The purposes served by HAI data and analyses vary by the perspective of the audience, and perhaps the most notable and important differences are between the lay public (healthcare consumers) and other audiences comprised of individuals who may be more familiar with HAI and their epidemiology (including clinicians, quality improvement professionals, and public health professionals). The workgroup recommends creating separate HAI public reports for these two audiences.

Differences in purposes and between key user groups of HAI reports underscore the importance of including a methods section in any public report of HAI data that is clearly stated and targets the intended audience. The consumer-friendly report may include a subset of key methodological points, while the more technically-oriented report may contain a detailed explanation of the techniques used to calculate the HAI summary statistics presented, along with an explanation of their underlying data elements.

In this section of the toolkit, a series of best practices that can be used when analyzing and publishing HAI data is presented. State legislative mandates and other internal reporting requirements may necessitate variation from these best practices in some cases.

I. **Metrics**

Public reports of HAI outcome data generally use one of two metrics – infection rates or standardized infection ratios (SIRs) that compare the number of reported infections to a predicted number of infections calculated from a given baseline period and reference population. Both metrics are useful in measuring and communicating HAI incidence.

Infection rates can provide valuable information about the HAI experience in different patient care areas of a hospital. An assessment of the need for risk adjustment should
precede publication of aggregated infection rates and should take into account known differences in risks of infection because of various patient- and hospital-specific factors. For example, some types of patient care areas within a hospital experience higher rates of device-associated infections than others (Dudeck, Weiner, Allen-Bridson et al., 2013), each patient undergoing a surgical procedure has different patient- and procedure-level infection risk factors (Mu, Edwards, Horan, Berrios-Torres, Friedkin, 2011) and facilities may experience a higher incidence of methicillin-resistant *Staphylococcus aureus* or *Clostridium difficile* infections due to the prevalence of these infection types in the community, and other facility-level factors (Dudeck, Weiner, Malpiedi et al., 2013). A single facility-wide rate may not take these various risk factors into consideration.

The SIR is a risk-adjusted metric that uses location-specific rates or individual patient, facility, and surgical factors to control for differences in infection risk. SIRs can be calculated at the individual location or procedure level as well as the aggregate facility-wide or statewide level.

Healthcare worker influenza vaccination data should be presented as a vaccination percentage. Please refer to Appendix 1 for detailed recommendations about the calculations and display of these data.

**II. Basic Elements to Include in the Methods Section of an HAI Report**

**IIA: All Audiences**

Regardless of the report’s audience and metric(s) included, any public report of HAI data should include the following key elements in a methodology section:

- **Data source** – describe the system used to obtain the HAI data (e.g., CDC’s NHSN, state reporting system, claims data)
- **Type of HAI** – summarize and define the infections that are reported, and consider providing separate tables or graphs for each infection type unless a composite metric is used. If a composite metric is used, describe the component measures and how they contribute to the composite score. When discussing the type of infection, include information about any surveillance definition changes or considerations that apply to the reporting time period’s data.
- **Place** – clearly describe the jurisdiction that the report covers – the nation, a region, a whole state, part of a state, or a select group of hospitals or other healthcare facility types within a state or across different states. If infections are reported from distinct location types within a hospital, this should be noted as well.
- **Time** – indicate the time period during which the events occurred. Be sure to note the difference between when the events occurred and when the report is published so report users are aware of how “real-time” the data are (e.g., data from HAI events occurring in 2013; published in 2015).
• **Freeze date** - the date on which the HAI data were pulled from the surveillance system and frozen for analysis should be included in the public report.

• **Facility types** – different facility types care for different types of patients and therefore may have different infection experiences. Be sure to indicate which healthcare facility types are included in the report and consider placing HAI data from different types of facilities [e.g., long-term acute care hospitals (LTACHs) or inpatient rehabilitation facilities (IRFs)] in separate tables or graphs.

• **Validation** – a robust data validation program may result in the identification of additional infections or corrections being made to denominator data. Details should be provided on any validation activities performed, including data quality assessment of oddities or outliers and/or medical record review to audit case ascertainment. References to any published validation protocols used should be provided. If no validation has been done on the data used to create the report, it is important to mention that as well.

• **Description of metrics included (e.g., rate, SIR)** – define the infection metrics used in the report.

