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Final Defense: Sepsis Screening Tool Assessment at a Freestanding Children's Hospital in the Midwest

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Abstract

Pediatric sepsis is a major contributor to childhood morbidity and mortality. Tools for predicting sepsis in pediatric patients have had poor predictive ability nor been validated. Risk assessment screening tools are effective at earlier detection of sepsis. The implementation of an evidence-based pediatric sepsis screening tool could reduce time to detect and diagnose severe sepsis so that patient treatment could occur earlier. This was a quality improvement project that evaluated a sepsis screening tool predictive validity at a children's hospital.

Keywords: sepsis, severe sepsis, screening tool, pediatric, child, risk assessment tool

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Final Defense: Sepsis Screening Tool Assessment at Helen DeVos Children's Hospital

Pediatric sepsis is a major contributor to childhood morbidity and mortality (Schlapbach & Kissoon, 2018). According to Weiss et al. (2015), there is an 8.2%prevalence of pediatric severe sepsis in critically ill patients globally, with a hospital mortality rate of 25%. Despite global recognition as a problem, unclear sepsis definitions prohibit bedside clinicians from accurately identifying sepsis (Schlapbach & Kissoon, 2018). Tools for predicting sepsis in pediatric patients have poor predictive ability nor can evidence be found in the literature that they are validated. Systemic inflammatory response syndrome (SIRS) was used to define and predict sepsis in pediatric patients (Schlapbach & Kissoon, 2018). However, this criterion had low specificity and of limited use to clinicians (Schlapbach & Kissoon, 2018). An evidence-based pediatric sepsis screening tool is needed in order to initiate earlier diagnosis of sepsis and decrease the number of sepsis cases per year. The purpose of this quality improvement project was to assess and validate a pediatric sepsis screening tool in use at a freestanding children's hospital in the Midwest (that referred to as CHM).

Assessment of the Organizational

An organizational assessment (OA) is a systematic process intended to evaluate the workflow and factors that affect the performance of an organization (Reflect & Learn, n.d.). From an OA, the organization can better understand areas of competence and areas needing improvement. The purpose of this OA was to analyze CHM using an OA framework. Primary stakeholders were identified, and strengths, weaknesses, opportunities, and the threats (SWOT) of the organization explored through a SWOT analysis.

Framework for Assessment

The Canadian Foundation for Healthcare Improvement (CFHI) assessment tool

evaluates an organization's capability for change, the strengths the organization possesses in implementing change, and how the organization can expand these strengths for improvements (CFHI, 2014). CFHI is guided by six core principles that were developed with the goal of supporting healthcare improvement. These factors include patient-centered and population-based care, evidence-based decision making, engaging a wide range of stakeholders, engaging participation from managers and providers, using an incremental process for large scale improvements, and viewing improvement as a collective learning process (CFHI, 2014). Appendix A depicts how these factors equally contribute to overall healthcare improvement (adapted from CFHI, 2018). The CFHI assessment tool analyzes how well organizations include each criterion to form suggestions for care improvements within the organization.

CFHI recognizes that healthcare improvement requires collaboration from all levels of a system, including policy, organizational, clinical, and front-line staff (CFHI, 2014). Furthermore, CFHI also advises for operating in change cycles for improvements, rather than constant reorganizing to maintain stability for the organization. Finally, CFHI holds the stance that change within a level of a health system can lead to improvements at the clinical level, including patient health outcomes and hospitalization experiences (CFHI, 2014).

Ethics and Protection of Human Subjects

CHM and the GVSU Institutional Review Boards (IRB) determined the project to be quality improvement (see Appendix B and C).

Stakeholders

Key stakeholders are individuals affected by change within an organization, or individuals who have an interest in the project outcome (Moran, Burson, & Conrad, 2017). For the implementation of a pediatric sepsis screening tool at CHM, the key stakeholders were the

healthcare providers i.e., physicians, physician assistants, nurse practitioners, and nurses. Patients were also an important stakeholder, because patients are the highest priority when implementing a change that affects patient outcomes. Other stakeholders included the sepsis steering committee at CHM, and the electronic health record (EHR) technical employees who worked to implement the chosen screening tool into the EHR. Finally, another key stakeholder that is of importance to note is CHM as an organization. It was pertinent the organization understood the importance of adding a pediatric screening tool, because there could have been a monetary cost to adding the tool into the EHR.

SWOT

A SWOT analysis is a tool used to analyze strengths, weaknesses, opportunities, and threats to a phenomenon of interest (Moran et al., 2017). Internal analyses include identifying attributes and evaluating successes and weaknesses within the organization. External analysis includes evaluating environmental influences and identifying opportunities or obstacles for the phenomenon of interest (Moran et al., 2017). The phenomenon of interest for this SWOT analysis was infection (sepsis). Appendix D displays the SWOT analysis discussed below.

Strengths. Strengths of CHM included their interprofessional collaboration as well as utilization of a sepsis steering committee. Along with this, building on existing sepsis protocols within the adult and neonatal populations aided in collaboration for this pediatric sepsis screening tool. Finally, a strength of CHM was their ranking as one of the best children's hospitals in six specialty areas for 2018 by U.S. News and World Report (Jensen, 2018). This shows what others perceive as CHM strengths, which is an important part of this analysis (Moran et al., 2017).

Weaknesses. Weaknesses of CHM included the current state of the pediatric sepsis screening tool being on paper and not embedded in the EHR. This caused tension with RNs, because it was an added task for the RNs to fill out a paper tool rather than within the EHR. Another weakness was collating paper documents. It was time consuming to evaluate use of the screening tool on paper compared to use in an EHR, which can generate a report. Furthermore, it was difficult to ensure screening tools were timestamped correctly when on paper, if RNs did not chart the exact time the screen was performed. Finally, the timing of the paper sepsis screening tool was initiated shortly after a new EHR was initiated at CHM. This caused RN dissatisfaction, confusion and errors, as RNs were overloaded with change. This led to a lack of proper screening and/or proper documentation of sepsis screening.

Opportunities. One opportunity was the CHA sepsis collaborative. This is a collaborative with other children's hospitals works together to find the best solution for sepsis screening. Another opportunity was the ability to work within the new EHR to initiate a tool within the electronic documentation platform to screen for pediatric sepsis. The EHR in use at CHM allows for creation and customization of tools and would support the pediatric sepsis screening tool built within the EHR.

Threats. Threats to this project were deadlines. Part of the CHA collaborative requires that data be entered by certain deadlines. The first deadline was October 1, 2018 when retrospective data must be entered so that CHM could continue as a CHA collaborative member. This was a difficult process at CHM, because retrospective data had to be retrieved from the older version of the EHR, and there had been difficulty generating reports. Another threat to this project was the rapid nature of the work being done without considering all the factors to create change and be successful, such as the lack of an evidence-based tool used within CHM. Without

evidence to support a tool, data collected may not be valid, which could threaten the work that had been done at CHM.

Clinical Practice Question

The following clinical questions were addressed. “Did the current pediatric sepsis screening tool in use at CHM identify patients at risk for sepsis?” As well as, “Did the sepsis screening tool used initiate interventions (i.e. fluid boluses and antibiotics) earlier than when compared to no tool being used?”

Review of the Literature

Method

Search methods. A comprehensive electronic search was conducted in the CINAHL, PubMed, and Web of Science electronic databases and was limited to reviews in the English language during the period of 2013 to 2018. Keywords were sepsis, tool, pediatric, neonate, child, and early warning score.

Inclusion and exclusion criteria. The inclusion criterion for the literature review search included articles that were published from 2013 to present. The type of studies included were meta analyses, randomized control trials (RCTs), and systematic reviews. The search was also limited to peer-reviewed journals. Exclusion criteria included clinical trials, pilot studies, observational studies, and articles published greater than 5 years ago.

