for local, state, and national surveillance and prevention efforts.

Task E. Justify and state conclusions, and make recommendations

While the NHSN surveillance system has been around since 2005, ADHS has only recently gained access to the data. Combined with the increasing attention placed on HAIs in recent years and national incentives for facilities to participate, ADHS has the opportunity to utilize these data to improve efforts to control and prevent HAIs in the future. CDC has identified eliminating HAIs as a winnable battle, and ADHS has made prevention of HAIs a priority in the state HAI plan. The NHSN surveillance system provides a means for helping to meet this objective. Through this evaluation, we are better equipped to accurately interpret the findings from Arizona's NHSN data.

This evaluation provides a clear picture of the completeness and representativeness of the ADHS data. Despite not having a mandatory reporting requirement, ADHS has access to the data for 90% of the acute care hospitals in the state reporting CLABSI and CAUTI. An area that may have room

for improvement is MRSA and CDI LabID reporting. Only 79% of facilities reporting to these modules have data available to ADHS. We accounted for VA and IHS/638 facilities, which ADHS will not be able to access according to current agreements, and identified the additional facilities missing from our Super Group. By identifying these missing facilities, we are working with CDC to obtain access to additional data. While the federal facilities identified are outside the jurisdiction of ADHS staff, these facilities nonetheless serve sectors of the Arizona population and thus contribute to the health status of the state. Also, in terms of completeness, this evaluation provided a thorough understanding of exactly which modules are being reported, including those SSI sites beyond COLO and HYST, which are required for CMS.

Evaluation of the representativeness of the data by facility type revealed a lack of representation beyond acute care hospitals. During the work on the evaluation, only data from acute care hospitals and one critical access hospital was available to ADHS. However, as a result of identifying this lack of representation from other facility types, access to data from 18 additional facilities was made available to ADHS during early December 2015. This included 10 long-term acute care hospitals (LTACHs) and eight inpatient rehabilitation facilities (IRFs). Using January 2015 reporting plans, all 10 LTACHs were reporting CLABSI, CAUTI, MRSA LabID, and C. diff LabID. Two of the 10 were also reporting VAE. Of the eight IRFs, all eight were reporting CAUTI, MRSA LabID, and C. diff LabID. While this is a good start, additional representation is needed, specifically in the form of dialysis facilities and long-term care facilities. CDC has been made aware of our request for dialysis data, and their leadership is discussing data access for the Dialysis Component of NHSN. It is also our understanding that long-term care facilities are in the early stages of NHSN enrollment; ADHS will continue to work with CDC to gain access to the LTCF data through the DUA as these facilities begin to report to the system.

Additionally, with the ADHS Super Group only capturing 72% of ACH and 7% of CAH in the state, further investigation was needed into obtaining data access for these facilities, especially CAH. Through discussions with CDC, it was discovered that the only NHSN Facility Types explicitly stated in our DUA for the Patient Safety Component are HOSP-GEN, HOSP-REHAB, HOSP-LTAC, and AMB-HEMO. Therefore, critical access hospitals are not a part of our DUA, and the one CAH that is captured in our Super Group is only there because it is designated as a HOSP-GEN in NHSN. We requested access to all facility types from CDC, and they worked to update our DUA/Super Group. In early February 2016, 11 additional facilities were made available to ADHS. These facilities represented six additional facility types (HOSP-ONC, HOSP-CAH, HOSP-CHLD, HOSP-ORTHO, HOSP-SURG, and HOSP-PSYCH).

Analyzing the sensitivity of NHSN for capturing MRSA events in MEDSIS proved challenging. Despite matching only 54% of our cases, much can be learned from the analysis. It should be noted that due to the lack of patient identifiers in NHSN, a fairly strict matching protocol was followed. Only cases that matched within seven days of specimen collection between the two surveillance systems were included. Of these, almost two-thirds matched the exact date of specimen collection. From manually examining the matches with a one to seven day difference in collection dates, we believe these are also accurate matches. We may have been able to achieve a higher number of matches by increasing the time allowed between dates of specimen collection, but elected for a seven-day window for a somewhat more conservative estimate of the sensitivity. There may be several reasons why MEDSIS MRSA were

not identified among the NSHN records, including: MEDSIS reports from facilities that are not reporting to NHSN or for which NHSN data was not available to ADHS; invasive MRSA cases that were not hospitalized; persons present in both sets of data but whose records did not match based on our matching criteria; MEDSIS cases that did not meet the criteria for reporting to NHSN, for example, MRSA in non-blood normally sterile sites in facilities only reporting blood isolates to NHSN; and lastly, under-reporting to NHSN of MRSA events by the reporting facilities. Again, data validation with Arizona facilities will help explain distinguish some of these factors.

