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Impact of Kamishibai Card Process on Central Venous Line Maintenance Bundle Compliance

Julia B. Frith
University of Kentucky, jfrith01@icloud.com

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The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Assistant Dean for MSN and DNP Studies, on behalf of the program; we verify that this is the final, approved version of the student's DNP Project including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Julia B. Frith, Student

Dr. Debbie Hampton, Advisor

Impact of Kamishibai Card Process on Central Venous Line Maintenance Bundle Compliance

Julia B. Frith MSN, RN, CIC

University of Kentucky

College of Nursing

Spring, 2018

Debbie Hampton, PhD, MSN, RN, FACHE, NEA-BC-Committee Chair

Michelle Pendleton, DNP, RN, CPHQ-Committee Member

Pam Isaacs, BSN, MHA, CIC-Clinical Mentor

Vicki Montgomery, MD, FCCM- Clinical Mentor

Dedication

I would like to dedicate this work to my family. To my husband, for being my eternal supporter; I can’t thank you enough for encouraging me to follow my dreams and sacrificing to get there. To my children, thank you for watching me through this process; you have had the opportunity to see firsthand what life-long learning means. To my parents, who instilled in me the importance of education and determination, and to my sibling and friends, for being the ear when I needed someone to listen-- thank you.

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Abstract

Background: Central venous line (CVL) maintenance "bundles" have been developed and implemented at Norton Healthcare to decrease central line-associated bloodstream infections. While maintenance bundle audits are performed and compliance scores are reported to frontline providers and institutional leaders, the traditional audit process does not capture the factors underlying noncompliance.

Methods: A retrospective evaluation of the implementation of the Kamishibai Card process for CVL maintenance bundle compliance in the NCH PICU was performed using a pre- and post-test design. Pre-implementation and post-implementation data was compared to assess the change in compliance with the individual CVL maintenance bundle components as well as the composite compliance score. K-Card data results were categorized according to frequency of identification and results were analyzed to assess for trends.

Results: Statistically significant change was noted in one element of the CVL maintenance bundle, tubing timed and dated (P=0.05) comparing the pre-implementation to the post implementation time period. The most frequent cause for non-compliance with the CVL maintenance bundle was incomplete communication during hand-off (92) followed by device associated (47). The most frequent follow-up action was nurse educated in the moment (103) followed by issue immediately resolved (94).

Conclusions: The information gathered from this only was found to be statistically significant in the bundle element, "tubing dated and timed," improvements occurred in all

bundle elements. Overall the K-Card process had a positive impact on CLABSI in the PICU.

Impact of Kamishibai Cards Process on Central Venous Line Maintenance Bundle Compliance

Introduction

Central line associated bloodstream infections (CLABSIs) are associated with an increased morbidity and mortality (Ziegler, Pellegrini, & Safdar, 2015). Insertion and maintenance bundles have been developed and implemented at Norton Healthcare as strategies to decrease these infections. Maintenance audits are performed, and compliance scores are presented in units in the acute care facilities, including the pediatric intensive care unit (PICU) at Norton Children's Hospital (NCH). Information about what causes decreased compliance is not available; however this information is crucial if we are to address the problem. The Kamishibai Card (K-Card) process is a performance improvement strategy designed to identify barriers to achieving a metric and to removing the barriers preventing achievement of the metric. The PICU at NCH implemented the K-Card process in January 2017 as a strategy to increase central line maintenance compliance and decrease infections. This paper will discuss barriers to optimal central line care as identified through the K-Card process, report how those barriers were removed, and examine the impact of this process on central line maintenance compliance and CLABSI rates.

Background

Any person who has a central venous line (CVL) is at risk for developing a CLABSI. The National Healthcare Safety Network (NHSN) definition of a CLABSI is a laboratory confirmed bloodstream infection in an individual with a CVL (CDC, 2017). According to the Centers for Disease Control and Prevention (CDC; 2014) CLABSIs

decreased by 50% in the United States between 2008 and 2014. Kentucky hospitals also reported a statistically significant reduction in CLABSIs (CDC, 2016). Unfortunately, 13% of the 39 Kentucky hospitals that reported infections to the NHSN, with enough information to calculate a Standardized Infection Ratio (SIR), had an SIR that was statistically higher than the national average (CDC, 2016).

CLABSIs are associated with substantial morbidity and mortality and increase health costs (CDC, 2017). Marschall et al. (2014) noted that the cost of a CLABSI ranges from $3,700-$39,000 per episode. These infections are potentially avoidable through proper care and maintenance of central venous access devices (Srinivasan et al., 2011).

At Norton Healthcare, evidence-based prevention bundles for CLABSI have been implemented based on the CDC's "2011 Guidelines for the Prevention of Intravascular Catheter-Related Infections." CVL maintenance bundle compliance data are gathered at the unit level and tabulated monthly. Ursprung et.al. (2005) reported that many healthcare facilities perform audits for quality metrics. However, the audits can become very time consuming and do not always allow for real-time feedback to care providers. Without this feedback, achieving sustainable change is less likely. According to Spears (2005), many times the same problem is repeatedly encountered with no change until "an event" occurs. Performance improvement strategies such as the K-Card process can provide real time opportunities to better understand the barriers and deficiencies in processes that can subsequently lead to infections.

The K-Card process is a story-telling methodology, developed for solving problems, which originated in manufacturing and has been adapted to healthcare (Jurecko, 2016). It is designed to help identify barriers and remove or redesign them, thus

creating an environment where it is easy to do the process the right way and difficult to do it the wrong way. This process allows for immediate assessment of a metric and provides specific information about the defects that occur to the process owner. Through identification of the root cause for barriers, the K-Card process is designed to clarify what factors prevent the process from functioning correctly. In this case, the focus was on what factors were preventing the healthcare workers from accomplishing the CVL maintenance bundle elements (See Table 1 for a list of the CVL maintenance bundles components). Using a strategy such as K-Card allows for defect identification to be focused on the process instead of the person. The K-Card process promotes understanding that when a lapse occurs, it is likely a result of a flaw in the system. This information is then used to fix the defect and prevent the error from occurring again. The K-Card process findings are shared with the process owners utilizing standardized communication platforms that are easily visualized and understood by staff. This includes red and green colored cards, Pareto charts and a tracking tool known as a Kaizen "newspaper." These elements provide a daily visual representation of the success of the process as well as opportunities. Providing this information to staff in real time encourages staff engagement and fosters a culture of safety (Spear, 2005).

Norton Healthcare has a health system goal of zero harm events to patients served, including elimination of healthcare-associated infections. To achieve the goal of zero infections, Norton Healthcare is working to become a high reliability organization (HRO). According to McKeon, Oswaks and Cunningham (2006), HROs are "organizations in high-risk, high-impact industries that consistently achieve quality outcomes despite facing many unexpected events where the potential for error and

disaster is very high" (p. 299). Additionally, HROs can achieve optimal outcomes even in the most chaotic situations. The K-Card process has the potential to help Norton Healthcare become a high-reliability organization by reducing variability in central line maintenance and ultimately reducing or eliminating CLABSIs.

The K-Card process was not consistently utilized in the PICU at NCH prior to 2017. Traditionally, CVL maintenance bundle audits have been completed through direct observation of a patient's CVL with the observation results being tallied and reported to staff as a composite score at the end of the month. Understanding of the root cause of non-compliance with the bundle was not specified in these reports. The implementation of the K-Card process is relatively new in the healthcare setting, which may explain why it is not being implemented more widely.

In January of 2017 the PICU began to perform CVL observations through direct observation of patients CVL utilizing the K-Card process for these observations. To understand the success or failure of the K-Card process on improvement of CVL maintenance bundle compliance and CLABSI rate, evaluation of the historical CVL maintenance bundle audit data and the K-Card CVL maintenance bundle data was performed. This evaluation focused on identification of barriers that could inhibit the frontline nurse from successfully completing all the CVL maintenance bundle components.

