



**Colorado Department of Public Health and Environment
Health Facility Acquired Infections Disclosure Initiative
Semi-Annual Bulletin: Volume 3, No. 2, December 2010
Central Line-Associated Bloodstream
Infection Rates and Associated Pathogens in Colorado
Adult Intensive Care Units (2007 to 2010)**

Introduction

This report was written to fulfill the requirements set forth in Colorado Revised Statute title 25, article 3, part 6, the Hospital-Acquired Infections Disclosure Act. The Act requires hospitals, hospital units, ambulatory surgery centers and dialysis treatment centers to report health facility acquired infections data as a condition of their state licensure. The Colorado Department of Public Health and Environment (the department) is the lead state agency administering the initiative. The department is required to produce semi-annual bulletins disclosing the results of the data collected.

This bulletin focuses on central line-associated bloodstream infections acquired in five adult intensive care units (ICUs) and the significant pathogens that cause the infections. The eight tables and nine graphs in this bulletin show the results of data collected in each ICU type and contain data from August 1, 2007 through July 31, 2010. Although these data have been presented in our annual reports, CDPHE and the Colorado Health Facilities Acquired Infections Advisory Committee felt it was important to present these data again to focus on three year trends. Additionally, this is the first bulletin that has focused on primary pathogens that cause central line-associated bloodstream infections.

In Colorado, there are 57 adult intensive care units that meet the National Healthcare Safety Network (NHSN) definition as an ICU and have been reporting central line-associated bloodstream infection data since 2007. This bulletin presents data submitted from 44 Medical/Surgical ICUs, six Medical ICUs, four Cardiac ICUs, two Surgical Cardiothoracic ICUs and one Surgical ICU that have reported data from August 2007 through July 2010. Data in this bulletin was submitted to the NHSN by Colorado hospitals. CDPHE uses the NHSN to access the data and format the information for presentation to the general public and depends on accurate information from the reporting facilities. CDPHE recently initiated a data validation project that will ensure the data are complete. This report should be used as one of many quality evaluation tools and cannot, on its own, paint a complete picture of hospital care in Colorado.

Overview of central line-associated bloodstream infections (CLABSI) and ICU types

Central line-associated bloodstream infections are primary bloodstream infections associated with the presence of a central line at the time of or before the onset of an infection. A central line is an intravascular catheter (tube in a vein) that terminates at or close to the heart or in one of the great vessels. An example of a great vessel is the aorta or superior vena cava. A central line can be used to infuse fluids or withdraw blood in patients. Central lines can be either temporary or permanent.

The department requested facilities report CLABSIs by NHSN defined units. The information in this bulletin will cover central lines in the following units:

- Adult Medical ICU: specializes in the care of patients who are being treated for non-surgical conditions
- Adult Medical Cardiac ICU: specializes in care of patients with serious heart problems that do not require heart surgery
- Adult Medical/Surgical ICU: specializes in the care of critically ill patients who are being treated for medical conditions, surgical conditions or both
- Adult Surgical ICU: specializes in the care of patients with serious illness before and/or after surgery
- Adult Surgical Cardiothoracic ICU: specializes in care of patients following cardiac and thoracic surgery (i.e., surgeries on the organs within the chest)

Since there are 44 Medical/Surgical ICUs in Colorado that report into the NHSN, the department further classified those facilities by the monthly average number of central line days. The number of central line days is the total number of days a central line was used in the ICU during the reporting period. This allows comparisons between similar facilities. Smaller facilities with lower average monthly central line days are likely to have very few infections compared to much larger facilities with high average monthly central line days. There are four groups of Adult Medical/Surgical ICUs:

- Group 1: < 20 central line days/month
- Group 2: Between 21 and 125 central line days/month
- Group 3: Between 126 and 210 central line days/ month
- Group 4: > 211 central line days/month

Not every hospital has all five intensive care units. Hospitals determine which type of ICU they have by measuring the type of patients cared for in that area and applying the “80/20 rule”, an NHSN criteria. For instance, the medical ICU serves non-surgical patients, so if a facility finds that 80 percent of their critical care patients are non-surgical that facility would have a medical ICU, according to NHSN definitions.

Reporting CLABSI by unit type allows for fairer comparisons between hospitals. It takes into account differences in the type of patients ICUs treat and the different risks for infection. Most CLABSIs that occur in these facility locations can:

- Be prevented by following established prevention techniques;
- Easily be detected and reported accurately; and
- Have a devastating impact on the patient’s quality of life.

Pathogens associated with central line-associated bloodstream infections

There are a variety of organisms that cause hospital-acquired infections, specifically, CLABSIs. These pathogens can be transmitted through a various routes including: direct contact, droplets in the air from coughing and/or sneezing, and contaminated items. There are many ways to prevent the transmission of these pathogens including: isolation precautions of infected individuals, hand washing, donning gowns and gloves and sanitizing soiled surfaces. Over time, the presence of certain pathogens can change due to various reasons including antibiotic resistance, evolution of pathogens, and increased prevention methods and surveillance.

Results

The tables below show facility specific data for CLABSIs attributed to the five ICU types discussed above. Results are presented separately for each type of ICU as well as for each group of Adult Medical/Surgical ICU. Since there are 44 Medical/Surgical ICUs in Colorado, the department further classified those facilities by the monthly average number of central line days. The tables contain cumulative data from August 1, 2007 through July 31, 2010. Of the nine graphs, seven show the yearly CLABSI trend data for each type of ICU and for each group of Adult Medical/Surgical ICU (Note: There is no graph depicting the trend data for Group 1 because the infection rate for all facilities but one was 0. This facility can be found in Graph 3b). There are two graphs that depict the changing presence of pathogens over the last three years.

