

## **TECHNICAL NOTES: Surgical Site Infections in California Hospitals, 2015**

### **Introduction**

Surgical site infections (SSI) are healthcare-associated infections (HAI) that occur after surgery (usually within 30 days) in parts of the body where surgery took place. SSI described in this report include deep incisional SSI, which occur beneath the incision area in muscles and tissues surrounding the muscles, and organ or space SSI, which can be in any area of the body that were involved in the surgery (other than skin, muscles, and surrounding tissues), including body organs and spaces between organs.

California Health and Safety Code 1288.55 (a)(3), (b)(2), and (c)(1) requires general acute care hospitals to report SSI to the California Department of Public Health (CDPH). These *Technical Notes* explain the methods used to collect, analyze and produce the SSI data for surgeries that occurred from January 1, 2015, to December 31, 2015. California hospitals reported SSI data to the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN). CDPH accessed the NHSN data to produce this SSI report.

California hospitals have been reporting SSI data via NHSN since April 2011, as specified by two CDPH All Facilities Letters (AFL) [3 and 4]. CDPH published the 2015 SSI data for 29 mandated NHSN-defined surgical procedure categories. We used only the SSI data for procedures included in each hospital's NHSN monthly reporting plan [5].

SSI frequency varies depending on modifiable risk factors, such as surgical technique and infection prevention measures, and non-modifiable risk factors, such as underlying patient illness, whether the surgery was an emergency, and whether the surgical site was contaminated prior to surgery. The distribution of non-modifiable risk factors among patients, or patient case mix, can vary widely among different hospitals. Adjusting for differences in patient case mix is critical for reporting SSI rates that can be compared between hospitals. CDPH uses the NHSN risk-adjustment method called the standardized infection ratio (SIR) to report SSI. NHSN calculates the SSI SIR by comparing the number of SSI that hospitals reported with the number of SSI predicted based on the national baseline SSI data reported to NHSN from 2006 to 2008. NHSN produces two SIR for each surgical category, one that includes all SSI (including superficial incisional SSI) and one, called the Complex A/R SIR, that includes only deep incisional and organ/space SSI identified during the index hospital admission or on readmission to the same hospital that performed the inpatient surgery. For this report and interactive map, CDPH used only the Complex A/R SIR (hereafter referred to as the SSI SIR).

In March 2015, CDPH recommended that hospitals incorporate the use of administrative data to improve the identification of SSI. Specifically, hospitals should use ICD-10 diagnosis codes during the post-operative surveillance period to “flag” patient records that should be reviewed for possible SSI. CDPH published ICD-10 flag codes for each of the 29 reportable surgical

procedure types, and suggested that hospitals routinely use them to improve the efficiency and effectiveness of their SSI surveillance practices

(<http://www.cdph.ca.gov/programs/hai/Documents/UsingICD%20DiagnosisFlagCodesForSSISurveillance041515.pdf>).

NHSN is using HAI data reported by U.S. hospitals in 2015 to establish new risk adjustment models and new national baselines against which future HAI prevention progress will be measured. In next year's annual report, we will show how California hospitals compare with the new 2015 national baselines and demonstrate whether HAI prevention progress was made in 2016.

## **Methods**

### ***Reporting hospitals***

In 2015, CDPH received data from 393 licensed general acute care hospitals representing 416 physical campuses that operated for the full 12 months of the reporting period. Of these, 21 hospitals reported combined SSI data for multiple hospital campuses under a single hospital license, and 372 hospitals reported data separately for each campus (Table A).

Table A. Reporting by General Acute Care Hospitals, 2015

	<b>Reporting Entities</b>	<b>Number of Campuses</b>
Hospitals that reported separately for each campus	372	372
Hospitals that reported multiple campuses together	21	44
<b>Total</b>	<b>393</b>	<b>416</b>

Most long term acute care (LTAC) hospitals, rehabilitation hospitals, and specialty hospitals do not perform any surgeries or do not perform any of the surgeries in the 29 reportable procedure categories. SSI SIR risk adjustment is not available for LTAC and rehabilitation hospitals. We presented SSI data for three LTAC hospitals that performed surgeries in 2015 (SSI Table 30).

