Florida Perinatal Quality Collaborative

Partnering to Improve Health Care Quality for Mothers and Babies

John Curran Quality Improvement Award

Name of Project/Program: Creating an Antibiotic Stewardship Program in a Tertiary Neonatal Intensive Care Unit: Charge Nurses Taking Charge, Reducing Central Line Infections, and Debunking the Culture of Culture-Negative Sepsis

Project Leaders' Names and Positions: 1) **Josef Cortez, M.D.**, NICU Medical Director and Quality and Patient Safety Initiative Leader; 2) **Colleen Timmons, D.O.**, Pediatric Resident; 3) **Bill Renfro, PharmD,** Pharmacy Supervisor and Antibiotic Stewardship Champion, 4) **P. Sireesha Nandula, M.D.,** Neonatologist and Antibiotic Stewardship Champion, 5) **Mark Yeoman, RN, MSN,** NICU Clinical Quality Nurse Leader, 6) **Ellen Gregory, BSN, RN,** NICU Nurse Manager, 7) **Carmen Ortiz, BSN, RN,** NICU Charge Nurse, 8) **Jennifer Wood, BSN, RN,** NICU Charge Nurse, 9) **Melissa Canady, BSN, RN,** NICU Charge Nurse, 10) **Melissa Flaherty, BSN, RN,** NICU Charge Nurse 11) **Rita Hazboun, M.D.,** Pediatric Resident, 12) **Rima Dababneh, M.D.,** Pediatric Resident, 13) **Adriana Pena-Ariet, M.D.**, Pediatric Resident , 14) **Yvette McCarter, PhD**, Director of Clinical Microbiology, 15) **Carmen Smotherman, M.S.**, Biostatistician, 16) **Trace Getzlaff, BS**, IT and NICU QA/QI Portal Database Manager, 17) **Melody Wu-Ballis, DVM, MPH, CIC,** Infection Control and Prevention 18) **Chad Neilsen,MPH, CIC,** Infection Control and Prevention, 19) Marilyn Middlebrooks, MSN, RN, CCRN, CIC, Infection Control and Prevention, 20) **Kartikeya Makker, M.D.**, FPQC Quality Improvement Leader, 21) **Samarth Shukla, M.D.**, Pediatric Performance Improvement Council Chair, 22) **Keith Cason, RRT**, Director of Respiratory Therapy, 23) **Azeem Rathore, D.O.**, Lake Erie Osteopathic Medicine, 24) **Jenny VanRavestein, MSN, RN, NE-BC** , Director of Women's and Children's Services, 25) **Ana Alvarez, M.D.,** Pediatric Infectious Disease Senior Adviser, 26) **Mark L. Hudak, M.D.**, Chairman of Pediatrics and Division Chief of Neonatology, Senior Adviser

Project Timeframe (start and stop month/year): January 1, 2016 to present

INTRODUCTION: [Word Limit: 396/400]

Part of the "Choosing Wisely in Newborn Medicine" campaign to identify and eliminate unnecessary tests and treatments that contribute to health care waste, Ho et al (2015) identified judicious use of antibiotics as one of the practices that may contribute to improved outcomes and reduced expense in the NICU. Longer duration of antibiotic therapy has been associated with higher rates of mortality, necrotizing enterocolitis, late-onset sepsis, and lengthier hospitalization. In 2016, the Vermont Oxford Network (VON) and the Center for Disease Control and Prevention (CDC) launched "Choosing Antibiotics Wisely", an internet-based, multi-center collaborative aimed to curb non-judicious use of

antibiotics in newborn medicine. The neonatal intensive care unit (NICU) at the University of Florida Health Jacksonville has been a member of VON since 2012. As part of the "Choosing Antibiotics Wisely" collaborative, we formed an inter-disciplinary team to create an antibiotic stewardship program (ASP) in the NICU in March 2016. Since then, we have tracked our antibiotic usage rate (AUR) and implemented quality improvement (QI) initiatives to decrease our AUR.