  ❖ **Sample introductory language defining the SIR** (if used in the report):
    The SIR is a summary measure that can be used to track HAIIs over time and can be calculated on a variety of levels, including unit, facility, state, and nation. It adjusts for differences between healthcare facilities such as types of patients and procedures, as well as other factors such as the facility’s size and whether it is affiliated with a medical school (please refer to section/page number {include link to other material in the report} for more information about risk adjustment). It compares the number of infections reported in a given time period to the number of infections that were predicted using data from a baseline time period, which varies for different infection types. Lower SIRs indicate better performance.

    \[
    SIR = \frac{\text{Number of observed infections}}{\text{Number of predicted infections}}
    \]

  ❖ **Sample language defining an infection rate**: An infection rate provides information about the number of infections that occurred in a particular population at risk for an infection. For example, a central line-associated bloodstream infection (CLABSI) rate calculates the number of CLABSIs that occur for every 1,000 days that patients have at least one central line in place. Lower rates indicate better performance.
\[
\text{CLABSI rate} = \frac{\text{Number of CLABSIs}}{\text{Number of central line days}} \times 1000
\]

- **Comparison group** – a comparison group should be cited if reporting infection rates and performing comparisons to national or state data. For SIRs, cite the baseline time period and describe the reference population used for each type of infection.

  > Sample language to describe the national baseline and how the predicted number of infections is calculated:
  > The national experience (or “national baseline”) is aggregated (summary) data reported to NHSN by all facilities during a baseline period. These data are used to “predict” the number of infections expected to occur in a hospital or state. Infection types presented have different baseline years for comparison. In this report, the number of predicted infections is an estimate based on infections reported to NHSN during the following time periods:
  > - 2006 to 2008: Central line-associated bloodstream infection (CLABSI) and surgical site infection (SSI) for acute care hospitals (ACHs)
  > - 2009: Catheter-associated urinary tract infections (CAUTI) (ACHs)
  > - 2010 to 2011: Methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia and *C. difficile* laboratory-identified events (ACHs)
  > - 2013: CLABSI [long-term acute care hospitals (LTACHs)] and CAUTI [LTACHs and inpatient rehabilitation facilities (IRFs)]

Once CDC updates the national baselines, [state] will be able to publish SIRs and compare infections to a more recent time period.

**IIB: Additional Material for the Technical Report**

The methods section in the technical report should include additional information about the methodology used to produce the HAI summary data and any statistical conclusions, including:

- **Risk adjustment** – if reporting infection rates, indicate the rationale for the level of stratification used (e.g., to align with NHSN published rates or to account for differences in infection risk among patient care area types or patients undergoing surgical procedures). If reporting SIRs, describe the risk adjustment methodology (e.g., risk adjustment using a reference population’s infection experience or applying a series of risk models to a reference population). NHSN produces SSI SIRs using several different risk models, with each one including a different subset of infections and surgical procedures. The risk model used (and
any modifications done to the risk model outside of NHSN) should be explicitly stated.

- **Sample language defining the factors used in the SIR risk adjustment produced by CDC (modify as needed to specify the risk adjustment performed by the state and/or the SIR model used in the report):**
  The SIRs are risk adjusted by taking into account risk factors, such as type of patient care location, bed size of the hospital, patient age, and other factors, that vary among hospitals and that may underlie differences in the number of reported infections. The SIR is adjusted differently depending on the type of infection measured.

The SIRs for CLABSIs and CAUTIs are adjusted for:
- Type of patient care location
- Hospital affiliation with a medical school (for some units)
- Bed size of the patient care location (for some units)

The SIRs for hospital-onset *C. difficile* and MRSA bloodstream LabID events are adjusted using slightly different risk factors:
- Facility bed size
- Hospital affiliation with a medical school
- The number of patients admitted to the hospital who already have a *C. difficile* or an MRSA bloodstream LabID event (“community-onset” cases)
- For hospital-onset *C. difficile*, the SIR also adjusts for the type of test the hospital laboratory uses to identify *C. difficile* from patient specimens

The SSI SIRs are presented using CDC’s Complex Admission/Readmission (A/R) model, which takes into account patient differences and procedure-related risk factors within each type of surgery. These risk factors include:
- Duration of surgery
- Surgical wound class
- Use of endoscopes
- Re-operation status for orthopedic surgeries (e.g., knee replacement, hip replacement)
- Patient age
- Patient assessment at time of anesthesiology

- **Data exclusions** – include information about analytic decisions such as types of surgical site infections that are excluded or outlier data that are excluded.
- **Sample language defining the use of the Complex A/R model for SSI SIRs:**
  To capture those infections most likely to be reported consistently across facilities, only deep incisional and organ/space infections detected during the same admission as the surgical procedure or upon readmission to the
same hospital that performed the surgical procedure are included in the reported SIRs. Superficial incisional SSIs and those identified on post-discharge surveillance are excluded. More details on the Complex A/R model, as well as definitions for the different types of surgical site infections, can be found in the NHSN SSI Protocol: 

- **Statistical comparisons or tests** – information about statistical significance tests used to produce confidence intervals or p-values should be included only in a technical report. If confidence intervals are presented and there are facilities or units for which the lower bound of the confidence interval cannot be calculated, an explanation of the interpretation of the lower bound may be included in the data table. Note that the NHSN application uses a mid-P exact test when calculating p-values and 95% confidence intervals.