It was predicted that the utilization of the K-Card process would improve overall compliance with the CVL maintenance bundles and decrease the number of CLABSIs in the PICU. This success would be achieved through identification and removal of barriers

to compliance by end-users. With this information, leaders would have the opportunity to provide immediate feedback to staff about steps taken to remove barriers.

Purpose

The purpose of this study was to evaluate the effectiveness of the K-Card process in the PICU at NCH on CVL maintenance bundle compliance and CLABSI rates. The specific aims were:

1. To evaluate barriers that prevented front-line staff from executing the CLABSI prevention maintenance bundles.
2. To evaluate whether implementation of the K-Card process had an impact on overall maintenance compliance for prevention of CLABSI.
3. To identify if there has been a decrease in CLABSI rate post implementation of the K-Card methodology for assessing CVL maintenance bundle.

Methods

A retrospective evaluation of the implementation of the K-Card process for CVL maintenance bundle compliance in the NCH PICU was performed using a pre-test and post-test design. The pre-implementation period was January 1, 2016 through December 31, 2016. The post-implementation period was from January 1, 2017 to November 30, 2017.

Setting

This study was conducted in the pediatric intensive care unit at NCH, a 267-bed hospital that is part of a five-hospital system. Located in Louisville, Kentucky, NCH is the only free standing pediatric hospital in the state and is a regional referral center.

According to the Norton Healthcare (2017), the mission of this facility is "to provide quality health care to all those we serve, in a manner that responds to the needs of our communities and honors our faith heritage." NCH serves approximately 150,000 pediatric patients a year and is the predominant pediatric teaching facility for the University of Louisville medical school which is also located within Louisville, Kentucky. This pediatric facility provides services for cancer, diabetes, cardiac and neonatal patients. The PICU is a 32-bed medical-surgical unit with approximately 2500 admissions annually.

The PICU was chosen as a pilot site at NCH to evaluate the effectiveness of the K-Card process because this unit had a well-established auditing process for central line maintenance and a history of involvement in local and national quality improvement collaboratives. Unit leadership was also committed to the process and providing personnel resources to the project.

Sample

All PICU patients with a CVL in place and for whom a maintenance bundle observation was performed from January 1, 2016 to November 30, 2017 were eligible for inclusion in this study. The PICU averaged approximately 200 admissions per month and 500 CVL device days per month. CVL observations were performed on all patients in the PICU with a CVL as part of quality improvement initiatives and only these observations were used for this study. The estimated sample size was 1400 observations annually.

Procedures

During the baseline period (January 1, 2016 to December 31, 2016), CVL maintenance compliance was assessed as part of a comprehensive quality improvement

program using standard audit methodology employed at Norton Healthcare. A trained healthcare worker performed a visual observation of a patient's CVL. This observation may or may not have been completed with the patient's primary nurse. CVL maintenance bundle audits were only performed on those patients with a CVL. Upon completion of the CVL maintenance bundle audit, data from the individual elements of the bundle were entered into an electronic database, and both composite compliance and individual bundle element compliance were calculated. Composite maintenance compliance utilizes "all or nothing" scoring. Non-compliance with a single bundle element resulted in a composite score of zero.

During the intervention period (January 1, 2017 through November 30, 2017), CVL maintenance audits were performed using the K-Card process. The tools of the K-Card process included the Kaizen newspaper (see Appendix A for a sample of the newspaper), Pareto charts and compliance sheets (see Appendix B for a sample of the Pareto chart and compliance sheet) and the K-Card (see Appendix C for a sample complaint K-Card; see Appendix D for a sample non-complaint K-Card). The Kaizen newspaper is the paper tool in which barriers that were identified by the auditor and frontline staff during the CVL maintenance bundle observation were documented. The Pareto chart was used during the K-Card process as a visual tool for staff to see the biggest area of non-compliance with the CVL maintenance bundle. This chart was specific to the CVL bundle elements, listed in Table 1, and reflects non-compliance for the individual bundle elements. This chart was completed in real time by the auditor who performed the CVL maintenance bundle observation utilizing the K-Card process.

CLABSI Rate. All positive blood cultures obtained from PICU patients at NCH were reviewed by the facility infection preventionist. Positive blood cultures meeting NHSN definitions were designated as CLABSIs. The CLABSI rate was calculated as number of CLABSI events/total central line days.

Data Collection

Approval for this study was obtained through the University of Kentucky Institutional Review Board (IRB) as well as through the Norton Healthcare Office of Research and Administration (NHORA). Data for this study were obtained in two ways: electronic and paper. The PICU CLABSI rate for 2016 and 2017 was requested from the Norton Healthcare Data Analytics Department and provided to the researcher by the data analytics department. CLABSI rate for the PICU was a retrospective review comparing all twelve months of calendar year 2016 to January 2017 through November 30, 2017. CVL Maintenance bundle compliance was a retrospective review of PICU CVL maintenance bundle compliance data from January 1, 2016 through November 30, 2017. For 2016, this electronic database was the only database used for the bundle compliance data. Starting in 2017, the bundle compliance was also collected on paper documents as part of the K-Card process. CVL maintenance bundle compliance data were obtained from the electronic database maintained within the PICU (baseline period) as well as through the paper documents (intervention period). The researcher for this study did not perform any of these audits and the researcher had no contact with patients in NCH for the purpose of this study.

Both a quantitative and qualitative count of identified barriers was performed comparing the first six months of 2017 to the last six months of 2017. To reduce bias, a

team approach was utilized for grouping identified causes and actions taken. This team consisted of three individuals, one of whom was the researcher. The two other team members were not involved in the data collection for this study.

Data collection tools. The Kamishibai Kaizen Newspaper tool was used to analyze the following qualitative data:

- Issues/barriers identified to successfully performing the CVL maintenance bundle
- Potential causes of the identified issue/barrier
- Follow-up that was done to rectify the issue or barrier identified

From this analysis of the information provided on the Kamishibai Kaizen Newspaper, the most frequently identified issues and the potential causes for those issues and frequency for resolution of those issues were analyzed for trends.

The Pareto chart and monthly percent of compliance forms were used to analyze composite data for overall rate of compliance with the CVL maintenance bundle. The Pareto chart was utilized to analyze compliance with individual bundle components during a given period of time, both weekly and monthly. Monthly CVL maintenance bundle compliance data from the Pareto chart and the electronic 2016 data from the PICU were utilized for the study.

Data Analysis

Both quantitative and qualitative analyses were performed. A t-test was utilized to analyze the CVL maintenance compliance data. Pre-implementation and post-implementation data were analyzed to assess the change in compliance with the individual CVL maintenance bundle components as well as the composite compliance score. For analysis of the K-Card data, causes for bundle non-compliance and actions

taken were grouped by themes developed by reviewer consensus. When reviewers disagreed about how to categorize a cause or "action," they took a vote. Causes of non-compliance and actions taken were compared during two time periods. Determination for categories was done based on the information provided on the Kaizen newspaper.

Results

Sample Characteristics

A total of 1003 CVL maintenance observations using traditional audit methodology were completed during the baseline period. During the post-implementation period, 1,304 CVL maintenance observations were performed utilizing the K-Card methodology. Overall there was an increase in the number of observations performed in the post-implementation period compared to the pre-implementation period.

Impact of the K-Card Process on CVL Maintenance Compliance

CVL maintenance bundle compliance was similar in the pre-implementation and post-implementation periods, as illustrated in Table 2 that outlined comparison bundle elements. A statistically significant change was noted in one element of the CVL maintenance bundle, tubing timed and dated (P=0.05), comparing the pre-implementation time period to the post implementation time period. No statistically significant changes were identified in the analysis of the remaining CVL maintenance bundle elements or overall composite compliance, pre-implementation compared to post-implementation of the K-Card process (see Table 2). Compliance rates were numerically higher for "dressing dry, occlusive, dated and timed" (see Figure 1), "tubing timed and dated" (see Figure 2), "hub disinfection prior to entry" (see Figure 3), "microclave cap present and dated" (see Figure 4), and "central venous line continued need discussed and documented

daily" showed no change (see Figure 5). These increases were clinically but not statistically significant. CVL maintenance bundle composite compliance over the study period is found in Figure 6.

