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Expanding central line care bundle to address line manipulations

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ABSTRACT

Background: Central Line-Associated Blood Stream Infections (CLABSI) are serious healthcare-acquired conditions associated with high morbidity and mortality. Nationally the CLABSI incidence has reduced with the implementation of Centers for Disease Control and Prevention recommended prevention bundles. However, central line manipulation by healthcare workers and patients continue to cause CLABSIs and has not been adequately addressed in prevention bundles.

Project Aim: To evaluate line manipulations as CLABSI risk factor and describe prevention strategies.

Methods: The study evaluated CLABSIs during 2013-2015 from five hospital units admitting medicine service patients. CLABSI data were provided by the infection control division of the department of medicine. Data included demographics (age, gender, race), LOS, CLABSI information (date of event, pathogen, line type and location), and mortality. Additional chart reviews were conducted to obtain information on indication for line insertion, duration of line, manipulation and patient behaviors. Demographics and risk factors are reported as frequencies and percentages. CLABSI incidence per 1000 line days are reported over time.

Results: Thirty CLABSI events were reported during the study period. Line manipulation was noted within 48-72 hours prior to first documentation of symptoms of infection in 16 (53%) instances of CLABSI. Of these 16, nine (56%) line manipulations were for thrombolysis of blocked catheters, five (31%) CLABSI followed patient accession of lines for IV drug abuse, two (13%) patients had opioid dependence and received parenteral opioids at frequent intervals. Two of the patients who had thrombolysis also had line accession, one by the patient and one by healthcare worker for frequent IV medications prior to developing CLABSI.

Conclusions: Fifty-three percent of CLABSI occurred following line manipulations by healthcare worker or the patient. More intensive line care and strategies to avoid line manipulations by patients are needed to effectively further reduce CLABSIs.

KEY WORDS:

Central venous access; bloodstream infection; healthcare-associated infections; hygiene; infection control; infection prevention; intravenous use; misuse; non-adherence

BACKGROUND

Central Line-Associated Blood Stream Infections (CLABSIs) are healthcare-acquired conditions (HACs) associated with high morbidity and mortality. A total of 250,000 bloodstream infections (BSI) occur annually in hospitalized patients and about one third are CLABSI in ICU settings (1). One in four patients who develop CLABSI will die within 30 days as per 2014 report from the Centers for Disease Control and Prevention (CDC) (2). CLABSIs are known to increase median length of hospital stay by 24 days (3). Implementation of CDC recommended prevention bundle has significantly reduced CLABSI incidence across the United States by 50% in 2013 and 2014 from the 2008 baseline (4). The common mechanisms of developing CLABSIs are pathogen migration along external surface of the catheter which usually occurs in first seven days of insertion, or hub contamination from the handling of equipment causing intraluminal colonization and infection within ten days of insertion. Less common mechanism is hematogenous seeding of pathogens from infection source elsewhere in the body and contaminated infusion fluids. The CLABSI risk factors present at the time of insertion are well established such as selection of site, type of catheter (non-antibiotic impregnated), number of lumens of the port, lack of aseptic precautions, multiple attempts, skill and experience of the person inserting line (5). Factors during line

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maintenance phase causing contamination at the puncture site as well as intravenous fluids and equipment; are frequent handling and manipulations of the catheter, line days, and inadequate hand hygiene and barrier precautions (4-7).

The recommended prevention bundle mainly incorporates strategies to reduce risk at insertion and maintenance of central lines (8). Healthcare providers manipulate central lines as part of usual line care. They flush the lines, administer fluids, pharmaceuticals and thrombolytic therapy. It has been known that soiled dressings and local contamination leads to line infection (9). Frequent access of lines causes colonization and can lead to bacteremia and sepsis (10). Some patients may tamper with the central line due to underlying delirium or behavioral health issues, or they may inject illicit substances. This also leads to contamination and subsequent BSIs (11,12).

