# **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. Reportable infections occur within 30 days of the procedure or within one year if a permanent implant is used during the procedure. 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.

- 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. The impacts from an SSI can be devastating, often leading to a longer hospital stay, increased treatments, and higher costs. 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.<sup>iii</sup>

### **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.

## **Abdominal procedures**

### **Background**

The surgeries included in this section are hernia repairs and hysterectomies (abdominal and vaginal). These procedures can be performed as in- or outpatient procedures.

A herniorrhaphy is the repair of a hernia or bulging of internal organs or tissues which protrude through an abnormal opening in the muscle wall. Reportable NHSN hernia procedures include inguinal, femoral, umbilical, or anterior abdominal wall repairs.

A hysterectomy is the surgical removal of the uterus typically performed by a gynecologist. Hysterectomy may be total (removing the body, fundus, and cervix of the uterus; often called "complete") or partial (removal of the uterine body while leaving the cervix intact; also called "supracervical"). The two types of hysterectomies are abdominal and vaginal. Removal of the uterus can occur either through the abdomen or the vagina.

Most hysterectomies are done through an abdominal incision. Vaginal hysterectomy is performed through the vaginal canal and has fewer complications than abdominal hysterectomies, as well as shorter hospital stays and shorter healing time.

### **Results**

<u>Tables 14 through 17 show facility specific data for SSI attributed to herniorrhaphies and hysterectomies as described above.</u> 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 healthcare facility 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 <u>herniorrhaphies</u> are:

Age

- American Society of Anesthesiologists Score (ASA score, describes the health of the patient)
- Length of the procedure
- Gender
- Outpatient versus inpatient

The specific patient risk factors used to calculate the expected number of infections for <u>abdominal hysterectomies</u> are:

- Age
- Receiving anesthesia
- American Society of Anesthesiologists Score (ASA score, describes the health of the patient)
- Length of the procedure
- Use of an endoscope
- Facility bed size

The specific patient risk factors used to calculate the expected number of infections for <u>vaginal hysterectomies</u> are:

- Age
- American Society of Anesthesiologists Score (ASA score, describes the health of the patient)
- Length of the procedure
- Facility has a medical school affiliation

Table 16: Abdominal Hysterectomies, Inpatient and Outpatient Procedures for Hospitals, 2009 – 2010 and 2010 – 2011

# Surgical Site Infections (SSI) in Abdominal Hysterectomies in Hospitals (In/Out-Patient Combined) Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region			20	09-2010		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	27	0	0.0	Same	20	0	0.0	Same	
Arkansas Valley Regional Medical Center	La Junta	5	***	***	***	5	***	***	***	
Aspen Valley Hospital	Aspen	5	***	***	***	8	***	***	***	

# Surgical Site Infections (SSI) in Abdominal Hysterectomies in Hospitals (In/Out-Patient Combined)

Reporting Period: August 1, 2009-July 31, 2011

			09-2010		2010-2011				
Health Facility and Region		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
<b>Boulder Community Hospital</b>	Boulder	27	0	0.0	Same	4	***	***	***
Boulder Community Hospital- Foothills	Boulder	46	0	0.0	Same	32	1	1.6	Same
Centura Avista Adventist Hospital	Louisville	56	0	0.0	Same	45	1	1.2	Same
Centura Littleton Adventist Hospital	Littleton	83	2	1.4	Same	76	0	0.0	Same
Centura Penrose St. Francis Health	Colorado Springs	194	10	2.2	Worse	153	5	1.4	Same
Centura Porter Adventist Hospital	Denver	109	1	0.7	Same	123	1	0.6	Same
Centura St. Anthony Hospital	Lakewood	108	1	0.5	Same	58	1	1.0	Same
Centura St. Anthony North Hospital	Westminster	31	0	0.0	Same	22	0	0.0	Same
Centura St. Francis Medical Center	Colorado Springs	210	3	0.8	Same	202	3	0.8	Same
Centura St. Mary Corwin Medical Center	Pueblo	65	2	1.7	Same	44	0	0.0	Same
Centura St. Thomas More Hospital	Canon City	35	0	0.0	Same	25	0	0.0	Same
Colorado Plains Medical Center	Fort Morgan	30	0	0.0	Same	25	0	0.0	Same
Community Hospital	<b>Grand Junction</b>	5	***	***	***	7	***	***	***
Delta County Memorial Hospital	Delta	35	0	0.0	Same	22	0	0.0	Same
Denver Health Medical Center	Denver	56	3	2.6	Same	51	0	0.0	Same
Estes Park Medical Center	Estes Park	3	***	***	***	0	***	***	***
Exempla Good Samaritan Medical Center	Lafayette	171	1	0.3	Same	139	1	0.4	Same
Exempla Lutheran Medical Center	Wheat Ridge	247	2	0.6	Same	287	4	1.0	Same
Exempla St. Joseph Hospital	Denver	380	8	1.1	Same	234	5	1.0	Same