The bundle element most frequently identified as a barrier to successfully completing the CVL maintenance bundle was "dressing dry, occlusive, dated and timed." Review of the K-Card data for this element showed that device issues were the most frequent cause for non-compliance. The bundle element that was seldom a barrier to successfully completing the CVL maintenance bundle was "central venous line continued need discussed and documented daily." When this element was identified as a barrier in the CVL maintenance bundle process, communication was the most frequent cause for non-compliance.

Main Causes for CVL Maintenance Non-Compliance

A comparison was done of the main cause for non-compliance with the CVL maintenance bundle in the first half of 2017 and the second half of 2017 (see Table 3). The most frequently identified cause for non-compliance with the CVL maintenance bundle was incomplete communication during hand-off (92) followed by device associated cause (failure of device, use of device, availability of device; 47). Table 4 shows the main causes for non-compliance by CVL maintenance stratified by bundle element. Incomplete hand-off was found to be the most frequent cause for non-compliance with the following CVL maintenance bundle components: "tubing dated and timed" (31), "microclave cap present and dated" (22), and "central venous line continued need discussed and documented daily" (33). Device-associated factors (failure of device, use of device, availability of device) were the most frequent causes of non-compliance

for “dressing dry, occlusive, dated and timed” (41) while “forgot” was the most frequent cause for non-compliance with “hub disinfection prior to entry” (10).

Action Taken to Remove Identified cause

A comparison of actions taken to remove identified causes for CVL maintenance bundle non-compliance, during the first half of 2017 and the second half of 2017, are depicted in Table 5. Actions taken were also stratified by CVL maintenance bundle element (Table 6). The most frequent follow-up action was “nurse educated in the moment” (94) followed by “issue immediately resolved” (103). Analysis of action taken to eliminate the cause for the barrier showed that “issue immediately resolved/problem fixed” was the most frequent action taken related to “dressing dry, occlusive, dated and timed”(47). Nurse education in the moment was the most frequent action taken for the following CVL bundle elements: “tubing dated and timed” (21), “hub disinfection prior to entry” (12), “microclave cap present and dated” (37) and “central venous line continued need discussed and documented daily” (19).

Impact on CLABSI Rate

In 2016, the overall CLABSI rate in the PICU was 0.40 (2/4981 device days). In the post-implementation period, the CLABSI rate increased to 2.17 (11/5075 device days). The CVL maintenance composite compliance over the study period compared with the CLABSI rate for the same time frame is reflected in Figure 7. During this time frame there was no significant increase in the overall composite compliance for the CVL maintenance bundle; however, the CLABSI rate did increase.

Discussion

Following evidence-based bundles is a critical component to preventing CLABSI in patients with a CVL. Understanding why non-compliance occurs is imperative since without this critical information, success with these bundles is unlikely to be reliable. Working to eliminate these identified causes is a key strategy to improve maintenance compliance. Analysis of CVL maintenance bundle compliance data pre-implementation and post-implementation of the K-Card process was completed as part of this study. From this analysis the most frequent cause for non-compliance with the CVL maintenance bundle was identified, along with the most frequent actions taken to prevent the event from occurring in the future. This information was not known prior to the implementation of the K-Card process and therefore sustainable change was not possible. While many of the results of this study were not statistically significant, the improved trend of increased overall compliance with the CVL maintenance bundle indicated that the K-Card process worked for improving the process metric of CVL maintenance compliance.

Statistical significance was found in the evaluation of one of the bundle elements, "tubing dated and timed." Failure to date and time the tubing was most frequently caused by incomplete communication (hand-off related) and follow-up action was in-the-moment education with the nurse. The statistical increase in compliance with this bundle element may be due to the fact that compliance with this element was 91% in 2016, the second lowest of all the bundle elements, indicating a high opportunity for improvement. The improvement in compliance with this elements indicates that providing nurses with in-the-moment education was effective in changing behavior with this bundle.

The results of this study showed that the trend is moving up in overall compliance with the CVL maintenance bundle, with "tubing dated and timed" having a statistically significant improvement, indicating that the K-Card process was effective. Individually, each of the components for CVL maintenance bundle was relatively high. "Dressing dry, occlusive, dated and timed" had the lowest individual component score in both 2016 and 2017, 90% and 93% respectively. The main cause for non-compliance identified within this bundle element was found to be device-related factors. This may be a result of inappropriate application of a device, failure of the device to work as intended or not having the device readily available for use. These external factors could be contributing to the lack of compliance.

Incomplete communication (hand-off related) was the most frequent cause for non-compliance with the CVL maintenance bundle. Communication is a cause for many breakdowns in process and can lead to adverse patient outcomes. Multiple barriers to communication have been identified. Haig, Sutton and Whittington (2006), suggested that these barriers could include hierarchy, lack of clarity around who is responsible, and different communication styles. Not having a hand-off process that works effectively within the NCH PICU may have led to this increased cause of non-compliance. Haig et al. (2006) suggested that situation, background, assessment and recommendation (SBAR) communication is a strategy for performing effective patient hand-offs; this strategy was employed at NCH. The information provided on the K-Card newspaper does not clearly indicate which part of the hand-off was unsuccessful. Visualizing all the patient's devices, including their CVL, is a part of the standard handoff employed in the PICU. However, compliance data for this process were not reviewed in this study.

Device-related causes comprised the second most common cause for non-compliance with the CVL maintenance bundle and included issues with device availability, the device working as intended and the use or application of the device. These device related issues presented an opportunity to create workarounds in processes, including reinforcing the dressing, leaving the dressing in place when it should be removed or having to repeatedly replace a device. While these workarounds may get the job done and provide care for the patient, many times they prevent the standard execution of the process, allowing for acceptable deviation. In a review conducted by Debone et al. (2015), one of the most frequent causes for workarounds was the need to provide patient care in a timely manner. Additionally, they found that individual causes for workarounds included knowledge of a technology. These factors may have played a role in the device-related issues identified in this study. Further investigation is needed to understand what the device issues truly are.

All causes identified had a subsequent action taken to prevent the cause from occurring in the future. The most common action was "nurse educated in the moment." This was also the most frequent action for "tubing dated and timed," the one CVL element that was found to be statistically significant pre-implementation compared to post implementation. Ericsson (2008) suggested that "the best training situations focus on activities of short duration with opportunity for immediate feedback, reflection and correction" (p. 993). This type of training scenario allows for the learner to practice skills until proficiency is achieved. Real-time education may be an effective means to educate an individual; however, it does not allow for education of the entire group. The Kaizen newspaper did not capture the content of the education and it is unknown to the

researcher if additional education was provided to the PICU staff after this one-on-one education was complete.

"Issue immediately resolved (problem fixed)" was the second most frequent action taken to address CVL maintenance bundle non-compliance and from a patient care prospective, it is important that any issue compromising patient safety be resolved in the moment. The action of immediate resolution of the cause for non-compliance shows that patient safety is top priority within the NCH PICU. It also illustrates, since leaders performed the K-Card audits, that they were available to assist in removing the barriers immediately showing engagement within the unit.

Unfortunately, during this time frame, even though the compliance overall was higher, the CLABSI rate also increased, indicating that other factors may have been at play impacting CLABSI rates. While this was not the desired outcome, this project yielded valuable information about the causes of barriers to the CVL maintenance bundle, and suggested strategies for removing these barriers.

Unfortunately, during this time frame, CLABSI rates increased coincident with introduction of the K-Card methodology, even though maintenance bundle compliance was similar to that observed during the pre-implementation period. There may be factors not captured by the CVL maintenance bundle that impacted CLABSI rates. A comprehensive analysis of factors associated with CLABSI rates was beyond the scope of this study.

Limitations

This study had several limitations. Even though all patients with a CVL in the PICU during this time were eligible for an observation, observations may not have occurred every day and not all CVLs were observed.