  ❖ **Sample language defining the p-value and 95% confidence interval:**
  (Note: The sample language below is designed for a technical audience only and can be incorporated into a technical HAI report. The workgroup does not recommend displaying statistical measures for a consumer audience. While the toolkit recommends displaying the 95% confidence intervals in the HAI data tables, sample language for the p-value is also provided below.)

  **HAIs:**
The p-value and 95% confidence intervals are statistical measures that describe the likelihood that a numerical estimate, i.e., what was observed, was due to random chance. These measures tell us whether or not a facility’s SIR is significantly different from 1 (the value we would expect if the facility performed exactly the same as what was predicted based on the national data). If the p-value is less than or equal to 0.05, we can conclude that the number of observed infections is *significantly different* than the number of predicted infections (i.e., the facility’s SIR is significantly different from 1). If the p-value is greater than 0.05, we can conclude that the number of observed infections in a facility is *not significantly different* than the number predicted (i.e., the facility’s SIR is no different than 1).

The 95% confidence interval is a range of values. We have a high degree of confidence (in this case, 95%) that the true SIR lies within this range. The upper and lower limits are used to determine the significance and precision of the SIR. If the confidence interval includes the value of 1, then the SIR is *not significant* (i.e., the number of observed events is not significantly different than the number predicted). If the confidence interval does not include the value of 1, then the SIR is *significant* (i.e., the number of observed events is significantly different than the number predicted). When the SIR is 0, the lower bound of the 95% confidence
interval cannot be calculated. However, for ease of interpretation, it can be considered 0.

**Influenza Vaccination:**
The p-value is used to compare the observed vaccination percentage to the chosen benchmark. If the p-value is less than or equal to 0.05, we can conclude that the facility’s vaccination percentage is *significantly different* than the benchmark. If the p-value is greater than 0.05, we can conclude that the facility’s vaccination percentage is *not statistically different* than the benchmark.

### III. Best Practices for Analysis of HAI Data

When analyzing data to be used in an HAI public report, consider the best practices that are outlined below. State-specific reporting requirements (legislative or otherwise codified) may constrain use of a specific practice.

**Basic analytic considerations for infection rates:**
- If data from NHSN are used, analyses limited to data that facilities have included in their monthly reporting plans are preferable to analyses that do not take reporting plans into account. Data that are included in a facility’s monthly plan must be collected and entered into NHSN according to standardized CDC protocols. Data that are not in a facility’s monthly plan may not have been collected according to NHSN requirements and may not contain all data elements. Some states require the use of “off-plan” reporting for some infections.
- If reporting requirements allow, ensure that a facility has enough exposure volume to create a minimally precise infection rate. Many states have set minimum thresholds for including a facility’s infection rate in their public report. As a recommendation, device-associated infection rates should only be calculated for locations with at least 50 device days, and SSI rates should only be calculated for facilities that perform at least 20 surgical procedures. States may wish to use higher denominator thresholds when calculating rates.
- Serial comparisons of stratified rates can be performed to measure the facility’s experience from one reporting period to the next. SAS code to perform this comparison is available on the NHSN website at [http://www.cdc.gov/nhsn/PS-Analysis-resources/index.html](http://www.cdc.gov/nhsn/PS-Analysis-resources/index.html)

**Device-Associated Infections**
- If the public report will compare facility device-associated infection rates to national rates, the best practice is to align the format and stratification of patient care areas that are published in a state’s report with those used in nationally published data. CDC produces national device-associated infection rates for all patient care area types reporting sufficient data to NHSN each year. Due to differences in risk, it is recommended that rates be presented by unit type and not aggregated to higher levels, such as the healthcare facility as a whole or the
entire state. However, the workgroup acknowledges that some states are required by legislation or regulation to publish crude rates.

- When comparing facility performance to the national experience using infection rates, prioritize the location types with the greatest exposure volume. Medical, surgical, and combined medical/surgical intensive care units tend to have more data reported than respiratory intensive care units, for example. Some states are required to compare all patient care areas, regardless of patient volume within the state or in the national data. If a national comparison rate is not available for a given patient care area, those rates may be withheld from public reporting, published with no comparison, or published with a comparison to a state-level rate.