Each table lists all the hospitals in Colorado with that type of ICU, the city where the hospital is located, the number of central line days in the unit, the average monthly central line days, the number of infections in the unit, the infection rate for the unit and comparisons to the national infection rate and Colorado infection rate as well as a comparison to the group infection rate for the Medical/Surgical ICU. The central line-associated bloodstream infection rate is the number of infections per 1,000 central line days. There are three categories summarizing how a Colorado hospital compares to other infection rates for that ICU:

1. Hospitals can have a statistically lower (better) infection rate than the national/CO/Group unit rate;
2. Hospitals can have an infection rate that is statistically the same as the national/CO/Group unit rate; or
3. Hospitals can have a statistically higher (worse) infection rate than the national/CO/Group unit rate.

The comparison is based on statistical significance. Statistical significance is the likelihood that a result occurred due to a scientific reason and not by chance alone. In these data, statistical significance suggests that the difference between the national or Colorado infection rate and the facility specific infection rate was due to a scientific reason. For example, a facility that is significantly better than the national average could be instilling certain protocols that are preventing infections. Additionally, if a facility is worse than the national average, it could be due to a need for improvement of protocols and procedures to prevent infections or their patient population is at a higher risk for infection. There are three different levels of statistical significance. The 1st level (*) suggests that there is a > 95% chance that the difference between the national or Colorado and facility specific infection rate was due to a scientific reason. The 2nd level (**) and the 3rd level (***) suggests that there is a greater than 99.0% and 99.9% chance, respectively, that the difference in rates was due to a scientific reason and not chance alone.

Table 1: Adult Medical ICU CLABSI rates from 2007 – 2010

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate+++	National comparison National Rate = 1.9	CO comparison CO rate= 1.47
Boulder Community Hospital Foothills*	Boulder	233	6.5	0	0.00	Same	Same
Centura Littleton Adventist Hospital**	Littleton	2561	71.1	1	0.39	Better*	Same
Centura St Anthony Central Hospital	Denver	8645	240.1	4	0.46	Better***	Better**
Centura St Anthony North Hospital	Westminster	10090	280.3	12	1.19	Same	Same
Denver Health Medical Center	Denver	10245	284.6	12	1.17	Better*	Same
Platte Valley Medical Center	Brighton	1149	31.9	3	2.61	Same	Same
University of Colorado Hospital	Aurora	10674	296.5	32	3.00	Same	Worse***

+ Data collected from 12/2007 through 7/2010

++ Data collected from 8/2007 through 6/2008

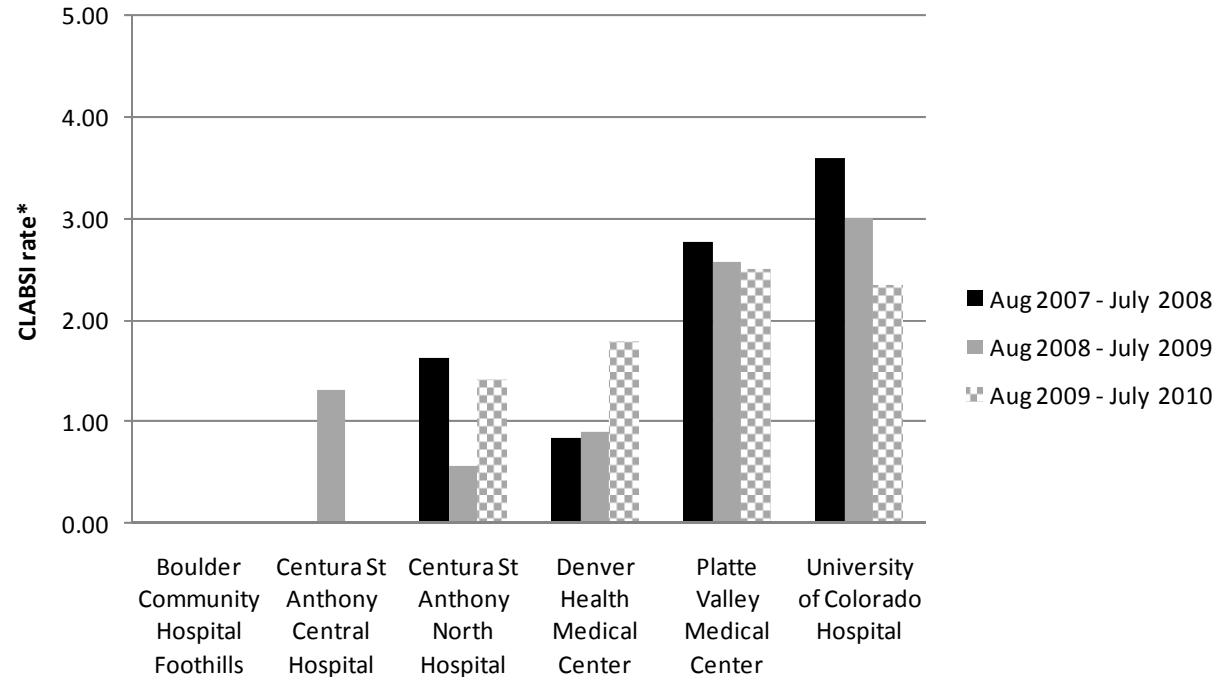
+++ CLABSI rate is number of infections/1000 central line days

* > 95.0% chance that the difference between the national or CO rates and the facility specific rates was due to a scientific reason

