Surgical Site Infection Overview

Surgical site infections (SSI) are infections directly related to an operative procedure. Surgical procedures selected for SSI reporting are (1) performed at a high volume, (2) performed at a variety of facilities, or (3) associated with a high risk for health facility-acquired infections. The surgeries monitored for SSI in Colorado include cardiac procedures, hip and knee replacements, hernia repairs, and hysterectomies (abdominal and vaginal). Evidence has shown that reporting of infections may lead to better adherence to preventive practices and decreased medical complications.

The National Healthcare Safety Network (NHSN) manual defines reportable procedures for surveillance as those that occur in a single trip to an operating room, where the incision is closed following the procedure. Surgeries are performed as either in- or outpatient procedures. An inpatient procedure as defined by NHSN is a procedure whose dates of admission and discharge are different calendar days. An outpatient procedure is defined as a procedure whose dates of admission and discharge are the same calendar day.

Surgical site infections are classified into three different categories, based on the location of the infection.[9] Reportable infections occur within 30 days of the procedure or within one year if a permanent implant is used during the procedure. [9] There are specific criteria for each infection category, based on specific signs of infection and the location of the infection. Common signs of infection are fever, pain, or tenderness, drainage, redness, or abscess.[i]

- Superficial incisional infection (SIP) – the infection involves only the top layers of the skin
- Deep incisional (DIP) – the infection involves deeper soft tissues (e.g., fascial and muscle layers) of the incision.
- Organ space (OS) – the infection involves any part of the body that is opened or manipulated during the operative procedure, excluding the skin incision, fascia, or muscle layers.

It is estimated more than 20% of HAI are attributed to infections stemming from surgical sites, equating to infections in approximately 2% of all surgical procedures nationally.[ii] The impacts from an SSI can be devastating, often leading to a longer hospital stay, increased treatments, and higher costs.[iii] The lives lost, increased medical treatments, and time spent in rehabilitation following an SSI are not the only negative outcome that occurs. The economic toll that is associated with SSI is also a staggering statistic with far reaching implications. In 2005, United States acute care hospital discharge data projected that an additional 928,663 hospital treatment days, and an additional $1.6 billion in hospital costs were attributed to SSI. Furthermore, when these numbers are examined at the

individual level, the difference between a patient with and without an SSI is determined to average an increased length of stay in the hospital of 9.7 days and an increased cost of $20,842.[iii]

Standardized Infection Ratio

Facilities' surgical site infection results are compared using standardized infection ratio (SIR). The SIR is a risk adjusted summary measure that accounts for the type of procedure and patient risk. It is the ratio of the observed to expected number of SSI (observed infections / expected infections = SIR). The expected number of infections is calculated based on national infection data and patient risk at each health facility. The SIR is used to compare facilities instead of using a crude rate, which is the number of SSI per total number of procedures performed. Overall crude rates for SSI are not risk adjusted and should not be used to compare facilities due to inherent differences in the patient risk in each facility.

The risk adjustment is accomplished by estimating an expected number of infections for a facility, for a particular procedure type. The NHSN develops an expected number of infections by analyzing nationwide facility historical data. For SSI, the expected risk of infection is calculated for each patient who undergoes the procedure, which is then summed for the expected number of infections for the facility. In this report, hospitals and ambulatory surgical centers use different patient parameters to determine the expected number of infections (for orthopedic procedures only). This is because the NHSN has released an updated risk adjustment method that does not apply to orthopedic procedures performed in ASC. The specific risk factors are chosen based on their ability to predict an SSI. The parameters for the patient risk adjustment are included in the specific procedure overviews in this report.

Interpretation of the SIR is as follows: A hospital's SIR value is compared to 1.0 (observed and expected number of SSI are the same). If the SIR value is greater than 1.0, there are more infections than expected. If the SIR value is less than 1.0, then fewer infections occurred than expected. A statistical test (Poisson test) is used to determine if the difference is statistically significant. It is important to note that it is possible for a facility's SIR to be higher or lower than 1.0, but due to statistical comparison and the total number of procedures and infections, not be significantly better or worse than the national rate. Also, it is possible for an SIR to be statistically high or low, even when a different facility has an even higher or lower (respectively) SIR that is not statistically significant. Again, this is due to the numbers of procedures, infections, and the statistical testing process. For an example of how this calculation works please refer to Appendix E.

