

IMPLEMENTATION OF A DISCHARGE PATHWAY TO DECREASE INFANT'S
POSTOPERATIVE LENGTH OF STAY IN A CARDIAC INTENSIVE CARE UNIT

A Doctor of Nursing Practice Project Report

by

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Submitted in Partial Fulfillment of the Requirements for the Degree of

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This Doctor of Nursing Practice Project Report meets the standards for scope and quality of Texas A&M University-Corpus Christi College of Nursing and Health Sciences and is hereby approved.

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DEDICATION

I would like to dedicate this work to my children Ryan, Riley, Regan, and Remy who have cheered me on through this entire process. You four are my entire world and my greatest blessings and I am forever grateful that I get to be your mom. I would also like to dedicate this to my late husband Darrel Buckner. Earning this degree is my first major milestone since graduating high school that I must celebrate without him by my side and cheering louder than everyone else in the crowd. When he died last year I did not know how I was going to live a single day without him let alone finish the work for this degree. I still struggle with adjusting to living life without him, but with the support of my kids I finished this project and know he would be proud. I will love you forever Darrel Wayne, until we meet again.

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I would like to acknowledge Dr. Kevin Schooler because without the standardization of care that you spent countless hours putting into place, your passion for quality improvement, and your unwavering support, this project would not have been possible. I would also like to acknowledge the leadership, medical staff, and nursing staff in the Cardiac Intensive Care Unit for your support and participation in this quality improvement project.

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ABSTRACT

Congenital heart defects (CHDs) are the most prevalent of all birth defects. In the United States there are about 40,000 new cases diagnosed annually. About 25% of those infants have a critical congenital heart defect (CCHD) requiring surgical intervention in the first 30 days of life in order to survive. Discharge from the hospital to home is a major process that, if fragmented, is inconsistent or unstructured can lead to medication errors, treatment delays, increased health care costs, and lower quality of care. Safely transitioning infants with CCHDs from the hospital to home requires planning that begins on admission. The purpose of this quality improvement project was to determine if implementing a standardized discharge pathway for infants with CCHDs could improve the discharge processes and decrease postoperative length of stay in a 22-bed mixed Pediatric Intensive Care Unit (PICU) and Cardiac Intensive Care Unit (CICU). The pathway was initiated on all infants requiring a surgical intervention within the first 30 days of life. The aim of having 100% of participants with a completed checklist by the end of the three-month project and 100% of parents completing the required rooming in period before discharge were met. However, no decrease in PLOS was demonstrated in this quality improvement cycle for *STAT 2* and *STAT 3* categories and a 0.5 day decrease in PLOS was demonstrated in *STAT 5*.
Keywords: critical congenital heart defects, discharge, postoperative length of stay, discharge pathway

Implementation of a Discharge Pathway to Decrease Infant's Postoperative Length of Stay in a Cardiac Intensive Care Unit

INTRODUCTION

Congenital heart defects (CHDs) represent 28% of all congenital anomalies and they have the highest mortality in the first year of life for any single anomaly (CDC, 2022; Lopes et al., 2018; Mai et al., 2019). Global reporting and documenting of CHDs at birth varies widely but an estimation is 10 out of 1000 births (Hoffman, 2013; Van der Linde et al., 2011). The prevalence of CHDs in the United States is one in 110 births, or 40,000 cases each year (Arth et al., 2017). In 2016, The Texas Birth Registry data reported the prevalence of CHDs in Texas as 20.78 per 10,000 births (Texas Health Data, 2016). Of the 40,000 infants born with a CHD, 25% have a critical congenital heart defect (CCHD) requiring surgical intervention in the first 30 days of life to survive. In Texas, about 800 infants are born annually with a CCHD (Lopes et al., 2018; Texas Health Data, 2016).

Infants with critical congenital heart defects (CCHD) are at higher risk for feeding problems, poor weight gain, learning problems and developmental delays in speech, motor, and behavior compared to infants with structurally normal hearts (Chen et al., 2016; Clouchoux et al., 2013; Mussatto et al., 2014; Sables-Baus et al., 2012). Due to these significant delays, infants with CCHDs utilize more healthcare resources and require increased specialized care compared to infants without a CCHD (Chen et al., 2016). Importantly, post discharge care for these infants requires extensive planning and training for the parents to ensure a safe transition from hospital to home (Shackleford et al., 2021).

Discharge from hospital to home is a major process that, if fragmented, is inconsistent or unstructured can lead to medication errors, treatment delays, increased health care costs, and

lower quality of care (Madsen et al., 2021; Wu et al., 2016). An adverse event during the discharge process happens in 20% of patients and half of those events are preventable (Forster et al., 2003; Forster et al., 2004). Safely transitioning infants with CCHDs from the hospital to home requires daily planning that begins on admission and continues throughout the hospital stay.

Background

Review of Literature

A systematic review of the literature supported the need for comprehensive discharge planning in order to ensure a safe and timely postoperative discharge for infants with critical congenital heart defects. The literature also supported standardization in discharge care to improve outcomes and make practice safer by decreasing inconsistency in the discharge process.

There is existing literature, including interdisciplinary policy statements and evidenced based guidelines endorsed by the American Academy of Pediatrics (AAP) and the National Association of Neonatal Nurse (NANN), to support a structured discharge of infants to home from the neonatal intensive care unit (AHRQ, 2013; AAP, 2008; NAAN 2014). The AAP position statements, and NAAN guidelines provide information on discharge needs and milestones for preterm infants and infants with special health care needs. However, they do not directly address the specific needs of infants with critical congenital heart defects (CCHDs).

Infants with CCHDs are complex and medically fragile when discharged from the hospital to home. Parents of these infants must provide constant vigilance, use durable medical equipment, and follow strict adherence to medication and feeding schedules (Abernathy, 2018; Hartman & Medoff-Cooper, 2012). Providing anticipatory guidance and ensuring parents are prepared to care for their infant at home is an integral part of the discharge process (AAP, 2017).

A qualitative study by Lee & Koo (2020) found that parents of infants with CHDs wanted education on how to manage their child's disease after hospital discharge. In addition, they preferred visual tools that were dependable, easy-to-understand, and easily accessible. In another qualitative study, Wray et al. (2018) used an online forum to obtain information from parents of infants with congenital heart defects in order to learn about their experiences caring for their child after discharged from the hospital. One consistent theme from each of the 91 participants was that they valued the direct learning required before they left the hospital with their infant.

Focused initiatives detailing efforts aimed at improving pediatric postoperative discharge processes and interventions further highlighted the need for caregiver anticipatory guidance and discharge planning. In a published quality improvement initiative, Wright (2018) described the planning, execution, and assessment of a "nesting protocol" that allowed caregivers to room in with their infant and provide total care while the infant was still in the hospital. This protocol allowed the parents to feed, give medications, comfort, and provide general care to their infant who was recovering from heart surgery and preparing to go home. Parent satisfaction and preparedness for discharge improved after implementation of the nesting protocol (Wright, 2018).

Problem Description in the Setting

This quality improvement project was implemented in a 14-bed Cardiac Intensive Care Unit (CICU) that had undergone major workflow changes. One of the biggest changes in workflow was all infants more than 32 weeks gestation and more than 2 kg in weight with a critical congenital heart defect (CCHD) were admitted to the CICU instead of the neonatal intensive care unit (NICU). These infants remained in the CICU before surgery, after surgery and were discharged directly home from the CICU. Historically the CICU staff did not discharge

patients. Infants recovered from the acute postoperative period and then transferred to the NICU until ready for discharge home. Once CICU staff assumed this responsibility, discharging these fragile infants and making sure the parents were prepared for the care they would need to provide at home became a major challenge. A need for improvement and standardization in the discharge process was quickly identified by CICU staff and leadership.