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Graph 1: Adult Medical ICU CLABSI Rates by year for 2007 – 2010



* CLABSI rate is number of infections/1000 central line days

Table 2: Adult Medical Cardiac ICU CLABSI rates from 2007 – 2010

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate++	National comparison National Rate = 2.0	CO comparison CO rate= 1.0
Exempla Lutheran Medical Center	Wheat Ridge	5789	160.8	5	0.86	Better*	Same
Memorial Hospital Central†	Colorado Springs	4498	124.9	2	0.44	Better**	Same
North Colorado Medical Center	Greeley	6173	171.5	2	0.32	Better***	Same
University of Colorado Hospital	Aurora	3483	96.8	12	3.45	Same	Worse***

+ Data collected from 08/2007 through 4/30/2010

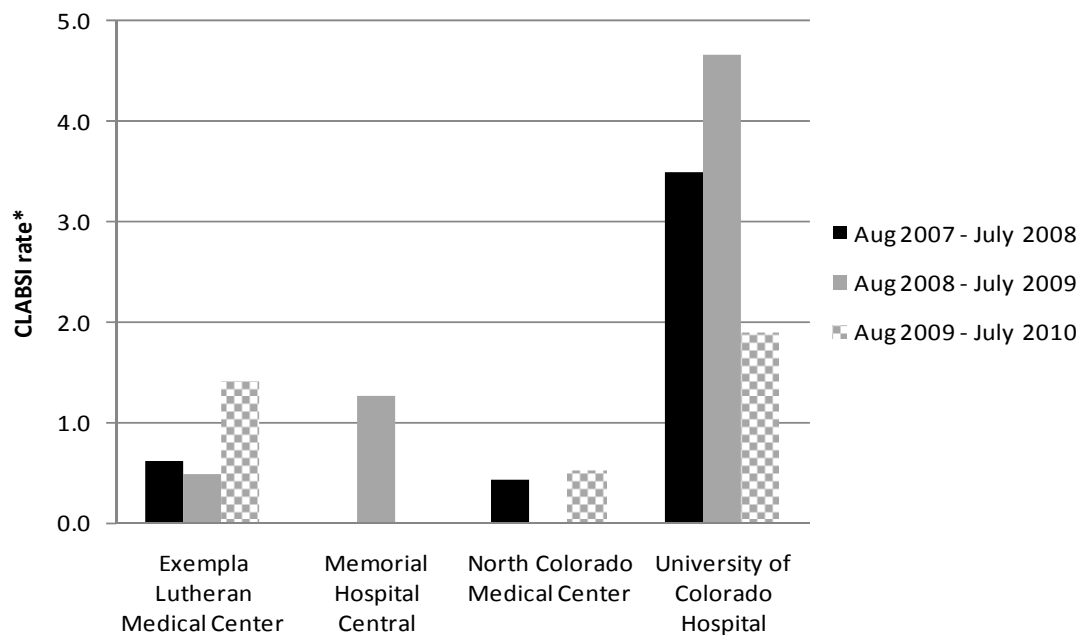
++ CLABSI rate is number of infections/1000 central line days

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Graph 2: Adult Medical Cardiac ICU CLABSI rates by year for 2007 – 2010



* CLABSI rate is number of infections/1000 central line days

Table 3a: Adult Medical/Surgical ICU CLABSI rates from 2007 – 2010 (Group #1: ≤ 20 central line days/month)

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate+	National comparison National Rate = 1.5	CO comparison CO rate= 1.2	Group comparison Group rate = 0.3
Arkansas Valley Regional Medical Center	La Junta	457	12.7	0	0.00	Same	Same	Same
Aspen Valley Hospital	Aspen	176	4.9	0	0.00	Same	Same	Same
Centura St Thomas More Hospital	Canon City	165	4.6	0	0.00	Same	Same	Same
Colorado Plains Medical Center	Fort Morgan	225	6.3	0	0.00	Same	Same	Same
Gunnison Valley Hospital	Gunnison	4	###	###	###	###	###	###
Heart of the Rockies Regional Medical Center	Salida	94	###	###	###	###	###	###
Southwest Memorial Hospital	Cortez	437	12.1	0	0.00	Same	Same	Same
St Anthony Summit Medical Center	Frisco	329	9.1	1	3.04	Same	Same	Same
Sterling Regional Medical Center	Sterling	467	13.0	0	0.00	Same	Same	Same
Vail Valley Medical Center	Vail	593	16.5	0	0.00	Same	Same	Same
Yampa Valley Medical Center	Steamboat Springs	142	3.9	0	0.00	Same	Same	Same

Infections data for hospitals with fewer than 50 central line days in a twelve month period are suppressed to protect confidential health information. These hospitals have met the reporting requirements.

+ CLABSI rate is number of infections/1000 central line days

Note: Since all but one of the facilities in this table has an infection rate of zero, there is no graph associated with this table. The data for St. Anthony Summit can be found in Graph 3b.

