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Multi-level Intervention Program – A Quality Improvement Initiative to Decrease Central Line-Associated Bloodstream Infections in the Pediatric Acute and Hematology/Oncology Units

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ABSTRACT

Introduction: Central Venous Catheters (CVCs) are placed in pediatric patients that require frequent and/or long-term access for intravenous treatments and increase the risk for Central line-associated bloodstream infections (CLABSIs). The specific aims of the study were to evaluate adherence to the intervention components and rates of Central Line Associated Bloodstream Infections (CLABSIs) over five years.
Methods: Implementation occurred on the acute care and hematology-oncology pediatric units of a quaternary health care setting in Southern California. Adherence rates were quantified using a CVC audit sheet and CLABSI rates were obtained quarterly before, and at year 1, 2, 3, 4, 5 of implementation.
Results: CLABSI rates for both pediatric units decreased over the five-year period. Adherence rates were 90% to 100% on the different features of the intervention; the lowest was adherence to Patient Protective Equipment (PPE). A total of 41 incidents of hospital-acquired CLABSIs were reported the year prior to the Bug Buster Committee, which decreased steadily to 9 incidents after implementation. The quarterly CLABSI rates in the Pediatric Acute Care ranged from 2.8 to 6.6/1,000 catheter days and in Pediatric Hematology-Oncology from 2.1 to 4.3/1,000 catheter days the year prior to implementation.
Conclusions: While adherence for staff remains high, parent/family adherence was low. We recommend including in the multi-level intervention, procedures targeting parent adherence such as patient education handouts, reviewing content on admission, placing signs on doors indicating PPE requirements, and promptly providing PPE to non-adherent family members.

Introduction

Central Venous Catheters (CVCs) are placed in pediatric patients that require frequent access for intravenous delivery of caustic medications, long-term infusion therapy, nutritional support, blood transfusions, and/or blood draws for medical tests (Cheung, Baerlocher, Asch, & Myers, 2009). Central line-associated bloodstream infections (CLABSIs) occur when bacteria or viruses enter the bloodstream through the CVC. CLABSIs consequently, may lead to unnecessary increased medical costs ($3700 to $36,000) due to sepsis, transfer to higher level of care, antibiotic use and prolonged hospital length of stay (Scott, 2009). Approximately 30,100 CLABSIs occur in the United States ICUs every year (Centers for Disease Control [CDC], 2018). CLABSI related mortality rates range from 12 to 25% (CDC, 2011). CLABSIs are a major and preventable source of morbidity and mortality in the pediatric patient population (The Joint Commission [TJC], 2012).

The most common types of microorganisms that cause CLABSIs are Candia albicans, Coagulase-negative Staphylococci, Enterobacter, Enterococcus, *Escherichia coli, Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and Streptococcus pneumonia (Haddadin & Regunath, 2018). There are many negative contributing

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factors that place a patient at risk for developing CLABSIs such as being immunocompromised, recipient of a transplant, dialysis dependent, total parenteral nutrition (TPN) dependent, the presence of an ostomy, and having multiple lines, tubes, and drains (Dissanaike, Shelton, Warner, & O'Keefe, 2007; Kelly et al., 2013).

We described and evaluated the four features of a multi-interventional program – a quality improvement initiative to decrease the number of CLABSIs on the acute care and hematology/oncology pediatric units in a quaternary health care setting in Southern California. The four features of the program included the 1) formation of the Bug

Table 1
Summary of components of the CVC bundle as reported in the literature.