After matching cases, we have an additional 2277 (77%) of 2966 NHSN records that did not match MEDSIS cases. We believe that while many of the NHSN records do represent cases that are also reported through our laboratory surveillance system, our analysis also demonstrates that NHSN LabID MRSA surveillance represents a substantively different group of events from what we can capture through other surveillance systems. NHSN surveillance captures MRSA events beyond invasive cases, for those facilities reporting to the MRSA LabID "All Specimens" module, and also contains multiple laboratory-confirmed positives for a single patient. Additionally, NHSN classifies MRSA events as Community-Onset (CO) or Healthcare Facility-Onset (HO) based on when the specimen was collected in relation to admission. Thus, the NHSN surveillance data will represent a valuable source of information for monitoring MRSA trends in Arizona. Upon additional review, only 47 of our 54 hospitals reported an NHSN MRSA event for 2014. Among these 47 that reported at least one MRSA event, 42 hospitals were able to match at least one NHSN and MEDSIS case. We plan to do further analysis of both the matches and non-matches, which may further clarify the similarities and differences in records reported to each system, and identify gaps in reporting that could be corrected, resulting in better data being reported to ADHS. We were also able to identify a health system that was responsible for a large proportion of the "unspecified" lab results. We reached out to them to provide us with some background on the reason for submitting the sample type as "unspecified". They are currently investigating the matter, and we hope to receive some clarification in the near future.

An important factor to consider regarding NHSN is the means by which it is supported and maintained. The burden of operating the system falls on the CDC and healthcare facilities reporting the data. The only resources needed by ADHS to take advantage of the surveillance system are the personnel required to analyze, interpret and appropriately disseminate the data, though even that level of resources can be challenging to maintain. The low level of ADHS resources need to collect the NHSN data allows us to instead expend available resources in developing strategies targeted at reducing the HAI burden in the state and monitoring that progress over time. An additional area to which it may be beneficial to apply resources is conducting validation of NHSN data. As shown by the work conducted in other states, and hinted at by our MRSA sensitivity analysis, validation efforts have often identified data problems or inconsistencies. By performing validation, ADHS can work with facilities to help identify, understand, and correct reporting problems. The CDC has set up standard methods for external validation for health departments and other appropriate agencies; it is recommended that ADHS move forward with efforts to conduct an external validation of NHSN data. During this validation process, assurances can be made that numerator data, denominator data, and risk adjustment variables

are all of high quality. Validation is an important step toward assuring that reported NHSN data are actionable and motivate improved infection control efforts as well as prioritization of efforts.[10]

Beyond resources and the need to become familiar with how to best use the data, the primary limitation of using NHSN for surveillance at ADHS is the lack of adaption to accommodate ADHS requirements. At ADHS, we must rely on NHSN to make future changes to improve the system and keep pace with emerging public health circumstances. Unlike MEDSIS, which we can modify to fit our needs, we do not have the ability to make adjustments NHSN. Therefore, those attributes such as simplicity, flexibility, timeliness, and stability are largely out of our hands. While this is a limitation, CDC is committed to improving the system to meet changing demands, and the lack of state-customization of the system also ensures more national standardization. When NHSN launched in 2005, it replaced the National Nosocomial Infection Surveillance (NNIS), which had been in place since 1970. NHSN began as a voluntary, confidential HAI reporting system designed for hospitals performing internal surveillance, benchmarking, and quality improvement for HAIs. Over time, state and federal agencies have begun using NHSN data for public reporting purposes, and CMS reporting requirements have also begun using NHSN data. This has grown NHSN into the most widely used HAI tracking system in the nation. CDC has shown they can adapt to the changing environment and to emerging requirements. Furthermore, they are dedicated to making ongoing improvements in NHSN, and providing high quality surveillance data that can drive change in the HAI field. Therefore, it is recommended that ADHS recognize the value NHSN provides, and begin using the data to drive progress in reducing healthcare-associated infections in the state of Arizona. This analysis and evaluation has already proved useful to the Department for laying the groundwork for more specific analyses, improving and expanding access to the data available to ADHS, and establishing current levels of facility representativeness.

Task F. Ensure use of evaluation findings and share lessons learned

Key findings from this report will be presented to the Arizona HAI Advisory Committee, and data validation plans will be prepared and discussed. Additionally, the HAI Program will use NHSN data to create an annual report for HAIs, and also use the data to drive collaborative interventions. The final evaluation report will be published to the ADHS website to provide information to interested stakeholders. An abstract highlighting the findings has been submitted to CSTE for presentation at the CSTE Annual Conference in June 2016. Further, during the course of preparing the evaluation, we were able to identify a lack of different facility types reporting data to ADHS. As a result, in early December 2015, ADHS was granted the rights to 18 additional facilities' data, including 10 long-term acute care hospitals (LTACHs) and 8 inpatient rehabilitation facilities (IRFs). Additionally, in early February 2016, 11 additional facilities were made available to ADHS. These facilities represented six additional facility types (HOSP-ONC, HOSP-CAH, HOSP-CHLD, HOSP-ORTHO, HOSP-SURG, and HOSP-PSYCH). ADHS will continue working with CDC to identify and address gaps in accessibility to this important data.