Population. Included were samples that featured sepsis populations in acute care settings. For the purpose of this review, a pediatric population was defined as patients zero to 18 years of age, including the neonatal period (0-28 days). After limited research presented on pediatric sepsis independently, articles that discussed adult sepsis protocols while acknowledging pediatric differences were also included in this review.

Intervention. Interventions for this literature review targeted sepsis screening tools in the acute care setting. This excluded studies that only analyzed biomarkers or medication therapies for the treatment or prevention of sepsis. Screening tools intended for use in outpatient settings were excluded.

Comparison. The comparison group for this was pediatric acute care settings that did not utilize a pediatric sepsis screening tool. This included settings that utilized an adult sepsis screening tool on a pediatric population. Also included were pediatric sepsis screening tools in use that were not supported by an evidence-base.

Outcome. The intended outcome was increased early identification of pediatric sepsis. In time, this could lead to decreased morbidity and mortality rates caused by pediatric sepsis. This also, could lead to increased quality of life outcomes for survivors of pediatric sepsis. Currently, 17% of pediatric sepsis survivors globally have at least moderate disability after surviving sepsis (Weiss et al., 2015).

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline served as the framework for this review (Moher et al., 2015). The search initially yielded 243 CINAHL, PubMed, and Web of Science articles. Nine duplicates were found, with 234 articles remaining. Each paper was screened using inclusion and exclusion criteria according to PRISMA criteria (Moher et al., 2015) (see Appendix E). Review of titles and abstracts resulted in removal of 214 articles that did not meet the inclusion criteria. An additional 16 articles were excluded after in-depth examination of content, as did not meet inclusion criteria. The remaining four articles were included in this review.

Summary of Results

Four papers met inclusion criteria and were included in the review (see Appendix F). These four studies included three systematic reviews and one RCT.

Study characteristics. Three of the articles were conducted in the United States (Davis et al., 2017; Lake, Fairchild, & Moorman, 2014; & Roney et al., 2015 and one in Australia (Paliwoda & New, 2015). All of the studies took place in the acute care hospital setting. One article examined heart rate activity in neonatal infants as a marker for neonatal sepsis (Lake, Fairchild, & Moorman, 2014). The other three articles systematically reviewed sepsis protocol screening tools for the neonatal, pediatric, and adult populations (Davis et al., 2017; Roney et al., 2015; & Paliwoda & New, 2015). All of the studies involved analysis of screening for earlier identification of sepsis.

Intervention and comparison characteristics. Each of the reviews reported on efficacy of screening for sepsis and protocol to identify sepsis-based articles within each review's inclusion criteria (Davis et al., 2017; Roney et al., 2015; & Paliwoda & New, 2015). One review evaluated a sepsis screening tool based on mortality predictive value and/or reduction, emergency calls, and utilization of a rapid response team (Roney et al., 2015). Another compared neonates whom received an intervention based upon use of a sepsis screening tool (Paliwoda & New, 2015). The third compared previous sepsis guidelines to more recent quality improvement initiatives to identify sepsis sooner (Davis et al., 2017). The RCT compared heart rate characteristics (HRC) of neonates with and without confirmed sepsis (Lake, Fairchild, & Moorman, 2014).

Measures. A variety of outcome measures were used. The outcomes in the systematic reviews were earlier identification of patient deterioration and decreased time to intervention (Davis et al., 2017; Roney et al., 2015; & Paliwoda & New, 2015). The RCT measured risk

markers for proof of improved clinical outcomes, such as analyzing HRC as a predictor for sepsis development and how much monitoring HRC improves clinical outcomes for septic neonates by means of analyzing mortality rate (Lake, Fairchild, & Moorman, 2014).

Efficacy of earlier identification and decreased time to intervention. Earlier identification of patient deterioration had variation in measures within each review. One review found use of the modified early warning scoring (MEWS) screening tool effectively detected earlier identification of sepsis as evidenced by a significant rate in mortality reduction (Roney et al., 2015). This review also analyzed MEWS effectiveness for early sepsis identification by a decrease in rapid response team utilization. Davis et al. (2017) also discussed efficacy of a tool by analyzing mortality rate. This review found after initiating a trigger tool for sepsis, mortality rates decreased for both the pediatric and neonatal populations. One study within the review discussed a mortality rates decreased from 38% to 8% after initiating the sepsis tool. Another study discussed within this review had a mortality rate decrease from 20% to 7% (Davis et al., 2017). After performing a systematic review on early warning tools (EWTs) Paliwoda and New (2015) applied the new tool (EWT) to old charts of children who were identified with pediatric sepsis. As a result of the EWT, 47% of neonates would have received an intervention for sepsis (Paliwoda & New, 2015).

Efficacy of HRC risk markers. Lake, Fairchild, and Moorman (2014) discussed risk markers for proof of improved clinical outcomes. To detect predictive values of sepsis risk, antibiotic initiation and use in neonates with and without HRC monitoring were analyzed. The RCT looked at mortality rate differences between use or non-use of the HRC, and the mortality rate decreased in the HRC use group from 10.2% to 8.1% ($p=0.04$). Furthermore, in low birth

weight neonates, the mortality rate decreased from 17.6 to 13.2% ($p < 0.02$) with use of HRC monitoring (Lake, Fairchild, & Moorman, 2014).

Evidence for Project

Findings of this review suggested use of a screening tool for earlier identification and initiation of interventions for pediatric sepsis improved patient outcomes. Factors to be included in a sepsis screening tool include respiratory rate, heart rate, blood pressure, temperature (specifically hypothermia or hyperthermia), altered mental status, and capillary refill (Davis et al., 2017; & Roney et al., 2015). Furthermore, it was suggested that neonates have more specific criteria for the screening tool, such as HRC, glucose level, and behavioral monitoring (e.g., lethargy or poor feeding) (Paliwoda & New, 2015; & Lake, Fairchild, & Moorman, 2014).

In addition to the neonatal population, units treating a specific type of pediatric patient population should have more specific criteria for the particular sub-population (Roney et al., 2015). For example, pediatric oncology/hematology patients may have indicators or a narrower index for the criteria listed above when screening for sepsis than the general pediatric population. This is under development and needs additional research (Roney et al., 2015).

There are limitations specific to the review that warrant discussion. First, as sepsis is an ever-evolving topic, there was limited data in the past 5 years regarding reliability and validity of pediatric sepsis screening tools. The studies in this review had small sample sizes and similar criterion. However, no standardized pediatric sepsis screening tools were used in the four studies. Although this is more of a limitation of current research rather than a reflection of this review.

Pediatric sepsis is a significant problem that often leads to devastating outcomes. Earlier identification and intervention may be a solution. Without use of an evidence-based pediatric sepsis screening tool, early signs of sepsis in this population are often missed. This review

highlighted pediatric sepsis screening tools as an efficacious approach to earlier identification of sepsis.

Results suggest that the current evidence is in favor of utilizing a screening tool for sepsis designed for use within the pediatric population as a gold standard for clinical practice in the acute care hospital setting. Use of this type of tool has the potential to improve patient outcomes and reduce mortality rates in the pediatric population.

Phenomenon Conceptual Model

Conceptual models are useful as guides for understanding a phenomenon. The phenomenon of interest for this quality improvement project was infection, more specifically sepsis. A conceptual model that was used to provide structure for this phenomenon of interest is the Center for Disease Control and Prevention (CDC) Infectious Disease Framework (IDF) (CDC, 2011). IDF is broken down into three elements that guide the process of disease prevention (see Appendix G). The model was designed to provide a map for improving and preventing infectious diseases. The IDF also acts as a guide for creating evidence-based policies (CDC, 2011).

Element one. The first element of IDF focuses on strengthening public health fundamentals, including surveillance of infectious disease (CDC, 2011). Surveillance of infectious disease drives public health actions. As suggested by the first element of IDF, surveillance can lead to the advancement of workforce development to prevent infectious diseases by improving knowledge on sepsis and improving earlier detection of sepsis (CDC, 2011).