Postoperative length of stay (PLOS) is one of the quality indicators measured in pediatric cardiac surgery programs. A combination of performance metrics including mortality rate, readmission rate within thirty days, and PLOS provide an indirect measure of pediatric cardiac surgery program quality (Johnson et al., 2016; Newburger et al., 2003; O'Brien et al., 2019; Pasquali et al., 2019). PLOS is the amount of time, measured in days, during which a patient remains in the hospital following surgery. If the surgery goes well and the patient has minimal or no complications, PLOS will be low. If there are significant complications, the patient will remain in the hospital for a proportionately longer period and PLOS will be high. A lower PLOS, with no increase in mortality or readmission rate, provides a surrogate measure for improved patient outcomes and better resource utilization (Pasquali et al., 2019).

The complexity of any underlying cardiac abnormality determines which cardiothoracic procedure the patient requires. The specific cardiac procedure the patient requires then predicts the probability of mortality for that patient. The STAT (The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery) score is a metric which defines the risk for mortality associated with any congenital heart surgery procedure. The STAT categories range from 1 to 5. A STAT score of 1 indicates a procedure with the lowest risk of mortality while a STAT score of 5 indicates a surgical procedure with the highest risk of mortality. In short, the

STAT score measures the probability of mortality associated with a specific procedure and not the complexity of the heart lesion itself (Jacobs et al., 2019).

The most cited non-modifiable factors affecting PLOS are surgical complexity (represented by STAT score), chromosomal abnormalities and extrachromosomal abnormalities (Al-Haddad et al., 2007; Brown et al., 2003; Pagowska-Kilmek et al., 2011; Pasquali et al., 2014). Higher mortality surgeries are typically longer, more complex and performed on the sickest and youngest patients. (Jenkins et al., 2002; Lacour-Geyet et al., 2004; O'Brien et al., 2019).

Infants with critical congenital heart defects (CCHDs) tend to have high hospital readmission rates, poor weight gain, and longer hospital length of stays. These factors increase the financial burden on both the family and society (Hehir et al., 2012; Ghanayem et al., 2012). Because these infants have such complex needs that require extensive discharge teaching and preparation, this quality improvement project focused on implementing a discharge pathway to improve the discharge process and decrease PLOS. The standardized discharge pathway included an awareness board, discharge checklist, parent teaching, and a required rooming-in period. The discharge pathway can decrease overall hospitalization costs by decreasing PLOS (Carlo et al., 2017; Davidson et al., 2020; Ghanayem et al., 2012).

Standardization of health care practice reduces variation and promotes improved outcomes (Kugler et al., 2009). The pre intervention discharge process was not standardized or consistently documented in the electronic medical record. Implementation of a standardized discharge pathway has potential to decrease delays in discharge, decrease postoperative length of stay, decrease hospitalization costs, and, more importantly, improve patient outcomes by preparing parents for a complex discharge.

Project Purpose and Aims

The purpose of this quality improvement project was to determine if implementing a standardized discharge pathway for infants with critical congenital heart defects would improve the discharge processes and decrease postoperative length of stay in a 14-bed Cardiac Intensive Care Unit (CICU). The clinical PICOT question this project sought to answer was: in infants with critical congenital heart defects, would a standardized discharge pathway, when compared to the current discharge practice, decrease postoperative length of stay during a three-month period?

The first aim was to standardize the discharge process for infants with critical congenital heart defects (CCHDs) and determine if it effected postoperative length of stay. The intervention consisted of implementation of a standardized checklist (Figure 1), an awareness board (Figure 2), and tracking tool (Figure 3) to be completed before discharge. The discharge checklist was implemented within 24 hours of admission to the CICU, updated, and reviewed daily on multidisciplinary rounds. The goal was to have 100% of participants with a completed checklist by the end of the three-month project.

Figure 1 *CICU Discharge Checklist*

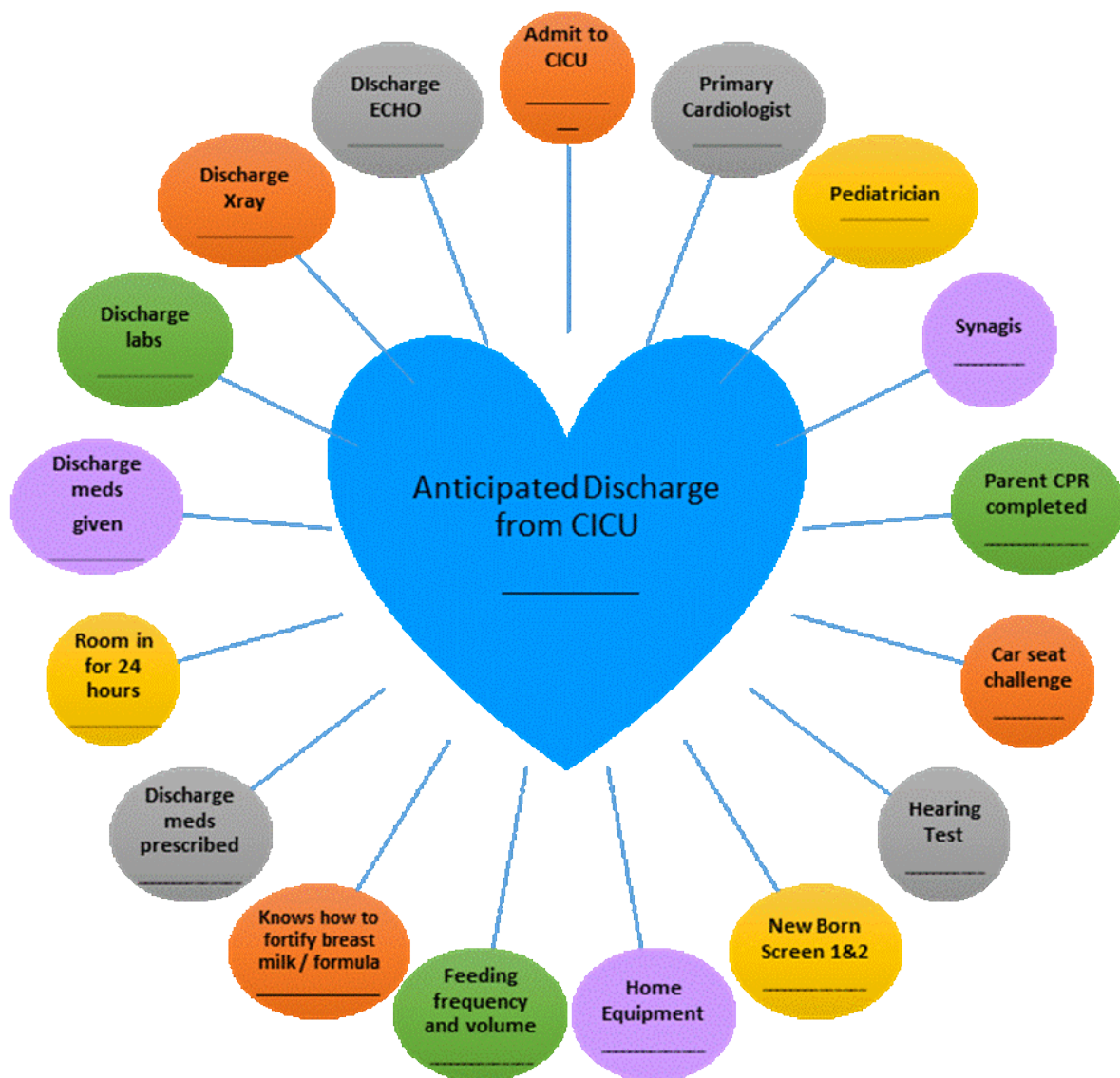
To Do:	
<u>Check box when complete</u>	
<u>Teach-Back</u>	
☐ Date: _____	Caregiver can explain child's heart condition and what surgeries to expect.
☐ Date: _____	Caregiver knows how to prepare breast milk or formula, how much, and how often.
☐ Date: _____	Caregiver can explain what medications child will go home on and what they are for.
☐ Date: _____	CPR training