**Procedure-Associated Infections**

- If possible, procedure-associated infection rates should be presented separately for each procedure type included in the report. Due to advances in risk adjustment of inpatient surgical site infection data, crude inpatient SSI rates or rates adjusted using the legacy National Nosocomial Infection Surveillance System (NNIS) three-level basic risk index should be avoided or explicitly labeled as “non-risk adjusted” or “calculated with limited risk adjustment.” Current NHSN inpatient SSI data should be presented as SIRs using the existing risk models that adjust for more than the three core NNIS risk factors. Some states are required to publish crude rates.

- Operational and methodological constraints limit the use of the SIR for outpatient procedures, including outpatient procedures reported from ambulatory surgery centers (ASCs). Many of the SSI risk models require facility-level factors that are not relevant to or collected by ASCs. This includes medical school affiliation and facility bed size. In addition, the ASA score – a risk factor included in the majority of SSI risk models – is not a required data element when reporting outpatient procedures to NHSN. Given these limitations, states may not be able to present SIRs for ASCs depending on the procedure categories reported. States encountering these limitations may wish to consider the use of SSI rates for outpatient procedures.

**MRSA Bacteremia and *C. difficile* LabID Events**

- CDC does not publish national infection rates for MRSA or *C. difficile* LabID events, as the SIR offers an enhanced risk adjustment for acute care hospital data. MRSA and *C. difficile* LabID event data for acute care hospitals should ideally be presented as SIRs.
  - Until national baseline data are available, MRSA and *C. difficile* LabID event data from long-term acute care hospitals (LTACHs) and inpatient rehabilitation facilities (IRFs) are recommended to be presented as rates.

**Basic analytic considerations for SIRs:**

- If data from NHSN are used, analyses should only include data that facilities have included in their monthly reporting plans. Data that are included in a facility’s monthly plan must be collected and entered into NHSN according to standardized CDC protocols. Data that are not in a facility’s monthly plan may
not have been collected according to NHSN requirements and may not contain all data elements. Some states require the use of “off-plan” reporting for some infections.

- If state requirements allow, only produce an SIR for facilities that use enough invasive devices, have enough patient days, or perform enough surgical procedures to do so. In an effort to set a minimum level of precision, the NHSN reporting application’s analysis tool will only produce an SIR when there is at least one predicted infection. Calculating an SIR for a facility with less than one predicted infection can result in a very large SIR value if the facility reported even one infection, which may be misleading. Some states are required to produce SIRs for all facilities, regardless of exposure volume.

- For facilities that report no infections for a time period, an upper limit of the SIR’s 95% confidence interval should be calculated, but a lower limit should not. When interpreting this 95% confidence interval, the lower bound can be assumed to be zero.

- A report that presents hospital-level HAI metrics may carry with it the implication that all facilities contributed the same number of months of data included in the report, and should be qualified by an explanatory footnote if data contributions differ among hospitals. If some facilities reported fewer months than the maximum included in the report, or if some months or quarters are excluded from the SIR calculation (e.g., quarters with an outlier C. difficile or MRSA community-onset prevalence rate are excluded from the SIR), a footnote should be provided for those facilities to indicate that less than the maximum number of months are included in the calculation.

- As the time since the baseline period has increased over the past several years, consideration should be given to comparing a facility’s serial SIRs from one reporting period to the next (e.g., 2013 CLABSI SIR vs. 2014 CLABSI SIR). This will provide a more real-time measure of facility performance compared to changes from the baseline period. SAS code to perform this comparison is available on the NHSN website at [http://www.cdc.gov/nhsn/PS-Analysis-resources/index.html](http://www.cdc.gov/nhsn/PS-Analysis-resources/index.html). These comparisons may be better suited for a technical report audience for the reasons described in the “Other Considerations” chapter.

- After the updated SIR baselines are established using 2015 data, discussions will occur between CDC and state health departments in order to provide recommendations on how best to analyze and interpret the new SIRs.

### IV. Interpreting the SIR

**Summary information about the SIR and its interpretation:**

An advantage of the SIR is its ability to summarize a large amount of HAI data from a single facility, a state, or some other group of facilities into a single summary statistic. However, it can be difficult to communicate the meaning of the SIR, even as a single statistic that compares “observed” and “predicted” (or “expected”) numbers of infections.
Describing the numerator of the SIR is straightforward – it is the number of infections that were identified and reported during the surveillance period. The denominator is more challenging to describe to a lay audience, which may include individuals who are unfamiliar with comparisons to a baseline period. By comparison, clinical audiences are likely to be more familiar with observed to expected ratios, which are commonly used in quality improvement efforts. However, an important communication consideration for HAI reporting is the use of the word “expected” in the denominator. No one “expects” to be infected when entering the healthcare system; the expectation is to be protected from HAIs. When describing the denominator of the SIR, the term “predicted infections” should be used instead of “expected infections.” That denominator can be described more fully as the number of infections that would be predicted during the surveillance period if the underlying HAI experience of the reference population has not changed from the baseline period.