Resources:

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3. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Patient Safety Component Manual (2015, April). Retrieved from http://www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf
4. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central line-associated Bloodstream Infection) Manual. Retrieved from http://www.cdc.gov/nhsn/PDFs/pscManual/4PSC_CLABScurrent.pdf
5. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and Non-Catheter-Associated Urinary Tract Infection [UTI] and other Urinary System Infection [USI]) Events Manual. Retrieved from http://www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf
6. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Surgical Site Infection (SSI) Event Manual. Retrieved from http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf
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8. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Multidrug-Resistant Organism & *Clostridium difficile* Infection (MDRO/CDI) Module Manual. Retrieved from http://www.cdc.gov/nhsn/pdfs/pscmanual/12pscmdro_cdadcurrent.pdf
9. Centers for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group. MMWR 2001;50(No. RR-13)
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11. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). National Healthcare Safety Network (NHSN) External Validation Guidance and Toolkit, 2014. Retrieved from http://www.cdc.gov/nhsn/pdfs/validation/2014/2014-nhsn-ev-guidance.pdf
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14. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN). Operational Guidance for Acute Care Hospitals to Report Central Line-Associated Bloodstream Infection (CLABSI) Data to CDC's NHSN for the Purpose of Fulfilling CMS's Hospital Inpatient Quality Reporting (IQR) Requirements (2014, November). Retrieved from http://www.cdc.gov/nhsn/pdfs/cms/final-ach-clabsi-guidance-2015.pdf

Appendix I. Arizona Data Use Agreement

Data Use Agreement between CDC National Healthcare Safety Network and Arizona Department of Health Services
Data File Specifications Template - Patient Safety Component

The template below can be used to describe which data from the NHSN Patient Safety Component will be shared with the state health department.
Only data that is included in a facility's monthly reporting plan will be included in datasets shared with the state health department.
"Time Period" of data shared with state health department will completed on template after signing of DUA.
Please complete the template and provide to CDC/NHSN for further discussion.

Specify level of aggregation and patient identifiers to receive:

	Only requesting facility level aggregate data (no patient level data)
	Pt level data with all patient identifiers
	Pt level data with no patient identifiers
X	Pt level data with specific patient identifiers (please select below)

X	DOB
X	Gender
X	Ethnicity
X	Race

General and surveys:

X	Monthly reporting plans
X	Facility annual surveys

Device-Associated Module events and denominators:
Select event types of interest below:

X	Central line-associated bloodstream infection (CLABSI)
X	Catheter-associated urinary tract infection (CAUTI)
X	Ventilator-associated events (VAE)
	Central line insertion practices (CLIP) - please note that requesting CLIP events will result in inserter code being shared
X	Dialysis Event (DE)

For these events, please specify the facility types, locations, and time period that will be shared with state health department below.
You will receive both event (numerator) and summary (denominator) data for the locations that you specify.

Plan	Time Period	Location Type (Ex - ICUs, Wards, etc)	Specific Facility Types and Locations (Ex - All ICUs, Medical ICUs, etc)
IN		Acute care hospitals	All adult, pediatric, and neonatal intensive care locations
IN		Acute care hospitals	All ward and specialty care area locations
IN		Long-term acute care hospitals	All patient care locations
IN		Rehabilitation hospitals	All patient care locations
IN		Outpatient dialysis centers	All outpatient facilities reporting
IN			

Procedure-Associated Module events and denominators:
Select event types of interest below:

X	Surgical Site Infection (SSI) - please note that requesting SSI events/denominators will result in surgeon code being shared
	Post-procedure Pneumonia (PPP)

For these events, please specify the facility types, procedures, and time period that will be shared with the state health departmentin the table below.
You will receive both event (numerator) and procedure (denominator) data for the locations that you specify.

Plan	Time Period	NHSN Procedure Category	Specific Facility Types and Settings (Inpatient, Outpatient, or Both)
IN		CBGB and CBGC	Both
IN		CARD	Both
IN		KPRO	Both inpatient and outpatient from acute care hospitals and ASCs
IN		HYST	Both inpatient and outpatient from acute care hospitals and ASCs
IN		COLO	Both inpatient and outpatient from acute care hospitals and ASCs
IN			

MDRO Module events and denominators:
Select event types of interest below:

	Infection Surveillance
X	LabID Event - all specimens
	LabID Event - blood specimens only

Select organisms of interest below:

X	MRSA
	MRSA and MSSA
X	C. difficile

	VRE
X	Ceph-R Klebsiella
X	CRE Klebsiella
X	CRE E. coli
X	MDR Acinetobacter

For these events, please specify the facility types, locations, and time period that will be shared with state health department below.
You will receive both event (numerator) and summary (denominator) data for the locations that you specify.

Plan	Time Period	Location Type (Ex - ICUs, FACWIDE, etc)	Specific Locations (Ex - All ICUs, FACWIDEIN, etc)
IN		Acute care hospitals	FACWIDE IN LabID Events
IN		Long-term acute care hospitals	FACWIDE IN LabID Events
IN		Rehabilitation hospitals	FACWIDE IN LabID Events
IN			
IN			
IN			

MDRO Module Process and Outcome Measures
Select process and outcome measures of interest below:

	Hand Hygeine
	Gown and Gloves
	AST Adm
	AST D/T
	AST Incidence
	AST Prevalence

Select organisms of interest for AST Process and Outcome Measures below:

	MRSA
	VRE

Antimicrobial Use and Resistance Module:
Select event types of interest below:

	Antimicrobial Use (AU)
	Antimicrobial Resistance (AR) - to be implemented in the future

For these events, please specify the locations and time period that will be shared with the state health department below.

Plan	Time Period	Location Type (FACWIDEIN or By Location)
IN		
IN		
IN		
IN		

Please include any other comments that do not fit into the template structure in the field below.