☐ Date: _____	Caregiver can demonstrate how to use the home scale.
☐ Date: _____	Caregiver can demonstrate how to use the home pulse oximeter.
☐ Date: _____	Caregiver can verbalize what red flags to monitor their child for.
☐ Date: _____	Caregiver can verbalize who to call for concerns.
<u>Medication</u>	
☐ Date: _____	Provide medication information sheets for each medication.
☐ Date: _____	Discharge medications filled by pharmacy of choice and brought back to bedside for verification by RN..
☐ Date: _____	Caregiver is shown and provides a return demonstrate on how to draw up and administer medications.
☐ Date: _____	Bedside RN documents in EHR Discharge Navigator medications were received prior to discharge, brought back to bedside, verified by RN and education was completed.
<u>Feeding</u>	
☐ Date: _____	Goal feeds at discharge provided to caregiver including minimum amount allowed per feeding and/or per day.
☐ Date: _____	Mixing instructions given for home preparation of fortified breastmilk or formula if applicable.
☐ Date: _____	Return demonstration of fortified breastmilk or formula mixing if applicable.
☐ Date: _____	WIC prescription (to be given by dietician) if applicable
<u>Other</u>	
☐ Date: _____	24-hour rooming in complete
☐ Date: _____	Car Seat Challenge complete
☐ Date: _____	Synagis administered and a monthly plan for follow up administration is in place (only during RSV season)
☐ Date: _____	Discharge Echocardiogram/EKG complete
☐ Date: _____	Newborn hearing screen done
☐ Date: _____	Newborn Screen # 1 complete date: Newborn Screen #2 complete date: Newborn Screen #3 (if applicable) complete date:

Figure 2 *CICU Awareness Board*

STAT Score:
Expected PLOS:
POD #
Expected Extubation:
Urinary Catheter Days:
Central Line Days:
Arterial Line Days:
Intra Cardiac Line Days:
Activase Use:

Figure 3 *CICU Tracking Tool*



The second aim was to improve caregiver preparation for discharge while the child was hospitalized. This intervention required the caregivers complete a period of no less than 24 hours of rooming in where they demonstrated the ability to provide all necessary care to their infant. Caregivers were required to demonstrate the ability to prepare breastmilk or formula at the appropriate caloric density; measure oral intake; count wet diapers; measure and administer medications; and use durable medical equipment required for discharge. The goal of this

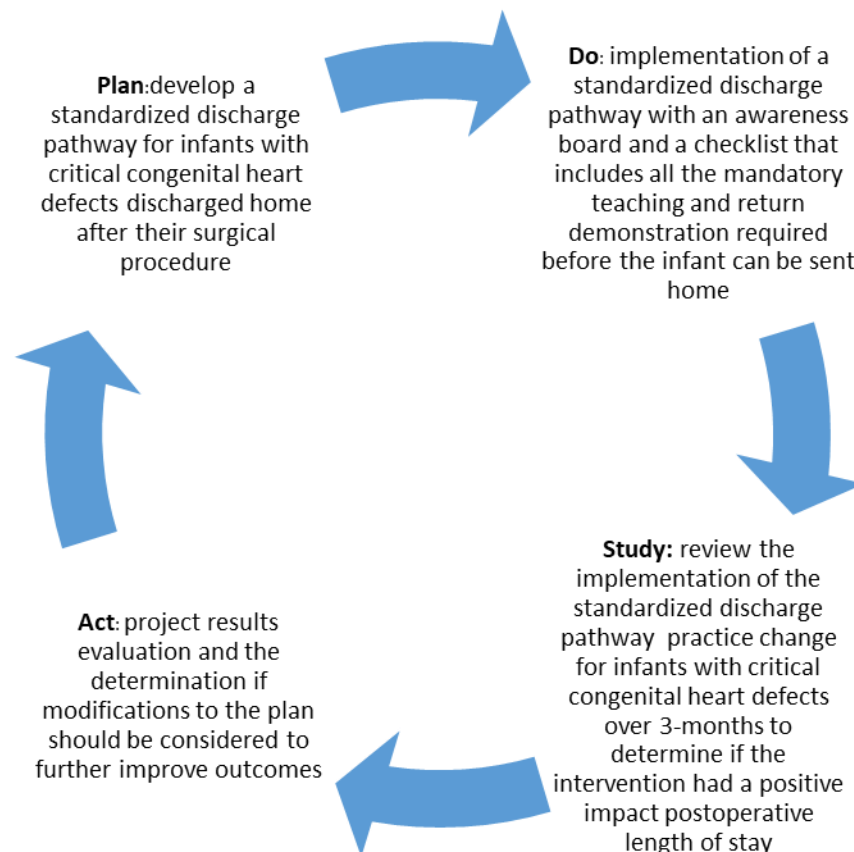
intervention was 100% of participants completing a rooming in period and demonstrating competency preparing breast milk or formula, feeding the infant, administering medications, and working durable medical equipment before discharge.

Guiding Frameworks

The theoretical framework for the project was the Plan-Do-Study-Act (PDSA) cycle (Langley, 2009.). The PDSA, (Figure 4), is a theoretical framework consisting of a four-step continuous cycle which supports a change in practice by planning, implementation, evaluation of results, and practice modification, and adjustment (Deming, 1994). The PDSA framework guided the project intervention through the four steps of planning, implementation, evaluation of results, and practice modification, and adjustment to improve the discharge processes and decrease postoperative length of stay for infants with critical congenital heart defects.

- Plan (P): developed a standardized discharge pathway for all infants with critical congenital heart defects discharged home after their surgical procedure.
- Do (D): implemented a standardized discharge pathway with an awareness board, a discharge checklist including all the mandatory teaching and return demonstration with a rooming-in period by the parents required before the infant can be sent home.
- Study (S): reviewed the implementation of the standardized discharge pathway practice change for infants with critical congenital heart defects over 3-months to determine if the intervention had a positive impact on postoperative length of stay.
- Act(A): evaluated project results and determined if modifications to the plan should be considered to further improve outcomes.