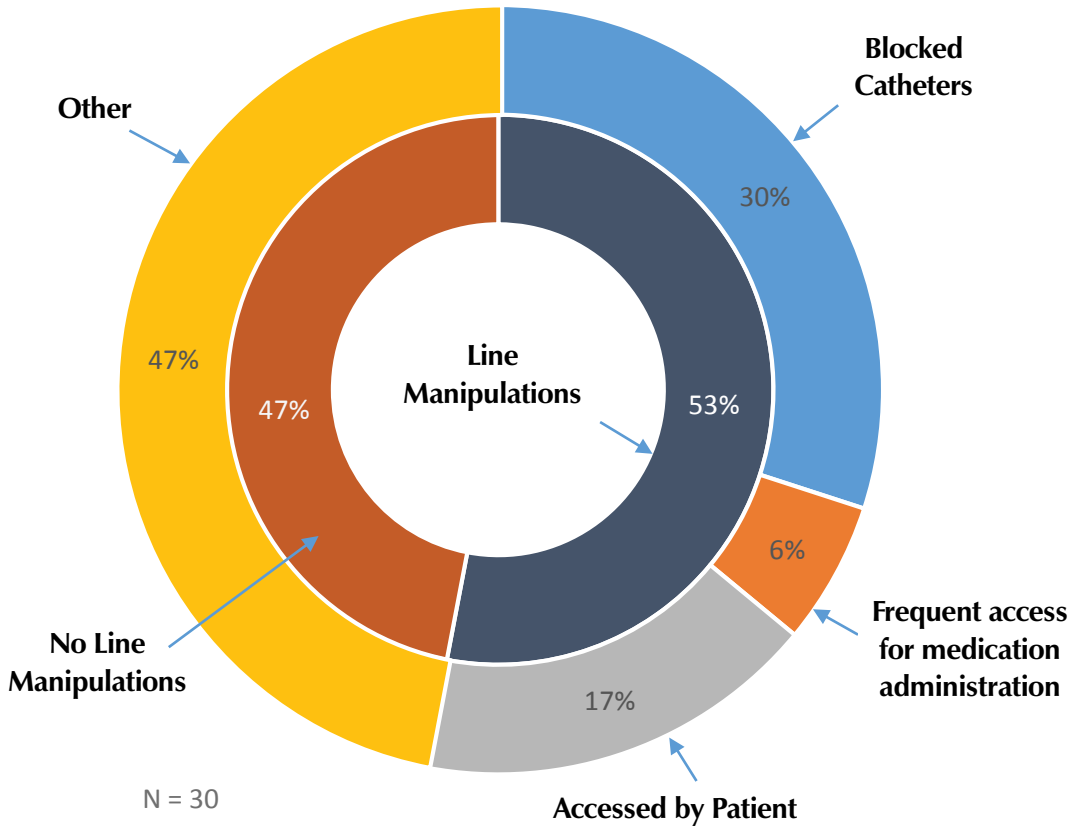
However, the CDC prevention bundle does not specifically address line manipulations. Lately, BSIs have not been counted as central line-associated if there is clear documentation of accession or high suspicion of accession of central lines by the patients (13). Apart from mandatory surveillance and reporting, line manipulation is a safety concern associated with very high risk of BSI which needs to be addressed. Our study evaluates the risk factors and discusses interventions aimed at preventing line manipulations.

METHODS

As part of national surveillance CLABSIs are reported to National Health Safety Network (NHSN). A CLABSI is a laboratory-confirmed bloodstream infection where central line was in place for more than two calendar days on the date of event, with day of device placement being Day 1, and the line was also in place on the date of event or the day before. A BSI is also considered CLABSI if it develops on or within 24 hours of removal of central line.