The post-implementation evaluation time period of eleven months was a major limitation to this study. This time period was simply too short to identify a statistically significant change in overall maintenance compliance and measure an impact on CLABSI rates. There is a learning curve with any new process and it is likely that during the first few months of the intervention period, auditors were still perfecting their use of the K-Card audit methodology and identifying causes associated with non-compliance. Ultimately, the bundle element that was most frequently identified as a barrier to successfully completing the CVL maintenance bundle was "dressing dry, occlusive, dated and timed." An intervention to improve compliance with this bundle element was implemented in the fourth quarter of 2017, but the time frame for this study was not long enough to observe changes that may have occurred in bundle compliance.

The K-Card process was not the only quality improvement intervention occurring in the PICU during the post-implementation time frame that had the potential to impact CLABSI rates. There was a hospital-wide focus on CLABSI prevention during this period. An intensive campaign to improve hand hygiene was also implemented. Both of these initiatives had the potential to impact CLABSI rates. Paradoxically, the PICU CLABSI rate increased during the post-implementation period. Unmeasured factors, such as patient mix, could have contributed to this increase.

The study design was a retrospective review of the K-Card process. This did not allow for in the moment education of the individuals that were performing the audits. This education could have allowed for more in-depth cause analysis throughout the study period.

Finally, The K-Card information collected for this study was limited to the PICU at NCH. The information obtained in this study may not be generalizable to other units at NCH or PICUs in other hospital.

Recommendations for Future Studies

Future studies should evaluate the longitudinal impact of the K-Card process on CVL maintenance bundle compliance in the PICU. In this pilot study, incomplete communication during the hand-off process was identified as the most common cause of non-compliance with the maintenance bundle. An in-depth analysis of the hand-off process is warranted in order to identify specific strategies to improve communication. Device-associated factors were also frequently identified as a cause of non-compliance. However, detailed information about specific devices associated with failure was not available. This compliance element deserves further investigation. As other units within NCH that provide care to patients with CVL implement the K-Card process, factors associated with non-compliance should be analyzed and compared to reasons identified for non-compliance in the PICU. When reasons for non-compliance are similar among units, facility-wide intervention may be impactful. When reasons diverge, unit-specific interventions may be required.

Conclusion

While K-Card audits were only found to be statistically significant in one bundle element, "tubing dated and timed," during an 11-month period, useful information related to non-compliance was identified. Incomplete communication during hand-offs and problems with devices were identified as barriers to compliance with the CVL maintenance bundle in this PICU. This information was not available prior to institution of the K-Card process. The actions most frequently taken to address non-compliance—"problem fixed" and "nurse educated in the moment"—were focused on short term solutions rather than eliminating the root cause of the identified problem. The information gathered during K-Card audits can be used to develop new interventions to support sustained, reliable implementation of the CVL maintenance bundle and improve patient outcomes.

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Table 1: *Central Venous Line Maintenance Bundle Elements*

Hub scrubbed prior to entry
Tubing dated and timed
Dressing dry, occlusive, dated and timed
Hub disinfection prior to entry
Microclave cap present and dated
Central venous line continued need discussed and documented daily

Table 2: *Average Annual Comparison of Bundle Elements and Composite Score*

Compliance measures	2016 *Mean* (SD)	2017 *Mean* (SD)	*p* *(0.05)*
Dressing Dry, Occlusive, Dated and Timed	0.90 (0.05)	0.93 (0.05)	0.17
Tubing Dated and Timed	0.91 (0.07)	0.96 (0.03)	0.05
Hub Disinfection Prior to Entry	0.97 (0.02)	0.99 (0.01)	0.13
Microclave Cap Present and Dated	0.95 (0.03)	0.96 (0.02)	0.34
Central Venous Line Continued Need Discussed and Documented Daily	0.99 (0.02)	0.97 (0.04)	0.11
Total CVL Maintenance Bundle Composite Compliance	0.78 (0.06)	0.82 (0.08)	0.24

Table 3: *Causes for CVL Maintenance Non-Compliance*

Cause	Cause identified (January 2017- June 2017)	Cause identified (July 2017- Novemeber 2017)	Total
Knowledge deficit	23	20	43
Choice	4	4	8
Forgot	30	9	39
Non-compliance on arrival to the unit	16	2	18
Cause not identified by the auditor	16	3	19
Device associated (failure of device, use of device, availability of device)	32	15	47
Assignment acuity	3	2	5
Non-unit staff providing care to patient including: float nurse, pull nurse, hemodialysis nurse or IV team)	5	9	14
Incomplete communication (hand-off related)	66	26	92

Table 4: *Frequency of identified cause per CVL bundle element*

	Dressing not dry, occlusive, dated and timed (n=84)	Tubing not dated and timed (n=58)	Hub not scrubbed prior to entry (n=19)	Microclave cap not present and dated (n=77)	Central venous line continued need not discussed and documented daily (n=47)	Total Cause Identified n= 285
Knowledge deficit	11 (13%)	9 (16%)	3 (16%)	16 (21%)	4 (9%)	43 (15%)
Choice	6 (7%)	1 (2%)	0	1 (1%)	0	8 (3%)
Forgot	3 (4%)	12 (21%)	10 (53%)	12 (16%)	2 (4%)	39 (14%)
Non-compliance on arrival to the unit	5 (6%)	4 (7%)	0	9 (3%)	0	18 (6%)
Cause not identified by the auditor	11 (13%)	0	1 (5%)	2 (5%)	5 (11%)	19 (7%)
Device associated including: failure of device, use of device, availability of device	41 (49%)	0	2 (11%)	4 (5%)	0	47 (16%)
Assignment acuity	2 (2%)	1 (2%)	0	1 (1%)	1 (2%)	5 (2%)
Non-unit staff providing care to patient including: float nurse, pull nurse, hemodialysis nurse or IV team)	2 (2%)	0	0	10 (13%)	2 (4%)	14 (5%)
Incomplete communication (hand-off related)	3 (4%)	31 (53%)	3 (16%)	22 (29%)	33 (70%)	92 (32%)

Table 5: *Action Taken to Remove Identified Cause*

Action taken	Action identified (January 2017- June 2017)	Action identified (July 2017- Novemeber 2017)	Total
Issue immediately resolved (problem fixed)	64	30	94
No follow-up provided	27	1	28
Nurse educated in the moment	49	54	103
Communication with external department	3	1	4
Email sent, content unknown	27	12	39
Email sent, content education	34	1	35
Inaction due to patient risk	3	2	5

Table 6: *Frequency of identified actions taken to remove cause per CVL bundle element*

	Dressing not dry, occlusive, dated and timed (n=89)	Tubing not dated and timed (n=65)	Hub not scrubbed prior to entry (n=21)	Microclave cap not present and dated (n=83)	Central venous line continued need not discussed and documented daily (n=50)	Total Action taken n=308
Issue immediately resolved (problem fixed)	47 (53%)	20 (31%)	4 (19%)	20 (24%)	3 (6%)	94 (31%)
No follow-up provided	13 (15%)	5 (8%)	2(10%)	7 (8%)	1 (2%)	28 (9%)
Nurse educated in the moment	13 (15%)	21 (32%)	12 (62%)	37 (45%)	18 (38%)	103 (33%)
Communication with external department	3 (3%)	0 (0%)	0 (0%)	1(1%)	0 (0%)	4 (1%)
Email sent, content unknown	4 (4%)	7 (11%)	2 (10%)	8 (10%)	18 (36%)	39 (13%)
Email sent, content education	4 (4%)	12 (18%)	0 (0%)	10 (12%)	9 (18%)	35 (11%)
Inaction due to patient risk	5 (6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (2%)