When the SIR is calculated, there are three possible results:

- The SIR is less than 1.0 – this indicates that there were fewer infections reported during the surveillance period than would have been predicted given the baseline data.
- The SIR is equal to 1.0 – as in any ratio, the nominal value of 1 indicates that the numerator and denominator are equal. In this case, the number of infections reported during the surveillance period is the same as the number of infections predicted given the baseline data.
- The SIR is greater than 1.0 – this indicates that there were more infections reported during the surveillance period than would have been predicted given the baseline data.

Example of how to calculate a CLABSI SIR from a facility with multiple critical care locations:

\[
P_{\text{Pred}} = \frac{\text{NHSN CLABSI pooled mean} \times \text{central line days}}{1000}
\]

<table>
<thead>
<tr>
<th>Location type</th>
<th>CLABSI (#)</th>
<th>Central line days (#)</th>
<th>NHSN CLABSI pooled mean for this location</th>
<th>Predicted CLABSI (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical cardiac</td>
<td>2</td>
<td>380</td>
<td>2.0</td>
<td>0.76</td>
</tr>
<tr>
<td>Medical</td>
<td>1</td>
<td>257</td>
<td>2.6</td>
<td>0.67</td>
</tr>
<tr>
<td>Med/Surg</td>
<td>3</td>
<td>627</td>
<td>1.5</td>
<td>0.94</td>
</tr>
<tr>
<td>Neurosurg</td>
<td>2</td>
<td>712</td>
<td>2.5</td>
<td>1.78</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>...</td>
<td></td>
<td>4.15</td>
</tr>
</tbody>
</table>

Overall CLABSI SIR = \( \frac{\text{observed}}{\text{predicted}} \) = \( \frac{8}{4.15} \) = 1.93
Interpretation: During this time period, facility X reported 93% more CLABSIs than were predicted.

Reporting the results of SIR statistical significance testing, when the SIR is used to summarize the facility’s performance, poses a communications challenge. The workgroup recommends the following interpretation language to be used in a technical report data table geared towards clinicians and others more experienced in the HAI reporting arena:

- Significantly fewer infections (better) observed than predicted, based on the national baseline
- No significant difference (same) between the number of observed and predicted infections, based on the national baseline
- Significantly more infections (worse) observed than predicted, based on the national baseline

A plain language approach is a suitable strategy for explaining SIR results to a consumer audience. The workgroup recommends the following interpretation be used in a data table for a consumer audience:

- Fewer infections (better) than predicted based on the national experience
- About the same number of infections as predicted based on the national experience
- More infections (worse) than predicted based on the national experience

V. Other Metrics and Considerations

The “Other Considerations” chapter includes recommendations on several topics that may be of interest to an agency preparing an HAI report:

- How to incorporate the Targeted Assessment for Prevention (TAP) strategy into an HAI report
- Considerations for comparing a facility’s HAI performance to the overall state or national experience
- Comparing the state SIR to the national SIR
- Presenting trend data
- Rationales for the recommended colors and symbols
- And more!

Please see “Other Considerations” for more information.
VI. Considerations for Small Hospitals

The suggestions below assume that data are presented as a single SIR per HAI and hospital location-type. If your state reports individual unit-specific data, the guidance below may not apply. The workgroup recommends considering alternative analysis/display techniques only when the SIR cannot be calculated for a facility at all levels of stratification included in the data table (i.e., for all location types shown in the CLABSI and CAUTI table).

When hospitals do not have a large enough denominator to have even one predicted infection, the workgroup recommends not calculating the SIR for that facility to ensure precision and interpretability of the metric. However, hospitals in this situation are left without a performance metric for that infection type. As a result, hospitals with no infections may not get credit for that accomplishment and hospitals that are doing worse than predicted may not be identified. Small units within hospitals can also fall into this category. Hospitals may view not having a performance metric as unfair since data are reported and having a “no conclusion” performance does not explain the context clearly. The following suggestions have been made on how to handle these situations:

Highlight Hospitals with Zero Infections:
- Provide number of months since last infection for those hospitals with zero infections. Points to be considered if using this metric:
  - How often would this metric be updated?
  - How could the state track this metric to ensure it is accurate?
  - This measure shows only a point in time and is not updated in real time. Conveying that message to the public may be difficult. For example, a hospital could be showing 6 months since the last infection (at the time of report publication) when in reality they have had an infection in the past month.
- Provide an additional symbol for hospitals with zero infections, regardless of SIR calculation, to highlight this achievement. Some states have done this and received positive feedback from facilities. A point to consider is that this may favor smaller hospitals as well as hospitals with lower risk patients, as it may be increasingly difficult for larger hospitals that perform more procedures or have patients with more invasive devices to have zero infections.