In February 2016, we participated in our first VON Day Audit where we answered a survey about our hospital and NICU. We identified that we had gaps including establishing NICU-specific guidelines for antibiotic prescription. This was the start of our ASP in the NICU. Subsequently, we identified key drivers to our quality improvement projects (Figure 1). Our specific, measurable, attainable, relevant, and time-limited (SMART) aims for our ASP were as follows: ***specific*** – to reduce AUR (days of treatment (DOT) per 1000 patient-days from a baseline average of 330 in 2015, to 275 in December 2018; ***measurable*** – to track AUR monthly as well as DOT of all antibiotics and NICU census; ***attainable*** – to collaborate with NICU pharmacists and nurses to provide DOT and census respectively, using electronic medical record (EMR), established definitions, and QI toolkits provided by VON via a series of educational webinars; ***relevant*** – to achieve a decrease in AUR that is practical, and to correlate decrease in AUR to clinical outcomes such as decrease in length of stay and cost; and ***time-bound*** – to achieve our specific objective by December 2018, with regular audits and timely reporting to staff.

Although AUR was our primary outcome measure, we hoped to instill a culture of more judicious antibiotic prescription, to decrease central line infections, to engage charge nurses and parents, and to challenge the concept of culture-negative sepsis.

METHODS: [Word Limit: 499/500]

Setting: University of Florida Health – Jacksonville (UFHJ) is an academic medical center that serves an inner city, urban population. The level III NICU is a state-designated regional referral center. On average, there are 90 (range, 73-107) preterm infants <30 weeks' gestation admitted per year from 2012-2017; more than 80% are inborn while the rest are referred from other medical centers. In 2017, the average daily census in the NICU was 38. There are 2 clinical teams: advanced practice providers' (APP) and the residents' teams; each team is supervised by a neonatologist. The number needed to influence is 67 composed of 4 pediatric and family residents per month, 6 APPs, and 13 neonatologists. Through a series of Plan-Do-Study-Act (PDSA) cycles, we established an ASP, monitored AUR, and improved NICU outcomes.

Choosing Antibiotics Wisely: In January 2016, we participated in VON's "Choosing Antibiotics Wisely" campaign. We formed a multi- and inter-disciplinary team that included physician champions, residents, pharmacists, and nurses. From our first VON Day Audit in February 2016, we identified gaps in our practice, including the lack of clinical practice guidelines for diagnosis and antibiotic treatment (i.e., antibiotic choice, dose, and duration). We have since established evidence-based, consensus-derived clinical guidelines for the diagnosis of and antibiotic prescription for the following: early-onset sepsis, late-onset sepsis, necrotizing enterocolitis, suspected respiratory and ventilator-associated infections, prophylaxis for urinary tract infection, and targeted antifungal prophylaxis. We collaborated with our NICU pharmacists and utilized EMR to track monthly AUR run charts.

Antibiotics Time-Out and Charge Nurses Taking Charge: We first instituted an antibiotics time-out (ATM) process in May 2016 to increase parental knowledge about antibiotics, and for the clinical team to pause and decide on the appropriateness of antibiotics. Between February-April 2017, we incorporated the ATM process in our morning clinical huddles led by NICU charge nurses, and we continued to report our monthly AUR.

Reducing Central Line Infections (CLABSI): In January 2018, we observed an increase in our CLABSI rates. We engaged Infection Prevention and Control to identify and address knowledge and practice gaps. We revisited our clinical practice in the past that had been successful in decreasing CLABSI. We identified the following processes: treat all lines (peripheral and central) equally, replace alcohol swabs with chlorhexidine swabs, enforce strict handwashing, and incorporate line days in our morning clinical huddles.

Challenging the Concept of Culture-Negative Sepsis: Starting in January 2017, we tracked the number of infants who had negative blood cultures but still received antibiotics for more than 48 hours. We also included this information in our morning huddles with subsequent discussions on the merits of continuing antibiotics for >48 hours if blood cultures were normal.

Analysis: We reported monthly AUR run charts to monitor our primary outcome. The u'-chart served as the primary tool for statistical process control (SPC) analysis. The visual representation of our improvement efforts (i.e., AUR SPC chart) yielded insight into inherent process variations or special-cause variations ($p<0.001$). We also plotted CLABSI rates and percentage of infants treated for culture-negative sepsis (p-chart).