Data Use Agreement between CDC National Healthcare Safety Network and Arizona Department of Health Services
Data File Specifications Template - Healthcare Personnel Safety Component

The template below can be used to describe which data from the NHSN Healthcare Personnel Safety Component will be shared with the s
Only data that is included in a facility's monthly reporting plan will be included in datasets shared with the state health department.
"Time Period" of data shared with state health department will completed on template after signing of DUA.
Please complete the template and provide to CDC/NHSN for further discussion.

General and Surveys:

	HCW Data
	With Identifiers
	Without Identifiers
	Monthly Reporting Plans
	Annual Survey
X	Seasonal Flu Survey

Specify the facility types from which HPS data will be shared: Acute care hospitals, long-term acute care hospitals, reha

Blood and Body Fluid Exposure Module:

	Exposure to blood and body fluid data

Healthcare Worker Influenza Vaccination Module:

X	HCW summary flu vaccination data

Laboratory Data

	Laboratory data

Prophylaxis/Treatment

	Prophylaxis/Treatment data

Data Use Agreement between CDC National Healthcare Safety Network and Arizona Department of Health Services
Data File Specifications Template - Long Term Care Facility Component

The template below can be used to describe which data from the NHSN Long Term Care Facility Component will be shared with the state health de
Only data that is included in a facility's monthly reporting plan will be included in datasets shared with the state health department.
"Time Period" of data shared with state health department will completed on template after signing of DUA.
Please complete the template and provide to CDC/NHSN for further discussion.

Specify level of aggregation and patient identifiers to receive:

	Only requesting facility level aggregate data (no resident level data)
	Resident level data with all patient identifiers
X	Resident level data with no patient identifiers
	Resident level data with specific patient identifiers (please select below)
	DOB
	Gender
	Ethnicity
	Race

General and surveys:

	Monthly reporting plans
X	Facility annual surveys

UTI events and denominators:

	UTI event and denominator data (FACWIDE IN)

LabID events and denominators:

Select organisms of interest below:

X	Acinetobacter
X	C. difficile
X	Ceph-R Klebsiella
X	CRE E. coli
X	CRE Klebsiella
X	MRSA
	MSSA
	VRE

Prevention Process Measures

	Hand Hygeine
	Glown and Gloves

Appendix II. Laboratory-Confirmed Bloodstream Infection (LCBI) Criteria

Criterion	Laboratory-Confirmed Bloodstream Infection (LCBI) *Comments and reporting instructions that follow the site-specific criteria provide further explanation and are integral to the correct application of the criteria.* Must meet ***one*** of the following criteria:
LCBI 1	Patient has a recognized pathogen cultured from one or more blood cultures **AND** organism cultured from blood is not related to an infection at another site.
LCBI 2	Patient has at least one of the following signs or symptoms: fever (>38.0oC), chills, or hypotension AND organism cultured from blood is not related to an infection at another site (See Appendix 1 Secondary BSI Guide) AND the same common commensal (i.e., diphtheroids [Corynebacterium spp. not C. diphtheriae], Bacillus spp. [not B. anthracis], Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., and Micrococcus spp.) is cultured from two or more blood cultures drawn on separate occasions (see comment 3a below). Criterion elements must occur within the Infection Window Period (see Chapter 2), the seven-day time period which includes the date the positive blood culture was collected, the 3 calendar days before and the 3 calendar days after. (See complete list of common commensals by selecting the common commensal tab at the bottom of the Excel worksheet at http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx) Note: The matching common commensals represent a single element; therefore, the collection date of the first common commensal is the date of the element used to determine the Date of Event.
LCBI 3	Patient ≤ 1 year of age has at least one of the following signs or symptoms: fever (>38.0oC), hypothermia (<36.0oC), apnea, or bradycardia AND organism cultured from blood is not related to an infection at another site (See Appendix 1 Secondary BSI Guide) AND the same common commensal (i.e., diphtheroids [Corynebacterium spp. not C. diphtheriae], Bacillus spp. [not B. anthracis], Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., and Micrococcus spp.) is cultured from two or more blood cultures drawn on separate occasions (see comment 3a below). Criterion elements must occur within the Infection Window Period, the seven-day time period which includes the date the positive blood culture was collected, the 3 calendar days before and the 3 calendar days after. (See complete list of common commensals by selecting the common commensal tab at the bottom of the Excel worksheet at http://www.cdc.gov/nhsn/XLS/master-organism-Com-Commensals-Lists.xlsx)

	Note: The matching common commensals represent a single element; therefore, the collection date of the first common commensal is the date of the element used to determine the Date of Event.

Appendix III. Mucosal Barrier Injury Laboratory-Conformed Bloodstream Infection (MBI-LCBI) Criteria

Criterion	**Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI)** *In 2015 when reporting an LCBI, it is required to indicate which of the underlying conditions of the MBI-LCBI criterion was met, if any. All CLABSI, whether LCBI or MBI-LCBI, must be reported if CLABSI is part of your Monthly Reporting Plan.* Must meet ***one*** of the following criteria:
MBI-LCBI 1	Patient of any age meets criterion 1 for LCBI with at least one blood culture growing any of the following intestinal organisms with no other organisms isolated (See Comment #5): *Bacteroides* spp., *Candida* spp., *Clostridium* spp., *Enterococcus* spp., *Fusobacterium* spp., *Peptostreptococcus* spp., *Prevotella* spp., *Veillonella* spp., or Enterobacteriaceae* **And patient meets at least *one* of the following:** 1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood culture: a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the positive blood culture was collected. 2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm3 within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before *and* the 3 calendar days after (See Table 4 for example).
MBI-LCBI 2	Patient of any age meets criterion 2 for LCBI when the blood cultures are growing only viridans group streptococci with no other organisms isolated **And patient meets at least *one* of the following:** 1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood culture: a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the first positive blood culture was collected. 2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm3 within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before *and* the 3 calendar days after (See Table 4 for example).
MBI-LCBI 3	Patient ≤1 year of age meets criterion 3 for LCBI when the blood cultures are growing only viridans group streptococci with no other organisms isolated