Element two. The second element of IDF builds upon the first, in that it discusses implementation of interventions to reduce infectious diseases (CDC, 2011). This element

specifically discussed identifying and validating tools for disease reduction. This is what the foundation of this project was built upon; validating a sepsis risk assessment tool in order to reduce high-burden infectious diseases through earlier identification (CDC, 2011).

Element three. Finally, the third element of IDF focuses on developing policies to prevent, detect, and control infectious diseases (CDC, 2011). Validating a sepsis risk assessment tool covers the prevention aspect of this element, because it aligns with the CDC's position of evidence-based detection policies. However, controlling this type of infectious disease is a step beyond what this specific project covered. Beyond this project, policies can be developed and implemented within CHM based on evidence. This could include a sepsis bundle for initiation of interventions once sepsis is diagnosed.

Project Plan

Purpose of Project and Objectives

The overarching goal of the project was to improve pediatric sepsis detection using a screening tool. The current tool used at CHM underwent expert review, thus, it had content validity. Construct validity to determine if the screening tool detects sepsis never occurred. Thus, the project examined if the sepsis screening tool would detect risk of sepsis.

Design for the Evidence-based Initiative

This project was a quality improvement project focused on tool examination to validate the sepsis screening tool effectiveness at predicting and identifying risk of sepsis. The project also examined if use of the screening tool improved time to treatment (i.e. fluid boluses and antibiotics) in those with a sepsis diagnosis compared to when no tool was used.

Quality improvement projects involve systematic activities designed to monitor, assess, and/or improve an organization's quality of healthcare (Health Resources and Services

Administration, 2011). To examine if the screening tool detected risk of sepsis, a cohort of patients diagnosed with sepsis were examined using the current sepsis screening tool just prior to the patient demonstrating signs of sepsis. To examine time to intervention (i.e. fluid boluses and antibiotics), the actual time administered was examined in those who used the screening tool then compared to those who did not use the screening tool.

Setting

The setting for this project was a freestanding children's hospital in the Midwest (CHM). This included units with specialties in hematology, oncology, cardiology, respiratory, surgical, and behavioral health. Administrative approval to conduct the project was obtained from the organization (see Appendix H).

Participants

Patients with a diagnosis of severe sepsis in the hematology, oncology, cardiology, respiratory, surgical, or behavioral health units were included. The sample size was 122 patients to examine the detection of risk; and 167 to examine time to intervention (122 with no screening tool and 45 with a screening tool).

Model Guiding Implementation

The model guiding implementation of this project was the Institute for Healthcare Improvement (IHI) Plan Do Study Act (PDSA) cycle (see Appendix I). This model is useful for documenting and testing a proposed change (IHI, 2017). At CHM, the PDSA model is well recognized and used, which was a big draw for using it within the context of this project.

Plan. The plan phase of PDSA includes stating the question and a prediction for what will happen, developing a plan to test the change, and identifying what data needs to be collected (IHI, 2017). The clinical question was, as previously discussed, "Did the current pediatric sepsis

screening tool in use at CHM identify patients at risk for sepsis?" As well as, "Did the sepsis screening tool used initiate interventions (i.e. fluid boluses and antibiotics) earlier than when compared to no tool being used?" A prediction for what will happen was that time to detection of sepsis will be quicker with use of this tool and better overall sepsis outcomes will ensue. A plan was developed to validate the screening tool for sepsis included analyzing patient charts of those diagnosed with severe sepsis to determine predictive ability of the tool. Identification of data collected is discussed within the measures section of the paper.

Do. The next step of PDSA is the do stage. During this stage, a test is carried out on a small scale with data collection and analysis (IHI, 2017). This phase was carried out by performing a small 5-chart audit of pre-tool patients diagnosed with severe sepsis. This small sample provided data to discover the amount of time needed to perform a chart audit in order to determine a sample size for the tool validation, with over 100 charts likely to be needed for statistical models to examine validity.

Study. During the study phase of PDSA, results are analyzed and compared to original predictions (IHI, 2017). After deciding on a sample size, the chart audits occurred on patients both before implementation of current tool and after tool was implemented at CHM of patients with diagnoses of severe sepsis. During this phase, data were analyzed to determine if the current tool at CHM detected sepsis risk or not.

Act. In this stage of PDSA a decision has to be made to adapt, adopt, or abandon the change before starting a new cycle in the plan phase of PDSA (IHI, 2017). Adapting the change involves making modifications and running another test. Adopting the change involves testing the change on a larger scale. Abandoning the change involves changing the idea altogether (IHI, 2017). The anticipated outcome was that during this phase CHM would be adopting the change.

Implementation Steps and Strategies

According to Powell et al. (2015), there are evidenced-based implementation strategies to be used within the implementation of a project. Each will be discussed.

Readiness assessment and identify barriers. First, a strategy that was used within the context of this project was assessment of readiness and identifying barriers to the project (Powell et al., 2015). This was conducted during the organizational assessment and SWOT analysis. The assessment discovered implementation strategies in place that further assisted with this project.

Capturing and sharing knowledge and creating a collaborative. These strategies included capturing and sharing knowledge, creating a learning collaborative, organizing implementation team meetings, and using an implementation advisor (Powell et al., 2015). Capturing and sharing knowledge, as well as creating a learning collaborative, are both aspects of ongoing implementation strategies at CHM. CHM is part of a greater sepsis collaborative put on by the Children's Hospital Association (CHA). This collaborative has a goal of reducing hospital-acquired severe sepsis and sepsis mortality by 75% by the year 2020 (CHA, 2018). By joining this collaborative, CHM became part of an all-teach, all-learn interdisciplinary team which allowed them to view current research other hospitals are doing in order to see what is working for them. After joining this collaborative, CHM also created a sepsis steering committee to work as the driving force for the organization; this fulfilled the implementation strategy of organizing a team and team meetings (Powell et al., 2015). Finally, this committee appointed an implementation advisor to direct the group meetings.

Consultation and tools for quality improvement. Beyond these initial strategies already in place, the project purposely re-examined the implementation, provided ongoing consultation, and developed tools for quality monitoring (Powell et al., 2015). Purposely re-

examining the implementation of a risk-assessment tool took place by the DNP student, because CHM initially implemented the risk assessment tool without first ensuring it was evidence-based. Next, the DNP student provided ongoing consultation with CHM based on findings in literature and work found through chart audits to validate the risk assessment tool. Finally, the DNP student developed tools for quality monitoring through a table of measures and codebook used to conduct chart audits.

Measures

Measures for gauging the project success included system and pediatric patient measures. System measures were admission to ICU, time to admit to ICU after diagnosis, time to antibiotic initiation, time to fluid bolus, time to "trigger" tool, and time to sepsis huddle. The patient measures were tachycardia, bradycardia, hypotension, fever, hypothermia, current use of steroids, altered mental status, the presence of chills, capillary refill greater than 3 seconds, mottled or cool extremities, presence of neck stiffness, "flash" capillary refill less than 1 second, and presence of neutropenia (ANC less than 500). Definitions for each measure are shown in Appendix J and K. A flow chart further defining triggers that prompt measurement is shown in Appendix L.

Items on the screening tool for sepsis were selected by CHM based on information from the CHA (2018) sepsis collaborative. To assure screening tool items were evidence based, literature supporting each item on the tool are shown in Appendix M. In addition, content experts from the CHM sepsis steering committee reviewed each item on the tool and reconfirmed usage.

Data Collection Procedures

Data were collected by the DNP student through chart reviews in the EHR as described in Appendix J (January 1, 2017 through August 31, 2018). CHM changed to a new EHR in

November of 2017 thus, data prior to that date were from the old platform. Data were collected from patients who had a diagnosis of severe sepsis. This included the old EHR dates of January 1, 2017 through October 31, 2017 and new EHR dates of November 1, 2018 through August 31, 2018. Data were kept on a secure network password protected internal drive at the site, accessible by members on the team from CHM.