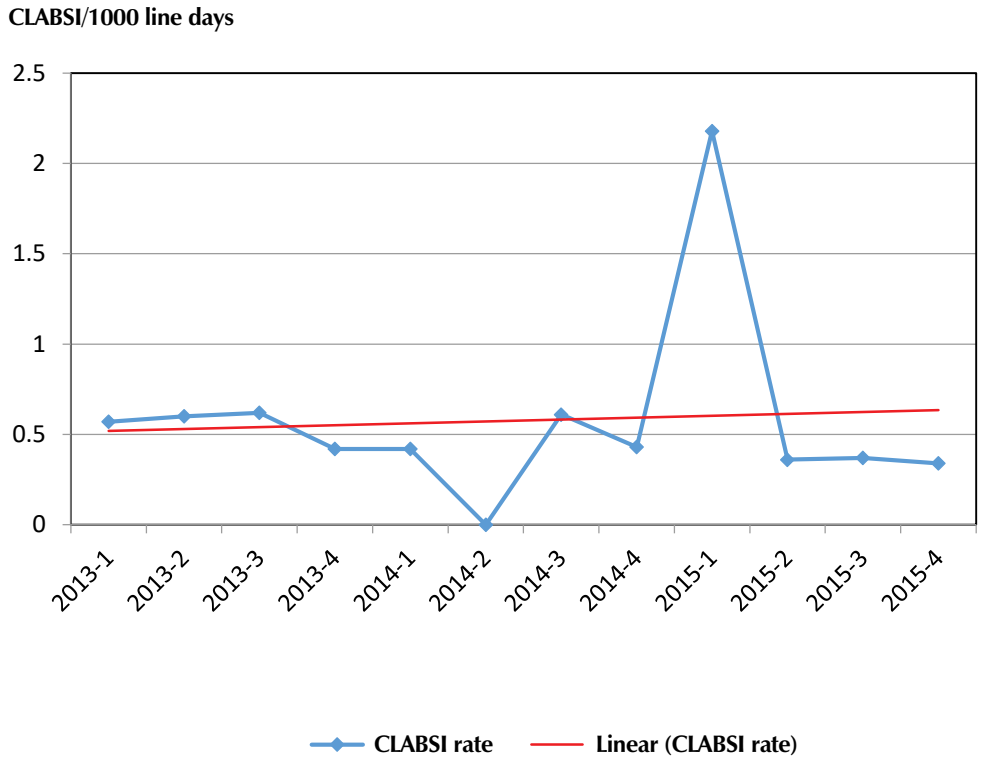
If the patient is admitted or transferred into a facility with an implanted central line (port) in place, and that is the patient's only central line, the day of first access in an inpatient location is considered risk Day 1. "Access" is defined as line placement, insertion of needle into the port, infusion or withdrawal through the line. Such lines continue to be eligible for a CLABSI once they are accessed until they are either discontinued (i.e., removed from body) or the day after patient discharge. The CLABSI

FIGURE 1: CLABSI Risk Factors



Return to TABLE OF CONTENTS

FIGURE 2: CLABSI Rates on medicine units over time



defining and reporting also follows the rules for repeat infection timeframe, transfer rule for attribution to the unit, and secondary infection due to other site infection or commensal organisms. Additional details can be found at the NHSN website (13).

Our study evaluated CLABSIs reported to NHSN during 2013-2015 from hospital units admitting medicine service line patients at a tertiary care academic center. CLABSI data was provided by the infection control division of department of medicine. Data included demographics (age, gender, race), hospital length of stay (LOS), CLABSI information (date of event, pathogen, line type and location), and mortality. Additional chart reviews were conducted to obtain information on indication for line, line insertion details, duration of line, line manipulation and patient behaviors. Study results are reported descriptively as frequencies and percentages for the demographics and risk factors. The CLABSI incidence are reported as events per thousand line days.

RESULTS

There were 30 CLABSIs reported in 29 patients on medical units from 2013-2015. Patient demographic characteristics were: 10 females (33.3%), age range 26 to 88 years with median age of 42 years. Twenty-three (76.7%) patients were younger than 65 years. Four (14%) patients were African-American, 23 (79%) Caucasian and two (7%) did not have race identified in the charts. Two (7%) patients died in the hospital.

Thirteen (45%) of these patients developed CLABSI during readmission within 30 days and seven (24%) were transferred from outside hospital. The LOS ranged from eight to 189 days with 29 days being median duration. The medicine study units CLABSI incidence rates for 2013, 2014 and 2015 were respectively 0.57, 0.36 and 0.64 per 1000 line days.

The central line types included twenty (66.7%) peripherally inserted central catheters (PICC) and 10 (33.3%) central venous catheters (CVC). The CVC insertion sites included two subclavian, one femoral and seven internal jugular veins. Twenty-four (80%) lines were inserted on right side. All lines were elective procedures except for one emergency femoral line insertion. Lines were placed by interventional radiology (12, 40%), IV team (12, 40%) and by physicians on the floor or ICU (6, 20%). Seventy-nine (23) percent of line placements involved a single puncture.