RESULTS: [Word Limit: 492/500]

When we began participation in the VON collaborative "Choosing Antibiotics Wisely" in January 2016, we formed a team composed of neonatologists, nurses, pharmacists, hospital administrators, pediatric infectious disease consultants, and respiratory therapists. In collaborating with our NICU pharmacists and EMR experts, we determined that our AUR from July 2015 to December 2015 was 330. We established a goal to decrease our AUR to 275 by December 2018. We instituted a series of PDSA cycles that started in April 2016 with establishing evidence-based, consensus-derived clinical guidelines for the diagnosis of infections and for prescription of antibiotics (type, dose, and duration). We also aimed to increase parental understanding of antibiotic treatment. To do this, we instituted an antibiotics time-out process (ATM) where the clinical team held an hour per day "time-out" to reach out to parents and update them about their infants' clinical status, including the usage of antibiotics. Although adherence to both clinical guidelines and ATM was poor, nonetheless, our AUR has decreased to 199 by December 2016. In spite of this decrease, there was no discernible special-cause variation detected in the SPC analysis of the AUR run chart (Figure 2). The ATM process was likewise tedious as per feedback from the clinical teams, likely contributing to non-adherence.

In 2017, we tackled the lack of adherence to both clinical guidelines and ATM, and rolled out a "Charge Nurses Taking Charge" initiative in April 2017. We incorporated the ATM process in our daily clinical huddles, led by NICU charge nurses. However, we still did not observe any special-cause variation in our AUR run chart. Additionally, we correlated our ASP with duration of hospitalization or length of stay (LOS) and cost. We observed decreasing LOS and cost following the start of our ASP (Figure 3).

By early 2018, it became clear that CLABSI rates (yearly rate per 1000 line-days) in the NICU had increased from 2.6 in 2016 to 3.6 in 2017. In the first quarter of 2018, this rate climbed further to 5.3 (Figure 4). We focused our efforts on reducing CLABSI in a joint effort with Infection Prevention and Control. We instituted small processes of change that included the following: treat all intravenous lines equally, use ionized silver-impregnated disc as antimicrobial barrier on both peripheral and central lines, use chlorhexidine gluconate swabs instead of alcohol as antiseptic agent, and reinforce strict handwashing and appropriate hand-gloving techniques. We likewise added information about line-days in our morning clinical huddles. At the current time, we have had no CLABSI since February 23, 2018. Our average AUR has decreased to 243 in 2018 year to date (Figure 2).

As a process measure to monitor adherence to established clinical guidelines, we tracked the rates of culture-negative sepsis that were treated with antibiotics for >48 hours. In the SPC (p) chart (Figure 5), we do not observe special-cause variation, i.e., we continue to treat culture-negative sepsis even though we have included information about negative blood cultures in clinical huddles.

DISCUSSION: [Word limit: 322/500]

We report several key observations during our journey to establish an antibiotic stewardship program in the NICU. First, through a series of PDSA cycles, and utilizing QI methods we have learned along the way, we experienced a reduction in our AUR from a baseline of 330 in the second half of 2015 to a running average of 243 from January 2018 to October 2018, consistent with more judicious use of antibiotics in our NICU. We implemented small processes of change to establish a robust antibiotic stewardship program. This program included regular antibiotic time-outs during clinical huddles led by NICU charge nurses; a focus on prevention of CLABSI; and an effort to shorten antibiotic treatment of culture-negative sepsis. It is likely that our success in reducing CLABSI had the greatest single impact on reducing AUR. This emphasizes that infection prevention is a key element in antibiotic stewardship.

Second, we observed that our length of stay declined after the implementation of an antibiotic stewardship program. However, there were other clinical innovations that we have initiated in parallel with antibiotic stewardship such as optimized nutrition, use of donor milk and human-milk based fortifier, and implementation of an ICH bundle and golden hour strategy. Any of all of these may have contributed to shorter lengths of stay and improved outcomes.

Finally, the lessons learned in this quality improvement project are not lost on our members as we continue to effect change to improve outcomes in the NICU. The ultimate goals for these types of projects are to improve outcomes broadly while meeting the stated objectives. Additionally, it was also our goal to change the mindset and create a paradigm shift in clinical practice. This is still a work in process. Going forward, we plan to continue tracking our AUR, continue the “Charge Nurses Taking Charge” initiative in morning huddles, revise our clinical practice guidelines in light of newer evidence, and challenge the culture of culture-negative sepsis.