Table 3b: Adult Medical/Surgical ICU CLABSI rates from 2007 – 2010
Group #2: 21 - 125 central line days/month

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate+	National comparison National Rate = 1.5	CO comparison CO rate= 1.2	Group comparison Group rate = 0.8
Centura Avista Adventist Hospital	Louisville	1757	48.8	2	1.14	Same	Same	Same
Community Hospital	Grand Junction	1233	34.3	1	0.81	Same	Same	Same
Delta County Memorial Hospital	Delta	1027	28.5	0	0.00	Same	Same	Same
McKee Medical Center	Loveland	2018	56.1	3	1.49	Same	Same	Same
Medical Center of the Rockies-North Wing	Loveland	4498	124.9	0	0.00	Better**	Better**	Better*
Mercy Regional Medical Center	Durango	3277	91.0	2	0.61	Same	Same	Same
Montrose Memorial Hospital	Montrose	1156	32.1	0	0.00	Same	Same	Same
Parker Adventist Hospital	Parker	2494	69.3	6	2.41	Same	Same	Worse*
San Luis Valley Regional Medical Center	Alamosa	982	27.3	0	0.00	Same	Same	Same
St Mary's Hospital	Grand Junction	4395	122.1	5	1.14	Same	Same	Same
Valley View Hospital	Glenwood Springs	1148	31.9	0	0.00	Same	Same	Same

+ CLABSI rate is number of infections/1000 central line days

* > 95.0% chance that the difference between the national, CO or group rates and the facility specific rates was due to a scientific reason

** > 99.0% chance that the difference between the national, CO or group rates and the facility specific rates was due to a scientific reason

Graph 3b: Adult Medical/Surgical ICU CLABSI Rates by year for 2007 – 2010
Group #2: 21 – 125 central line days/month

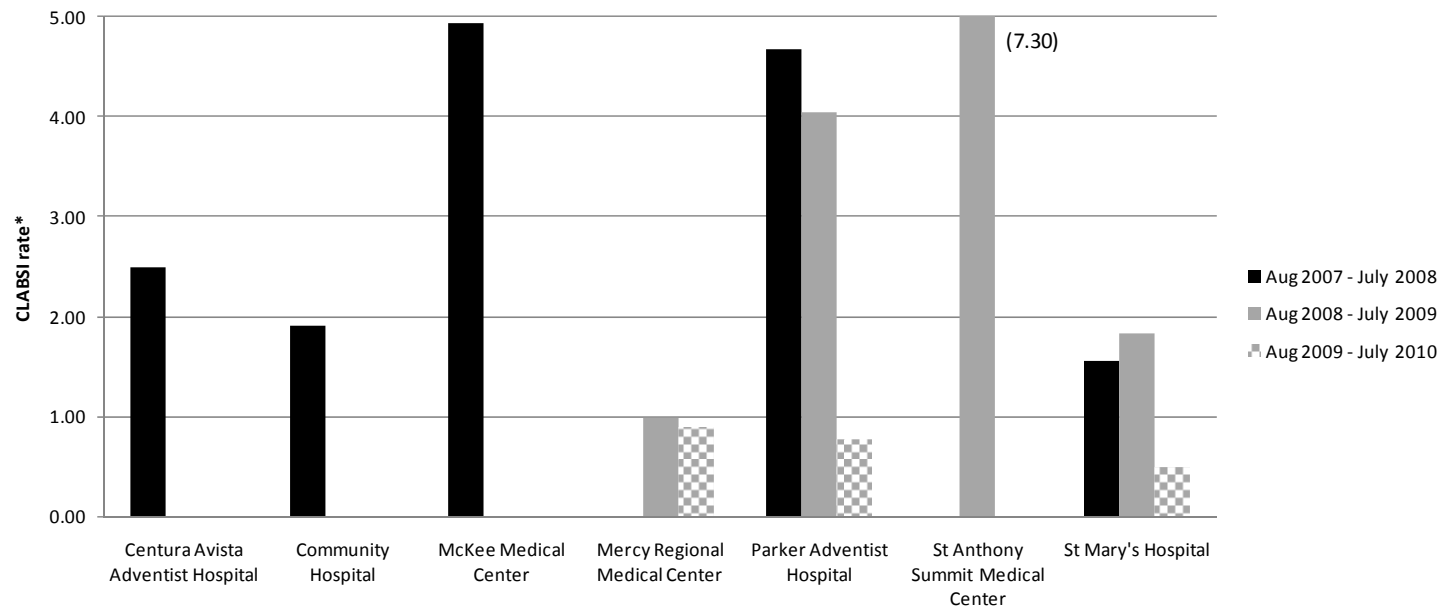


Table 3c: Adult Medical/Surgical ICU CLABSI rates from 2007 – 2010
Group #3: 126 – 210 central line days/month

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate++	National comparison National Rate = 1.5	CO comparison CO rate= 1.2	Group comparison Group rate = 0.8
Boulder Community Hospital	Boulder	5644	156.8	7	1.24	Same	Same	Same
Centura Littleton Adventist Hospital+	Littleton	6124	170.1	2	0.33	Better**	Better*	Same
Centura St Mary Corwin Medical Center	Pueblo	7473	207.6	5	0.67	Better*	Same	Same
Exempla Good Samaritan Medical Center	Lafayette	7161	198.9	7	0.98	Same	Same	Same
Medical Center of the Rockies-South Wing	Loveland	5334	148.2	3	0.56	Better*	Same	Same
North Colorado Medical Center	Greeley	7029	195.3	5	0.71	Better*	Same	Same
North Suburban Medical Center	Thornton	5097	141.6	4	0.78	Same	Same	Same
Parkview Medical Center	Pueblo	5321	147.8	4	0.75	Same	Same	Same
Poudre Valley Hospital	Fort Collins	5084	141.2	5	0.98	Same	Same	Same
Sky Ridge Medical Center	Lone Tree	7316	203.2	9	1.23	Same	Same	Same