Figure 4 *Plan Do Study Act Framework*



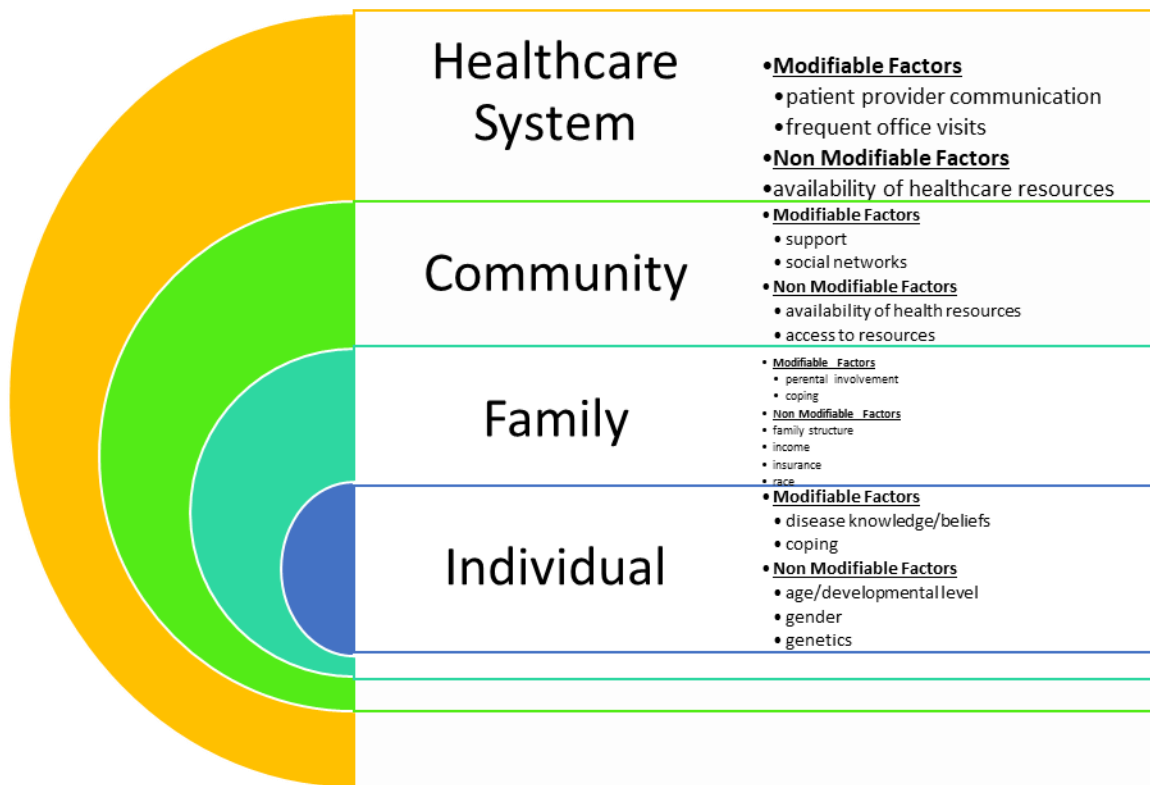
The Pediatric Self-Management Conceptual Framework (Figure 5) was used as the conceptual framework for this quality improvement project. This framework is a comprehensive pediatric healthcare model supporting self-management based on family, clinical, and developmental domains including the child, parent, healthcare system, and community (Modi et al., 2012). Self-management is defined by Modi et al., (2012) as the interaction of health behaviors and related activities that patients and families participate in to manage a chronic condition. The definition excludes the general healthy population with health behaviors such as diet and exercise which are treatment focused and do not apply to children with a chronic health condition. The four domains of individual, family, community, and healthcare systems consist of

the three concepts of self-management, adherence, and outcomes including modifiable and nonmodifiable risk factors (Modi et al., 2012).

Infants with CCHDs have a chronic condition which requires lifelong treatment and management. Nearly 60% of infants with CCHDs have special healthcare needs compared to 20% of children without a heart defect (Chen et al., 2016). Since infants are not developmentally ready for self-management of their chronic condition, the parents as caregivers, assume the responsibility. The duties for management of treatment regimens included medication administration, specialized feeding instructions, travel for laboratory studies, and frequent clinic appointments. If parents are empowered to know what medications they administered to their child, why they are needed, why proper mixing of breast milk or formula and adequate oral intake is imperative, the parent will be more likely to adhere to the treatment plan for their child with a chronic health condition.

The Pediatric Self-Management Conceptual Framework demonstrates how the individual family, community and healthcare systems work in collaboration to address each of the complex needs of the infant with CCHD. Self-management of a chronic condition can improve health outcomes and reduce healthcare utilization and costs, subsequently reducing the burden on the caregiver (Modi et al., 2012). Self-management affects adherence to the treatment plan and affects outcomes (Lozano & Houtrow, 2018).

Figure 5 *The Pediatric Self-Management Conceptual Framework*



METHODS

Ethical Considerations

This project plan was reviewed by the Texas A&M University-Corpus Christi Institutional Review Board (IRB) for project classification and received a determination of “Not Human Subjects Research” and permission to proceed as a Quality Improvement project (See Appendix A). Personal Health Information (PHI) was collected for project purposes only. A letter of support was provided by the Chief Nursing Officer of the facility agreeing to fully support the project and acknowledged collection of PHI for project purposes only (See Appendix B).

Project Design

Organizational Assessment

A small-scale evaluation was performed, including interviews with the unit manager and front-line staff, to determine needs and perceptions of the discharge process in the CICU. The lack of a consistent and standardized discharge plan, as well as discharge delays secondary to missing steps required before discharge were identified in the pre intervention process.

The CICU had adopted a discharge pathway from the neonatal intensive care unit which was modified to meet the needs of the postoperative cardiac infant. However, the pathway was not easily accessible and not all staff were aware of its existence. Physicians, nurse practitioners, unit leadership, and bedside nurses provided positive feedback related to designing a standardized discharge pathway that was easily accessible and posted in a place that parents and healthcare staff could see every day.

The mission and vision of the site where the quality improvement project was implemented is to provide expert evidence-based healthcare, education, outreach, and advocacy for all children. The mission and vision of this institution aligned with the goals of this quality improvement project to implement a standardized discharge pathway to decrease postoperative length of stay for infants with critical congenital heart defects in the cardiac intensive care unit.

Setting

This quality improvement project was conducted in a 14-bed Cardiac Intensive Care Unit (CICU) led by a multidisciplinary heart center team. The heart center began a renewed pursuit of excellence in 2019 under the leadership of a new cardiothoracic surgeon. The heart center philosophy noted that low mortality, low complication rates, and a short length of stay were foundations of program quality. The CICU is staffed with six board certified pediatric intensive

care physicians, three board certified pediatric acute care nurse practitioners, over 40 registered nurses (RNs), one cardiac discharge coordinator, one clinical pharmacist, one clinical dietitian, one case manager, one social worker, one chaplain, and rotating respiratory therapists.

Risk Assessment

Potential barriers to successful implementation of this quality improvement project were identified using a strength, weaknesses, opportunities, and threats (SWOT) analysis (Teoli et al., 2021). One of the top weaknesses identified was the substantial number of new and inexperienced nurses working in the CICU. Because of the pandemic and the competitive market for nursing employment, many of the tenured staff resigned and accepted lucrative travel positions. As a result of unit turnover, most of the replacement nurses in the unit were new graduates with no post-licensure clinical experience or were nurses with post-licensure experience in specialty areas other than CICU. The new nursing staff's lack of CICU knowledge and experience was expected to be an added challenge during the implementation of a change initiative, as these nurses were learning their current roles.

The strengths and opportunities identified were the dedication and support of quality improvement, including full support of this project from the CICU leadership, physicians, nurses, and multidisciplinary staff. Identifying and discussing the potential weaknesses and threats through the SWOT analysis provided the outline needed to work through and address the potential barriers. One mitigating measure implemented to ensure success of the project was taking advantage of the backing from CICU leadership and utilizing the support to educate the staff on why the QI initiative was important and how it could impact their patients.