ATTACHMENTS:

Figure 1 – Key Driver Diagram

Figure 2 – Annotated Statistical Process Control Chart (u-Chart) of Antibiotic Usage Rate from July 2015 to October 2018

Figure 3 – Length of Stay from January 2015 to April 2017

Figure 4 – Rates of Central Line Associated Bloodstream Infection from January 2016 to November 2018

Figure 5 – Statistical Process Control Chart (p-Chart) of Infants Treated with Antibiotics with Culture-Negative Sepsis from January 2017 to June 2018

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Figure 1 – Key Driver Diagram

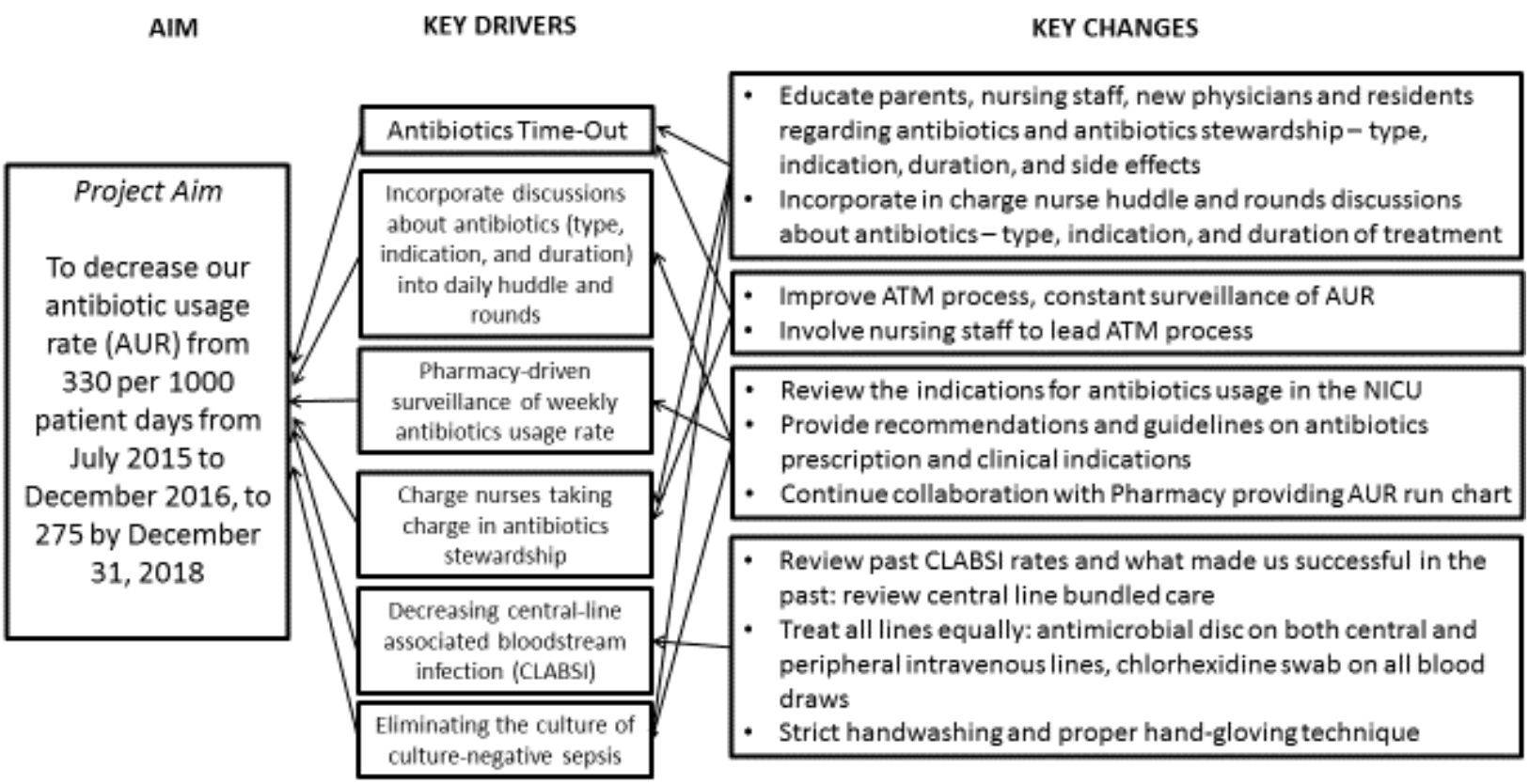


Figure 2 – Annotated Statistical Process Control Chart (u' Chart) of Antibiotic Usage Rate from July 2015 to October 2018