# Surgical Site Infections (SSI) in Abdominal Hysterectomies in Hospitals (In/Out-Patient Combined)

Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region			20	009-2010		2010-2011				
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	
Grand River Medical Center	Rifle	7	***	***	***	7	***	***	***	
Gunnison Valley Hospital	Gunnison	18	***	***	***	16	***	***	***	
Heart of the Rockies Regional Medical Center	Salida	12	***	***	***	7	***	***	***	
Longmont United Hospital	Longmont	93	3	1.9	Same	59	1	1.0	Same	
McKee Medical Center	Loveland	80	1	1.0	Same	47	1	1.3	Same	
Medical Center of Aurora	Aurora	147	6	2.3	Same	82	1	0.7	Same	
Medical Center of the Rockies	Loveland	44	0	0.0	Same	73	1	0.9	Same	
Melissa Memorial	Holyoke	2	***	***	***	0	***	***	***	
Memorial Hospital Central	Colorado Springs	223	3	0.9	Same	220	10	3.1	Worse	
Memorial Hospital North	Colorado Springs	311	2	0.5	Same	216	1	0.4	Same	
Mercy Regional Medical Center	Durango	109	1	0.8	Same	104	1	0.9	Same	
Montrose Memorial Hospital	Montrose	54	1	1.0	Same	79	0	0.0	Same	
Mt. San Rafael Hospital	Trinidad	7	***	***	***	3	***	***	***	
North Colorado Medical Center	Greeley	145	0	0	Same	120	1	0.5	Same	
North Suburban Medical Center	Thornton	141	3	1.3	Same	121	1	0.5	Same	
Parker Adventist Hospital	Parker	114	2	0.9	Same	90	0	0	Same	
Parkview Medical Center	Pueblo	120	1	0.6	Same	99	2	1.4	Same	
Pikes Peak Regional Hospital	Woodland Park	0	***	***	***	1	***	***	***	
Platte Valley Medical Center	Brighton	36	2	3.9	Same	26	2	5.2	Same	
Poudre Valley Hospital	Fort Collins	239	3	0.8	Same	267	3	0.8	Same	
Presbyterian St. Luke's Medical Center	Denver	57	0	0	Same	50	0	0	Same	
Prowers Medical Center	Lamar	25	0	0	Same	20	0	0	Same	
Rose Medical Center	Denver	343	3	0.4	Same	409	1	0.1	Better	

### Surgical Site Infections (SSI) in Abdominal Hysterectomies in Hospitals (In/Out-Patient Combined)

Reporting Period: August 1, 2009-July 31, 2011

Health Facility and Region			20	09-2010		2010-2011				
		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	
San Luis Valley Regional Medical Center	Alamosa	24	0	0	Same	12	***	***	***	
Sky Ridge Medical Center	Lone Tree	209	1	0.3	Same	193	2	0.6	Same	
Southwest Memorial Hospital	Cortez	1	***	***	***	2	***	***	***	
St. Anthony Summit Medical Center	Frisco	34	0	0	Same	36	0	0	Same	
St. Mary's Hospital	<b>Grand Junction</b>	187	1	0.3	Same	174	1	0.3	Same	
Sterling Regional Medical Center	Sterling	5	***	***	***	6	***	***	***	
Swedish Medical Center	Englewood	499	3	0.4	Same	460	6	0.7	Same	
The Memorial Hospital	Craig	6	***	***	***	0	***	***	***	
University of Colorado Hospital	Aurora	177	7	1.2	Same	152	3	0.6	Same	
Vail Valley Medical Center	Vail	17	***	***	***	12	***	***	***	
Valley View Hospital	Glenwood Springs	12	***	***	***	30	1	1.9	Same	
Yampa Valley Medical Center	Steamboat Springs	17	***	***	***	17	***	***	***	
Yuma District Hospital	Yuma	3	***	***	***	0	***	***	***	

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).

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.

<sup>\*\*\*</sup> Indicates value not shown due to suppression of infections data.

Table 17: Vaginal Hysterectomies, Inpatient and Outpatient Procedures for Hospitals, 2009 – 2010 and 2010 – 2011

#### Surgical Site Infections (SSI) in

Vaginal Hysterectomies in Hospitals (In/Out-Patient Combined).

Reporting Period: August 1, 2009-July 31, 2011.