	And patient meets at least *one* of the following: 1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood culture: a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD] b. ≥20 mL/kg diarrhea in a 24-hour period with onset on or within 7 calendar days before the date the first positive blood culture is collected. 2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm^3 on or within a seven-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before *and* the 3 calendar days after. (See Table 4 for example)

Appendix IV. Urinary Tract Infection Criteria

Criterion	Urinary Tract Infection (UTI)
	Symptomatic UTI (SUTI) Must meet at least ***one*** of the following criteria:
SUTI 1a Catheter-associated Urinary Tract Infection (CAUTI)	Patient must meet 1, 2, and 3 below: 1.Patient had an indwelling urinary catheter that had been in place for > 2days on the date of event (day of device placement = Day 1) AND was either: □Still present on the date of event†, OR □Removed the day before the date of event‡ 2.Patient has at least ***one*** of the following signs or symptoms: •fever (>38.0°C) •suprapubic tenderness* •costovertebral angle pain or tenderness* •urinary urgency* •urinary frequency* •dysuria* 3.Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of $\geq 10^5$ CFU/ml. All elements of the UTI criterion must occur during the Infection Window Period (See Definition Chapter 2 Identifying HAIs in NHSN). † When entering event into NHSN choose "INPLACE" for Risk Factor for Urinary Catheter ‡ When entering event into NHSN choose "REMOVE" for Risk Factor for Urinary Catheter ***With no other recognized cause (see Notes below) **Notes:** □An indwelling urinary catheter in place would constitute "other recognized cause" for patient complaints of "frequency" "urgency" or "dysuria" and therefore these cannot be used as symptoms when catheter is in place. □Fever and hypothermia are non-specific symptoms of infection and can not be excluded from UTI determination because they are clinically deemed due to another recognized cause.
SUTI 1b Non-Catheter-associated Urinary Tract Infection (Non-CAUTI)	Patient must meet 1, 2, and 3 below: 1.One of the following is true: □Patient has/had an indwelling urinary catheter but it has/had not been in place >2 calendar days on the date of event† **OR** □Patient did not have a urinary catheter in place on the date of event nor the day before the date of event‡ 2.Patient has at least ***one*** of the following signs or symptoms:

	•fever (>38°C) in a patient that is ≤ 65 years of age •suprapubic tenderness* •costovertebral angle pain or tenderness* •urinary frequency* •urinary urgency* •dysuria* 3.Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of ≥10^5 CFU/ml. All elements of the SUTI criterion must occur during the Infection Window Period (See Definition Chapter 2 Identifying HAIs in NHSN). † When entering event into NHSN choose "NEITHER" for Risk Factor for Urinary Catheter *****With no other recognized cause (see Notes below) **Notes:** An indwelling urinary catheter in place would constitute other recognized cause for patient complaints of "frequency" "urgency" or "dysuria" and therefore these cannot be used as symptoms when catheter is in place. Fever and hypothermia are non-specific symptoms of infection and cannot be excluded from UTI determination because they are clinically deemed due to another recognized cause.
SUTI 2 CAUTI or Non-CAUTI in patients 1 year of age or less-	Patient must meet 1, 2, and 3 below: 1.Patient is ≤1 year of age (with‡ or without an indwelling urinary catheter) 2.Patient has at least ***one*** of the following signs or symptoms: •fever (>38.0°C) •hypothermia (<36.0°C) •apnea* •bradycardia* •lethargy* •vomiting* •suprapubic tenderness* 3.Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of ≥10^5 CFU/ml. All elements of theSUTI criterion must occur during the Infection Window Period (See Definition Chapter 2 Identifying HAIs in NHSN). *****With no other recognized cause
	Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)
	Patient must meet 1, 2, and 3 below: 1. Patient with***** or without an indwelling urinary catheter has no signs or symptoms of SUTI 1 or 2 according to age (**Note**: Patients > 65 years of age with a non-catheter-associated ABUTI **may** have a fever and still meet the ABUTI criterion)

	2.Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of $\geq 10^5$ CFU/ml (see Comments ection below) 3.Patient has a positive blood culture with at least ***one*** matching bacteriato the urine culture, or meets LCBI criterion 2 (without fever) andmatching common commensal(s) in the urine. All elements of theABUTI criterion must occur during the Infection Window Period (SeeDefinition Chapter 2 Identifying HAIs in NHSN). *****Patient had an indwelling urinary catheter in place for >2 calendar days, with day of device placement being Day 1, and catheter was in place on the date of event or the day before.
Comment	"Mixed flora" is not available in the pathogen list within NSHN. Therefore it cannot be reported as a pathogen to meet the NHSN UTI criteria. Additionally, "mixed flora" represent at least two species of organisms. Therefore an additional organism recovered from the same culture, would represent >2 species of microorganisms. Such a specimen also cannot be used to meet the UTI criteria.