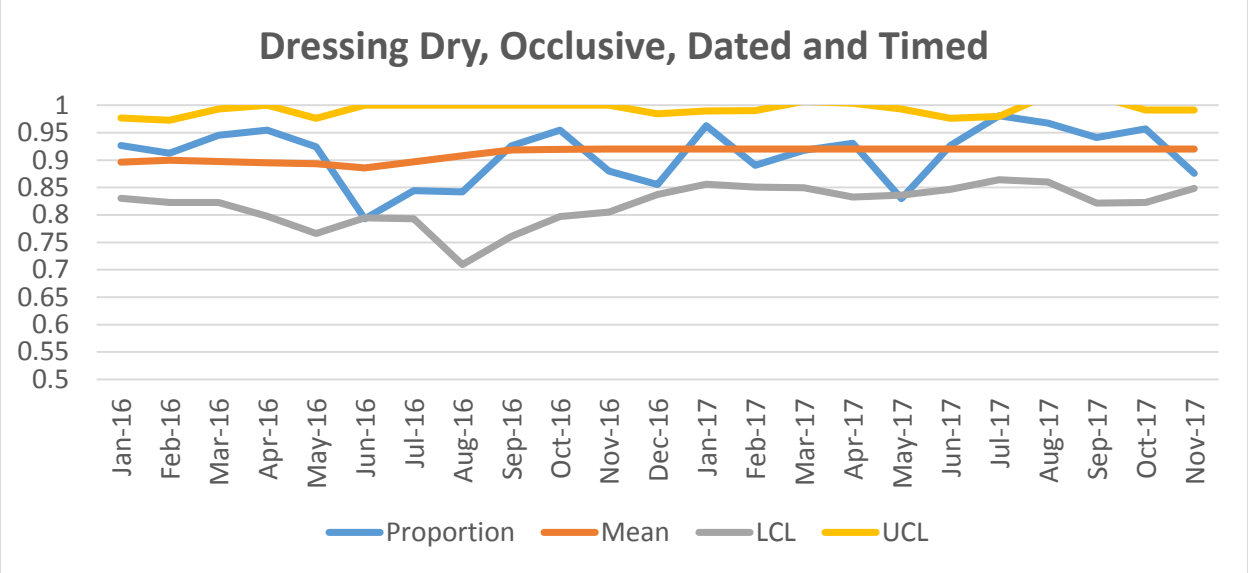


Figure 1: Compliance with CVL maintenance bundle element "dressing dry, occlusive, dated and timed "over study period

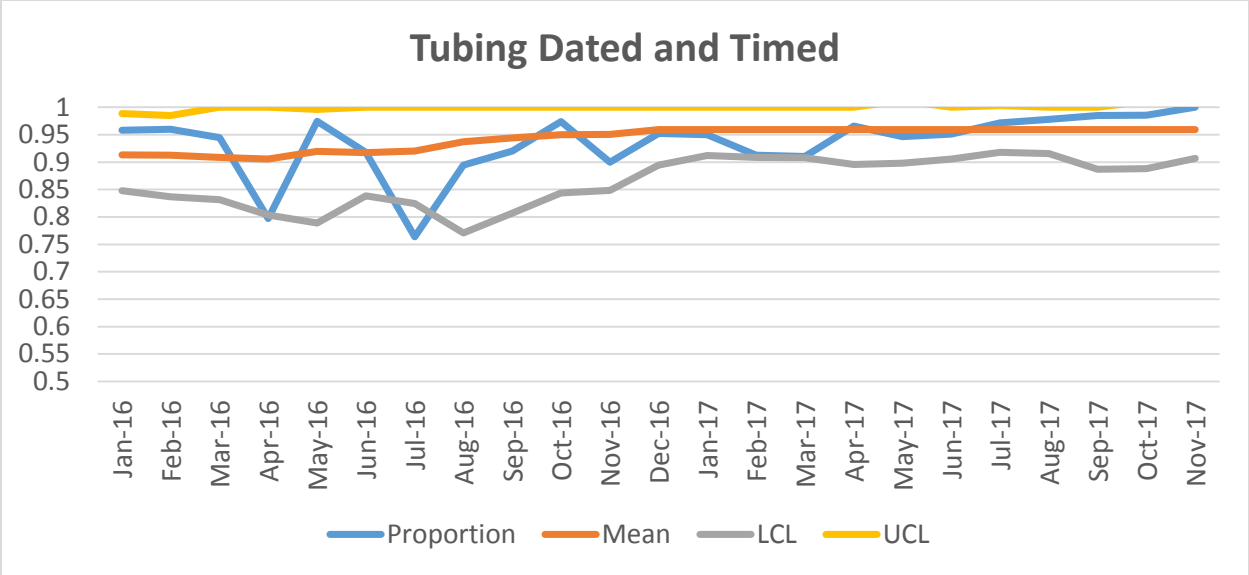


Figure 2: Compliance with CVL maintenance bundle element "tubing dated and timed" over study period

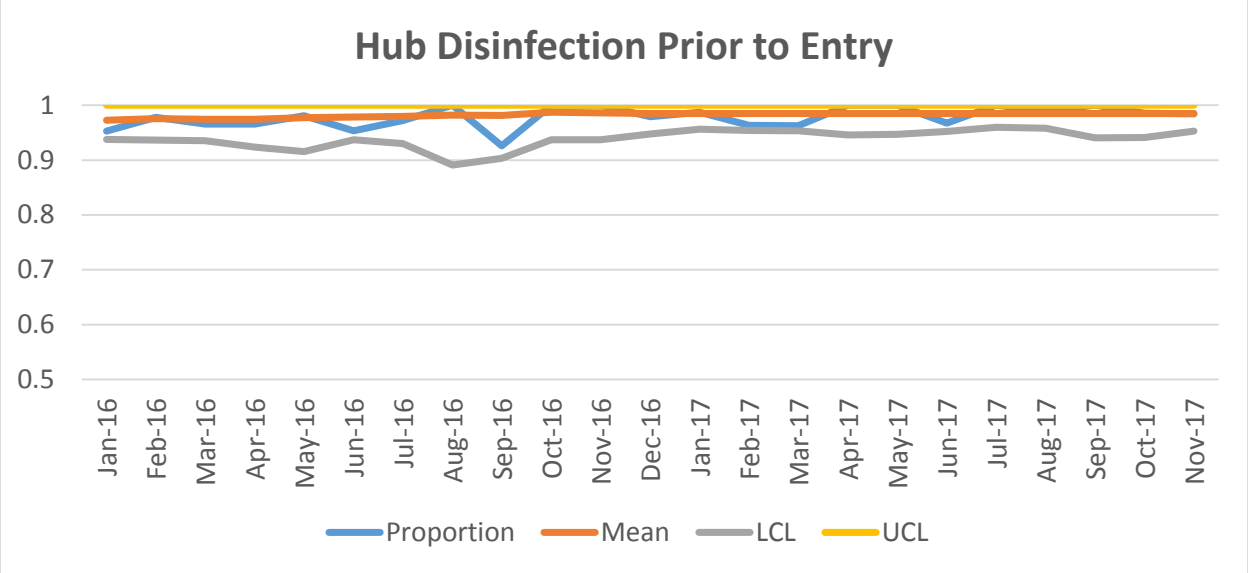


Figure 3: Compliance with CVL maintenance bundle element "hub disinfection prior to entry" over study period