Participants and Recruitment

Participants

All infants admitted to the CICU directly from their birth hospital or the neonatal intensive care unit (NICU) with a critical congenital heart defect requiring a surgical intervention within the first 30 days of life, were included in the project sample. Infants admitted to the CICU were required to be at least 34 weeks gestation and weigh at least 2 kg. Infants admitted to the CICU that did not receive a cardiothoracic surgical intervention were excluded from the sample.

Intervention

This quality improvement project used a standardized discharge pathway to mitigate discharge delays, ensure all steps for a safe discharge were completed, and prepared caregivers to take their infant home safely and confidently from the CICU. Staff were trained on the standardized discharge pathway including the discharge checklist, awareness board, and rooming in requirements. The project director met with every staff nurse in the CICU either individually or in small groups of no more than three. The discharge pathway and awareness boards were explained, and each nurse was educated on postoperative length of stay and correlation with the STAT score.

Caregivers were taught each item on the discharge checklist and were provided a return demonstration when necessary. The awareness board was used as a visual communication tool for staff and parents. The discharge goal was established based on the surgical procedure required, along with the correlating STAT score, and was placed on the awareness board the day the infant went to the operating room. The awareness board was filled out by the bedside RN and updated daily on multidisciplinary rounds. Caregivers roomed-in with their infant for a minimum of 24 hours before going home.

Timeline

Please see the project timeline in Figure 6 for a visual diagram of the time utilized to conduct each part of this project, from collection of organizational assessment data to dissemination of results. The project implemented a standardized discharge pathway over three months in this first PDSA cycle.

Figure 6 *Project Timeline*

Project Phase	Milestone	Nov	Dec	Jan	Feb	March	April	May
Initiation	Project approved	11/20						
Plan	Project planning meeting		12/21					
	Chart review for previous year interstage readmission		12/21					
	Chart review for previous year interstage mortality		12/21					
	Project plan completed		12/21					
	Communication plan completed		12/21					
	IRB approved		12/21					
Do	Training completed		12/21					
	Intervention started			01/22				
Study	Mid-project evaluation complete				02/22			
	January Data Review				02/22			
	February Data Review					03/22		
	March Data Review						04/22	
	Analysis of outcomes						04/22	
Act	Project presented to CICU staff							05/22

Project Team

The quality improvement project team consisted of the project director (PD), the CICU Director, clinical experts, and bedside nursing staff. The project director, who was a pediatric

acute care nurse practitioner in the CICU and a DNP student, oversaw all aspects of the quality improvement project, provided staff education, and collected data. The clinical leader provided staff education and implementation of the discharge pathway. The CICU nursing staff were educated on the requirements of the awareness board, discharge checklist, the documentation required on the discharge checklist, and the rooming in requirements. The bedside nursing education also consisted of explanation of the STAT score and its correlation to postoperative length of stay.

Data Collection

The PD or clinical leader collected data daily to assess if the discharge checklist was implemented within 24 hours of admission to the CICU and updated daily during multidisciplinary rounds. Once a potential date for discharge had been identified, it was placed on the awareness board and on the discharge pathway. During daily bedside rounds, the awareness board and visual diagram were updated with any progress towards discharge.

Measurement tools

The tools used to measure the outcomes of this quality improvement project included a discharge-teaching checklist, an awareness board, and a visual diagram listing steps taken before discharge. The discharge teaching checklist was created by the PD and two clinical leaders based on a neonatal discharge pathway already developed by the heart center team in addition to goals identified by the CICU leadership team. Data collected using these tools included whether the discharge pathway was initiated within 24 hours of admission to the CICU and if the PLOS goal was documented on the bedside discharge checklist on the day of surgery (postoperative day zero).

Figure 7 Data Collection Form

Discharge Pathway Data Collection Tool	
1. MRN:	_____
2. Check List initiated date:	___/___/___ (mm/dd/yyyy) ☐ Unknown/not documented
3. Check List initiated within 24 hours of admission to CICU?	☐ Yes ☐ No/unknown
4. Check List updated daily on multidisciplinary rounds?	☐ Yes ☐ No/unknown
5. Awareness Board initiated date:	___/___/___ (mm/dd/yyyy) ☐ Unknown/not documented
6. Awareness board placed in room within 24 hours of admission to CICU?	☐ Yes ☐ No/unknown
7. Potential Date for Discharge Identified and Rooming in Checklist initiated	☐ Yes ☐ No/unknown
8. Rooming in Checklist initiated date:	___/___/___ (mm/dd/yyyy) ☐ Unknown/not documented
9. Discharge date:	___/___/___ (mm/dd/yyyy) ☐ Unknown/not documented

The Society of Thoracic Surgeons (STS) Congenital Heart Surgery Database (CHSD) is the largest database in North America for congenital cardiac malformations. The database captures more than 90% of all congenital heart surgery cases in the United States and has more than 90% of all congenital heart surgery centers as participants (Mayer et al., 2020). The CICU participates in the CHSD and submits extensive data on each surgical patient. The data collection form is 57 pages in length and not included in the appendix. The entire data collection form can be accessed from the STS website and a screenshot of the form is shown in Figure 8 (STS,

2022). Data from the CHSD collected for this project included gender, age, STAT score, postoperative length of stay, and presence of any chromosomal anomaly.

Figure 8 *Partial Sample of STS Data Collection Form*



STS National Database
Using data to drive quality

**The Society of Thoracic Surgeons
Congenital Heart Surgery Database**
Version 3.41
Updated May 5, 2020



ADMINISTRATIVE		
Participant ID:	Patient Participating in STS-Related Clinical Trial:	☐ None ☐ Trial 1 ☐ Trial 2 ☐ Trial 3 ☐ Trial 4 ☐ Trial 5 ☐ Trial 6
(If not None→)		STS-Related Clinical Trial ID:

DEMOGRAPHICS		
Patient ID (software generated)	Patient Nat. ID (SSN):	MRN:
Last Name:	First Name:	Middle Name:
Region:	Postal Code:	Country:

BIRTH INFORMATION
Did the patient have a laboratory confirmed diagnosis of Covid-19? ☐ No (Harvest Code 10) ☐ Yes, prior to hospitalization for this surgery (Harvest Code 11) ☐ Yes, in hospital prior to surgery (Harvest Code 12) ☐ Yes, in hospital after surgery (Harvest Code 13) ☐ Yes, after discharge within 30 days of surgery (Harvest Code 14)
Date of Positive Covid-19 Test (closest to OR date) ____/____/____ (mm/dd/yyyy)
Born by IVF: ☐ Yes ☐ No

RESULTS

Descriptive statistics were collected on every infant with a critical congenital heart defect admitted to the CICU. Descriptive variables were comprised of information that may be related to, or impact, outcomes (Sylvia & Terhaar, 2018). Gender, age and presence of chromosomal anomaly were collected to describe the population and to provide levels of measurement to compare between groups. Nonmodifiable comorbidities such as chromosomal and extrachromosomal abnormalities are known to lead to longer hospitalizations due to feeding

difficulties, airway problems, and other chronic issues (Jacobs et al., 2014). Therefore, the presence of a chromosomal anomaly was considered to be an important descriptive statistic to collect and assess with PLOS (Pagowska-Kilmek et al., 2011).