Provide a Different Metric for Small Hospitals:
- Aggregate data over a longer period of time to calculate a SIR. Points to consider if using this metric would be:
  - The data will not be comparable to other hospitals since the time period is not the same.
  - Would the data be meaningful since it covers a longer period of time?
  - How should a consumer interpret the data?
- Use an extended explanation for the SIR interpretation when an SIR is not calculated. For example, Hawaii’s HAI Program uses the following explanation: “ICU patients had too few central line days (procedures, etc.) to
calculate a reliable SIR. When an SIR cannot be calculated, a comparison to national data is not possible”.

- On the consumer report, show an infection rate instead of the SIR. Of note, rates do not offer the same level of risk adjustment as the SIR. If used, rates should be stratified. Further details and recommendations concerning the use of rates are outlined in earlier parts of this document.

At this time, the workgroup does not recommend one approach over another to address the issue of small hospitals reporting a low volume of data. The workgroup recognizes the need to continue to learn from states as different methods are implemented or changed over time. The toolkit is anticipated to evolve with future iterations.

VII. Next Steps: Using these Recommendations

The “Consumer Report Template” and “Technical Report Template” sections of the toolkit that follow provide examples of how these best practices can be used to display facility-level HAI data. These templates also include information on how to describe data limitations and intended uses, as well as the SIR’s interpretation, to the report’s intended audience. Sample data tables for HAIs and influenza vaccination are provided in the “Data Tables” section of the toolkit.

In addition to a methods section, public reports of HAI data should also include a description of any limitations of the data or data analysis. An example of how a limitations section might be formatted is included in the Consumer Report and Technical Report Templates.
Appendix 1: Healthcare Worker Influenza Vaccination Summary Data

Introduction

The Advisory Committee on Immunization Practices (ACIP) recommends that all healthcare workers and persons in training for healthcare professions should be vaccinated annually against influenza (CDC, 2009). Persons who are infected with influenza virus can transmit the virus to others, particularly those who are at a high risk for complications from influenza (e.g., elderly, immunocompromised, etc.). Vaccination of healthcare workers has been associated with reduced work absenteeism and with fewer deaths among nursing home patients and elderly hospitalized patients. The Healthy People 2020 goal for healthcare worker influenza vaccination in the United States is 90% (Healthy People 2020 Topics and Objectives: Immunization and Infectious Diseases) (i.e., 90% of healthcare workers in every facility receive the influenza vaccine).

The workgroup recommends that state health departments include healthcare worker (also known as healthcare personnel) influenza vaccination summary data in state HAI reports if these data are available. Data from the most recent influenza season should be displayed, after the influenza season has ended and all summary data for that season have been entered (i.e., after May 15th).

As with HAI outcome measures, showing facility-specific healthcare worker influenza vaccination percentages may influence performance and encourage facilities with lower vaccination percentages to improve their vaccination efforts.

Part 1: Calculation

Healthcare worker influenza vaccination data are presented as a percentage of healthcare workers vaccinated. The percentage of healthcare workers vaccinated is calculated as:

\[
\text{Percentage of healthcare workers vaccinated} = \frac{\text{Total number of healthcare workers vaccinated}}{\text{Total number of healthcare workers in the facility}} \times 100\% 
\]

**Denominator:** Healthcare workers who were physically present in the healthcare facility for at least 1 working day between October 1 and March 31 (i.e., the measure reporting period) of the following year. This includes all facility employees, licensed independent practitioners, adult students/trainees, and volunteers regardless of full-time/part-time status or patient contact.
(Optional denominator category, as of 2015 NHSN protocol): Other contract personnel who provide care, treatment, or services at the facility through a contract but do not fall into any of the other worker categories may also be reported.

Numerator: Number of healthcare workers from the denominator population who received the influenza vaccine during the time from when the vaccine became available (e.g., August or September) through March 31 of the following year.

This calculation is performed within NHSN for each of the three (or four, if other contract personnel data are reported) employment groups; however, the workgroup’s recommendation is to present an overall vaccination percentage by healthcare facility (e.g., total vaccination percentage inclusive of all employment categories) in both the consumer and technical HAI report. Refer to part 2 of this document for more details on the display recommendations.