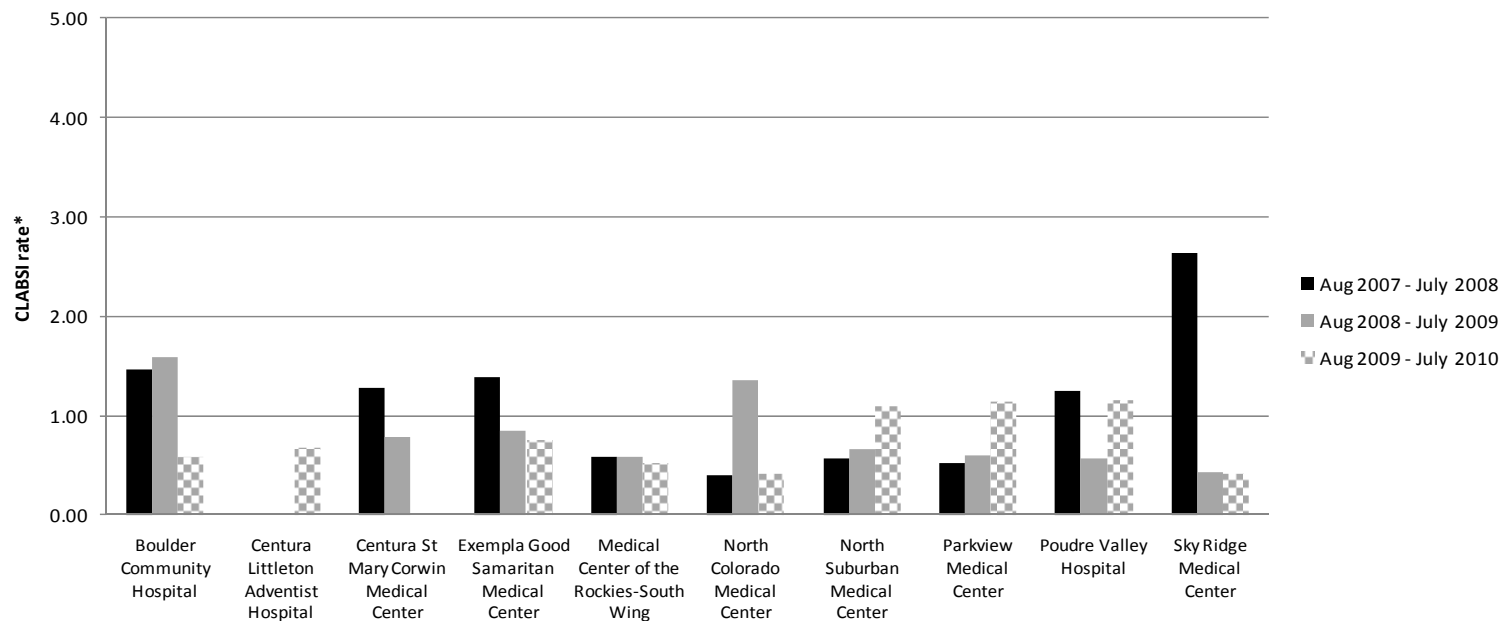
+ Data collected from 06/08 through 07/10

++ CLABSI rate is number of infections/1000 central line days

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Graph 3c: Adult Medical/Surgical ICU CLABSI Rates by year for 2007 – 2010
Group #3: 126 - 210 central line days/month



* CLABSI rate is number of infections/1000 central line days

Table 3d: Adult Medical/Surgical ICU CLABSI rates from 2007 – 2010
Group #4: ≥ 211 central line days/month

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate++	National comparison National Rate = 1.5	CO comparison CO rate= 1.2	Group comparison Group rate = 1.5
Centura Penrose St Francis Health	Colorado Springs	10979	305.0	21	1.91	Same	Worse*	Same
Centura Porter Adventist Hospital	Denver	12458	346.1	18	1.44	Same	Same	Same
Exempla Lutheran Medical Center	Wheat Ridge	10563	293.4	6	0.57	Better**	Better*	Better**
Exempla St Joseph Hospital	Denver	13485	374.6	4	0.30	Better***	Better***	Better***
Longmont United Hospital	Longmont	8111	225.3	3	0.37	Better**	Better*	Better**
Memorial Hospital Central	Colorado Springs	13471	408.2	18	1.34	Same	Same	Same
Presbyterian St Luke's Medical Center	Denver	7904	219.6	12	1.52	Same	Same	Same
Rose Medical Center	Denver	7663	212.9	18	2.35	Worse*	Worse**	Worse*
Swedish Medical Center	Englewood	25999	722.2	60	2.31	Worse**	Worse***	Worse**
The Medical Center of Aurora	Aurora	16487	458.0	32	1.94	Same	Worse**	Same