Data Management

First, data were collected from the EHR in an Excel datasheet stored on the CHM internal drive. Next, data in the excel datasheet was de-identified. After de-identified, the student and biostatistician analyzed the data using Statistical Analysis System (SAS) version 9.4 (statistical software).

Analysis

Data were analyzed using factor analysis (shown below) to determine if the screening tool detected sepsis prior to the sepsis diagnosis. For time to intervention, a pre- and post-tool comparison provided data on if time to intervention improved after initiation of screening tool usage used t-test or chi-square, with a p-Value of 0.05 demonstrating a difference.

Factor analysis. A plan was devised to use factor loading of the following variables: did patient go to ICU, time to ICU, time to antibiotic initiation, time to fluid bolus, time to “trigger” tool, time to sepsis huddle, and presence of tachycardia, bradycardia, hypotension, fever, hypothermia, current use of steroids, altered mental status, chills, capillary refill greater than 3 seconds, mottled or cool extremities, neck stiffness, "flash" capillary refill less than 1 second, or neutropenia was conducted. Construct validity testing of the unidimensionality of the risk of sepsis variables using structural equation modeling (SEM) techniques of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) with principal axis factoring varimax

(orthogonal) rotation was assessed. SEM is an analytical tool that provides an alternative to experimentation for examining the plausibility of hypothesized models (Kline, 2005). Missing data were checked and corrected if possible, otherwise cases with missing data were removed prior to analysis. Random assignment to two datasets occurred splitting data in half, one half used for EFA and the other CFA. Cross-validation of a dataset strengthened predictive validity (Vandenberg, 2006).

Exploratory analysis. Sampling adequacy tests was done using the Kaiser-Meyer-Olkin (KMO) and Bartlett test. KMO is a measure of sampling adequacy comparing the magnitudes of the observed correlations coefficients to the correlation coefficients, which should be greater than .50 for a satisfactory factor analysis to proceed (Kline, 2005). Bartlett is an indicator of the strength of the relationship among variables testing if the correlation matrix is uncorrelated and whether the correlation matrix is an identity matrix; a significance level must be small enough to conclude that the association of the relationship among the variables is strong (Kline, 2005). If significant then the correlation matrix is not an identity matrix, structure exists and the strength of the relationship among the variables is large enough for factor analysis (Kline, 2005).

Confirmatory analysis. A two-step approach was taken, testing the measurement model for fit before testing the full structural model (Joreskog & Sorbom, 2004). Two indictors were used to examine CFA: comparative fit index (CFI), a relative fit index with values ≥ .95 indicating good fit; and the root mean square error of approximation (RMSEA), an indicator of the discrepancy in fit per degree of freedom adjusted for sample size, with values smaller than 0.08 providing a reasonable approximation of the factor loading (Kline, 2005). If the model converges, and the fitting measures indicated a good fit (RMSEA; CFI), confirmation of a relationship will exist.

Resources & Budget

Resources for this project included the DNP student, the sepsis steering committee, clinicians, and RNs. Further resources for this project included organizational support such as the facility itself, computers, and the ability to print the pediatric sepsis paper tools. The DNP scholarly project to validate the sepsis screening tool included a budget (see Appendix N). The DNP student filled a need for the organization at no cost other than use of staff time to provide information or data related to the project. The site staff involved in this project had approved time to put towards this project as part of their roles.

Timeline

Institutional Review Board (IRB) approvals were obtained from the site and university. The groundwork (i.e. performing an organizational assessment and completing a literature review) for the project was completed on July 28, 2018. The project proposal took place on November 7, 2018. Upon approval, data collection began and was collected through February 1, 2019 followed by data analysis. Findings were disseminated to key stakeholders by March 4, 2019. The final project defense took place on April 8, 2019. The time line for this project is shown in Appendix O.

Results

Descriptive statistics were run and a pre- and post-tool comparison were utilized to provide data to determine if time to intervention improved after initiation of screening tool usage using t-test or chi-square, with a p-value of 0.05 demonstrating a difference were used as SEM was found to be insufficient.

Patient Characteristics

The characteristics of patients in the audit are shown in Appendix P. Mean age was 7.05(SD 6.05) years with a range of 0.02-20.57. There were nearly even numbers of males (55.7%; n = 93) and females (44.3%; n = 74); most were Caucasian (60.5%; n = 101) or African American (6.2%; n = 27); and 13.8% (23) were Hispanic. Length of stay was a median of 10.5 (IQR 4.94 –19.14) and 6% (n = 10) had hospital acquired sepsis.

Audit of Clinically Derived Time Zero (CDTZ)

Patients audited during data collection all had a *Clinically Derived Time Zero* (CDTZ) – this was determined by a physician within the organization who retrospectively determined the time when each patient first showed signs of severe sepsis. CDTZ acted as "time zero" for determining the length of time it took for fluid, antibiotics, and transfer to ICU to be initiated. CDTZ also acted as the last point where the sepsis screening tool should have flagged in order to be still considered "screening" for the detection of sepsis.

Overall 71.7% (n = 119) would have flagged within 24 hours. Of these patients, 34.8% (58) would have flagged before or at CDTZ. However, 28.3% (n = 47) of patients would not have flagged within 24 hours of clinically derived time zero using the tool (see Appendix Q).

Frequency of High-Risk Factors

The sepsis screening tool took into account certain high-risk factors to be considered when screening patients for sepsis. These factors would not in and of themselves flag the tool but having high-risk factors in addition to flagging steps 1 and 2 on the tool would initiate a call for a provider to come assess the patient.

Of the high-risk factors evaluated, when the factor occurred, documentation was not always easily found in the audit (see Appendix R). For example, "Leukopenia, Leukocytosis, or

Bands >10% in the last 12 hours" was only credited if the labs were documented before or at clinically derived time zero. If labs were drawn after CDTZ of sepsis, it was considered as not an early enough indicator to flag the tool. Further, it was difficult to document "no" for a high-risk factor unless it specifically stated somewhere within a patient's chart that they patient did not have the factor. For example, not a single chart specifically stated that a patient "did not" have asplenia. Due to this, all patients were considered "not documented/unclear" besides the 2 whose chart explicitly stated they did have asplenia. This was a common problem in auditing the high-risk factors of where to find in the chart an actual documentation of the risk factor.

Abnormal High-Risk Condition: ANC

A particular high-risk factor added for immunocompromised patients was calculating of the ANC. The ANC was specifically analyzed in relation to being less than 500 for greater than 7 days. For the purpose of this analysis, ANC below 500 in and of itself was analyzed as a high-risk factor, regardless of the number of days it had been present. As shown in Appendix S, of the times an ANC value (N = 47) was calculated, the median 35.57, was below 500.

Time from Status Change to ICU admission, Antibiotic, and Fluid initiation

Appendix T shows a decrease in median time to patient transfer to ICU (2.24) and fluid administration (0.17), while time to antibiotic treatment increased (0.29). There was not sufficient evidence to say that time SEPSIS was flagged improved when comparing before to after tool use (p=0.19).

Clinical Status Symptom/Sign that Flagged the Tool

As shown in Appendix U, the top five clinical status symptoms/signs that flagged the tool were tachycardia (65.3%, n = 109), fever (62.9%, n = 105), altered mental status (38.9%, n =

65), capillary refill greater than 3 seconds (18.6%, n = 31), and hypothermia (18.0%, n = 30). Mottled and/or cool extremities and neutropenia were also above 10% occurrence.

Age Range Parameters

Appendix V shows the mean or IQR for heartrate, fever, and blood pressure by age groups and should be interpreted within the parameters expected of each age group. For example, the mean heart rate for >1 – 2 months and 3 – 11 months did not meet parameters for sepsis criteria. Furthermore, no age group had an average systolic blood pressure that would have met the criteria for that age group. It also is important to note that diastolic values were used for the purpose of this calculation, but the tool did not have parameters for the diastolic blood pressure values.