Component of CVC bundle	Protocol	CLABSI rate outcomes (per 1000 catheter days)
Hand hygiene (Dandoy et al., 2015; Yuan et al., 2016)	• Before and after donning of gloves for palpation of catheter site insertion • Before and after catheter insertion, access, dressing, repair, or removal • After all other removal of gloves • Seven-step hand washing protocol with checklist surveillance	• Decrease from 2.03 to 0.39 ($p = 0.008$); pediatric oncology unit • Decrease from 3.1% in the control group to 0% in the study group (<0.05); very low birth weight infants
Personal protective equipment and aseptic technique (Atilla et al., 2016) Lin et al., 2017; Pallotto et al., 2017; Pavia & Mazza, 2016; Yuan et al., 2016).	• CVC inserter to wear a mask and cap, a sterile gown, and sterile gloves • Use a large (head-to-toe) sterile drape over the patient during placement of a CVC or exchange of the catheter over a guidewire • Pre-puncture upper site was washed with warm soapy water and cleaned with a 75% alcohol solution • Sterile gloves, sterile CVC barrier, and mask for all catheter line handling • Patient face or tracheotomy mask • Protective vest to prevent catheter contamination	• Decrease from 3.1% in the control group and 0% in the study group; ($p < 0.05$); medical intensive care units • Decrease from 9.27 at baseline to 7.66 after the intervention period ($p < 0.001$); very low birth weight infants • Decrease from 1.59 at baseline to 0.78 ($p < 0.05$); neonatal intensive care unit • Decrease from 2.25 to 0.81 ($p < 0.05$); pediatric oncology (Rinke et al., 2012) • Decrease from 8.59 to 1.33 ($p < 0.05$); short bowel syndrome • Decrease from 2.72 to 0.40 ($p = 0.01$); medical/-surgical units • Decrease from 6.20 to 1.05 per ($p = 0.05$); medical intensive care unit
Catheter type selection & site selection (Habas et al., 2018; Yuan et al., 2016)	• Brachiocephalic vein (BCV) as the CVC insertion site via the ultrasound-guided supraclavicular approach with the more traditional placement techniques (femoral, subclavian, or jugular sites) • First-choice insertions site established as the basilic vein, followed by the cubital and axillary veins	• Decreased from 16.4%: 95% CI: 0.12–0.70 to 5.4%: 95% CI: 0.12–0.70; medical surgical unit • Decreased from 3.1% catheter days in the control group to 0% ($p < 0.05$) in the study group; very low birthweight infants
Sterile dressing & Line maintenance (Atilla et al., 2016; Lin et al., 2017; Pavia & Mazza, 2016; Rinke et al., 2012)	• Daily bathing of patients over 2 months of age with chlorhexidine preparation • Scrubbing the access port or hub with friction prior to each use with either chlorhexidine, povidone iodine, or 70% alcohol • Performing routine dressing/gauze changes at least every two days to 7 days depending on dressing type • Labeling and documenting old and new cap, tubing, dressing, and needles with clear date and time • Prohibiting the use of iodine ointment on or around the insertion site • Conducting needle changes every 7 days (unless soiled, loosened, dislodged, or infiltrated) • Creating prepackaged dressing change kits • Use of disinfection caps, SwabCaps, as a supplement to manual hub disinfection, which dispenses isopropyl alcohol (IPA) over hub when twisted and bathing the hub in IPA protecting the hub from external contamination • CVC lines scrubbed with chlorhexidine gluconate (CHG) after all diaper changes • Use of CHG sponge dressing, or Biopatch, that secretes CHG at the catheter insertion site to protect the line	• Decrease from 2.25 CLABSIs per 1000 CL-days (95% confidence interval [CI]: 1.02–4.26) at baseline to 0.81 (95% CI: 0.22–2.08) after two years; pediatric oncology • Decrease from 8.59 to 1.33 ($p < 0.05$); short bowel syndrome • Decrease from 9.27 at baseline to 7.66, $p < 0.001$, after the intervention period • Decrease from 6.20 to 1.05 per ($p = 0.05$); medical intensive care unit
Ongoing education and monitoring of adherence to CLABSI prevention (Dandoy et al., 2015; Rinke et al., 2012)	• Multidisciplinary team including a unit nurse manager, multiple physicians, pharmacists, quality improvement specialists, and infection preventionists • Complete a root cause analyses of all CLABSIs and discussed potential systems changes to improve bundle compliance • Attend a national collaborative learning sessions aimed at improving compliance and decreasing CLABSI rates • Standardize daily hygiene • Increase awareness of high-risk patients with CLABSI • Improve education and assistance for nurses performing high-risk central venous catheter procedures • Improve allocation of resources for system stress de-escalation	• Decrease from 2.25 CLABSIs per 1000 CL-days (95% confidence interval [CI]: 1.02–4.26) at baseline to 0.81 (95% CI: 0.22–2.08) after two years; pediatric oncology • Decrease from 2.03 at baseline to 0.39 post intervention ($p = 0.008$); hematology/oncology unit

Buster Committee, 2) the development of the CVC Bundle, 3) the implementation of the program, and 4) scheduled monitoring of adherence to the Infection Prevention Guidelines. The pediatric patient population in both units range in age from birth to 25 years old, with various medically complex conditions. The acute care unit serves a wide range of medical conditions (neurologic, cardiac, pulmonary, endocrine, gastrointestinal, renal). The hematology/oncology unit includes leukemias, lymphomas, brain and solid tumors, sickle cell disease, severe combined immunodeficiency syndrome, and bone marrow transplant recipients. A total of 41 hospital-acquired CLABSIs were reported the year prior to implementation the year prior to implementation. The rate of infection was as high as 6.6 infections per 1000 central line days in the acute care pediatric unit, and 4.3 infections per 1000 central line days on the pediatric hematology/oncology unit.

Formation of the Bug Buster Committee

A committee known as the Bug Buster Committee was formed to address the increasing rates of CLABSIs. The committee consisted of a 10-member task force that included registered nurses with varying levels of experience from one year to more than five years. Participation in the committee was voluntary and based on interest. A mission and vision statement was created to support their initiatives, facilitate evidence-based patient care, staff education, and implementation of evidence-based research and infection prevention guidelines. The vision of the committee was to create a "bug-free" zone by serving as leaders in promoting effective central line care, ensuring environmental cleanliness and proper isolation practices, and educating personnel in both units. The committee continued to meet monthly to create and implement strategies to achieve their mission and vision.

The Bug Buster committee's goal was to increase awareness of infection prevention and develop strategies to reduce the number of hospital-acquired CLABSIs to meet the hospital standard of <0.9 per 1,000 central line days. The committee also focused on infection control related issues affecting the unit and continued to develop short and long-term plans to reduce the overall number of hospital-acquired infections (HAIs). The committee utilized lean methodology (Cohen, 2018) to identify root causes of CLABSIs and HAIs and implement strategies to reduce the rate of infection and maximize quality and safety for patients.