Orthopedic Procedures

Background

The orthopedic procedures reported are hip replacements (total or partial) and knee replacements (total or partial). These procedures can be performed either as in- or outpatient procedures.

A total or partial hip replacement is a surgery for people with severe hip damage or pain related to chronic osteoarthritis, rheumatoid arthritis or other degenerative processes involving the hip joint. The surgical procedure for a hip replacement involves removing the damaged cartilage and bone from the hip joint and replacing them with an artificial device. The procedure consists of a cup, which is typically plastic, ceramic or metal that will replace the hip socket, a metal or ceramic ball that replaces the head of the thighbone and finally a metal stem that attaches to the bone.

A total or partial knee replacement is a surgery (arthroplasty) for people with severe knee damage and pain related to osteoarthritis, rheumatoid arthritis, or traumatic arthritis. A total knee replacement involves removing the damaged cartilage and bone from the surface of the knee joint and replacing them with an artificial device. In this procedure, the patella (kneecap) is removed, the femur (thigh bone) and tibia (shin bone) are cut down, and a metal, ceramic or plastic prosthesis is put in place.

Results

Tables 10 through 13 show facility specific data for SSI attributed to the two different procedures performed in hospitals (inpatient and outpatient) and ambulatory surgical centers (outpatient only). The tables present data from surgeries performed from August 1, 2009 through July 31, 2010 and August 1, 2010 through July 31, 2011.

Each table lists all the healthcare facilities in Colorado that performed the procedure, the city where the facility is located, the number of procedures performed, the number of infections, the standardized infection ratio (SIR) based on the national infection data, and the comparison to the national infection data. For the definition of SIR refer to page 34 or see Appendix E.

The three categories summarizing how a Colorado hospital compares to the national infection data for procedure performed are:

1. Statistically fewer (**better**) infections than expected based on national infection data;
2. Statistically similar (**same)** infections as expected based on the national infection data; or
3. Statistically more (**worse**) infections than expected based on national infection data.

The specific patient risk factors used to calculate the expected number of infections for **hospitals** are:

- Age
- Receiving anesthesia
- American Society of Anesthesiologists Score (ASA score, describes the health of the patient)
- Length of the procedure
- Type of knee (revision or primary) or hip (total primary, partial primary, or total revision/partial) replacement surgery
- Facility bed size
- Procedure was related to trauma
- Gender (for knee replacement only)

The specific patient risk factors used to calculate the expected number of infections for **ASC** are:

- Length of the procedure
- Wound type
- American Society of Anesthesiologists Score (ASA score, describes the health of the patient)

Table 12: Knee Replacement (total or partial), Inpatient and Outpatient Procedures for Hospitals, 2009 – 2010 and 2010 – 2011

Surgical Site Infections (SSI) in Knee Replacement Procedures (total or partial) in Hospitals (In- and Outpatient Combined) Reporting Period: August 1, 2009-July 31, 2011									
Health Facility and Region		2009-2010				2010-2011			
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
Animas Surgical Hospital	Durango	76	0	0.0	Same	81	0	0.0	Same
Arkansas Valley Regional Medical Center	La Junta	12	***	***	***	44	0	0.0	Same
Aspen Valley Hospital	Aspen	22	1	5.4	Same	28	0	0.0	Same
Boulder Community Hospital	Boulder	241	1	0.5	Same	256	2	0.8	Same
Centura Avista Adventist Hospital	Louisville	180	2	1.3	Same	156	1	0.8	Same
Centura Littleton Adventist Hospital	Littleton	131	0	0.0	Same	146	0	0.0	Same