Factors that Flagged the Tool Before- or At- CDTZ

As shown in Appendix W and X, the top five clinical status high risk factors that flagged the tool before or at clinically derived time zero were tachycardia (84.5%, n = 49), fever (79.3%, n = 46), altered mental status (65.5%, n = 38), CNS dysfunction (51.7%, n = 30), and presence of a central line (36.3%, n = 21). Capillary refill greater than 3 seconds, leukopenia leukocytosis Bands >10% in the last 12 hours, hypotension, and hypothermia were also above the 20% occurrence rate.

Discussion

Current State

This project found that the current tool use at CHM to detect risk of sepsis needs further examination of validity and reliability. This is supported by the current state of the literature in that no evidence-based sepsis screening tools are tailored for pediatric populations, as only content-reviewed factors to screen for when evaluating for sepsis in pediatrics (Davis et al.,

2017; Lake, Fairchild, & Moorman, 2014; Paliwoda & New, 2015 & Roney et al., 2015). As there are no other tool, the creation and testing of a tool to detect risk of Sepsis is needed before a tool will be validated for evidence-based use.

Key Findings

Although the anticipated outcome of tool construct validation was not met, there were several strengths found within this project. First, this is a much-needed area of study and any research findings to add to the current state of literature aid in shaping future tool validation. Second, a decrease in median time to ICU transfer and fluid bolus initiation were found when comparing pre- to post- tool implementation. This shows an improvement in a critical time-sensitive component of treating sepsis that is dependent on initially detecting sepsis through a screening tool. Thirdly, this study spoke to what the top clinical status signs/symptoms were in severe sepsis patients, this is useful information when deciding where to go next in configuring a tool that has construct validity. Finally, this project also was able to evaluate age-specific parameters for clinical status signs/symptoms such as heart rate, fever, and blood pressure. This information is also useful when determining next steps for a sepsis screening tool and could be used in future research.

Limitations

This project had a fairly short implementation period and small sample size. Although 20 months of data were used, there were still only 167 patients that met criteria of a severe sepsis diagnosis included in this project. Due to this, SEM analysis was not able to be performed, which could have been an advantageous statistical analysis to run for this type of project. Another limitation is the relatively small sample size of post-tool implementation patients (n=45). Time constraints for data collection, as well as not enough collated data on severe sepsis diagnosed

patients led to this smaller sample size. Another limitation was the lack of current evidence in literature to support any pediatric sepsis screening tool, let alone this specific tool. Finally, it is important to note that this project took place during a transition period from one EHR to another. Therefore, it is possible that different results could ensue as time goes on with longer EHR use as some results could have been due to a lack of understanding on how and where to properly chart assessments within the EHR.

Implications for Practice and Further Study in the Field

As previously discussed, the top five clinical status that flagged the tool were tachycardia, fever, altered mental status, capillary refill greater than 3 seconds, and hypothermia. These factors appear to be the most useful in identifying pediatric sepsis and perhaps another trial on a sepsis screening tool with these specific factors laid out in a different step-wise configuration would be worth analyzing. For example, step 2 (related to temperature of the patient) of the tool was often the last to flag. Thus, it may be worth reconsidering what factors are analyzed within step 2 of the tool or even worth considering combining step 2 and 3 of the tool into one category and then only enlisting a two-step function to flag the tool. It is also possible that a temperature was not taken frequently enough on patients; if this is the case than revisiting nursing assessment protocols for temperature frequency or critical thinking skills related to when obtaining a temperature is indicated may need to be discussed.

Additionally, further exploration of the age-specific parameters for vitals needed to flag the tool is needed. Specifically, definitions of hypotension in all age groups and heartrate in infants less than one year should be considered. Another indicator that may need to be additionally added to a pediatric sepsis screening tool is evaluating both systolic and diastolic blood pressure values, and not only systolic values as the current tool does. Another indicator

that a future study may want to evaluate is respirations per minute, peripheral capillary oxygen saturation (Sp02), and/or hypertension. These were values that were often noticed outside of normal parameters on patients, although they were not values collected or evaluated by the current sepsis screening tool.

Another aspect to consider in future studies is a better definition of Central Nervous System (CNS) dysfunction. This is a high-risk factor on the current screening tool that was found to be in the top 5 indicators of patients that flagged the tool before or at CDTZ. It may be worth considering redefining assessment standards for this patient population, as well as defining how these patients exhibit altered mental status compared to patients without CNS dysfunction.

Finally, a future project may consider combining risk assessment tools in the pediatric population into one cohesive tool. Currently at CHM there are several pediatric screening tools that assess for different problems, however, many of them have overlapping factors being assessed. It may be worth considering a way to combine these tools into one seamless tool that would have an algorithm to delineate which illness is detected based on the clinical status signs/symptoms found.

Dissemination of Results

Outcomes of this project were disseminated. First, tools for quality monitoring (table of measures and codebook used to conduct chart audits) and findings were distributed to CHM at the end of the project for use within the organization and collaborative. Second, findings were presented at the student's oral defense on April 8, 2019. Third, the final project defense paper was posted on Scholarworks and can be accessed by anyone who is interested. Fourth, findings will be presented at the organization's research council poster presentation on April 9, 2019. Fifth, findings will be presented to the sepsis steering committee at their May 6, 2019 meeting.

Sustainability Plan

Sustainability of this DNP project included the following. First, the sepsis steering committee chair will continue to monitor the effectiveness of the screening tool after the completion of this project. Second, the sepsis screening tool was embedded into the EHR at CHM on January 3, 2019 and will no longer be used as a paper tool, which makes for easier monitoring of tool effectiveness and sepsis detection. This should also increase RN compliance and morale towards the tool, because this eliminated the need for an extra step outside of electronic charting. A new policy will not be needed at CHM. However, a new build was needed in order for the screening tool for sepsis to be embedded into the EHR. This required IT involvement with the EHR company, as well as assistance from the CHA collaborative. The process for this new construct to be built into the EHR was completed as previously stated on January 3, 2019 making ongoing monitoring of this tool easier at CHM.

Conclusion

CHM sought to validate a sepsis screening tool currently in use for evidence-based use. An organizational assessment of the current policy and practice surrounding use of the sepsis screening tool combined with a literature review on sepsis screening tools, identified the current sepsis screening tool had content validity but still needed construct validity. Two theoretical frameworks and one theoretical model were used to understand the phenomenon and conduct a plan to validate the sepsis screening tool. Pre- and post-tool chart audits were performed to implement this tool validation plan. Data collection occurred over two months including patients from January 2017 through August 2018. Despite being unable to provide construct validity for this pediatric sepsis screening tool, individual factors within the tool were able to be evaluated

and future studies should build upon this research in order to work towards validating a pediatric sepsis screening tool for evidence-based use.

Reflection on DNP Essentials

The American Colleges of Nursing (AACN) requires proficiency from DNP students in the following 8 competencies which make up the foundation for advanced practice nursing roles. Each are reviewed below.

Essential I: Scientific Underpinnings for Practice

The DNP can integrate science using science-based theories and concepts to determine the significance of phenomena, as well as develop and evaluate outcomes of new practices based on evidence to alleviate or enhance the phenomena (AACN, 2006). This essential was achieved through this project by performing a literature review and using the knowledge gained from this review to improve care. Additionally, frameworks were utilized for implementing and guiding change.

Essential II: Organizational and Systems Leadership

The DNP can develop and evaluate care delivery approaches that meet the needs of patient populations based on evidence-based findings in nursing science and other clinical sciences (AACN, 2006). This essential was achieved through this project by evaluating a tool that enhances care provided to the pediatric population. Furthermore, developing and evaluating cost-effectiveness is another aspect of this essential that was met by developing a budget for this project and monitoring the project's cost effectiveness.

Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

The DNP can translate research into evidence-based practice through use of analytical methods to appraise existing literature, designing and implementing processes to evaluate

outcomes of practice, and apply relevant findings to develop and improve practice guidelines (AACN, 2006). This essential was achieved through this project by using analytic methods to evaluate literature regarding the best evidence for sepsis screening in pediatric populations. The project included designing a process to evaluate the effectiveness of the current sepsis screening tool in place. Furthermore, relevant findings were disseminated to improve practice guidelines for use of the tool.

Essential IV: Information Systems Technology

The DNP is proficient in use of and evaluation of information systems technology resources to support practice and care. This includes related ethical, regulatory, and legal issues related to use of information and systems technology (AACN, 2006). Through this project, this essential was met by utilizing and navigating two different EHRs to gather pre- and post-tool data. E-mail was used for communication with key stakeholders for progress updates and additional resources. Excel was used for organizing and analyzing data. Strict confidentiality of any identifiable patient data was maintained, and all ethical guidelines were followed during the course of this project.

Essential V: Advocacy for Health Care Policy

The DNP critically analyzes health policy proposals, demonstrates leadership in the development and implementation of policies, as well as educates and advocates for the nursing profession (AACN, 2006). Although no formal policy was changed through this project, education and advocacy for implementation of evidence-based policies at an organizational level were performed through this project. Additionally, this essential was met through attendance of Advocacy Day and meeting with state legislatures regarding policies that advocate for the expansion of the advanced practice registered nurse role.

Essential VI: Interprofessional Collaboration

The DNP exhibits leadership in collaborating between multiple healthcare specialties to create change in complex healthcare delivery systems (AACN, 2006). This essential was met through collaborating with multiple different healthcare roles in the development, implementation, and evaluation of this project. Collaborative healthcare professionals included RNs, managers, CNSs, educators, pharmacists, providers, IT/quality improvement data specialists, and statisticians. Incorporating a diverse collaborative group allowed for better understanding of the current practice, assessing barriers, and evaluating necessary practice changes.

Essential VII: Clinical Prevention and Population Health

The DNP can analyze scientific data, synthesize concepts, develop/implement/evaluate interventions, and address gaps in care related to clinical prevention and population health (AACN, 2006). This project was focused on prevention for better population health. Sepsis is a leading cause of hospital-related deaths – this not only causes poor patient outcomes but also costs both the patient and the healthcare system substantial amounts of money. Validating a tool in use to ensure it is actually detecting sepsis rates sooner allows the hospital to evaluate how well they are doing with detecting and treating sepsis in their patients.

Essential VIII: Advanced Nursing Practice

This essential encompasses the competencies that are necessary for all DNP-prepared specialties and act as a foundation for DNP practice. The DNP can: conduct comprehensive and systematic assessments in complex situations; design, implement and evaluate interventions; develop and sustain relationships with patients and other professionals in order to provide optimal care outcomes; and demonstrate systems thinking in order to improve patient outcomes

(AACN, 2006). This project covered all of these competencies. An organizational assessment of current practice was performed and systems thinking was used to design and implement a plan to evaluate the sepsis screening tool for evidence-based use. In order to carry out this project, many relationships with various stakeholders, primarily consisting of the sepsis steering committee members, were developed and sustained.

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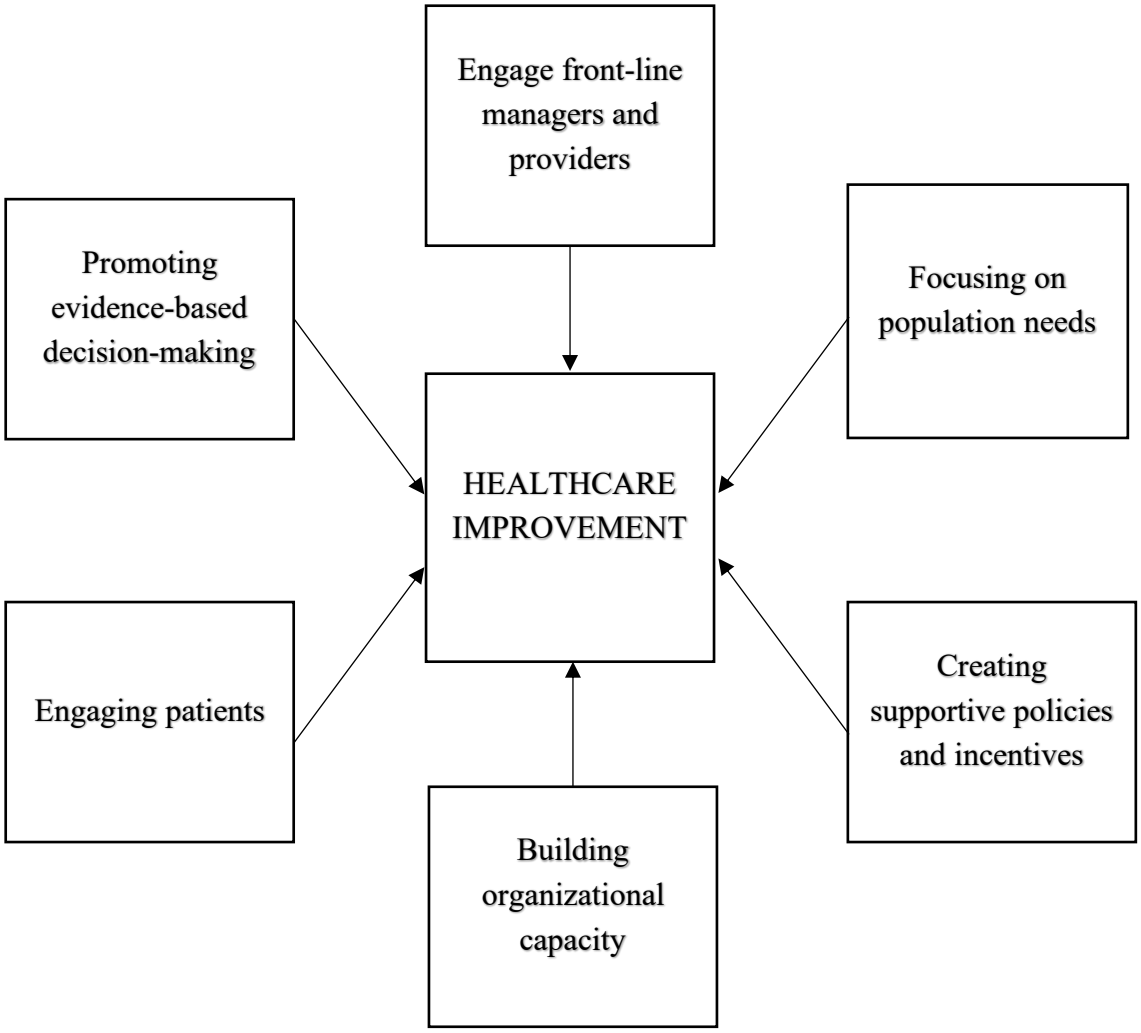
Appendices

Appendix A



Appendix A. The Canadian Foundation for Healthcare Improvement Model

Appendix B

Project Organization IRB Determination Letter

Appendix B. Available upon request.

Appendix C

GVSU IRB Determination Letter

GRAND VALLEY STATE UNIVERSITY
www.gvsu.edu

DATE:	June 21, 2018
TO:	Sandra Spoelstra
FROM:	HRRC
STUDY TITLE:	Evaluation of a Sepsis Screening Tool to Predict Infections in Children in Acute Care
REFERENCE #:	18-309-H
SUBMISSION TYPE:	HRRC Research Determination Submission
ACTION:	Not Research
EFFECTIVE DATE:	June 21, 2018
REVIEW TYPE:	Administrative Review

Thank you for your submission of materials for your planned scholarly activity. It has been determined that this project does not meet the definition of research* according to current federal regulations. The project, therefore, does not require further review and approval by the Human Research Review Committee (HRRC).