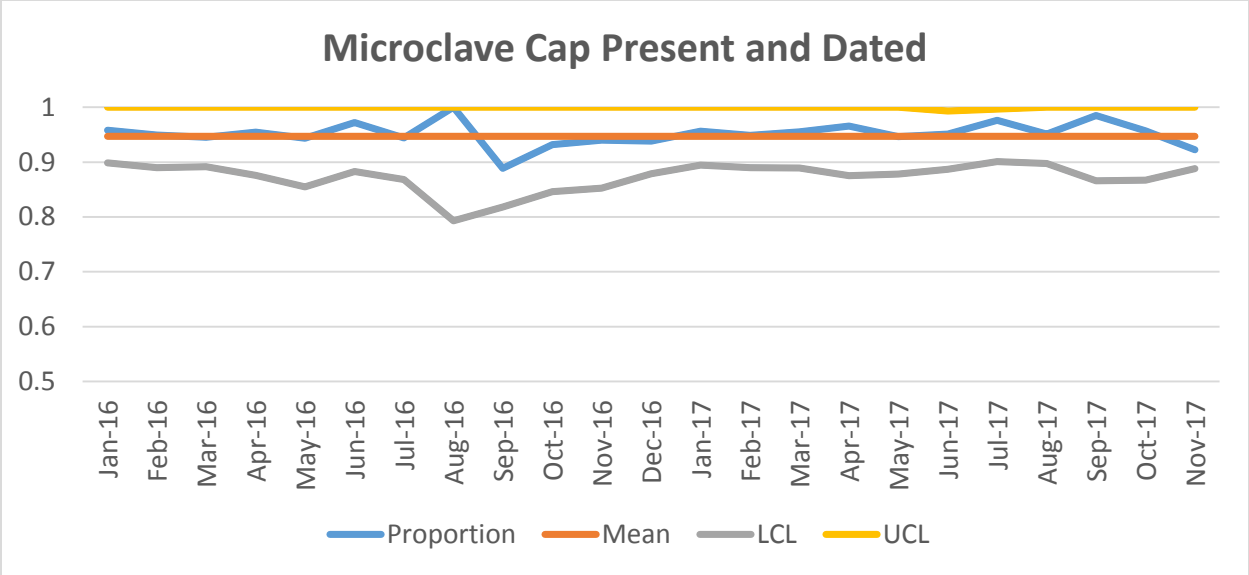


Figure 4: Compliance with CVL maintenance bundle element "microclave cap present and dated" over study period

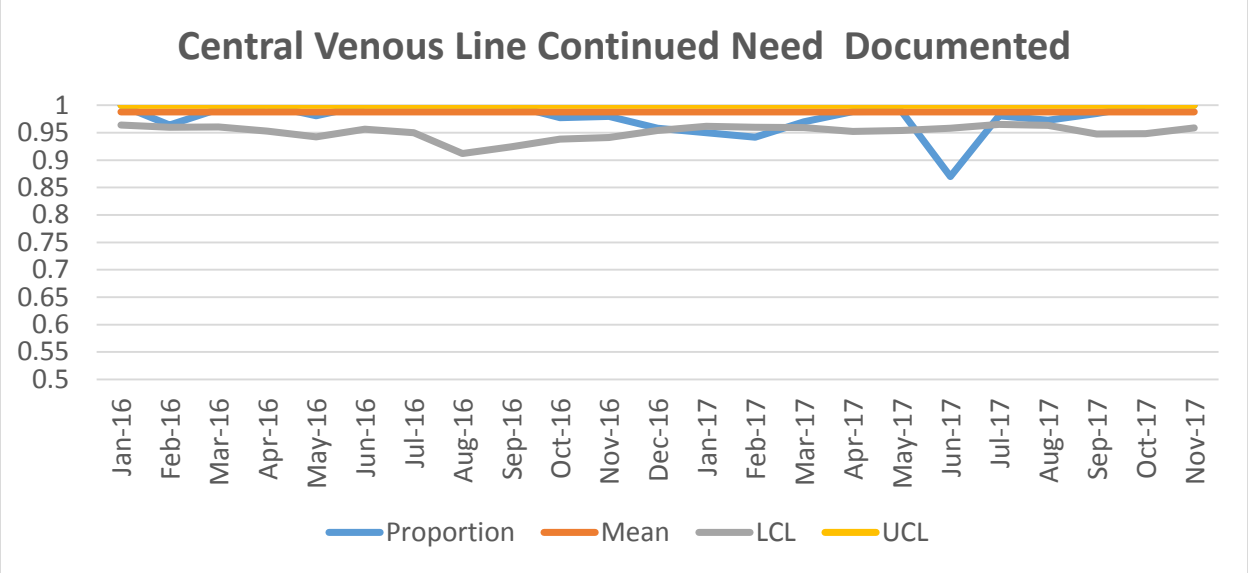


Figure 5: Compliance with CVL maintenance bundle "central venous line continued need discussed and documented daily" over study period