The Bug Buster committee collaborated with the nursing leadership team, physicians, the hospital infection control and epidemiology department, emergency department, dialysis team, environmental services, and other representatives from auxiliary teams (i.e. Child Life, Physical/Occupational Therapy). Areas of possible infection control concerns and best practices to reduce or eliminate infection risk to the acute care and hematology/oncology pediatric units were considered. The Bug Buster committee created awareness of compliance with hospital and unit specific policies, procedures, and guidelines. They created a CVC care bundle, implemented evidence-based practice changes, conducted internal audits, and disseminated the latest information through monthly emails, huddle news, and mandatory classes. A committee bulletin board was created and placed in each unit for ongoing education and sharing of information. Through the committee's hard work and dedication there was a remarkable improvement in clinical practice and patient outcomes.

Development of the CVC bundle

A review of the literature was conducted to examine various CVC Bundles that were evaluated in different settings. Though bundle components and implementation techniques varied greatly between settings and trials, the most commonly utilized interventions included 1) proper hand hygiene (Dandoy et al., 2015; Yuan, Zhao, Song, & Meng, 2016), 2) personal protective equipment (Atilla, Doğanay, Tomak, Günal, & Kılıç, 2016; Lin et al., 2017; Pallotto et al., 2017; Pavia & Mazza, 2016; Yuan et al., 2016), 3) aseptic technique, sterile dressing changes, and line maintenance (Atilla et al., 2016; Lin et al., 2017; Pavia

Table 2
– Bug Buster Committee root cause analysis findings.

Root cause of increased rate of CLABSIs	• Contaminated Lines • Expired Lines • Broken Lines • Multiple Line Accesses: lines, ports, caps • Inconsistencies in central line care practices amongst staff • Central line care practices not sterile • Insufficient cleaning or scrubbing when accessing central lines • Health Care Provider not washing hands and wearing gloves • IV tubings found inside diapers • Soiled dressings not changed • Missed dressing and cap changes • Inconsistencies in ○ Lab draw technique ○ Use of chlorhexidine preparation ○ Use of alteplase (TPA) ○ Dressing and cap change technique
Root causes related to infection control policies/guidelines	• Staff not placing patients on appropriate isolation status • Staff and visitors not wearing Patient Protective Equipment (PPE) • Environmental cleanliness not consistently maintained: patient rooms, nursing stations, etc • Staff not washing hands after patient care • Staff, families, and visitors not adhering to infection control policies • Wearing gloves outside patient's room and touching door handles, then performing patient care • Urinals hanging on IV poles • Hand sanitizers and gloves not readily available in patients' rooms • Staff not washing hands for 15 seconds • Staff eating at work stations • Outdated food in refrigerators • Boxes on floors in supply rooms • Refrigerators were not cleaned in nourishment rooms • Food from isolated patients placed in public refrigerator
Root causes related to knowledge & education	• Staff lacked knowledge about or were in consistent in ○ Scrubbing the hub for 15 seconds ○ Use of gloves when priming lines ○ Placement of lines Up, & drainage tubes down ○ Hand washing with soap & water for 15 seconds ○ Accessing lines unnecessarily ○ How to care for broken lines ○ Isolating patients appropriately ○ Understanding of line care and isolation practices ○ Not monitoring and evaluating each other's practices and making each other accountable ○ Performing patient care with gloves and changing if soiled
	• Staff not updated about infection control policies and rate of CLABSIs and HAIs ○ Inconsistencies in Documentation ○ Lack of adherence to policies and guidelines ○ Lack of knowledge about CLABSIs and HAI causative agents ○ New Grads and Float Staff not familiar with unit specific policies and guidelines

& Mazza, 2016; Rinke et al., 2012), 4) review of line necessity and duration, 5) periodic multidisciplinary education, and 6) ongoing monitoring and documentation (Dandoy et al., 2015; Rinke et al., 2012). Implementation and adherence to interventions with any combination of these integral components showed significant decreases in the rates of CLABSI incidence, regardless of unit setting. Though the sole efficacy of any one component in reducing CLABSI incidence is difficult to analyze due to the multi-interventional approach of the bundles, Table 1 summarizes the different components of the CVC bundle in the literature and their cumulative effects in decreasing CLABSI rates.

Implementation of the multi-intervention program

The committee met on a monthly basis to discuss infection control issues on the units. During the meetings the committee would review and analyze unit-based infection control data with a representative from the hospital infection control and epidemiology department. The committee also reviewed data from surveys and audits and created a plan to address CLABSIs and infection control practices on the units.

Over the course of six years, the Bug Busters committee had implemented many practice changes aimed at reducing the incidence of

Table 3
Bug Buster Committee timeline of interventions.