A summary of the reviewed project and determination is as follows:

The purpose of this project is to validate constructs of the current proposed sepsis-screening tool at a local hospital to ensure there is evidence to support the use of the proposed tool before it is implemented into the electronic medical record (EMR). The project is designed to improve the quality of care being provided at a single hospital and not to create new generalizable knowledge. While it is a systematic investigation, it does not meet the federal definition of research and therefore does not require IRB oversight.

An archived record of this determination form can be found in IRBManager from the Dashboard by clicking the "_ xForms" link under the "My Documents & Forms" menu.

If you have any questions, please contact the Office of Research Compliance and Integrity at (616) 331-3197 or rci@gvsu.edu. Please include your study title and study number in all correspondence with our office.

Sincerely,
Office of Research Compliance and Integrity

*Research is a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge (45 CFR 46.102 (d)).

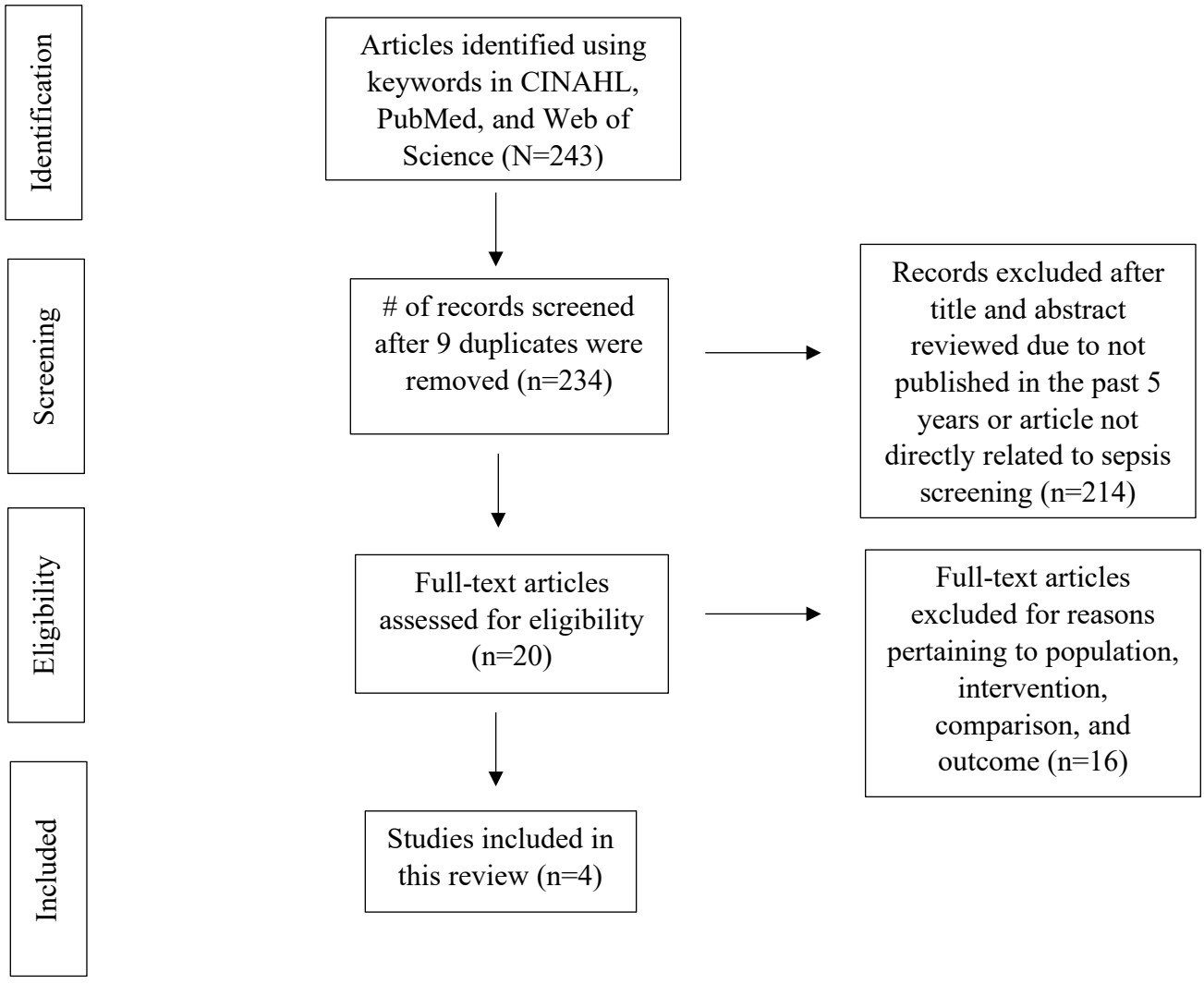
Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains: data through intervention or interaction with the individual, or identifiable private information (45 CFR 46.102 (f)).

Appendix D

Strengths	**Weaknesses**
• Interprofessional Collaboration • Sepsis Steering Committee • Collaboration with CHA • Collaboration within the organization of CHM in other populations (i.e. adult and neonatal) • Best Children's Hospital in 6 specialty areas for 2018	• Current paper screening tool • Tension with RNs over adding another task • Collating paper documents in order to generate reports • Inaccurate timestamp on paper tool • RN confusion and increased errors related to many changes occurring at once
Opportunities	**Threats**
• CHA sepsis collaborative • Working alongside new EHR to implement a clinical decision support tool within the EHR • Customization options within the new EHR	• Deadlines within CHA collaborative • Difficulty retrieving data from old EHR at CHM • Current lack of evidence to support a pediatric sepsis screening tool

Appendix D. SWOT Analysis of the Pediatric Sepsis Screening Tool at CHM.

Appendix E



Appendix E. PRISMA Flow diagram of search selection process.

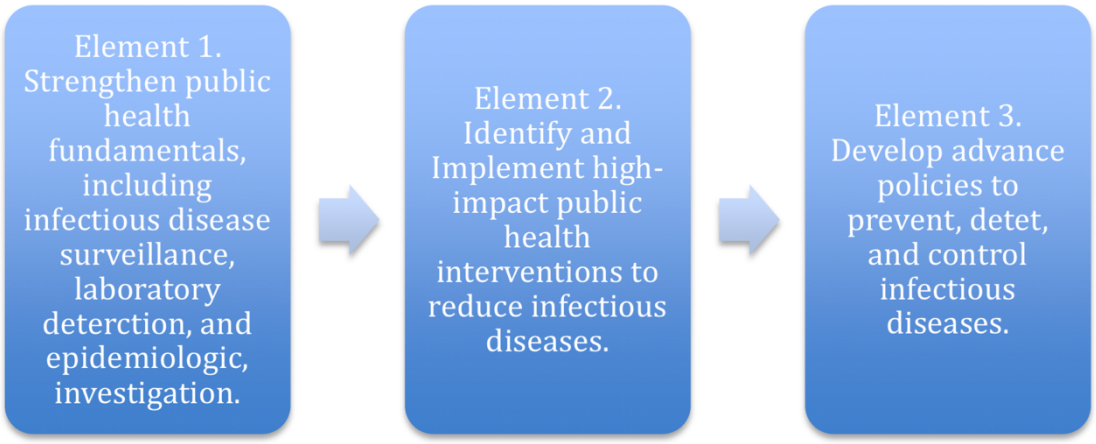
Appendix F

Author (Year) Purpose	Design (N)	Inclusion Criteria	Intervention vs Comparison	Results	Conclusion
Davis (2017) Provide update of 2007 American College of Critical Care Medicine to form guidelines for the newborn and pediatric age groups Septic Shock.	Systematic Review (N=143)	2006 - 2014, neonatal and pediatric population, sepsis tool monitoring guidelines	Older guidelines versus newer guidelines analyzing compliance, earlier identification, and earlier intervention	Improved compliance reduced hospital mortality from 4% to 2%. Improved mortality with compliance to first-hour and stabilization guideline recommendations	Consider institution—specific use of 1) a recognition bundle containing trigger tool for rapid identification of patients with septic shock, 2) resuscitation and stabilization bundle to help adherence to best practice principles 3) performance bundle to identify and overcome perceived barriers to best practice
Lake (2014) Heart rate characteristics for monitoring early detection of late-onset neonatal sepsis	RCT (N=1489)	2004 - 2010 neonates used a screening tool indicator to monitor neonatal sepsis	Compared data from prior sepsis without heart rate monitoring to current data	Predictive value affirmed good calibration, (increase of 0.03), continuous net reclassification index (0.39) and integrated discrimination index (0.01) Compares well to other risk factors	Heart rate characteristics monitoring is validated risk marker for sepsis in the NICU
Paliwoda (2015) Examine use and efficacy of early warning tools (EWTs)	Systematic Review (N=21)	2004 – 2014 systematic review, neonatal	Newly developed EWT and standard	Of the 19 infants who received an intervention, nine were identified	There is a need for validity and effectiveness of use of EWTs in