+ Data collected from 08/07 through 4/10

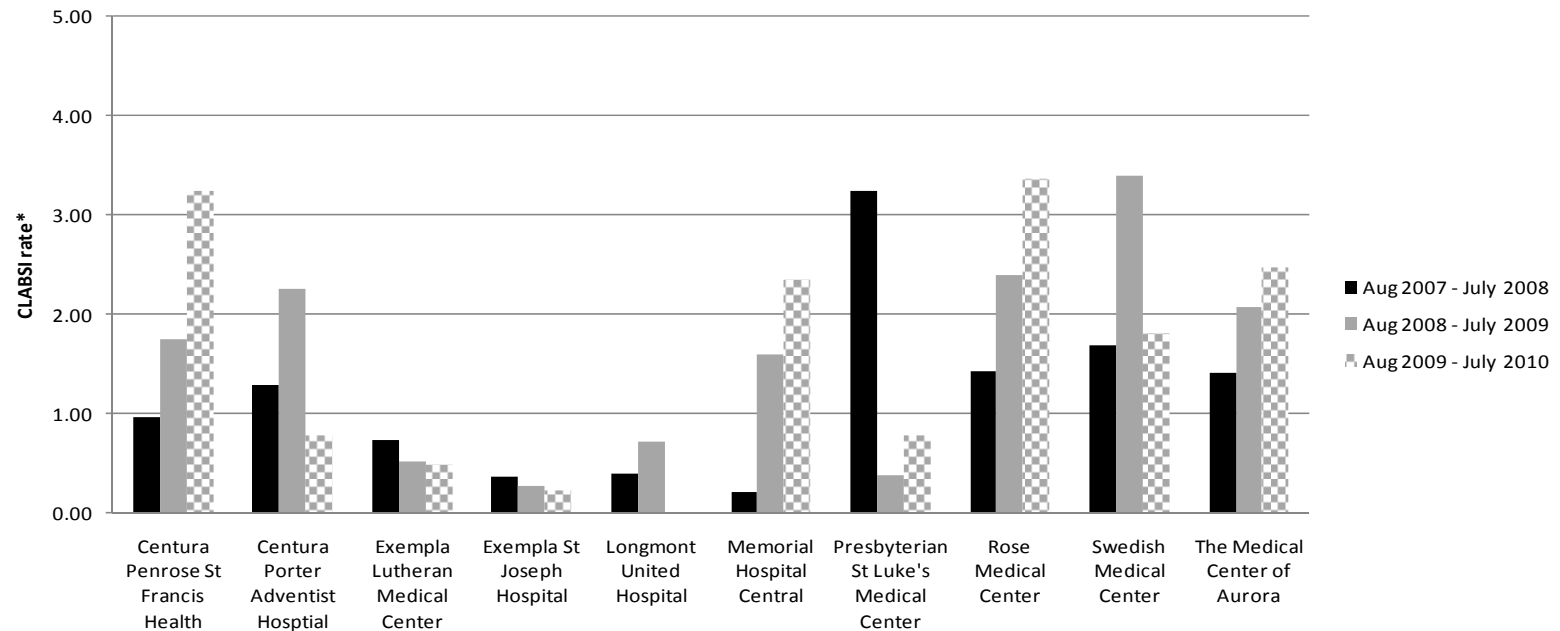
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Graph 3d: Adult Medical/Surgical ICU CLABSI Rates by year for 2007 – 2010
Group #4: ≥ 210 central line days/month



* CLABSI rate is number of infections/1000 central line days

Table 4: Adult Surgical ICU CLABSI rates from 2007 – 2010

Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate+	National comparison National Rate =2.3
University of Colorado Hospital	Aurora	11043	306.8	40	3.62	Worse**

+ CLABSI rate is number of infections/1000 central line days

** > 99.0% chance that the difference between the national or CO rates and the facility specific rates was due to a scientific reason

Table 5: Adult Surgical Cardiothoracic ICU CLABSI rates from 2007 – 2010

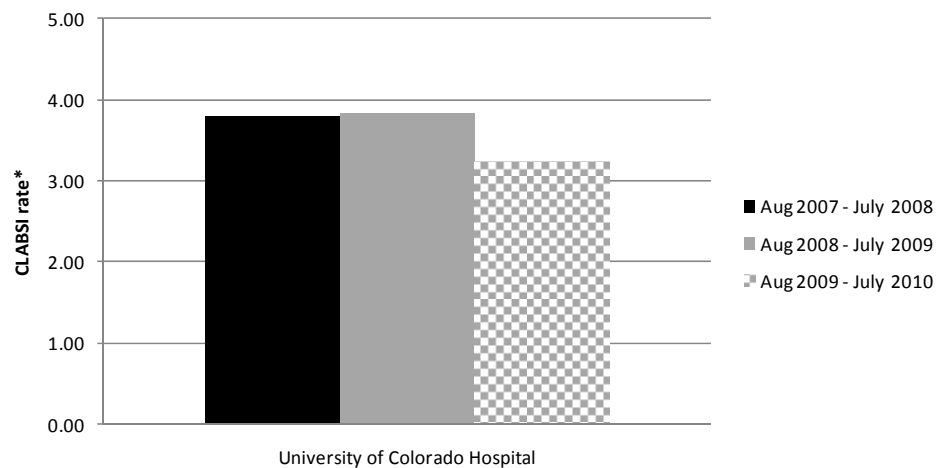
Facility Name	Region	Total central line days	Average monthly central line days	CLABSI	CLABSI rate+	National comparison National Rate = 1.4	CO comparison CO rate= 0.38
Centura St Anthony Central Hospital	Denver	6178	171.6	2	0.32	Better**	Same
St Mary's Hospital	Grand Junction	4310	119.7	2	0.46	Same	Same

+ CLABSI rate is number of infections/1000 central line days

* > 95.0% chance that the difference between the national or CO rates and the facility specific rates was due to a scientific reason