Based on data reports run from the STS database before the quality improvement project, the median PLOS for each STAT category, one through five, was three, four, six, eight, and 23 days, respectively. Almost half of the patients were discharged after cardiac surgery between days two to four in category *STAT 1*, days three to six in category *STAT 2*, days four to 10 in category *STAT 3*, days six to 20 in category *STAT 4*, and days 15 to 28 in category *STAT 5*. Almost 25% of patients were discharged in two days for *STAT 1*, three days for *STAT 2*, four days for *STAT 3*, six days for *STAT 4* and 15 days for *STAT 5* surgeries. The goal was to improve program quality as evidenced by median PLOS currently achieved for only 25% of patients while still maintaining below average mortality and a readmission within 30 days rate of 11% or less. Therefore, PLOS goals were set based on the 25% of patients discharged at two, three, four, six, and 15 days for *STAT 1 through STAT 5* categories, respectively.

Implementation

Implementation of the quality improvement project was completed during a three-month period from January 2022 to March 2022. Postoperative length of stay (PLOS) for infants with a critical congenital heart defect requiring a surgical intervention within the first 30 days of life was measured. Implementation of a standardized discharge pathway including an awareness board and tracking tool were measured for their effect on PLOS.

The first aim of this project was to implement the standardized discharge pathway within 24 hours of admission to the CICU, and ensure it was updated and reviewed daily on multidisciplinary rounds. The goal was to have 100% of participants with a discharge pathway

initiated within 24 hours of CICU admission and updated and reviewed daily on multidisciplinary rounds by the end of the three-month period. Within a few weeks of implementation, it was determined that measuring pathway initiation within 24 hours of CICU admission and daily review and updates were not a feasible or dependable way to project progress. The aim was altered to a realistic and measurable goal of having 100% of infants admitted to the CICU for cardiothoracic surgery having a completed checklist before discharge within the three-month project period.

The second aim of this project was to improve caregiver preparation for discharge by requiring the caregivers to complete a period of 24 hours or more of rooming in prior to discharge. The goal of this intervention was 100% of participants would complete a rooming in period and demonstrate competency preparing feeds, feeding the infant, administering medications, and working durable equipment if required.

Outcomes

Over the three-month course of this quality improvement initiative, 12 patient encounters meeting inclusion criteria took place and 100% of these patients had a completed checklist and 100% of the caregivers completed a rooming in period before discharge. The 12 infants (9 males, 75%; 3 females, 25%) who met criteria for the study were less than 30 days of age at the time of surgery and required a cardiothoracic surgical intervention. Participants were predominately from category *STAT 4* ($n = 7$; 58%) and the others were from category *STAT 5* ($n = 4$; 33%) and category *STAT 3* ($n = 1$; 9%). No mortality events occurred in any of the *STAT* categories during the project cycle.

After implementation of the standardized discharge pathway, the PLOS for category *STAT 3* was six days before the implementation compared to 19 days post implementation; there

was only one category *STAT 3* case. Median PLOS for *STAT 4* was eight days before the implementation compared to 13 days post implementation, with an interquartile range of 37 (3-40). Median PLOS for *STAT 5* category was 23 days before the pathway implementation compared to 22.5 days post implementation, with an interquartile range of 14.5 (13-41).

Figure 9 *PLOS (Days) Before Intervention*

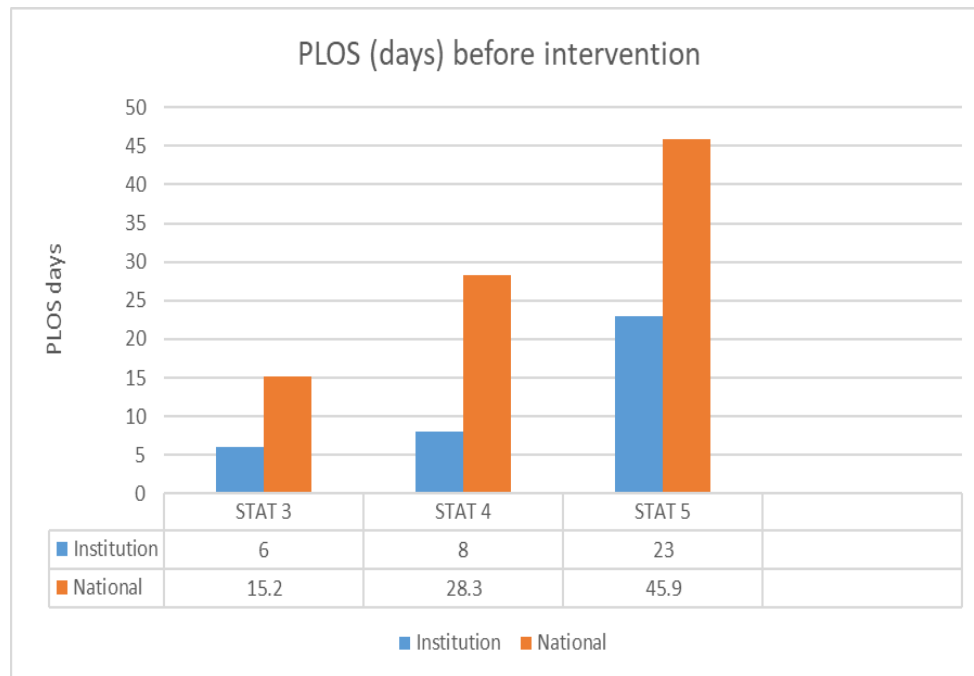
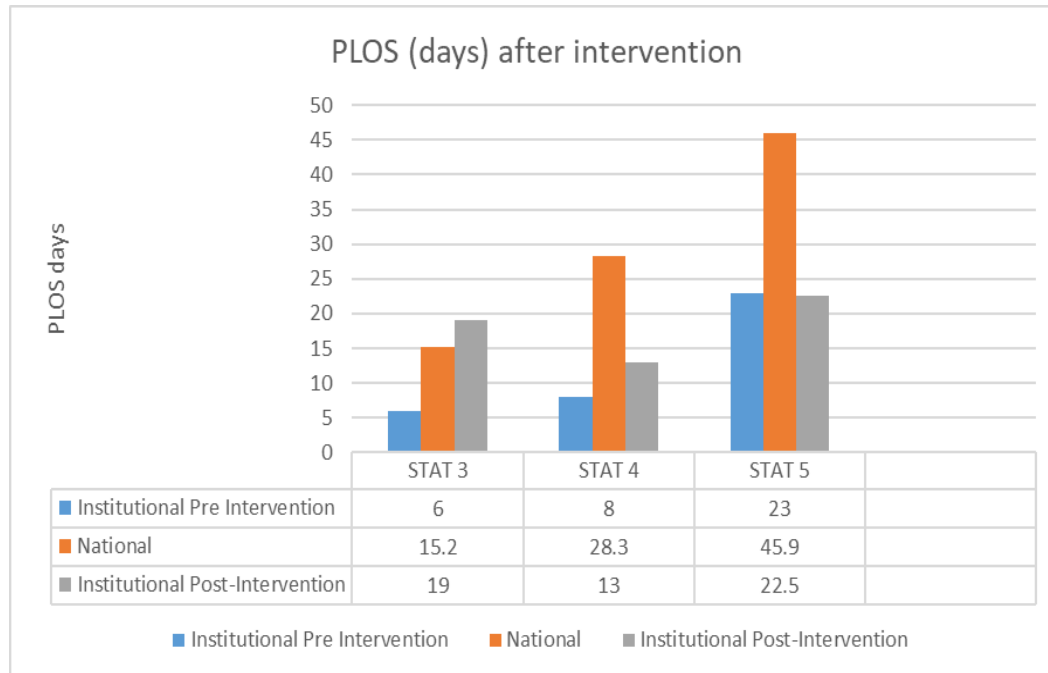


Figure 10 PLOS (Days) After Intervention



DISCUSSION

After implementation of the standardized discharge pathway, the median PLOS for each STAT category did not decrease as expected. The national standard for mortality and median PLOS for each STAT category is *STAT 1* = 0.4 % mortality and seven-day PLOS; *STAT 2* = 1.4% mortality and 19.7-day PLOS; *STAT 3* = 2.2% mortality and 15.2-day PLOS; *STAT 4* = 6.1% mortality and 28.3-day PLOS; and *STAT 5* = 13.4% mortality and 45.9-day PLOS with overall mortality 2.8% (Jacobs et al., 2012).