Year 1–2	Year 3	Year 4
• Bug Buster Committee was formed to address high rate of CLABSIs & Infection Control Practices on pediatric acute and hematology/oncology units. • CLABSI data was shared with staff to create awareness (ongoing). • Provided staff education on the accurate documentation of mucositis, graft versus host disease (GVHD), stomatitis, and rectal fissures to help identify definite course of action. • Provided staff education on appropriate care of central lines based on hospital policy and the appropriate steps in declotting central lines with alteplase (TPA). • New graduate nurses created teaching roadmaps to educate patients and families about proper central line care. • Sent out Bug of the Month emails to educate staff about different bacteria and organisms that cause infections (ongoing). • Monthly emails were sent to staff with clinical practice updates & new infection prevention topics (ongoing). • Educated staff about the importance of scrubbing the hub of tubing, caps, & ports for 15 seconds with alcohol pads to decrease CLABSIs (ongoing). • Hospital wide: caps changed from Max Plus to Micro-CLAVE caps. • Improved isolation practices by removing gloves from isolation carts to allow patients/families see staff perform hand hygiene before donning gloves, and to prevent using the same gloves to touch door handles, examine patients, and provide patient care (ongoing). • Installed hand sanitizer dispensers in every patients' room. • Created a central line care video to educate staff during annual skills lab. • Slogan: "Lines Up, Tubes Down" to keep IV lines and gastrointestinal tubes and ostomies away from central lines and tubings.	• Committee conducted central line care audits that addressed the following areas: dressing integrity, documentation, and environment (ongoing). • Committee gathered and analyzed data from the audits to create a plan and improve practices on the unit (ongoing). • The committee submitted a Quality Improvement Paper and Poster Presentation for the Annual Research & Evidence-Based Conference "Reducing the Incidence of Central Line Associated Bloodstream Infections in the Pediatric Population".	• New tubing change policy was implemented hospital wide. • Committee implemented initiative to decrease multiple unnecessary access into central lines. • Hospital wide chlorhexidine treatment for all patients with central lines was implemented. • 2 RN central line sterile dressing change implemented to decrease inconsistencies in practice and to hold each other accountable for practice (ongoing). • Reviewed central line care in annual skills lab and educated all staff about inconsistencies in practices and discussed updates with new practice changes (ongoing). • Created the Bug Buster Suggestion Box to get ideas from staff. • Created and implemented an isolation chart; a tool staff can utilize to recognize and initiate proper isolation precautions. • Updated handbook with infection control practices to educate patients and families on admission. • Standardized central line dressing & cap change days to Sundays to decrease missed dressing & cap change. • Implemented sterile cap change practices. • Performed root cause analysis of CLABSIs to determine causes and addressed factors (ongoing). • Implemented cleaning of high touch surface areas to decrease spread of infection and improve environmental cleanliness. • Designated rooms for bone marrow transplant patients and implemented strict infection prevention and isolation guidelines.
Year 5	**Year 6**	**Year 7**
• Implemented 2 RN sterile cap change. • Changed lab draw method to limit number of accesses into central lines. • Created and offered a mandatory 4 hour infection prevention class for all staff (including RNs, Clinical Care Partners, & Administrative Care Partners) to educate and create awareness of infection control practices on the units.	• Created a communication board to share information with staff and hospital leadership. • Standardized practice amongst all pediatric units within the hospital. • Met with Dialysis, Interventional Radiology, & other departments to standardize central line care for all pediatric patients across the system. • Educated staff about Precautions for Pregnant Health Care Workers. • Created a resource tool for new grads and float staff RNs which included unit guidelines for cap & dressing changes. • The committee submitted the following poster presentations for the Annual Research & Evidence-Based Practice Conference & the Southern California Association of Pediatric Hematology Oncology Nursing (SCAPHON) Conference: "A Multi-Interventional Approach to Reduce the Incidence of Central Line Associated Bloodstream Infections in an Acute Care Pediatric Setting".	• The committee submitted a poster presentation for the Annual Research & Evidence-Based Practice Conference: "A Five Year Retrospective Analysis of Infection Prevention Practice Changes in Acute Care Pediatrics".

CLABSIs and HAIs on the units. Practice changes were developed based on staff recommendations, current evidence – based practices, and findings from root cause analyses (see Table 2). The committee implemented the following interventions as part of the CVC bundle: scrubbing of all ports for 15 seconds with alcohol pads before access, having two registered nurses perform the sterile cap and dressing change procedures, and designating Sundays as the day of cap and dressing changes. Blood draws, medications, and infusions were consolidated to minimize unnecessary access into CVCs. Constant, careful attention was made for CVC tubings to be separated and kept away from gastrointestinal tubes, genito-urinary tubes, and ostomies. Maintaining daily chlorhexidine treatment for all patients with CVCs were implemented (see Table 3). Changes to isolation practices included installing hand sanitizer dispensers in each patients' room, keeping gloves readily accessible, and keeping the isolation cart well-supplied for proper isolation precautions. The frequently touched surface areas were wiped with bleach every shift. Dedicated rooms were designated for bone marrow transplant patients only (see Table 3).

With the help of the committee, the new graduate nurses created teaching roadmaps to educate patients and families about the CVC care protocol. The committee also updated the patient/family handbook to include infection control practices so staff could review this information with patients and families upon admission. The committee developed audit sheets for monitoring patient/family understanding or adherence to unit-based infection control guidelines.