1a: Recommended Comparison Group
The Department of Health and Human Services (HHS) Healthy People 2020 goal for healthcare worker influenza vaccination percentage is 90% for the entire facility. The workgroup recommends using this metric as the standard against which facilities’ vaccination percentages should be compared. Benefits to this approach are that the benchmark stays standard from year to year and that a state’s facilities can show progress toward a goal that is shared among all states in the nation.

1b: Other Comparison Groups for Consideration
A state may choose to benchmark healthcare facilities’ healthcare worker influenza vaccination percentages against other comparison groups. Options include:

- Three categories around the state pooled mean for that year.
  - A benefit to this approach is that the facilities are compared to other facilities within the state. This comparison can also potentially show more variation among facilities if the majority or minority of facilities are close to meeting the Healthy People 2020 goal.
  - A drawback to this approach is that the state pooled mean varies from year to year and healthcare facilities with vaccination rates above 90% may fall into the “significantly lower” category if the state pooled mean is significantly higher than 90%.
  - The calculation of the state benchmark has been performed in various ways. Hospital Compare and other national publications calculate a pooled mean by summing the numerator counts across all facilities and dividing this by the sum of denominator counts from all facilities in the state (and multiply the result by 100). While this method may result in some double-counting of healthcare workers, the effect of this on the overall state percentage is assumed to be minimal. Other states have
calculated a raw mean (state average) by summing all facilities’ vaccination percentages and dividing by the total number of facilities. If the state pooled mean or state average is used, it is recommended that the methods used to calculate the state benchmark and limitations are clearly explained in the report and a footnote is added to the data tables.

- Three categories around the national pooled mean for that year.
  - One drawback to this approach is that the national pooled mean is published on Hospital Compare and may not be available in a timeline that corresponds with the state’s desired deadline for publishing the HAI report. Like the state pooled mean, the national pooled mean also varies from year to year.

1c. Statistical Comparisons
The workgroup recommends using a statistical test to assess whether the facility’s vaccination percentage is significantly different from the benchmark. Recommended methods are below:

Use the macro posted on the NHSN website titled “SAS Macro for a Single Proportion” to perform a mid-P Exact test comparing each facility’s influenza vaccination percentage to the chosen benchmark. Use the p-value to determine whether the facility’s percentage is significantly higher, lower, or not significantly different from the benchmark. The macro is available at http://www.cdc.gov/nhsn/PS-Analysis-Resources/index.html

- Better or Worse: If the p-value is less than or equal to 0.05, the facility’s vaccination percentage is significantly different than the benchmark. Review both values to determine direction of the comparison.
- Same: If the p-value is greater than 0.05, the facility’s vaccination percentage is not significantly different than the benchmark.

Part 2: Display
An overall vaccination percentage by healthcare facility (e.g., total vaccination percentage inclusive of all employment categories) should be presented in both the consumer and technical HAI report. If states are interested in stratifying influenza vaccination percentages by employment category, the workgroup suggests that this is only done in the technical report. Some states may also want to present data by medical contraindication, declination, and unknown vaccination status in the technical report. The workgroup recommends that facility-specific percentages are shown without displaying actual numerator and denominator data. Raw numbers can be misleading and could potentially lead the audience to perform an incorrect calculation of the state’s total number of vaccinated personnel or overall vaccination percentage. However, if raw numbers are presented, the workgroup recommends aggregating data by facility, (i.e., not stratifying by employment status) and including a footnote beneath the data table to
caution the audience against calculating the state’s total number of vaccinated personnel.

**Example footnote language:** Caution should be used when interpreting the overall number of healthcare workers vaccinated in the state. In some instances, a single healthcare worker may be counted in multiple hospitals, and therefore the total number of vaccinated personnel in the state as shown in this table may be inflated.

The workgroup recommends that facility-specific influenza vaccination percentages be categorized into four performance categories, each with a corresponding symbol, based on the results of statistical testing (i.e., see details above). The below language assumes the Healthy People 2020 Goal is used as the benchmark:

A) Vaccination is higher (**better**) than the Healthy People 2020 Goal: ★ better
B) Vaccination is **similar** to the Healthy People 2020 Goal: = same
C) Vaccination is lower (**worse**) than the Healthy People 2020 Goal: × worse
D) Data were not reported from this facility: not reported (no affiliated symbol)

The actual facility-specific influenza vaccination percentage, along with the corresponding symbol, should be displayed in a data table specific to influenza vaccination. In addition, the workgroup recommends displaying the results of statistical testing (e.g., p-value) to a technical audience only (please review the example Healthcare Worker Influenza Vaccination Summary Table in the “Data Tables” chapter of the toolkit).