Surgical Site Infections (SSI) in
Knee Replacement Procedures (total or partial) in Hospitals (In- and Outpatient Combined)
Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region		2009-2010				2010-2011			
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
Centura Penrose St. Francis Health Services	Colorado Springs	442	7	1.5	Same	447	2	0.4	Same
Centura Porter Adventist Hospital	Denver	1,009	12	1.5	Same	979	7	0.9	Same
Centura St. Anthony Hospital	Lakewood	515	1	0.2	Same	285	0	0.0	Same
Centura St. Anthony North Hospital	Westminster	73	3	3.8	Same	80	2	2.8	Same
Centura St. Francis Medical Center	Colorado Springs	311	5	1.8	Same	294	2	0.7	Same
Centura St. Mary Corwin Medical Center	Pueblo	210	2	0.9	Same	214	3	1.5	Same
Centura St. Thomas More Hospital	Canon City	93	0	0.0	Same	79	1	1.6	Same
Children's Hospital Colorado	Aurora	2	***	***	***	2	***	***	***
Colorado Plains Medical Center	Fort Morgan	38	1	2.8	Same	31	0	0.0	Same
Community Hospital	Grand Junction	124	1	0.8	Same	124	2	1.6	Same
Delta County Memorial Hospital	Delta	129	0	0.0	Same	101	2	2.4	Same
Denver Health Medical Center	Denver	98	4	3.8	Worse	126	4	3.1	Same
East Morgan County Hospital	Brush	16	***	***	***	15	***	***	***
Exempla Good Samaritan Medical Center	Lafayette	512	1	0.2	Same	444	1	0.3	Same
Exempla Lutheran Medical Center	Wheat Ridge	547	5	1.1	Same	323	3	1.0	Same
Exempla St. Joseph Hospital	Denver	648	4	0.7*	Same	635	5	0.9	Same
Grand River Medical Center	Rifle	7	***	***	***	9	***	***	***
Gunnison Valley Hospital	Gunnison	8	***	***	***	4	***	***	***
Heart of the Rockies Regional Medical Center	Salida	15	***	***	***	40	2	5.6	Same
Longmont United Hospital	Longmont	207	0	0.0	Same	218	0	0.0	Same

Surgical Site Infections (SSI) in
Knee Replacement Procedures (total or partial) in Hospitals (In- and Outpatient Combined)
Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region		2009-2010				2010-2011			
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
McKee Medical Center	Loveland	230	0	0.0	Same	290	1	0.4	Same
Medical Center of Aurora	Aurora	374	6	1.6	Same	341	7	1.9	Same
Medical Center of the Rockies	Loveland	63	2	2.9	Same	87	0	0.0	Same
Memorial Hospital Central	Colorado Springs	543	5	0.8	Same	638	1	0.2	Better
Memorial Hospital North	Colorado Springs	244	0	0.0	Same	328	4	1.4	Same
Mercy Regional Medical Center	Durango	130	1	0.9	Same	114	0	0.0	Same
Montrose Memorial Hospital	Montrose	168	1	0.7	Same	141	1	0.9	Same
North Colorado Medical Center	Greeley	225	2	0.8	Same	286	3	0.9	Same
North Suburban Medical Center	Thornton	109	1	1.0	Same	174	2	1.3	Same
OrthoColorado Hospital at St. Anthony Medical Campus	Lakewood	29	0	0.0	Same	604	3	0.7	Same
Parker Adventist Hospital	Parker	75	0	0.0	Same	163	3	2.1	Same
Parkview Medical Center	Pueblo	325	9	2.7	Worse	361	6	1.5	Same
Pikes Peak Regional Hospital	Woodland Park	12	***	***	***	32	0	0.0	Same
Platte Valley Medical Center	Brighton	97	3	3.5	Same	48	0	0.0	Same
Poudre Valley Hospital	Fort Collins	1,014	5	0.6	Same	995	4	0.4	Same
Presbyterian St. Luke's Medical Center	Denver	360	3	0.8*	Same	373	4	1.0*	Same
Rose Medical Center	Denver	587	0	0.0	Better	532	3	0.7	Same
San Luis Valley Regional Medical Center	Alamosa	50	0	0.0	Same	42	1	2.7	Same
Sky Ridge Medical Center	Lone Tree	603	9	1.6	Same	806	15	1.9	Worse