Educational program

The Bug Buster Committee offered a mandatory infection prevention workshop to all staff members, including Registered Nurses, Clinical Care Partners, and Administrative Care Partners. The workshop introduced the role of the new Bug Buster Committee and discussed unit specific goals and projects aimed to reduce CLABSIs and HAIs on the pediatric acute care and hematology/oncology units. Topics also included the most prevalent pediatric infections, hospital and unit-based practices and policies, infection prevention in immunocompromised and neutropenic patients, HAIs, environmental hygiene, isolation practices, proper use of personal protective equipment (PPE), real-life case examples and the role of Hospital Epidemiology. Skills stations for RNs were set up to review and reinforce cap and dressing change practices, and scrubbing the hub. The majority (98%) of staff members attended and gave positive feedback for the workshop.

Communication board

The committee created a communication board to share information with staff and hospital leadership (see Fig. 1). The communication board included the mission and vision of the committee, list of committee members, monthly meeting minutes, quarterly infection prevention reports, root cause analysis of CLABSIs, a timeline of committee interventions, and a monthly quiz question for the staff. Staff that reviewed the board and answered the quiz questions correctly won a gift card from a monthly raffle. The communication board was also created to share the committee's successes and areas for improvement with other units and hospital leadership.

Staff adherence rates of the multi-intervention program

The implementation of the multi-interventional program occurred during a five-year period. The Bug Buster Committee developed a corresponding audit sheet (Fig. 2) to evaluate nursing quality of care and adherence to the bundle components. The outcome evaluated included adherence rates to the different bundle components. Nurses ensured the tubing was not on the floor (96.9%) and that tubing was not tangled (91.7%). Gloves were stocked in patient rooms (98.1%) and the overall patient room was clutter free (91.6%). High adherence rates were find in indicating the date and time of the tubing change (94.1%), ensuring the lines were up with tubes down (91.5%), and observing tubing to be current and clean/dry/intact (99.0%). Nurses recapped piggybacks

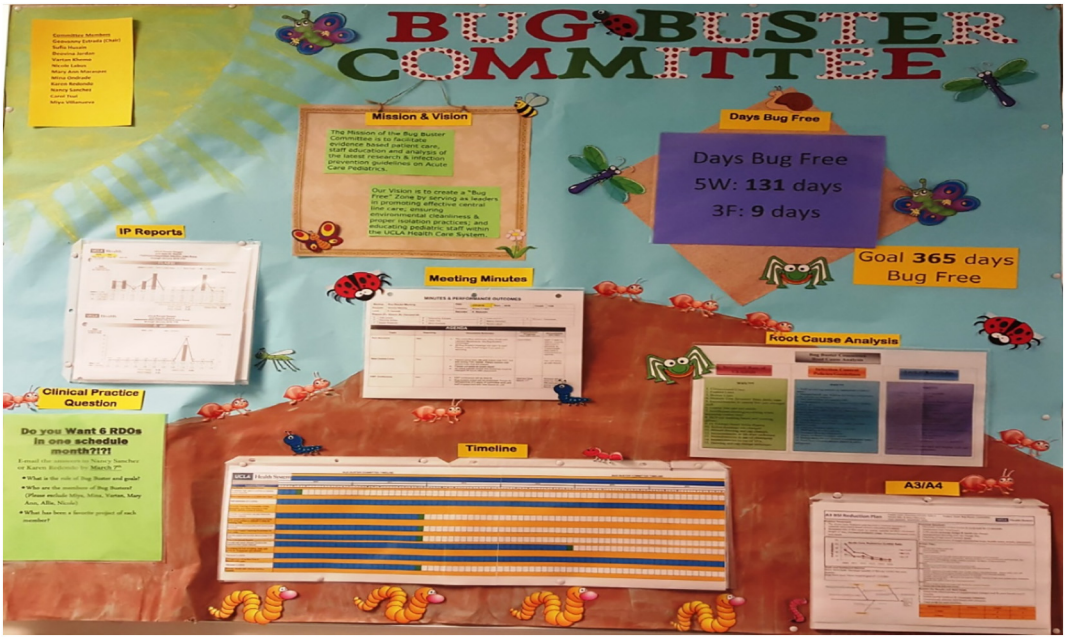

Fig. 1. The communication board used to share important information with the unit staff – includes the mission & vision of the Bug Buster's committee, name of committee members, timeline of committee activities, root cause analysis of CLABSIs and infection control, monthly infection control reports, meeting minutes, and the number of days both pediatric acute and pediatric hematology oncology units were free of CLABSIs.