Some states may want to show an additional comparison in the data table; a comparison between the facility’s vaccination percentage and the state pooled mean. This would allow multiple points of comparison (HP 2020 goal and the state benchmark) around each facility’s vaccination performance. However, adding this column complicates the data table, as an additional p-value column would also be warranted. If the state chooses this approach, the workgroup recommends including those extra columns only in the technical report.

If the HAI report will include other process measures such as central line insertion practices or compliance with infection prevention bundles or checklists, the state may consider including the corresponding healthcare worker influenza vaccination symbol for each facility (★ better /= same /× worse /not reported) in a summary table dedicated to HAI process measures. Please see the “Data Tables” toolkit section for a sample Summary Data Table for Hospital Process Measures.
Vaccination Survey

Some states have asked healthcare facilities if mandatory policies are in place through the use of a survey tool or as an add-on question to an existing hospital survey. Examples of surveys recently used by state health departments for this purpose are provided on the next few pages. Feel free to adopt some or all of the questions presented. If states are able to obtain information related to the below survey questions, we suggest including aggregated results of the survey responses in the HAI report, as it can influence other healthcare facilities to enact such policies.

As part of the Healthcare Personnel Safety Component of NHSN, CDC provides hospitals with an optional survey for seasonal influenza vaccination. This survey can be found here: http://www.cdc.gov/nhsn/forms/57-215-Seasonal-Survey-form.pdf
Hospital Survey on HCW Vaccination Policy: Example A

1. Does your facility have a seasonal influenza vaccination policy? Such a policy means that the facility requires all or some portion of HCW working at that facility to receive a seasonal influenza vaccine.
   a. Yes, there is a policy currently in place
   b. No, but we are considering a policy
   c. No, and we are not considering a policy
   d. Other (please specify): _______________________________________

2. If your facility has a seasonal influenza vaccination policy, what reasons for exemption are acceptable? Check all that apply.
   a. Medical
   b. Religious
   c. Personal/philosophical
   d. Any reason
   e. Other (please specify): _______________________________________

3. If your facility has a seasonal influenza vaccination policy, what do you require of unvaccinated HCW with an acceptable reason for exemption? Check all that apply.
   a. Wear a mask
   b. Receive verbal and/or written education
   c. Other (please specify): _______________________________________

4. If your facility has a seasonal influenza vaccination policy, what are the potential consequences for unvaccinated HCW without an acceptable reason for exemption? Check all that apply.
   a. Wear a mask
   b. Progressive discipline, potentially including termination
   c. Other (please specify): _______________________________________

5. Does your facility offer the high-dose influenza vaccine? (Y/N)
Hospital Survey on HCW Vaccination Policy: Example B

1. Does your hospital have a mandatory influenza vaccination policy in place for healthcare workers? (Y/N)

2. What strategies does your hospital employ to facilitate employee access to influenza vaccination? (Check all that apply)
   a. Provide vaccinations on-site in wards, clinics, or other common areas
   b. Provide vaccinations on-site through use of mobile vaccination carts
   c. Provide vaccination services during all work shifts
   d. Provide off-hours vaccination clinic
   e. Provide vaccination at staff and departmental meetings
   f. Other (please specify): ________________________________

3. Does your hospital currently provide influenza vaccination free or reduced cost to the following people:

<table>
<thead>
<tr>
<th></th>
<th>Free</th>
<th>Reduced cost</th>
<th>Not provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time employees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time employees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unpaid workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Are employees required to provide proof of off-site vaccination AND/OR medical contraindication? (Check all that apply)

   Off-site vaccination
   a. Printed document from other site
   b. Documentation not required
   c. Other (please specify): ________________________________

   Medical Contraindication
   a. Physician documentation of contraindication
   b. Signed declination
   c. Documentation not required
   d. Other (please specify): ________________________________
5. Is documentation maintained by the hospital to confirm employee vaccination? (Check all that apply)
   a. Documentation is maintained on employees who are vaccinated on-site
   b. Documentation is maintained on employees who are vaccinated off-site
   c. Documentation is maintained on employees who declined vaccination
   d. No documentation
   e. Other (please specify): ________________________________

6. If your hospital has a mandatory influenza vaccination policy, how does your hospital enforce compliance for employees who decline the vaccination? (Check all that apply)
   a. Termination of employment (if employee declines for reasons other than medical contraindication)
   b. Required to wear a face mask
   c. Restricted to certain areas of the hospital
   d. Suspension of privileges
   e. Impose monetary penalty
   f. No mandatory policy
   g. Other (please specify): ________________________________

7. If your hospital has a mandatory policy, how many people were terminated, suspended, resigned, or had to stop working in your hospital as a result of refusing the flu vaccine?
   a) Employees: _______
   b) Employed physicians/providers: _______
   c) Non-employed physicians/providers: _______