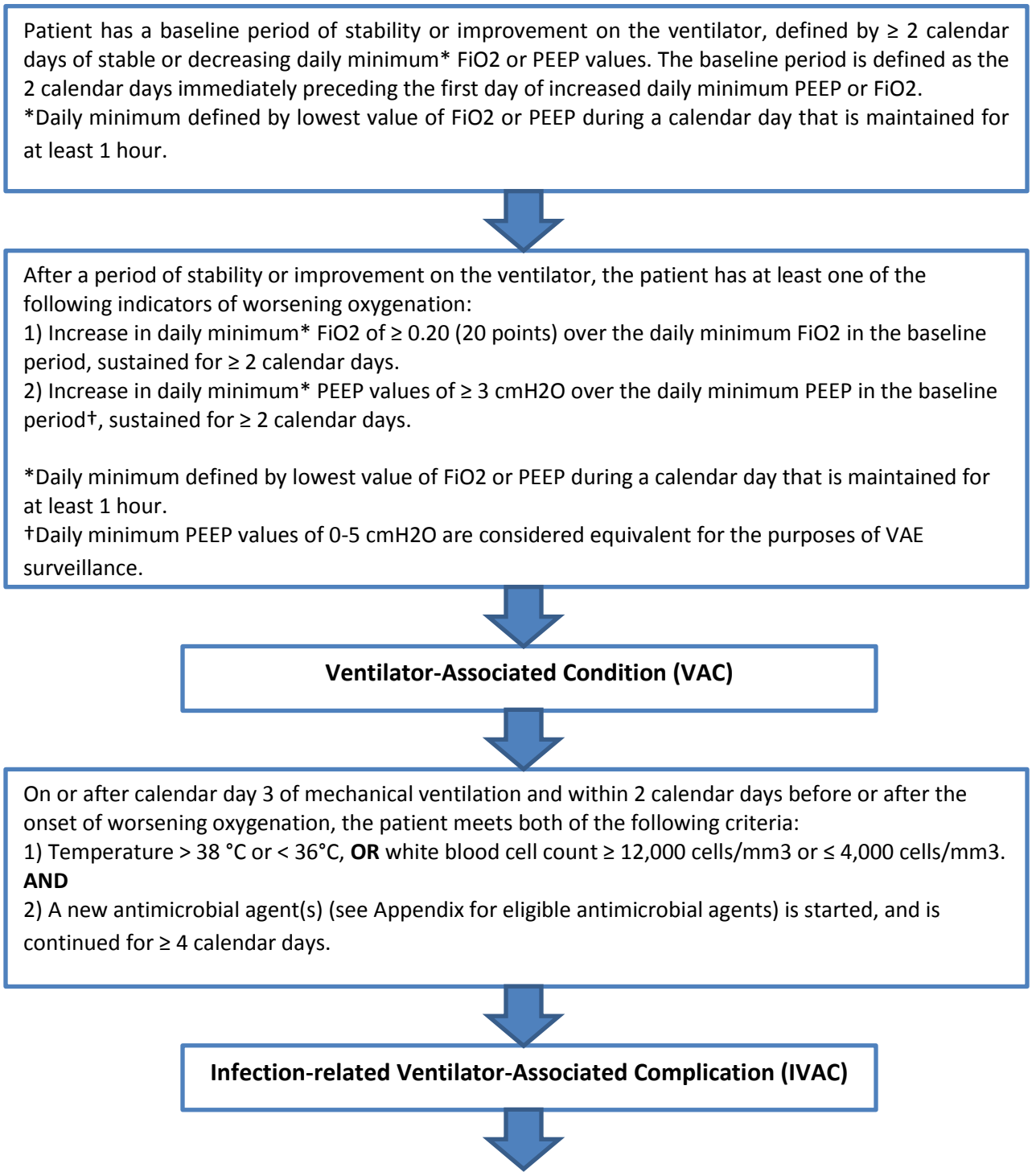
Appendix V. Surgical Site Infection Criteria

Criterion	Surgical Site Infection (SSI)
	Superficial incisional SSI Must meet the following criteria:
	Infection occurs within 30 days after any NHSN operative procedure (where day 1 = the procedure date), including those coded as 'OTH'***** **AND** involves only skin and subcutaneous tissue of the incision **AND** patient has at least ***one*** of the following: a. purulent drainage from the superficial incision. b. organisms isolated from an aseptically-obtained culture from the superficial incision or subcutaneous tissue. c. superficial incision that is deliberately opened by a surgeon, attending physician** or other designee and is culture positive or not cultured AND patient has at least ***one*** of the following signs or symptoms: pain or tenderness; localized swelling; erythema; or heat. A culture negative finding does not meet this criterion. d. diagnosis of a superficial incisional SSI by the surgeon or attending physician** or other designee. *****http://www.cdc.gov/nhsn/XLS/ICD-9-cmCODEScurrent.xlsx ** The term attending physician for the purposes of application of the NHSN SSI criteria may be interpreted to mean the surgeon(s), infectious disease, other physician on the case, emergency physician or physician's designee (nurse practitioner or physician's assistant).
Comments	There are two specific types of superficial incisional SSIs: 1. Superficial Incisional Primary (SIP) – a superficial incisional SSI that is identified in the primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB) 2. Superficial Incisional Secondary (SIS) – a superficial incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site incision for CBGB)
Reporting Instructions for Superficial SSI	**The following do not qualify as criteria for meeting the NHSN definition of superficial SSI:** □ Diagnosis/treatment of cellulitis (redness/warmth/swelling), by itself, does not meet criterion d for superficial incisional SSI. An incision that is draining or culture (+) is not considered a cellulitis. □ A stitch abscess alone (minimal inflammation and discharge confined to the points of suture penetration) □ A localized stab wound or pin site infection. While it would be considered either a skin (SKIN) or soft tissue (ST) infection, depending on its depth, it is not reportable under this module.