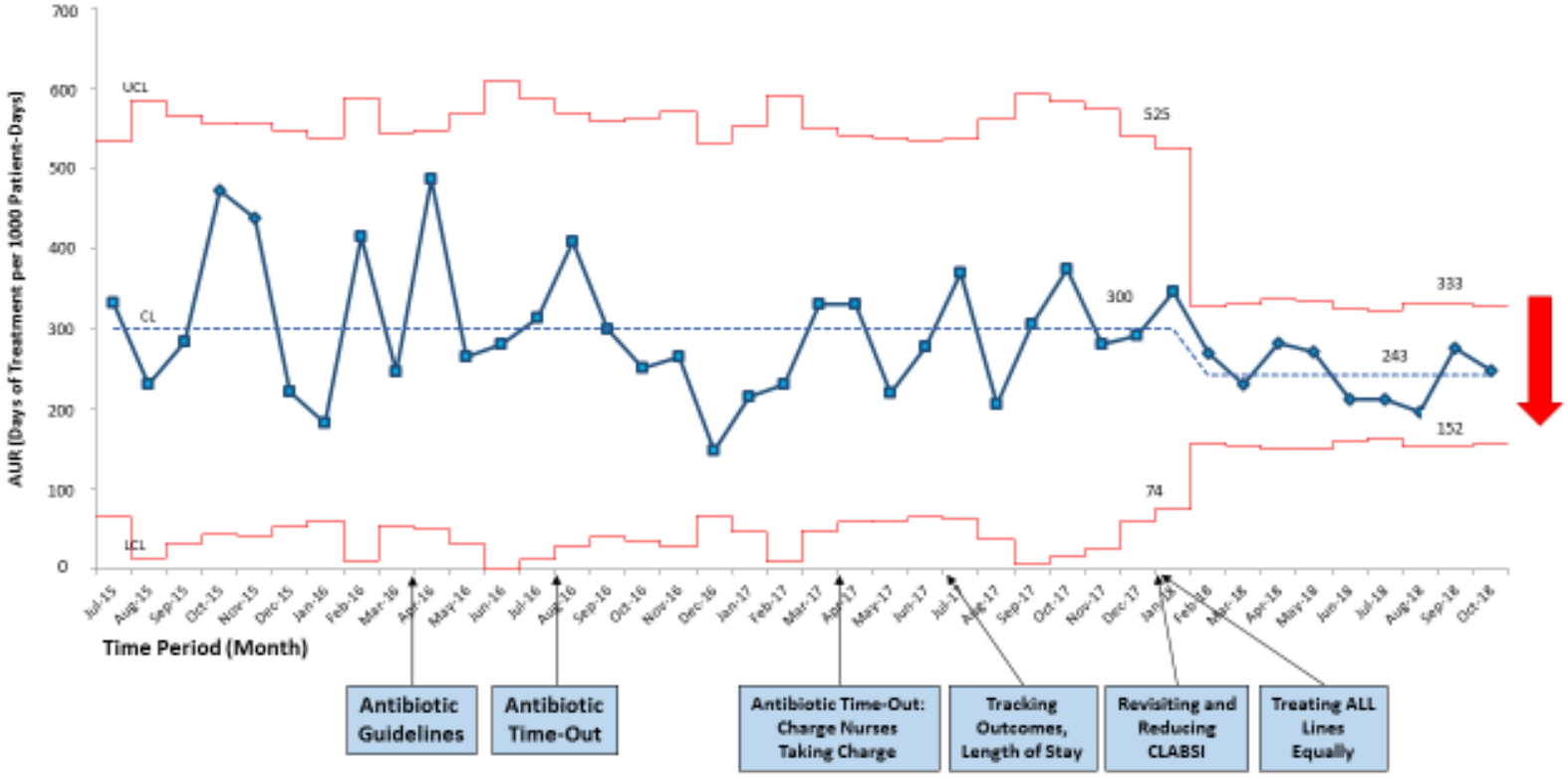
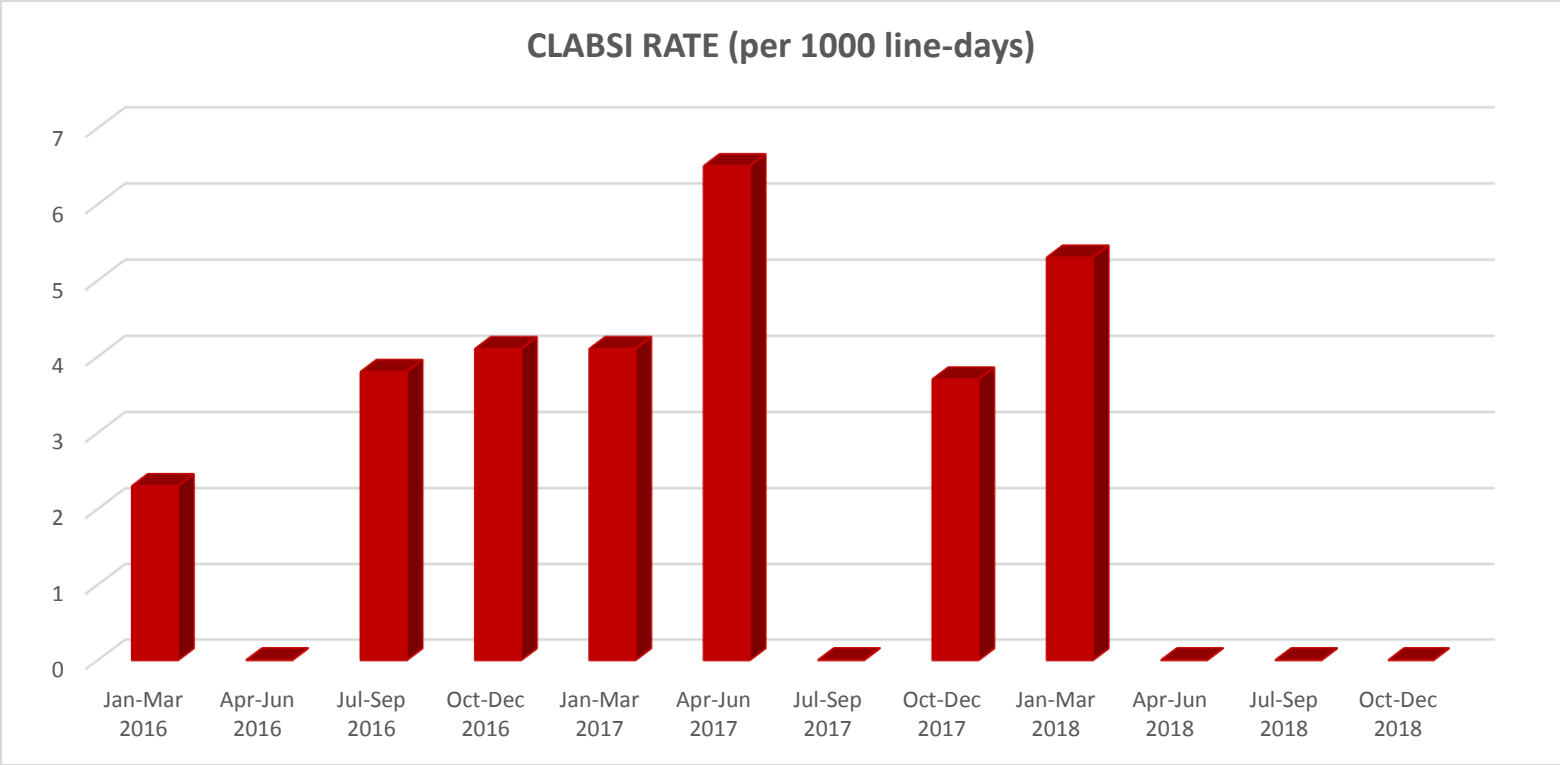


Figure 3 – Length of Stay from January 2015 to April 2017

Figure 4 – Rates of Central Line Associated Bloodstream Infection from January 2016 to November 2018



PERIOD	CLABSI	LINE-DAYS	CLABSI RATE (per 1000 line-days)	YEARLY CLABSI RATE (per 1000 line-days)
Jan-Mar 2016	1	435	2.3	
Apr-Jun 2016	0	378	0	
Jul-Sep 2016	2	521	3.8	
Oct-Dec 2016	2	490	4.1	2.6
Jan-Mar 2017	2	485	4.1	
Apr-Jun 2017	4	616	6.5	
Jul-Sep 2017	0	633	0	
Oct-Dec 2017	3	813	3.7	3.6
Jan-Mar 2018	4	752	5.3	
Apr-Jun 2018	0	647	0	
Jul-Sep 2018	0	607	0	
Oct-Dec 2018	0	416	0	1.3

Figure 5 – Statistical Process Control Chart (p Chart) of Infants Treated with Antibiotics with Culture-Negative Sepsis from January 2017 to June 2018