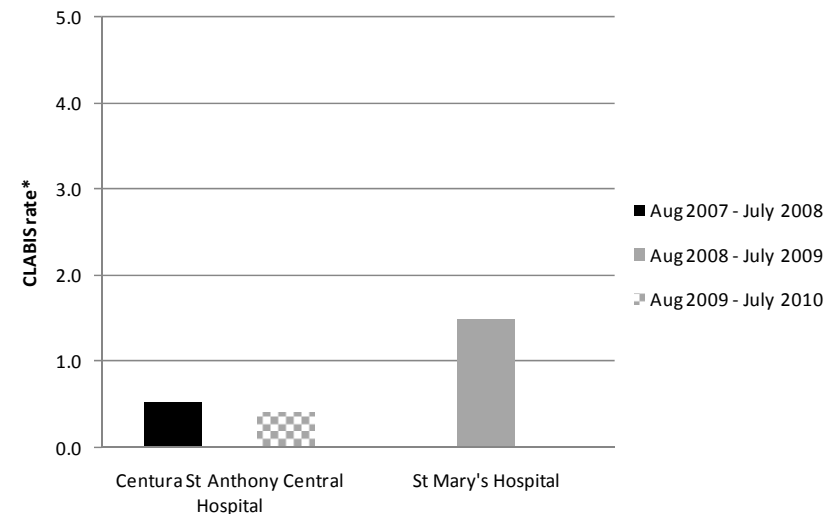
** > 99.0% chance that the difference between the national or CO rates and the facility specific rates was due to a scientific reason

Graph 4: Adult Surgical ICU CLABSI Rates by year for 2007 – 2010



* CLABSI rate is number of infections/1000 central line days

Graph 5: Adult Surgical Cardiothoracic ICU CLABSI Rates by year for 2007 – 2010



* CLABSI rate is number of infections/1000 central line days

Pathogens that cause central line-associated bloodstream infections

Below are brief descriptions of the significant pathogens that have contributed to approximately 90% of central line associated bloodstream infections in Colorado since 2007.

Candida species: *Candida* is yeast that is responsible for approximately 10% of all healthcare acquired bloodstream infections. Risk factors for a *Candida* infection include: broad-spectrum antibiotic use, presence of a central line catheter, gastrointestinal procedures, renal insufficiency, and the intensive care setting. In otherwise healthy individuals, these infections can be cured with antifungal medications, however, persistent and deep-seated yeast infections can be lethal in immunocompromised patients. The percentage of CLABSIs caused by *Candida* in Colorado ICUs has increased from 17.9% to 22.9% since 2007 (Graph 6).

Coagulase negative *Staphylococcus* (CNS): CNS is normal bacteria found on the skin; however, it can cause severe infections in immunosuppressed patients and those with central line catheters. CNS was once considered a relatively non-threatening pathogen and usually a contaminant when isolated from a clinical specimen. These organisms have become increasingly important healthcare acquired bloodstream pathogens, however in the Colorado population; the portion of CLABSIs caused by CNS has dropped from 36.9% to 30.0% in the last three years (Graph 6).

Enterococcus species: Enterococcal infection is the second most common cause of hospital-acquired infections in the United States. Most human clinical isolates are either due to *E. faecalis* and *E. faecium*, which are two pathogens that are typically found in human intestines. Risk factors for enterococcal infection include: prolonged hospitalization, lengthy ICU stay, and immunocompromised state. *Enterococcus* species have developed a resistance to the antibiotic, vancomycin, and the prevalence of vancomycin-resistant *Enterococcus* hospital-acquired infections are on the rise worldwide. In the Colorado ICU population the portion of CLABSIs caused by *Enterococcus* species ranged from 3.0 to 8.3% in the last three years (Graph 6).

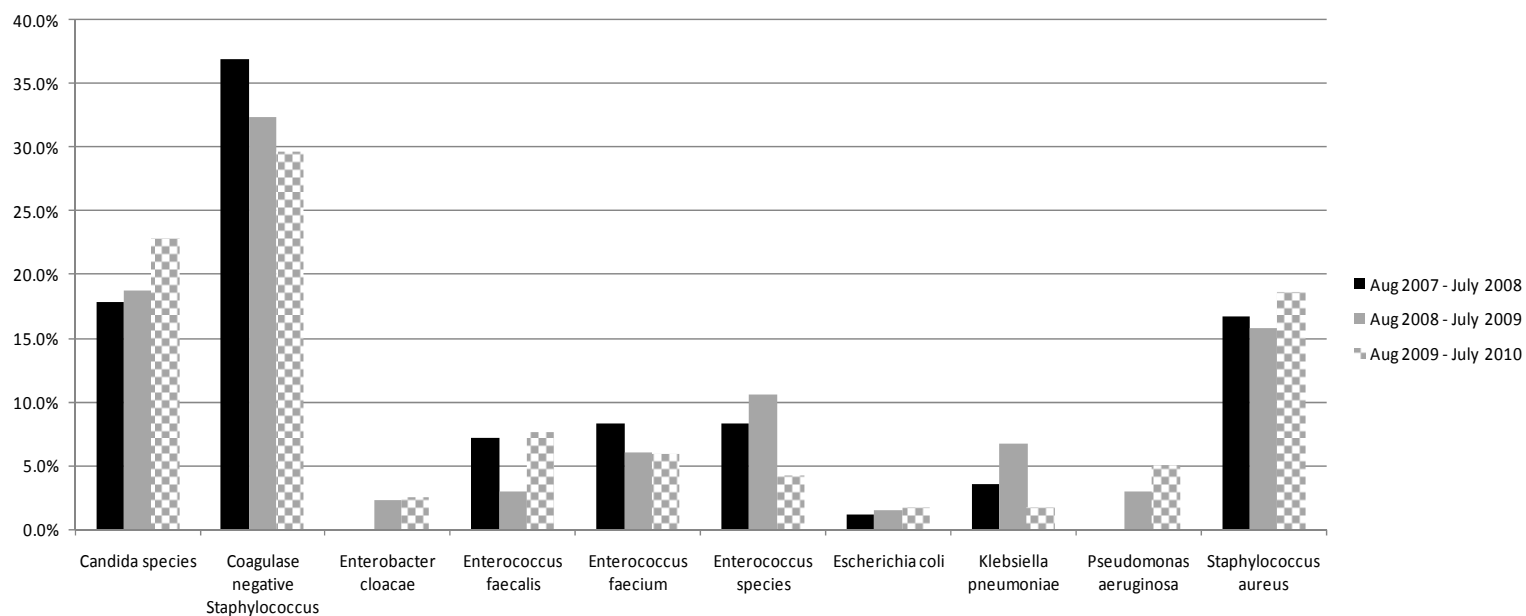
Klebsiella species: Klebsiellae are ubiquitous in nature. In humans, they may colonize the skin, pharynx, or gastrointestinal tract. Two members of this family likely to cause human infection are *K. pneumoniae* and *K. oxytoca*. They are typically found in the gastrointestinal tract of patients as well as on the hands of healthcare workers. The presence of an invasive device, such as a central line catheter, greatly increases the likelihood of a *Klebsiella* infection. Up to 6.8% of CLABSIs in the Colorado ICUs can be attributed to *Klebsiella* infections between 2007 and 2010 (Graph 6).