	Note: a laparoscopic trocar site for an NHSN operative procedure is not considered a stab wound. Circumcision is not an NHSN operative procedure. An infected circumcision site in newborns is classified as CIRC and is not reportable under this module. An infected burn wound is classified as BURN and is not reportable under this module. **Deep incisional SSI** Must meet the following criteria:
	Infection occurs within 30 or 90 days after the NHSN operative procedure (where day 1 = the procedure date) according to the list in Table 3 **AND** involves deep soft tissues of the incision (e.g., fascial and muscle layers) **AND** patient has at least ***one*** of the following: a. purulent drainage from the deep incision. b. a deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon, attending physician** or other designee and is culture positive or not cultured AND patient has at least ***one*** of the following signs or symptoms: fever (>38°C); localized pain or tenderness. A culture negative finding does not meet this criterion. c. an abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathologic exam, or imaging test. ** The term attending physician for the purposes of application of the NHSN SSI criteria may be interpreted to mean the surgeon(s), infectious disease, other physician on the case, emergency physician or physician's designee (nurse practitioner or physician's assistant).
Comments	There are two specific types of deep incisional SSIs: 1. Deep Incisional Primary (DIP) – a deep incisional SSI that is identified in a primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB) 2. Deep Incisional Secondary (DIS) – a deep incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site incision for CBGB)
	Organ/Space SSI Must meet the following criteria:
	Infection occurs within 30 or 90 days after the NHSN operative procedure (where day 1 = the procedure date) according to the list in Table 3 **AND** infection involves any part of the body deeper than the fascial/muscle layers, that is opened or manipulated during the operative procedure **AND** patient has at least ***one*** of the following:

	a. purulent drainage from a drain that is placed into the organ/space (e.g., closed suction drainage system, open drain, T-tube drain, CT guided drainage) b. organisms isolated from an aseptically-obtained culture of fluid or tissue in the organ/space c. an abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathologic exam, or imaging test **AND** meets at least ***one*** criterion for a specific organ/space infection site listed in Table 4. These criteria are in the Surveillance Definitions for Specific Types of Infections chapter.

Appendix VI. Ventilator-Associated Events (VAE) Surveillance Algorithm



On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met (**taking into account organism exclusions specified in the protocol**):

1) Criterion 1: Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds as outlined in protocol, without requirement for purulent respiratory secretions:

• Endotracheal aspirate, ≥ 105 CFU/ml or corresponding semi-quantitative result
• Bronchoalveolar lavage, ≥ 104 CFU/ml or corresponding semi-quantitative result
• Lung tissue, ≥ 104 CFU/g or corresponding semi-quantitative result
• Protected specimen brush, ≥ 103 CFU/ml or corresponding semi-quantitative result