CVC AUDIT SHEET

Date/Time: _____ **Room #:** _____

Auditor: _____ **Bedside RN:** _____

ENVIRONMENT	YES	NO	N/A
Tubing timed/dated			
Tubing current (not expired)			
Tubing off floor			
Tubing not tangled			
Gloves in room (not in isolation cart)			
Room clutter free			
DRESSING INTEGRITY			
Dated/Timed			
Not expired (<1 wk tegaderm; <48 hrs gauze/hypafix)			
Clean/Dry/Intact			
Lines up, tubes down			
IV ACCESS/MEDICATION ADMINISTRATION			
Washed hands for 15 seconds			
Donned gloves (if in iso room, Δ'd gloves after touching computer)			
Scrubbed hub for 15 seconds			
Scrubbed buretrol port/Y-site for 15 seconds			
Recapped piggybacks with new needleless cap			
DOCUMENTATION			
Dressing/Cap/Integrity charted in CareConnect (invasive devices)			
Bath within last 24 hrs			
CHG			
DRESSING CHA NGE			
Washed hands for 15 seconds			
Cleaned work surface with bleach			
Applied mask to self and patient			
Sterile technique			
Chlorhexidine scrub for 30 secs (or 3 alcohol/3 betadine)			
Air dry (no fanning/blotting/wiping/drying)			
2 RNs present			
CAP CHANGE			
Washed hands for 15 seconds			
Donned gloves			
Sterile technique			
3 alcohol first, 3 betadine second			
Alcohol/sterile gauze used to remove old cap			
PPE			
Pt on isolation?			
RN wearing PPE?			
Family/visitors wearing PPE?			

RISK FACTORS	**YES**	**NO**	**N/A**
TPN			
GVHD			
Mucositis			
Low ANC			
Immunosuppressant			
Ostomy			

Auditor Feedback:

RN Response (why task not completed; what corrective action will be taken; when will task be completed):

Fig. 2. CVC audit sheet for monitoring and evaluation.

with new needleless caps (97.6%), scrubbed the hub for 15 seconds (91.1%), and the majority of patients had bathed with chlorhexidine wipes within the past 24 hours (89.7%) (Table 4).

Nurses diligently washed hands before the dressing change procedure (100%). They cleaned the work surface with bleach (93.8%), applied masks to patient and self (91.7%), maintained sterile technique (95.8%) and scrubbed with chlorhexidine (95.8%) for a minimum of 30 seconds (90%). In addition, nurses allowed the area to air dry and utilized a second nurse per each dressing change (97.9%). Adherence was 100% in all aspects of the cap change procedure (Table 4).

Table 4
Outcome of multi-intervention program implementation – staff adherence rates.

Environment	**n (%)**
Tubing timed/dated	92 (95.8%)
Tubing current (not expired)	91 (95.8%)
Tubing off floor	93 (96.9%)
Tubing not tangled	88 (91.7%)
Gloves in room (not in isolation cart)	102 (98.1%)
Room clutter free	87 (91.6%)
Dressing integrity	**n (%)**
Dressing dated/timed	95 (94.1%)
Not expired (<1 week.tegaderm; <48 hours gauze/hypafix)	96 (99.0%)
Clean/dry/intact	100 (99.0%)
Lines up, tubes down	86 (91.5%)
IV access/medication administration	**n (%)**
Washed hands for 15 seconds	44 (100%)
Donned gloves (if in isolation room, change gloves after touching computer)	46 (100%)
Scrubbed hub for 15 seconds	41 (91.1%)
Scrubbed buretrol port/Y-site for 15 seconds	43 (100%)
Recapped piggybacks with new needleless cap	40 (97.6%)
Documentation	**n (%)**
Dressing/cap/integrity charted in CareConnect (invasive devices)	82 (96.5%)
Bath within last 24 hours	78 (89.7%)
Chlorhexidine (CHG) Bath	76 (90.5%)
Dressing change	**n (%)**
Washed hands for 15 seconds	46 (100%)
Cleaned work surface with bleach	45 (93.8%)
Applied mask to self and patient	44 (91.7%)
Sterile technique	46 (95.8%)
Chlorhexidine scrub for 30 seconds (or 3 alcohol/3 betadine)	46 (95.8%)
Air dry (no fanning/blotting/wiping/drying)	47 (97.9%)
2 RNs present	46 (97.9%)
Cap change	**n (%)**
Washed hands for 15 seconds	11 (100%)
Donned gloves	11 (100%)
Sterile technique	11 (100%)
3 alcohol first, 3 betadine second	11 (100%)
Alcohol/sterile gauze used to remove old cap	11 (100%)
Patient protective equipment (PPE)	**n (%)**
Isolation precautions	71 (77.2%)
Staff wearing PPE	63 (92.6%)
Family/visitors wearing PPE	21 (36.8%)
Risk factors	**n (%)**
Total parenteral nutrition (TPN)	37 (51.4%)
Graft versus host disease (GVHD)	1 (1.7%)
Mucositis	8 (13.6%)
Low Absolute Neutrophil Count (ANC < 500)	32 (43.8%)
Immunosupressant	40 (56.3%)
Ostomy	13 (20.6%)

Of the 77.2% of patients that were on isolation and thus requiring Personal Protective Equipment (PPE), 92.6% of nurses utilized appropriate PPE. However, only 36.8% of families used PPE when necessary (Table 4), prompting the committee to provide constant reminders to family members about the PPE use. Patients and family members were instructed on appropriate use of PPE and the rationale for its use. A sign on the door was placed to remind parents about PPE. Parents and family members not adhering to use PPE were provided the PPE to enforce adherence.

Since the inception of the Bug Buster committee, members have continuously disseminated important information to staff through monthly emails, huddles, staff meetings, mandatory classes, annual skills lab, and through the communication board. The committee shared their successes with the hospital wide infection control committee, hospital and nursing leadership, and with other units within the hospital.