Indications for central lines were total parenteral nutrition (1, 3%), monitoring (1, 3%), dialysis (4, 14%) and antibiotics, fluids and medications (24, 80%). Insertion sites appeared normal in 23 (77%) lines while swelling or bleeding was documented in seven (23%) lines. Time to infection ranged from 2 to 80 days, with a median of 11 days after insertion of lines.

TABLE 1: Demographics: 29 patients had 30 episodes of CLABSI	
Patients	N=29
Age, Median (Range) years	42 (26-88)
Patients <65 years age, N (%)	23 (76.7)
Female, N (%)	10 (33.3)
African American, N (%)	4 (14)

A total of 16 (53%) instances of line manipulations were noted within 48-72 hours of infection (Figure 1). Nine (56%) of these manipulations were by the IV team for thrombolysis of blocked catheters, six (31%) episodes of CLABSI followed patient accession of lines, five for IVDA and one was tampering by patient pulling out the line causing bleeding and exposure. Two (13%) patients were opioid-dependent requiring IV opioids at frequent intervals for pain management. Two of the patients who had thrombolysis also had line accession, one by the patient and one by healthcare worker for frequent IV medications prior to developing CLABSI.

During the study period, a total of 2053 doses of alteplase were used for thrombolysis in 1033 medical patients which demonstrates large number of patients are exposed to line manipulation.

DISCUSSION

In the last few decades there have been several initiatives to improve patient outcomes and curtail cost of healthcare in United States. Institute of Medicine reported high number of adverse events and hospital acquired conditions that prove costly and result in poor outcomes (14). CLABSIs were recognized as a priority for prevention, well studied, with risk factors identified and management standardized.

However, line manipulations as a risk factor is not adequately addressed for CLABSI prevention (5,15).

Our CLABSI cohort did not reveal any specific demographic characteristics except that 65% of patients were younger than 65 years. There were no management factors identified such as multiple attempts at insertion or poor line care. In our study 53% of CLABSI developed following line manipulations by healthcare worker or the patient. Elsewhere it has been reported that catheter manipulations in neonatal care unit were significantly associated with CLABSI in newborn children (16). The study implemented strategies to reduce line access by the nurses which resulted in reduction in CLABSI. The blocked catheters when flushed or accessed for thrombolysis also cause CLABSI by pushing colonized organisms into the blood. Similar mechanism is observed for line accession by the patients (3,4). Thus patients with intravenous drug abuse (IVDA) history are at risk for CLABSI. Many require outpatient intravenous antibiotics which makes PICC lines use necessary as an outpatient. Patients misuse the lines and a home central line is unsafe in this group of patients (17). If the physician knows or suspects that the patient will misuse the site then it is recommended not to discharge patient with central line (6,18,19). The authors explain the risk in these patients is four folds due to IVDA, frequent manipulation, long time CVC colonization and sepsis, air embolism, drugs may contain thrombogenic materials leading to thrombosis and related complication.

Our study also identified 14% patients as having IVDA history and opioid dependence. There has been introduction of tamper resistant devices that makes it difficult for the patient to access the lines (19). This may reduce the risk somewhat; however, tampering may still occur by a patient injecting drug into tubes or trying to break the caps.

Our study is limited in that we did not use controls; the data is retrospectively collected which carries documentation bias of missing data and misinterpretation. However, the frequency of line manipulations is striking and as a safety and quality initiative appropriately resulted in prevention strategies.

In 2015 the NHSN reporting requirements excluded BSIs as CLABSI if there was documentation of line manipulation or high suspicion of line access such as syringe or drugs found in patient room. This was appropriate since hospitals and providers should not be held accountable for the patient actions. However, the risk of BSI and sepsis needs to be addressed in these patients. To effectively reduce CLABSI in these situations more intensive line care during and after line manipulations are required.

Currently at our institution besides the recommended line care following efforts are implemented 1. Removing blocked line if possible or replacing if indicated. 2. Identifying patient behaviors IVDA, opioid dependency and avoiding lines in these patients. 3. Nurse reviews medication regimen carefully to reduce the frequency of accessing lines. 4. Reinforcing line care bundle and personal hygiene. These measures will benefit patients and outcomes.

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Return to TABLE OF CONTENTS

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