The overall mortality and PLOS for each STAT category at the institution where the quality improvement initiative was implemented was *STAT 1* = 0% mortality and three-day PLOS; *STAT 2* = 0% mortality and four-day PLOS; *STAT 3* = 3.4 % mortality and six-day

PLOS; *STAT 4* = 3.6% mortality and eight-day PLOS; and *STAT 5* = 0% mortality and 23-day PLOS with overall mortality 1.7%.

The overall mortality was less than the national standard in all subcategories, except *STAT 3*. The 3.4% mortality in *STAT 3* is the result of a single death and the 3.6% mortality in *STAT 4* reflects two deaths. Therefore, the overall mortality at this institution reflects three deaths out of 180 total cases (1.7% mortality), less than the national average for overall mortality of 2.8% (Jacobs et al., 2012). The national average for readmission in thirty days is between 11 and 14 percent. That number has not changed in over 10 years (Jacob et al., 2012). In 2021 the readmission rate for this institution was 11%.

As previously discussed, if mortality and readmission rate remain at or below the national average, PLOS provides a surrogate measure for overall surgical program quality (Johnson et al., 2016; Newburger et al., 2003; O'Brien et al., 2019; Pasquali et al., 2019). Lowering PLOS at the expense of rising mortality or rising morbidity would be unacceptable because getting patients out faster just so they can return to the hospital at a higher frequency would suggest patients were being discharged before they were ready. However, if mortality and morbidity remain low, a decrease in PLOS without an increase in 30-day readmission suggests that quality of care has improved (O'Brien et al., 2019; Pasquali et al., 2019).

The institution's median PLOS is well below the national average in all categories and 50% of their patients were discharged after cardiac surgery between days two to four in *STAT 1*, days three to six in *STAT 2*, days four to 10 in *STAT 3*, days six to 20 in *STAT 4*, and days 15-28 in *STAT 5*. The institution reported 25% of their patients were discharged in two days for *STAT 1*; three days for *STAT 2*; four days for *STAT 3*; six days for *STAT 4* and 15 days for *STAT 5* surgeries. Based on this data, the leadership elected to make the median PLOS goal reflect what

was achieved for 25% of the institution's patients while still maintaining below average mortality and readmission within 30 days rate.

The institution has maintained a mortality goal for all surgeries except *STAT 3* and the overall surgical mortality is well below the national average. The institution has already achieved and maintained a readmission rate of less than 11% for all patients. The institution has also achieved their PLOS goal in 25% of their patients. Since the institution already has excellent outcomes, it was not easy to push the median PLOS to the new goal.

If surgical mortality and morbidity are already low, it may be inferred that overall program quality is already adequate or even above average. It is easy to improve quality when a program is substandard. In contrast, it is much more difficult to make measurable gains when program outcomes are above average. There is data to suggest that significant improvement can be found even in low mortality and minimal morbidity programs by focusing on aggregation of marginal gains (Fleming et al., 2016). This means that small or even seemingly insignificant deficiencies in care that, when added together, create a significant increasing effect in overall quality of care.

After the implementation of the discharge pathway, the median PLOS for the *STAT 5 category* was 22.5 days, down from 23 days before the pathway. The median national PLOS for this category is 45.9 days (Jacobs et al., 2012). This 0.5-day reduction in median institutional PLOS for *STAT 5 category* and remains well below the national average of 45.9-days.

Using the Society of Thoracic Surgeons (STS) database linked to the Pediatric Health Information Systems (PHIS) database, a 2014 study determined the median cost of several common pediatric cardiac surgeries. Low mortality surgeries cost less than high mortality surgeries (Pasquali et al., 2014). The median cost of an ASD repair, which were included in the

STAT 1 category, was \$25,499, while the median cost of a Norwood operation, a *STAT 5* procedure, was \$165,168. Each of those costs was associated with a median PLOS of three days for the ASD repair and 29 days for the Norwood procedure. Pasquali et al. (2014) was able to show that, for all operations, the longer the PLOS was beyond the expected median, the more substantial the cost for each additional day became. One additional day following the *STAT 5* Norwood operation increased cost by \$43,789 (Pasquali et al., 2014). Every day of PLOS saved resulted in a substantial reduction in both overall program cost and, more importantly, the costs passed on to the patient. So, the 0.5-day reduction in median PLOS for *STAT 5* patients was significant when the length of stay was translated into dollars.

Since chromosomal abnormalities increased preoperative comorbidity on multiple physiologic levels, they also increased mortality, morbidity and, therefore, PLOS (Alexander et al., 2018; Brown et al., 2003; Jacobs et al., 2019; O'Brien et al., 2019). Of the 12 infants (*nine* males, 75%; three females, 25%) who met criteria for the study, two had chromosomal abnormalities. One of these infants was a *STAT 4* and one was a *STAT 5*. The PLOS for the *STAT 4* infant with a chromosomal abnormality was 40-days and the PLOS for the *STAT 5* infant with a chromosomal abnormality was 13-days. With the small sample size of only 12 participants including only one infant with a chromosomal abnormality in *STAT 4* and one in *STAT 5*, it is difficult to make an inference about the data. However, with a larger data set looking at chromosomal abnormality and the efficacy on PLOS would be important to determine if early recognition and intervention could help mitigate the known risks for increased morbidity and mortality.

Although propensity matching, statistical analysis and large patient populations can eliminate some variation within the population under analysis, differences in the quality of care

administered is impossible to avoid completely (Jacobs et al., 2012). If changes in practice are to be made based on outcomes measured, it is important to standardize care. Although different studies have shown different results, the use of clinical pathways and guidelines have been shown to reduce cost, complication rate, mortality and hospital length of stay (Gaies et al., 2019; Goitein & James, 2016; Lion et al., 2016; Rotter et al., 2010).

At this institution, a multidisciplinary cardiothoracic surgery pathways committee was assembled more than ten years ago with the goal of standardizing care of congenital heart defect patients in all phases of their care. The pathways are continually reviewed, updated, and made available to all caregivers on the institution's Intranet. The standardized discharge pathway was developed and approved by the pathways committee and the awareness board and tracking tool were evidence-based additions added to this quality improvement initiative to increase the usefulness of the pathway with the goal of decreasing PLOS.

Limitations

One of the limitations to this quality improvement project was the small sample size of 12 patients. The inclusion criteria for this project were limited to infants with critical congenital heart defect requiring a cardiothoracic operation within the first 30 days of life. The small sample size impacted the results of the project, as one patient who had a complication and/or required and extended hospitalization would negatively skew the PLOS data.