Conclusion

With these initiatives implemented by the Bug Buster Committee, CLABSI rates for both pediatric units have decreased tremendously over the five-year period. A total of 41 incidents of hospital-acquired CLABSIs were reported over the course of the year prior to the Bug Buster Committee, which decreased steadily to 9 incidents of CLABSIs after implementation (Fig. 3). Prior to implementation, the quarterly CLABSI rates ranged from 2.8 to 6.6/1000 catheter days in pediatric acute care (PAC) and 2.1 to 4.3/1000 catheter days in the pediatric hematology-oncology (PHO) (Fig. 4). The rates decreased steadily from 1.31 per 1000 catheter days (PAC), and 0.54 per 1000 catheter days (PHO) after implementation (Fig. 5). While staff adherence rates increased with the use of PPE, parents and family members adherence were low. Implementing procedures to enforce adherence of PPE may be made through a patient education handout about PPE upon admission to the room, and emphasizing its importance by reviewing content and encouraging family to ask questions and express concerns. In addition, a sign may be posted on the door and in the room indicating the need for PPE prior to entry and reminder in the room. Lastly, all staff should be consistent in providing family with PPE when family members are not adherent.

Acknowledgement

We thank the members of the Bug Buster Committee, all the nurses, multidisciplinary team, and supportive staff that continues to provide care to the pediatric acute care and hematology/oncology units, and in their efforts to minimize CLABSI and HAI rates.

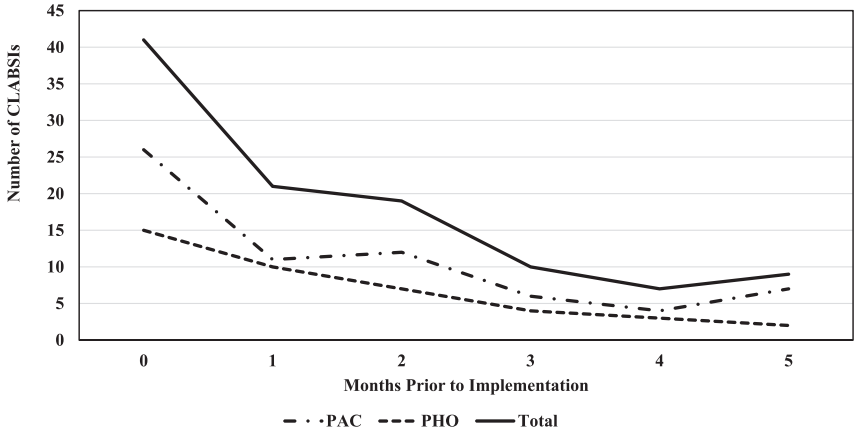

Fig. 3. Number of CLABSI incidents was high the year prior to implementation, which decreased steadily. PAC: Pediatric Acute Care Units; PHO: Pediatric Hematology Oncology Units.

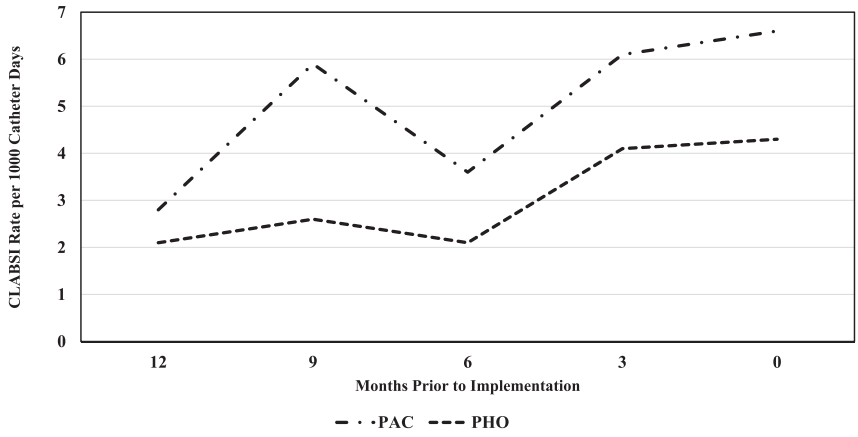

Fig. 4. Quarterly CLABSI rates (per 1000 catheter days) were high the year prior to implementation. Bug Buster Committee Goal was set to decrease to 0.9/1000 catheter Days. PAC: Pediatric Acute Care Units; PHO: Pediatric Hematology Oncology Units.

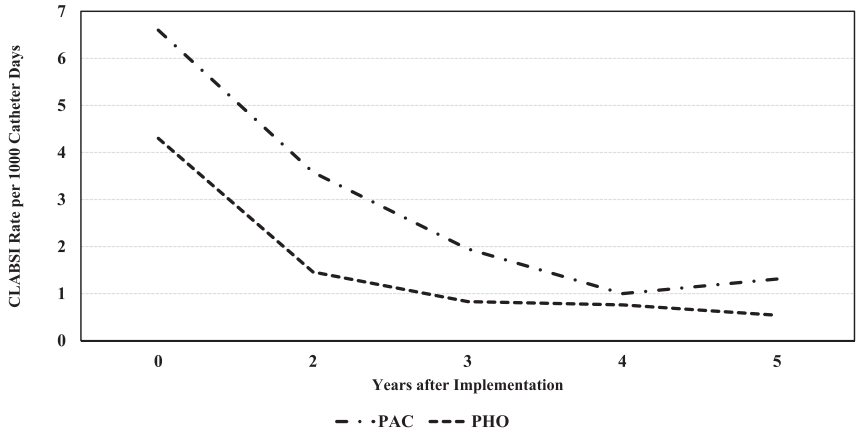

Fig. 5. Annual CLABSI rates (per 1000 catheter days) decreased steadily after implementation. PAC: Pediatric Acute Care Units; PHO: Pediatric Hematology Oncology Units.