### ***Data sources***

California hospitals reported SSI data for 29 surgical procedure categories: abdominal aortic aneurysm repair, appendix surgery, bile duct, liver or pancreatic surgery, cardiac surgery, coronary artery bypass graft with both chest and donor site incisions, coronary artery bypass graft with chest incision only, gallbladder surgery, colon surgery, cesarean section, spinal fusion, open reduction of fracture, gastric surgery, hip prosthesis, heart transplant, abdominal hysterectomy, knee prosthesis, kidney transplant, laminectomy, liver transplant, kidney surgery, ovarian surgery, pacemaker surgery, rectal surgery, refusion of spine, small bowel surgery, spleen surgery, thoracic surgery, vaginal hysterectomy, and abdominal surgery.

The surveillance period is the period of time in which an SSI may be identified after surgery. The post-operative SSI surveillance period is 30 days for most procedure types and 90 days for some procedure types. Eight California-reportable procedure types are followed for 90-day surveillance periods, including cardiac surgery, coronary artery bypass graft with chest and donor site incisions, coronary artery bypass graft with chest incision only, hip prosthesis, knee prosthesis, open reduction of fracture, and pacemaker surgery.

Hospitals entered surgical procedures into the NHSN online reporting system manually or electronically using the surveillance and reporting protocols described in the Procedure-associated Module. Hospitals indicated in their monthly reporting plans which of the 29 surgical procedure categories they performed. Hospitals specified whether each surgical procedure category was 'in plan' each month. 'In plan' status means that the data were incorporated into the NHSN national database and undergo validity checking. Hospitals may enter into NHSN the surgical procedures that are not 'in plan' and may have required information missing. For the 2015 SSI tables, we included only 'in-plan' data.

On May 3, 2016, CDPH downloaded the NHSN data sets used to produce this SSI report for surgical procedures performed in 2015

### ***Definitions***

CDPH required hospitals to comply with NHSN surveillance and reporting protocols, including NHSN standardized definitions [6]. Key definitions are:

- **Surgical procedure category** refers to the NHSN procedure code list of International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9-CM). NHSN updates the categories annually when ICD-9-CM codes may be reassigned to different NHSN categories [7].
- The **surgical procedure information** refers to the required information for each procedure and includes the patient's age, gender, weight, duration of surgery, closure, in- or out-patient, whether the procedure involved trauma, an emergency, whether the surgeon primarily used a scope or instrument to visualize the interior of a body cavity or organ (for example, an endoscope or laparoscope), general anesthesia, wound class, and ASA Score. Wound class was created by the American College of Surgeons. ASA was created by the American Society of Anesthesiologists as a score of general patient health.
- The **wound class** categories are clean, clean contaminated, contaminated, and dirty. CDPH is mandated to report SSI rates consistent with NHSN risk adjustment methodology. The NHSN risk adjustment process includes adjustments for all wound classes in to more fully characterize SSI. CDPH does not limit SSI reporting to only SSI following surgeries with clean and clean-contaminated designated wound classes. CDPH reports deep and organ/space SSI from all surgical procedures to complete risk adjustment using NHSN risk adjustment methods.

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- NHSN defines **the surgical closure** as primary or non-primary closure. The primary closure is the 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. This category includes surgeries where the incision is closed at the skin level. We excluded the non-primary closure from our analyses.
- **Surgical site infection events** are incisional infections that occur along the path of the surgical incision. California mandated reporting includes deep incisional and organ/space SSI, but does not include superficial incisional infections.
- **Infection detection categories** are used by NHSN to categorize SSI by where they are detected. CDPH SSI reports include SSI detected while a patient is still admitted in the hospital at which the surgery was performed or upon readmission to the same hospital at which the surgery was performed.