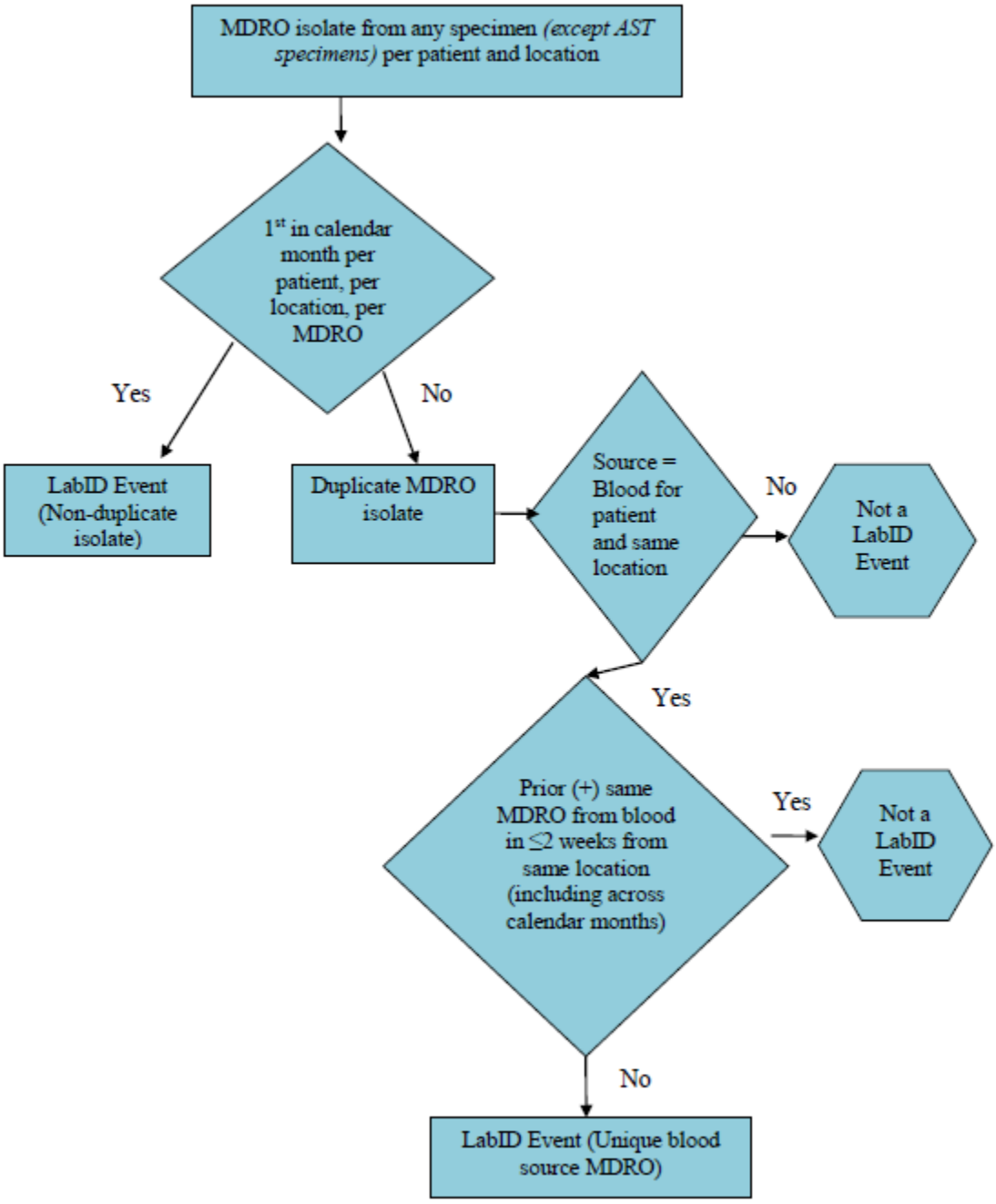
2) Criterion 2: Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain >25 neutrophils and <10 squamous epithelial cells per low power field [lpf, x100])† plus a positive culture of one of the following specimens (qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1): • Sputum
• Endotracheal aspirate
• Bronchoalveolar lavage
• Lung tissue
• Protected specimen brush

† If the laboratory reports semi-quantitative results, those results must correspond to the above quantitative thresholds. See additional instructions for using the purulent respiratory secretions criterion in the VAE Protocol.

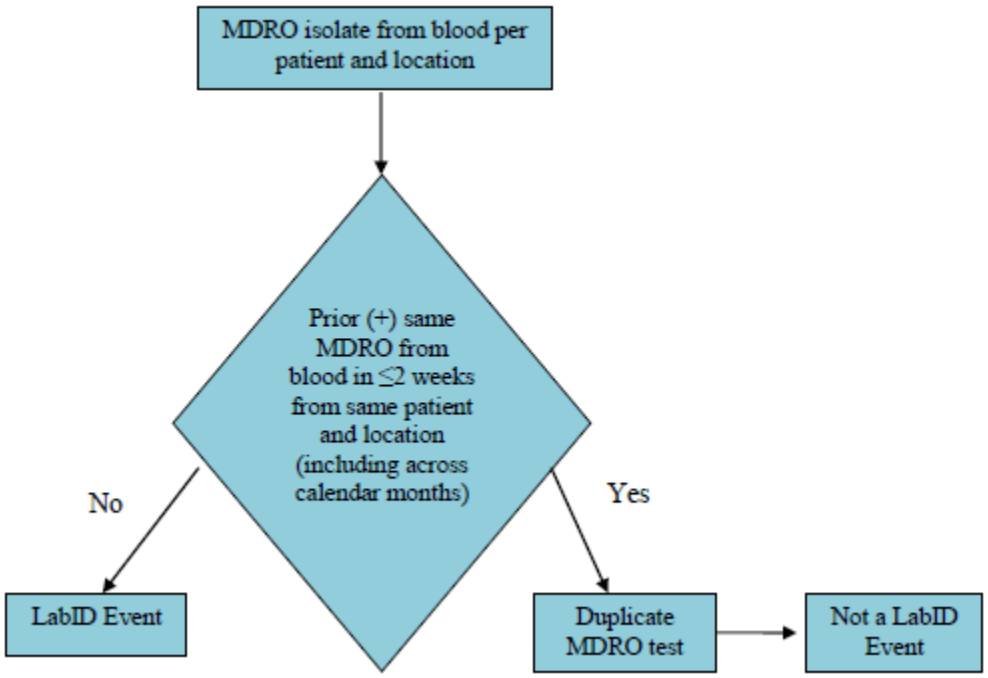
3) Criterion 3: One of the following positive tests: • Pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
• Lung histopathology, defined as: 1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli; 2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms); 3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
• Diagnostic test for *Legionella* species
• Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

Possible Ventilator-Associated Pneumonia (PVAP)

Appendix VII. MDRO Test Result Algorithm for All Specimens Laboratory-Identified (LabID) Events



Appendix VIII. MDRO Test Result Algorithm for Blood Specimens Only Laboratory-Identified (LabID) Events



Appendix IX. *C. difficile* Test Result Algorithm for Laboratory Identified (LabID) Events