Also, knowing that chromosomal abnormalities increased preoperative comorbidity, increased mortality, morbidity and, therefore, PLOS the two patients with the chromosomal abnormality could also negatively skew the PLOS data (Alexander et al., 2018; Brown et al., 2003; Jacobs et al., 2019; O'Brien et al., 2019).

The short duration of the quality improvement implementation phase also limited the true impact on PLOS of these patients. To address this, it is recommended that a logistical regression of a larger data set be completed. With a larger sample size, the PLOS data can be looked at separately for the infants with and without chromosomal abnormalities.

Interpretation

The theoretical framework for the project was the Plan-Do-Study-Act (PDSA) cycle (Langley, 2009). The PDSA framework guided the project intervention through the four steps of planning, implementation, evaluation of results, and practice modification, and adjustment to decrease PLOS for infants with critical congenital heart defects.

During the Planning phase, the PD developed a standardized discharge pathway for all infants with critical congenital heart defects discharged home after their surgical procedure. The discharge pathway was completed, and staff were educated before the implementation phase of the project began. In the future, I would plan to build continuing education into the plan. At times it seemed like staff forgot the original goal of the intervention.

During the Do phase of the project the PD and unit implemented a standardized discharge pathway with an awareness board, a discharge checklist including all the mandatory teaching and return demonstration with a rooming-in period by the parents required before the infant was sent home. This step of the PDSA cycle was initiated in January 2020 and ran through March 2020. The three-month period was not long enough to capture a patient sample large enough to provide meaningful data analysis. As a result, the next cycle will need to be extended.

In the Study phase of the project, the PD reviewed the implementation of the standardized discharge pathway practice change for infants with critical congenital heart defects over three-months to determine if the intervention had a positive impact on PLOS. This step was completed

in April 2022. Although the initial review did not show a decrease in PLOS, the intervention is not something that the unit will abandon. Discharge remains an area for improvement in this institution and, as previously mentioned, small or even seemingly insignificant improvements in care that, when added together, create a significant cumulative effect in overall quality of care. Although the PLOS was already below the national average, the institutional goals include continued optimization of length of stay, so we will keep focusing on advances so even an exceedingly minor change in PLOS will add up to a substantial change over time (Fleming et al., 2016).

Finally, during the Act phase of the project, the PD evaluated project results and determined if modifications to the plan should be considered to further improve outcomes. Staff have suggested changes they would like to make on the discharge checklist. One of the suggestions was to make a checklist for older children to prepare their discharge from the CICU. The feedback from the staff will be reviewed and, if applicable, implemented into future project cycles.

The Pediatric Self-Management Conceptual Framework was used as the conceptual framework for this quality improvement project. This Conceptual Framework demonstrates how the individual family, community and healthcare systems work in collaboration to address each of the complex needs of the infant. Self-management of a chronic condition can improve health outcomes and reduce healthcare utilization, costs, and reduce the burden on the caregiver (Modi et al., 2012). Self-management affects adherence to the treatment plan and affects outcomes (Lozano & Houtrow, 2018). Completion of the discharge checklist which includes the 24 hours rooming in period, allowed the parents to demonstrate their ability to self-manage the complex care of their infant.

Conclusions

An important part of quality improvement projects is sustainability. It is easy to forget why we are doing what we are doing when time passes, and oversight is no longer a daily occurrence. Sustainability of the project requires full support from bedside staff, quality improvement specialists, and unit leaders (Scoville et al., 2016). If the project is not sustained, unit leaders will find themselves looking for solutions to the same problem repeatedly.

Sustainability depends on the continuing commitment of frontline staff who directly understand the benefits of the quality improvement project (Scoville et al., 2016). The results of the project will be disseminated at unit staff meetings to define the positive changes noticed since the implementation of the project. Feedback for changes to the current process will also be solicited.

Although the first cycle of this quality improvement initiative did not show a significant decrease in PLOS, the discharge pathway, awareness board, and checklist will be maintained. One consistent area identified during the discharge process was securing medications prescribed and delivered to the bedside before discharge. As a result of this quality improvement initiative, another team has decided to work on that process which will also affect PLOS, since delays in delivery of prescribed medications before discharge slows down the ability to send patients home.

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APPENDIX A: TAMU-CC IRB Statement of Determination Letter

Dear Elizabeth Loika,

Activities meeting the DHHS definition of research or the FDA definition of clinical investigation and involve human subjects are subject to IRB review and approval.

On 11-16-2020, the Office of Research Compliance reviewed the project below and determined that the proposed activity does not meet the DHHS definition of research involving human subjects under 45 CFR 46.102:

Type of Review:	Not Human Subjects Determination
IRB ID:	TAMU-CC-IRB-2020-11-09
Project Lead:	Elizabeth Loika
Title:	Use of a Standardized Interdisciplinary Discharge Protocol to Improve Outcomes for Infants with Single Ventricle Physiology
Rationale:	

Therefore, this project does not require IRB review. You may proceed with this project.

Limits to this determination:

1. This determination applies only to the activities described in the documents reviewed. Any planned changes require submission to the IRB to ensure that the research continues to meet criteria for a non-human subject research determination.
2. This project may NOT be referenced as "IRB approved".

The following statement can be included in the manuscript: "This Project was reviewed and determined to not meet the criteria for human subjects research by the Texas A&M University-Corpus Christi Institutional Review Board."

Please do not hesitate to contact the Office of Research Compliance with any questions.

Respectfully,

Germaine Hughes-Waters

Office of Research Compliance

APPENDIX B: Facility Support Letter



Driscoll Children's Hospital
3533 S. Alameda Street
Corpus Christi, Texas 78411
(361) 694-5000
(800) DCH-LOVE or (800) 324-8683

October 13, 2020

Dr. Sara Baldwin
Associate Dean for Academic Programs
College of Nursing and Health Sciences
Texas A&M University – Corpus Christi
6300 Ocean Drive
Corpus Christi, TX 78412

Dear Dr. Baldwin,

The purpose of this letter is to provide Brenda Buckner, a Doctor of Nursing Practice student at Texas A&M University College of Nursing and Health Sciences, support in conducting a quality improvement project at Driscoll Children's Hospital. The project, Use of a Standardized Interdisciplinary Discharge Protocol for Infants with Single Ventricle Physiology, entails educating the multidisciplinary staff in the CICU on a discharge protocol, use of the MyChart application in EPIC, and implementing this protocol with the families of infants with single ventricle physiology.

The purpose of this project is to standardize the discharge process, decrease interstage readmissions, decrease interstage mortality, and decrease hospitalizations costs. Driscoll Children's Hospital was selected for this project because many infants with single ventricle physiology are cared for at this hospital and the patient's live within a large geographical area that the hospital serves; some are more than 200 miles south of the hospital after discharge. Implementation of this standardized discharge protocol, that includes intensive teaching on home monitoring, will increase the safety of these infants during the interstage period. Brenda Buckner is employed at this institution, and she has an interest in improving care at this facility.

I, Julie Pita, Chief Nursing Officer, at Driscoll Children's Hospital do hereby fully support Brenda Buckner in the conduct of this quality improvement project, Use of a Standardized Interdisciplinary Discharge Protocol for Infants with Single Ventricle Physiology at Driscoll Children's Hospital.

I also approve Brenda Buckner to access protected health information (PHI) for purposes of conducting this quality improvement project. She has signed a HIPAA release form.

Sincerely,

Handwritten signature of Julie Pita in black ink, followed by the date "10-13-2020".
Julie Pita, MSN, RN, CNOR, NEA-BC
Chief Nursing Officer