		20	09-2010		2010-2011				
Health Facility and Reg	ion	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
Animas Surgical Hospital	Durango	43	0	0.0	Same	49	0	0.0	Same
Aspen Valley Hospital	Aspen	27	0	0.0	Same	18	***	***	***
Boulder Community Hospital	Boulder	16	***	***	***	63	1	2.8	Same
Boulder Community Hospital- Foothills	Boulder	14	***	***	***	13	***	***	***
Centura Avista Adventist Hospital	Louisville	33	1	5.3	Same	43	3	10.7	Worse
Centura Littleton Adventist Hospital	Littleton	215	1	0.8	Same	181	2	2.0	Same
Centura Penrose St. Francis Health	Colorado Springs	30	1	6.8	Same	58	1	3.7	Same
Centura Porter Adventist Hospital	Denver	132	0	0.0	Same	131	0	0.0	Same
Centura St. Anthony Hospital	Lakewood	62	1	3.0	Same	12	***	***	***
Centura St. Anthony North Hospital	Westminster	84	1	2.4	Same	79	0	0.0	Same
Centura St. Francis Medical Center	Colorado Springs	141	1	1.4	Same	183	5	5.5	Worse
Centura St. Mary Corwin Medical Center	Pueblo	40	0	0.0	Same	57	0	0.0	Same
Centura St Thomas More Hospital	<b>Canon City</b>	21	0	0.0	Same	22	1	7.5	Same
Colorado Plains Medical Center	Fort Morgan	13	***	***	***	13	***	***	***
Community Hospital	<b>Grand Junction</b>	50	0	0.0	Same	82	2	5.3	Same
Delta County Memorial Hospital	Delta	37	0	0.0	Same	29	0	0.0	Same
Denver Health Medical Center	Denver	49	1	1.5	Same	60	0	0.0	Same
Estes Park Medical Center	Estes Park	1	***	***	***	0	***	***	***
Exempla Good Samaritan Medical Center	Lafayette	113	3	5.5	Worse	131	1	1.6	Same
Exempla Lutheran Medical Center	Wheat Ridge	140	1	1.5	Same	173	0	0.0	Same
Exempla St. Joseph Hospital	Denver	239	0	0.0	Same	327	0	0.0	Better

# Surgical Site Infections (SSI) in Vaginal Hysterectomies in Hospitals (In/Out-Patient Combined).

Reporting Period: August 1, 2009-July 31, 2011.

			09-2010		2010-2011				
Health Facility and Region		Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison	Procedure Count	Infection Count	Standardized Infection Ratio (SIR)	National Comparison
Grand River Medical Center	Rifle	21	0	0.0	Same	17	***	***	***
Longmont United Hospital	Longmont	96	0	0.0	Same	87	1	2.2	Same
McKee Medical Center	Loveland	155	3	3.2	Same	238	3	2.0	Same
Medical Center of Aurora	Aurora	115	0	0.0	Same	116	1	1.5	Same
Medical Center of the Rockies	Loveland	20	0	0.0	Same	16	***	***	***
Memorial Hospital Central	Colorado Springs	219	3	2.5	Same	340	6	3.3	Worse
Memorial Hospital North	Colorado Springs	159	4	4.7	Worse	209	5	4.1	Worse
Mercy Regional Medical Center	Durango	41	1	2.2	Same	22	0	0.0	Same
Montrose Memorial Hospital	Montrose	32	0	0.0	Same	34	1	5.7	Same
Mt. San Rafael Hospital	Trinidad	0	***	***	***	1	***	***	***
North Colorado Medical Center	Greeley	183	0	0.0	Same	178	0	0.0	Same
North Suburban Medical Center	Thornton	69	1	3.0	Same	46	0	0.0	Same
Parker Adventist Hospital	Parker	55	0	0.0	Same	59	0	0.0	Same
Parkview Medical Center	Pueblo	172	1	0.5	Same	187	1	0.4	Same
Pikes Peak Regional Hospital	<b>Woodland Park</b>	2	***	***	***	6	***	***	***
Platte Valley Medical Center	Brighton	17	***	***	***	18	***	***	***
Poudre Valley Hospital	Fort Collins	131	0	0.0	Same	139	1	0.6	Same
Presbyterian St. Luke's Medical Center	Denver	36	1	2.4	Same	26	0	0.0	Same
Prowers Medical Center	Lamar	5	***	***	***	0	***	***	***
Rose Medical Center	Denver	160	0	0.0	Same	183	0	0.0	Same
San Luis Valley Regional Medical Center	Alamosa	40	0	0.0	Same	31	0	0.0	Same
Sky Ridge Medical Center	Lone Tree	216	6	5.1	Worse	292	2	1.2	Same

#### Surgical Site Infections (SSI) in

#### Vaginal Hysterectomies in Hospitals (In/Out-Patient Combined).

Reporting Period: August 1, 2009-July 31, 2011.

Health Facility and Region			20	09-2010		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	0	***	***	***	4	***	***	***	
St. Anthony Summit Medical Center	Frisco	6	***	***	***	2	***	***	***	
St. Mary's Hospital	<b>Grand Junction</b>	181	1	0.4	Same	215	4	1.4	Same	
Sterling Regional Medical Center	Sterling	10	***	***	***	11	***	***	***	
Swedish Medical Center	Englewood	141	1	0.6	Same	224	0	0.0	Same	
University of Colorado Hospital	Aurora	84	0	0.0	Same	130	3	1.5	Same	
Vail Valley Medical Center	Vail	39	1	4.7	Same	31	0	0.0	Same	
Valley View Hospital	Glenwood Springs	26	3	21.1	Worse	38	2	8.6	Worse	
Yampa Valley Medical Center	Steamboat Springs	47	0	0.0	Same	32	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).

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.

<sup>\*\*\*</sup> Indicates value not shown due to suppression of infections data.

<sup>&</sup>lt;sup>1</sup> "National Healthcare Safety Network." Surgical Site Infection Event. <a href="http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf">http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf</a>>.

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