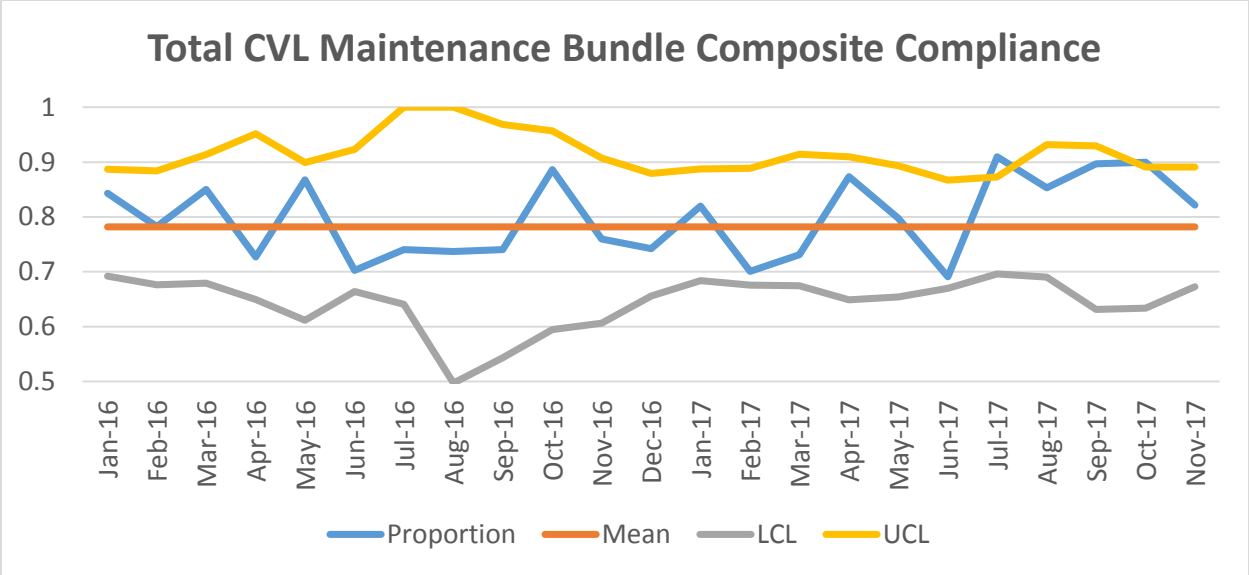


Figure 6: CVL maintenance bundle composite compliance over study period

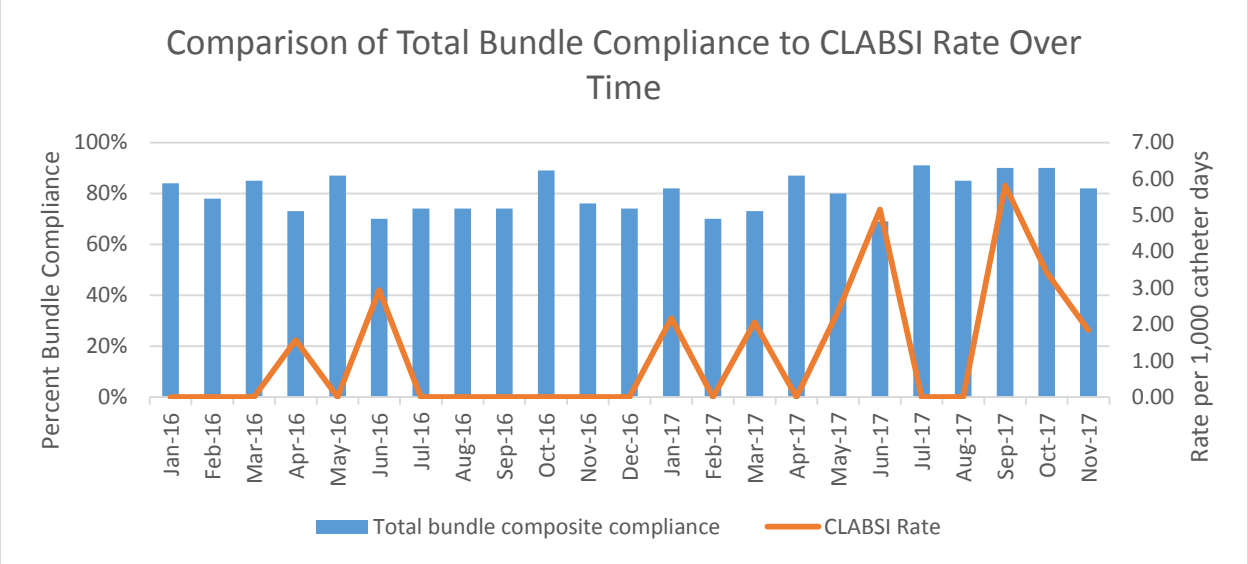
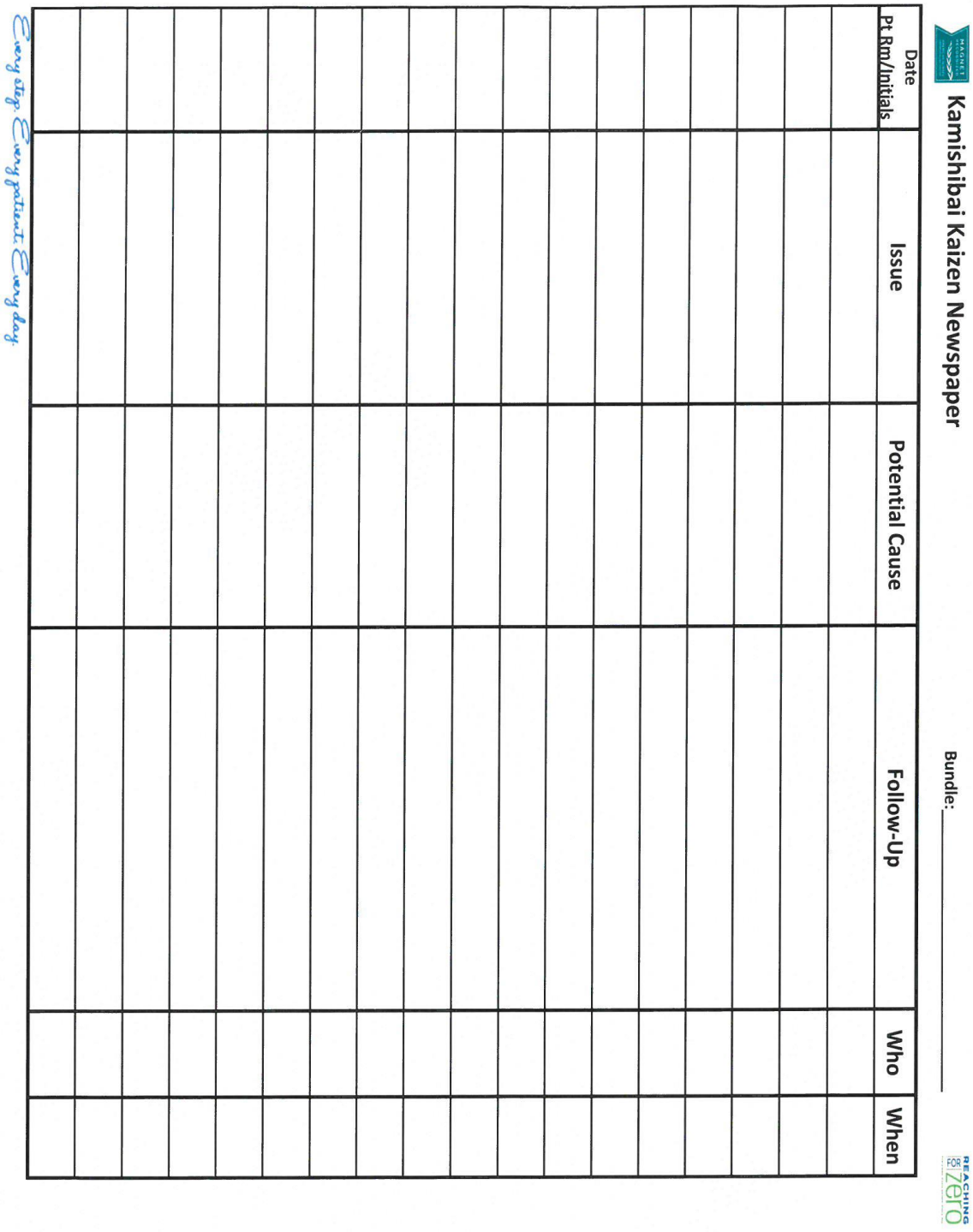


Figure 7: Comparison of CVL composite compliance to CLABSI rate over study period