### ***Quality assurance and control***

Hospital personnel are responsible for the quality and completeness of their SSI data. CDPH assisted hospitals in identifying systematic data errors by reviewing hospital-specific NHSN data and notifying hospitals of discrepancies. In September, October, November, and December 2015, and in February and March 2016, CDPH distributed quality assurance and control reports that identified potentially aberrant data for the reporting period. We encouraged hospitals to conduct a final review of their data and to complete all corrections and changes before the final data download on May 3, 2016. Hospitals were responsible for making data corrections in NHSN.

### ***Validation***

In 2013 and 2014, CDPH validation efforts helped hospitals assess and improve case-finding and reporting for colon and abdominal hysterectomy SSI. In 2015, CDPH asked all hospitals to participate in a validation process to specifically assess the completeness of SSI case finding and the accuracy of select denominator data elements used for risk adjustment (i.e., surgical duration, wound class, body mass index, and diabetes status). We invited all hospitals that performed colon surgery, abdominal hysterectomy, cesarean section, and/or hip prosthesis procedures to participate by completing an SSI validation workbook and submitting results electronically. Of 332 eligible hospitals, 312 (94%) participated. To perform validation, hospital staff queried their post-operative records for *International Classification of Diseases* (ICD) diagnosis infection codes that may indicate an SSI, thus “flagging” patient records for further review. Hospital staff reviewed all flagged records to rule out or identify SSI. Hospitals compared the SSIs found during validation with what they had previously reported to NHSN.

We instructed hospitals to make corrections in NHSN for any identified errors and address problems in routine surveillance practices that may have led to the errors. In 2016, CDPH is continuing to follow up with hospitals to ensure they are using ICD flag codes as part of routine SSI surveillance methods.

### ***Data presentation and statistical analyses***

Hospitals report demographic and clinical information for each patient undergoing surgery to NHSN. NHSN statisticians used data submitted from 2006-2008 to develop mathematical risk adjustment models for calculating the predicted SSI counts for each surgical procedure type. [8]. When the observed infection count is equal to the predicted infection count based on the national average, the SIR is equal to 1.0.

CDPH used the NHSN Complex A/R models that provided the predicted number of SSI following inpatient surgical procedures. The Complex A/R model includes only deep incisional and organ/space SSI detected upon admission or readmission to the same hospital. Superficial incisional infections and those detected in other settings are excluded. NHSN also excludes from the SSI SIR surgical procedures performed in outpatient settings, surgeries of excessively short or long duration, and surgical procedures with incomplete information as reported by the hospital.

NHSN calculates an SIR only when the predicted number of SSI is greater than 1.0. In 2015, CDPH also calculated and reported SIR when the predicted number of infections was less than 1.0, but greater than or equal to 0.2. This change allowed more hospitals (e.g., small and rural hospitals) to compare their infection incidence to the national baselines. CDPH was able to report HAI results (i.e. incidence higher than or the same as predicted) for more California hospitals. In the past, these hospital results would have been missing, with an indication that there were “too few data to calculate.”

If an SIR was generated for a hospital, the calculated 95% confidence interval determined if the observed number of infections was significantly different from predicted. If the confidence interval included the value of 1.0, the SIR indicated that the observed number of infections was not considered different from the predicted number of infections. Based on the 95% confidence interval, we labeled each SIR as indicating “no difference” between the numbers of observed and predicted infections, “higher” because more infections were observed than predicted, or “lower” because fewer infections were observed than predicted.

CDPH presented the SSI data in 31 tables. We displayed data for each surgical procedure category, including hospital submitted procedure counts, infection counts, SIR computed by NHSN or CDPH, and the 95% confidence interval for the SIR (Tables 1 through 24). There was no risk adjustment process for five of the 29 California-mandated reportable surgical procedure categories, heart transplant, kidney surgery, ovarian surgery, pacemaker surgery, and spleen surgery. For each of these five procedures, we displayed the numbers of procedures performed and SSI reported by each hospital (Tables 25 through 29). We listed the three LTAC hospitals that performed some surgeries (Table 30). We reported 38 hospitals that performed zero surgeries in the 29 surgical procedure categories (Table 31).