Surgical Site Infections (SSI) in
Knee Replacement Procedures (total or partial) in Hospitals (In- and Outpatient Combined)
Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region		2009-2010				2010-2011			
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
Southwest Memorial Hospital	**Cortez**	44	1	2.5	Same	48	0	0.0	Same
St. Anthony Summit Medical Center	**Frisco**	25	0	0.0	Same	40	1	3.5	Same
St. Mary's Hospital	**Grand Junction**	332	1	0.3	Same	301	1	0.3	Same
Sterling Regional Medical Center	**Sterling**	34	0	0.0	Same	29	0	0.0	Same
Swedish Medical Center	**Englewood**	273	1	0.4	Same	305	2	0.7	Same
The Memorial Hospital	**Craig**	6	***	***	***	0	***	***	***
University of Colorado Hospital	**Aurora**	316	4	1.1	Same	299	4	1.3	Same
Vail Valley Medical Center	**Vail**	200	2	1.2	Same	204	1	0.6	Same
Valley View Hospital	**Glenwood Springs**	133	0	0.0	Same	123	1	1.0	Same
Wray Community Hospital	**Wray**	12	***	***	***	16	***	***	***
Yampa Valley Medical Center	**Steamboat Springs**	80	0	0.0	Same	90	0	0.0	Same

The standardized infection ration (SIR) is the ratio of observed to expected infections, and is adjusted for procedure risk factors.
National comparison based on data collected and reported by NHSN-participating hospitals from 2006-2008.
See "Improving Risk-Adjusted Measures of Surgical Site Infection for the National Healthcare Safety Network" (Inf Control and Hosp Epi, October 2011, Vol 32, No 10, pp. 970-986).
* Indicates that the expected number of infections used in SIR is not accurately calculated due to an NHSN limitation.
*** Indicates value not shown due to suppression of infections data.
Infections data for hospitals with fewer than 20 procedures performed in a 12-month period are suppressed to protect confidential health information. These hospitals have met the reporting requirements.
Source: National Healthcare Safety Network (NHSN) Database.
Prepared By: Colorado Patient Safety Program, Colorado Department of Public Health and Environment.

Table 13: Knee Replacement (total or partial), Outpatient Procedures for Ambulatory Surgery Centers, 2009 – 2010 and 2010 – 2011

Surgical Site Infections (SSI) in
Knee Replacement Procedures (total or partial) in Ambulatory Surgery Centers (Outpatient)
Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region		2009-2010				2010-2011			
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
ASC Durango at Mercy Medical Center	Durango	0	***	***	***	1	***	***	***
Denver Midtown Surgery Center	Denver	1	***	***	***	0	***	***	***
Loveland Surgery Center	Loveland	3	***	***	***	3	***	***	***
Orthopaedic Center of the Rockies	Fort Collins	280	0	0.0	Same	329	0	0.0	Same
Rocky Mountain Surgery Center	Englewood	3	***	***	***	9	***	***	***
Skyline Surgery Center	Loveland	6	***	***	***	7	***	***	***
Surgical Center at Premier	Colorado Springs	9	***	***	***	14	***	***	***

The standardized infection ration (SIR) is the ratio of observed to expected infections, and is adjusted for procedure risk factors.
National comparison based on data collected and reported by NHSN-participating hospitals from 2006-2008.
See "National Healthcare Safety Network (NHSN) Report, Data Summary for 2006-2008, Issued December 2009" (Am J Infect Control 2009;37:783-805).
*** Indicates value not shown due to suppression of infections data
Infections data for ASCs with fewer than 20 procedures performed in a 12-month period are suppressed to protect confidential health information. These ASCs have met the reporting requirements.
Source: National Healthcare Safety Network (NHSN) Database.
Prepared By: Colorado Patient Safety Program, Colorado Department of Public Health and Environment.

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[i] "National Healthcare Safety Network." Surgical Site Infection Event. <http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf>.
[ii] Raymond DP, Pelletier SJ, Crabtree TD, Schulman AM, Pruett TL, Sawyer RG. "Surgical infection and the agin population." Am Surg (2001): 827-833.
[iii] de Lissovoy G, Fraeman K, Hutchins V, Murphy D, Song D, Vaughn BB. "Surgical site infection: Incidence and impact on hospital utilization and treatment costs ." AJIC (2009): 387-397.