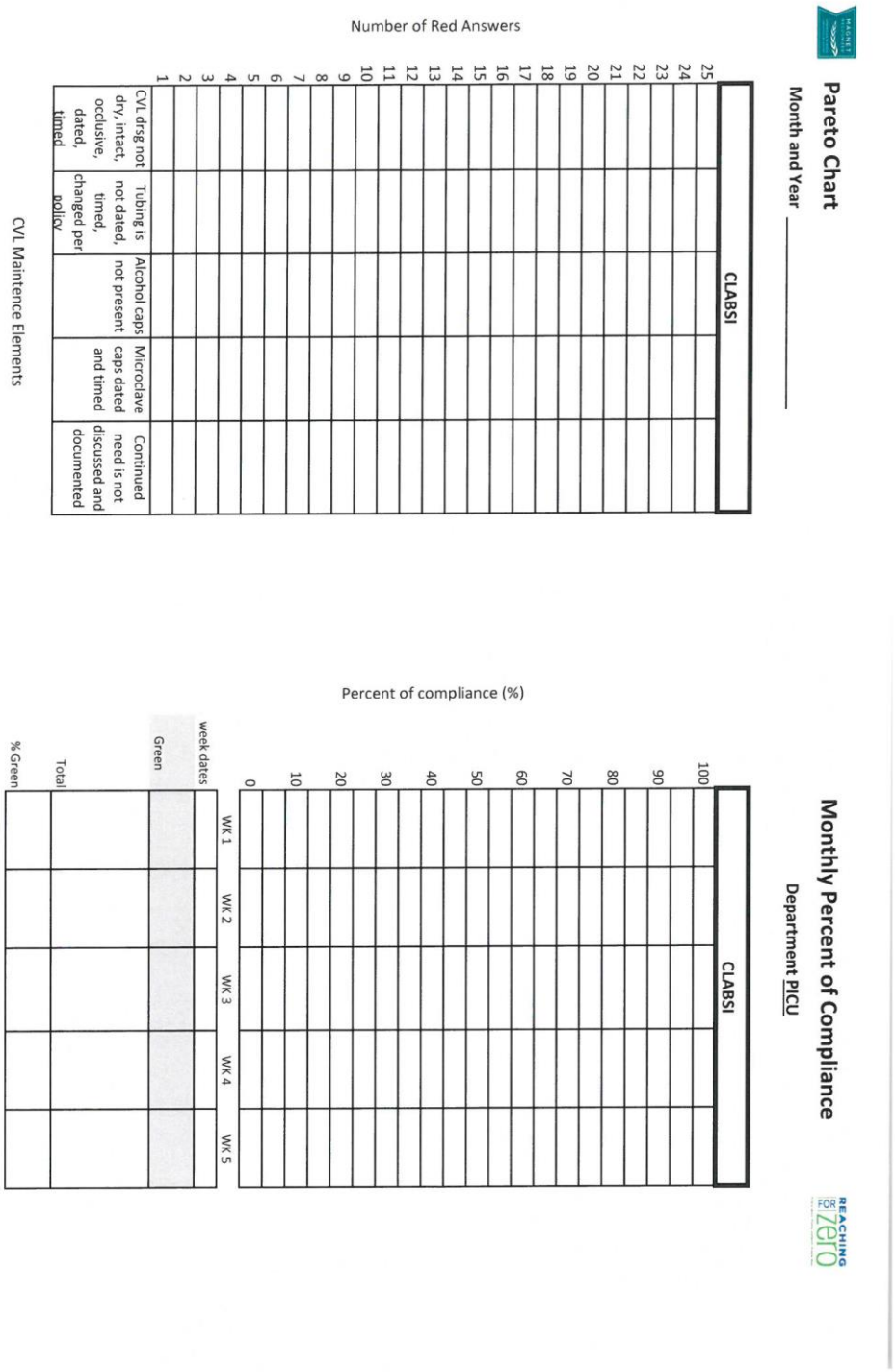
Appendix A

Sample Kamishibai Newspaper



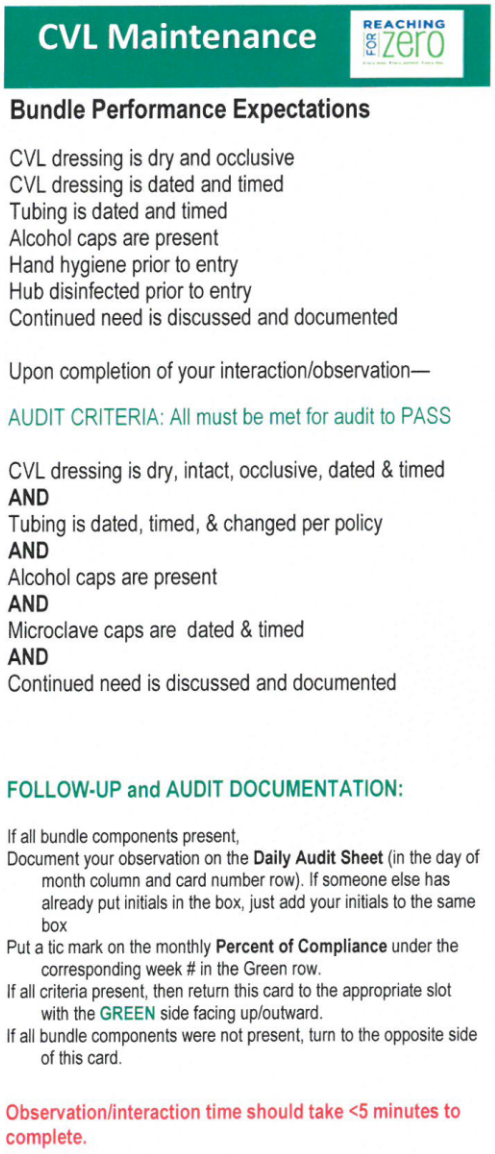
Appendix B

Sample Pareto Chart and Compliance Chart



Appendix C

Sample Compliant K-Card



CVL Maintenance REACHING FOR zero

Bundle Performance Expectations

CVL dressing is dry and occlusive
CVL dressing is dated and timed
Tubing is dated and timed
Alcohol caps are present
Hand hygiene prior to entry
Hub disinfected prior to entry
Continued need is discussed and documented

Upon completion of your interaction/observation—

AUDIT CRITERIA: All must be met for audit to PASS

CVL dressing is dry, intact, occlusive, dated & timed
AND
Tubing is dated, timed, & changed per policy
AND
Alcohol caps are present
AND
Microclave caps are dated & timed
AND
Continued need is discussed and documented

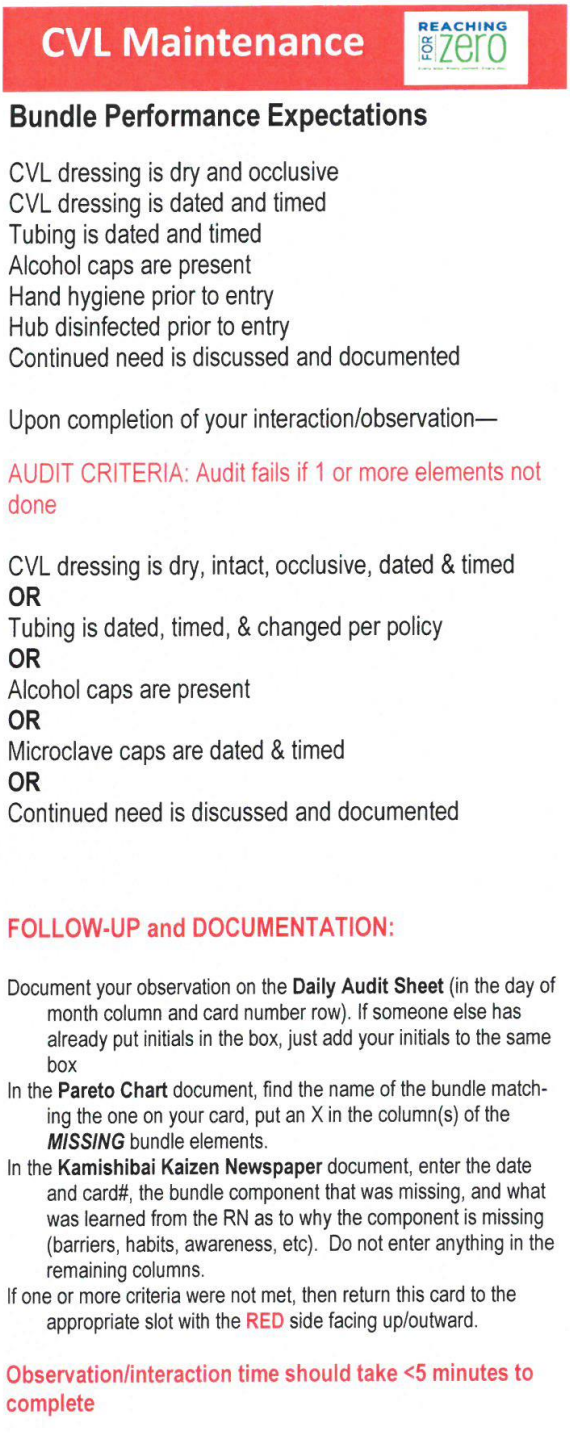
FOLLOW-UP and AUDIT DOCUMENTATION:

If all bundle components present,
Document your observation on the **Daily Audit Sheet** (in the day of month column and card number row). If someone else has already put initials in the box, just add your initials to the same box
Put a tic mark on the monthly **Percent of Compliance** under the corresponding week # in the Green row.
If all criteria present, then return this card to the appropriate slot with the **GREEN** side facing up/outward.
If all bundle components were not present, turn to the opposite side of this card.

Observation/interaction time should take <5 minutes to complete.

Appendix D

Sample Non-Compliant K-Card



CVL Maintenance REACHING FOR zero

Bundle Performance Expectations

CVL dressing is dry and occlusive
CVL dressing is dated and timed
Tubing is dated and timed
Alcohol caps are present
Hand hygiene prior to entry
Hub disinfected prior to entry
Continued need is discussed and documented

Upon completion of your interaction/observation—

AUDIT CRITERIA: Audit fails if 1 or more elements not done

CVL dressing is dry, intact, occlusive, dated & timed
OR
Tubing is dated, timed, & changed per policy
OR
Alcohol caps are present
OR
Microclave caps are dated & timed
OR
Continued need is discussed and documented

FOLLOW-UP and DOCUMENTATION:

Document your observation on the **Daily Audit Sheet** (in the day of month column and card number row). If someone else has already put initials in the box, just add your initials to the same box
In the **Pareto Chart** document, find the name of the bundle matching the one on your card, put an X in the column(s) of the ***MISSING*** bundle elements.
In the **Kamishibai Kaizen Newspaper** document, enter the date and card#, the bundle component that was missing, and what was learned from the RN as to why the component is missing (barriers, habits, awareness, etc). Do not enter anything in the remaining columns.
If one or more criteria were not met, then return this card to the appropriate slot with the RED side facing up/outward.

Observation/interaction time should take <5 minutes to complete