We also published HAI findings via “My Hospital’s Infections,” an interactive map on the CDPH website ([www.cdph.ca.gov/HAI](http://www.cdph.ca.gov/HAI)). To present SSI data on the map, we selected the ten surgical procedure categories with the highest numbers of hospitals for which an SSI SIR was calculated. NHSN generates SIR for high volume surgical procedure categories, surgeries that have a higher predicted number of SSI, or both. The ten surgical procedure categories displayed on the map, abdominal hysterectomy, cesarean section, coronary artery bypass graft, colon surgery, hip prostheses, knee prostheses, open reduction of fracture, spinal fusion, small bowel surgery, and bile duct, liver and pancreatic surgery, account for 66% of all SSI SIR calculated across all 29 reportable surgical procedure categories. These ten surgical procedure categories are where Infection prevention strategies can make the greatest impact.

### **Limitations and Context**

The SSI SIR may be impacted if the application of the NHSN surveillance rules, intended to allow fair comparisons, are applied differently by hospitals, thereby potentially biasing results.

To publish California hospital HAI data, CDPH must “follow a risk adjustment process that is consistent with the federal Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN)” (Health and Safety Code 1288.55(c)(1)). Since 2012, the Centers for Medicare and Medicaid Services (CMS) require hospitals participating in the CMS Hospital Inpatient Quality Reporting (IQR) Program to report SSI associated with abdominal hysterectomies and colon surgeries via NHSN. Those are two of the 29 surgical procedures that California hospitals report to CDPH. The SSI data displayed on the CMS Hospital Compare website are not comparable to SSI data reported by CDPH. CMS uses a different risk-adjustment model. The CMS SIR model includes deep incisional and organ/space abdominal hysterectomy and colon SSI detected during the surgery hospitalization and SSI detected upon readmission to the same hospital (as does the NHSN Complex A/R SIR model), but also includes SSI detected as readmissions to other hospitals and SSI detected in patients not admitted to a hospital (post-discharge). The CMS SSI SIR also excludes patients less than 18 years of age. The CMS SIR takes into account only patient age and ASA score in the risk-adjustment model for colon and abdominal hysterectomy SSI. The NHSN Complex A/R SIR, used by CDPH, risk adjusts colon surgery SSI for patient level factors (age and ASA score), surgical factors (wound class duration of surgery, and endoscope use), and hospital level factors (hospital size and medical school affiliation). The NHSN Complex A/R SIR risk adjusts abdominal hysterectomy SSI for age, ASA, surgery duration, and hospital size. The number of SSI observed (reported) by the hospital and the SSI incidence (SIR) may differ between CMS SSI reported data and CDPH reported data. We recommend avoiding comparisons.

CDPH also recommends caution when comparing these 2015 SSI data with previous years' data, because 2015 data were affected by the following surveillance improvements and changes:

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- Data validation improved the quality of the data reported by California hospitals and the quality of this CDPH annual report. CDPH designed the validation in 2014 and 2015 to help hospitals assess and improve HAI reporting. The validation efforts appear to have been successful, as indicated by more HAIs being reported in 2015 than in previous years. CDPH now has greater assurance that this annual HAI public report reflects that all California hospitals are performing standardized surveillance and are accurately and completely reporting their infections. Hospitals need accurate and complete HAI data to know their true infection incidence, to implement targeted interventions and to track HAI prevention progress over time.
- Data validation in 2014 revealed that hospitals were not completely finding all SSI cases. In March 2015, to improve SSI surveillance, CDPH promulgated International Classification of Diseases (ICD) diagnosis “flag” codes for each reportable surgical procedure type for use by hospitals to screen surgical patient records. CDPH encouraged hospitals to apply these flag codes in the post-operative period to identify patient records that should be reviewed for possible SSI. CDPH also suggested that hospitals use these ICD flag codes to help improve the efficiency and effectiveness of their routine SSI surveillance practices. These CDPH validation activities contributed to more SSI being identified and reported in 2015 than in previous years.

## **References**

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