Pseudomonas aeruginosa: This organism is widespread in nature, inhabiting water, soil, plants and animals and is the most frequent colonizer of medical devices. It is the most common pathogen isolated from patients who have been hospitalized longer than one week. All infections caused by *P. aeruginosa* are treatable and potentially curable. However, bloodstream infections are associated with mortality rates as high as 10%. In Colorado ICUs, the portion of CLABSIs caused by *P. aeruginosa* has increased from 0% to 5.1% from 2007 to 2010 (Graph 6).

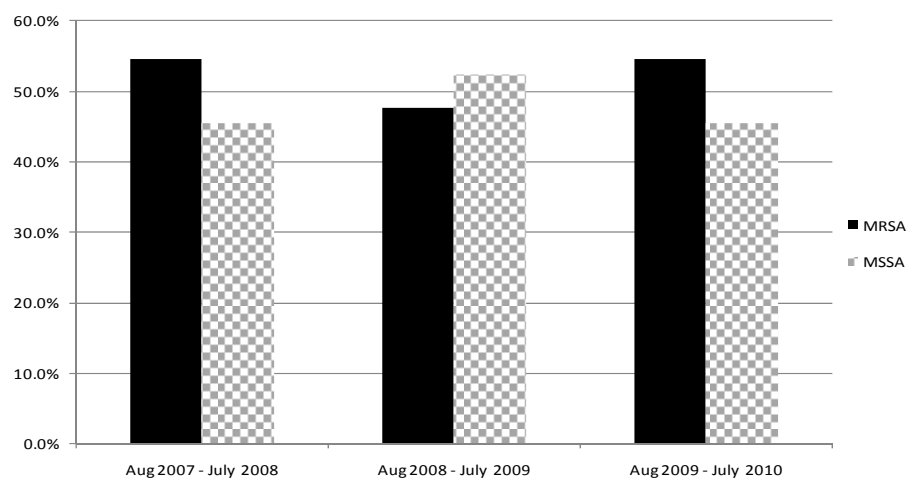
Staphylococcus aureus: *S. aureus* can be found on human skin, in human noses, and can survive on domesticated animals. It can survive for months on dry, environmental surfaces. This pathogen has facilitated transmission in the medical facilities mainly because of insufficient healthcare worker hygiene. The mortality rate of untreated *S. aureus* CLABSIs can exceed 80%. The percentage of CLABSIs caused by *S. aureus* in Colorado ICUs has ranged from 15.8% to 18.6% since 2007 (Graph 6).

Methicillin-resistant *Staphylococcus aureus*: Prior to 1950, *S. aureus* was effectively treated by penicillin. However, by 1959, *S. aureus* started becoming resistant to penicillin so it was treated by methicillin, an antibiotic slightly different from penicillin. A few years later, it was clear that the presence of methicillin-resistant *S. aureus* was on the rise. In Colorado adult ICUs, methicillin-resistant *S. aureus* has been as high as 55% of all *S. aureus* infections since 2007 (Graph 7).

Graph 6: Pathogens that caused CLABSIs in Colorado ICUs from 2007 to 2010



Graph 7: Percent of methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-susceptible *Staphylococcus aureus* (MSSA) associated with CLABSIs in Colorado ICUs



Conclusion

This report shows the results of data collection from 2007 to 2010. The department and the Colorado Health Facility Acquired Infection Advisory Committee recommend users of these data not base conclusions solely from the limited information that is currently available. Facilities vary in the types of patients they treat, and a facility that treats a high volume of severely ill patients may have higher infection rates. The department believes that this disclosure initiative will ultimately help Colorado health facilities identify areas for improvement and result in fewer infections in the coming years. Evidence suggests that tracking CLABSIs may lead to better adherence to preventive practices and decrease medical complications or death. The department and its infection advisory committee are eager to continue this initiative and are committed to providing this valuable information to Colorado healthcare consumers.

As infections are not the only adverse event that may happen to a consumer, it is important to weigh all factors in judging care quality. Consumers should always consult with their doctor, hospital, family and friends before deciding where to receive care. Consumers should consider the experience of the facility staff and other quality of care indicators in addition to the infection data below. For more information, please contact the patient safety initiatives program at:

Colorado Department of Public Health and Environment
HFEMSD-Patient Safety Initiatives
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: 303-692-2800
Fax: 303-753-6214
Email: cdphe.hfpatientsafety@state.co.us

Or view detailed information on implementing the disclosure initiative, including the annual and semi-annual reports by visiting the patient safety initiatives Web page at:

<http://www.cdphe.state.co.us/hf/PatientSafety/index.html>