References

Atilla, A., Doğanay, Z., Çelik, H. K., Tomak, L., Günal, Ö, & Kılıç, S. S. (2016). Central line-associated bloodstream infections in the intensive care unit: Importance of the care bundle. Korean Journal of Anesthesiology, 69(6), 599. doi:https://doi.org/10.4097/kjae.2016.69.6.599.

Centers for Disease Control (2011). Guidelines for the prevention of intravascular catheter-related infections, 2011. Retrieved from https://www.cdc.gov/hai/pdfs/bsi-guidelines-2011.pdf.

Centers for Disease Control (2018). Bloodstream infection event (central line-associated bloodstream infection and non-central line associated bloodstream infection). Retrieved from https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf.

Cheung, E., Baerlocher, M., Asch, M., & Myers, A. (2009). Venous access a practical review for 2009. *Canadian Family Physician*, *55*, 494–496 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2682308/.

Cohen, R. I. (2018). Lean methodology in health care. *Chest*, *154*(6), 1448–1454 Dec.

Dandoy, C. E., Hausfeld, J., Flesch, L., Hawkins, D., Demmel, K., Best, D., & Simmons, J. (2015). Rapid cycle development of a multifactorial intervention achieved sustained reductions in central line-associated bloodstream infections in hematology oncology units at a children's hospital: A time series analysis. *BMJ Quality & Safety*, *25*(8), 633–643. https://doi.org/10.1136/bmjqs-2015- 004450.

Dissanaike, S., Shelton, M., Warner, K., & O'Keefe, G. (2007). The risk for bloodstream infections is associated with increased parenteral caloric intake in patients receiving parenteral nutrition. *Critical Care*, *11*(5), 1–9 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2556767/.

Habas, F., Baleine, J., Milési, C., Combes, C., Didelot, M., & Romano-Bertrand, S. G. (2018). Supraclavicular catheterization of the brachiocephalic vein: A way to prevent or reduce catheter maintenance-related complications in children. *European Journal of Pediatrics*. https://doi.org/10.1007/s00431-017-3082-x.

Haddadin, Y., & Regunath, H. (2018). Cental line associated bloodstream infections (CLABSI). Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK430891/?report=reader#_NBK430891_pubdet.

Kelly, M., Conway, M., Wirth, K., Potter-Bynoe, G., Billett, A., & Sandora, T. (2013). Microbiology and risk factors for central line-associated bloodstream infections among pediatric oncology outpatients a single institution experience of 41 cases. *Journal of Pediatric Hematology Oncology*, *35*(2), 71–76. https://doi.org/10.1097/MPH.0b013e3182820edd.

Lin, W., Chang, Y., Wu, U., Hung, M., Chuang, P., Wang, J., & Chang, S. (2017). Multimodal interventions for bundle implementation to decrease central line-associated bloodstream infections in adult intensive care units in a teaching hospital in Taiwan, 2009–2013. *Journal of Microbiology, Immunology and Infection*. https://doi.org/10.1016/j.jmii.2017.08.008.

Pallotto, E. K., Piazza, A. J., Smith, J. R., Grover, T. R., Chuo, J., Provost, L., & Brozanski, B. (2017). Sustaining SLUG bug CLABSI reduction: Does sterile tubing change technique really work? *Pediatrics*, *140*(4). https://doi.org/10.1542/peds.2016-3178.

Pavia, M., & Mazza, M. (2016). Adding innovative practices and technology to central bundle reduces bloodstream infection rate in challenging pediatric population. American Journal of Infection Control, 44(1), 112–114. doi:https://doi.org/10.1016/j.ajic.2015.08.026.

Rinke, M. L., Chen, A. R., Bundy, D. G., Colantuoni, E., Fratino, L., Drucis, K. M., & Miller, M. R. (2012). Implementation of a central line maintenance care bundle in hospitalized pediatric oncology patients. *Pediatrics*, *130*(4), 996–1004. https://doi.org/10.1542/peds.2012-0295.

Scott, D. R. (2009). The direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention. Retrieved from https://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf.

The Joint Commission (2012). Preventing central-line associated bloodstream infections: A global challenge, a global perspective. Retrieved from https://www.jointcommission.org/assets/1/18/CLABSI_Monograph.pdf.

Yuan, C., Zhao, Q., Song, X., & Meng, F. (2016). Prevention of peripherally inserted central catheter-related infections in very low-birth- weight infants by using a central line bundle guideline with a standard checklist. International Journal of Nursing Sciences, 3(1), 50–53. doi:https://doi.org/10.1016/j.ijnss.2016.02.013.