in identifications of deterioration in neonates.		population, used a screening tool to monitor neonatal deterioration	observation tool in identifying early deterioration of neonates	using EWT (47%)	neonatal population
Roney (2015) Evaluate current research on modified early warning scoring (MEWS) system tools to prevent failure to rescue in hospitalized adult medical-surgical/telemetry patient.	Systematic Review (N=18)	Literature prior to 2014, systematic review, adult screening tools monitoring sepsis	MEWS versus other standardized screening tools	6 of 18 (33%) reported mortality predictive value and/or reduction, 3 (17%) measured impact on emergency calls, and 4 (39%) reported impact on mortality and rapid response team utilization	Development of all-cause illness screening tools, including sepsis, needed. Clinical picture, when with scoring tools, may assist clinical decision-making leading to improved outcomes and decreased failure to rescue

Appendix F. Articles included in review with author, year, purpose, design, inclusion, results, conclusions.

Appendix G



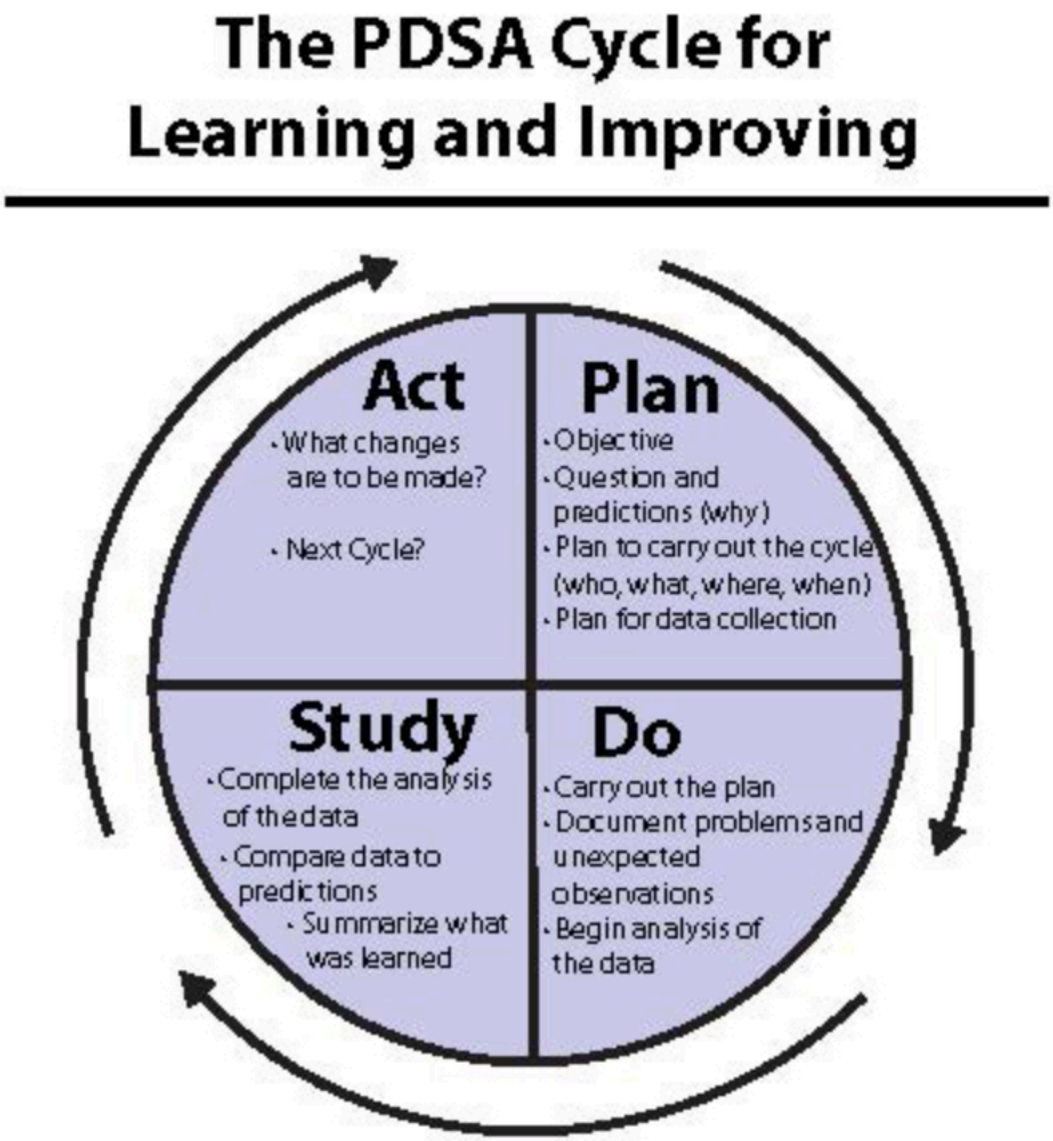
Appendix G. Center for Disease Control and Prevention's Infectious Disease Framework (CDC, 2011). Retrieved from https://www.cdc.gov/oid/docs/ID-Framework.pdf

Appendix H

Administrative approval to conduct this project at the project organization

Appendix H. Available upon request.

Appendix I



Appendix I. Institute for Healthcare Improvement's Plan Do Study Act Implementation Model (IHI, 2017). Retrieved from http://www.ihi.org/resources/Pages/Tools/PlanDoStudyActWorksheet.aspx

Appendix J

	Item	Measurement Level	How Time Measured/Assessed	When Measured/Assessed
System	Did patient go to ICU?	Yes, No (Categorical)	Time (Military)	After sepsis diagnosis occurred
	Time to ICU	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to antibiotic initiation	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to fluid bolus	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to "trigger" tool	Minutes (Numeric)	Time (Military)	From admission to when sepsis was declared from tool
	Time to sepsis huddle	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
Pediatric patient	Tachycardia*	Numeric	Time (Military)	At time of SEPSIS Huddle**
	Bradycardia*	Numeric	Time (Military)	
	Hypotension*	Numeric	Time (Military)	
	Fever*	Yes, No (Categorical)	Time (Military)	
	Hypothermia	Yes, No (Categorical)	Time (Military)	
	Current use of Steroids	Yes, No (Categorical)	Time (Military)	
	Altered Mental Status	Yes, No (Categorical)	Time (Military)	
	Chills	Yes, No (Categorical)	Time (Military)	
	Capillary Refill > 3 seconds	Yes, No (Categorical)	Time (Military)	
	Mottled cool extremities	Yes, No (Categorical)	Time (Military)	
	Neck Stiffness	Yes, No (Categorical)	Time (Military)	
	"Flash" Capillary Refill < 1 second	Yes, No (Categorical)	Time (Military)	
	Neutropenia (ANC <500)	Yes, No (Categorical)	Time (Military)	

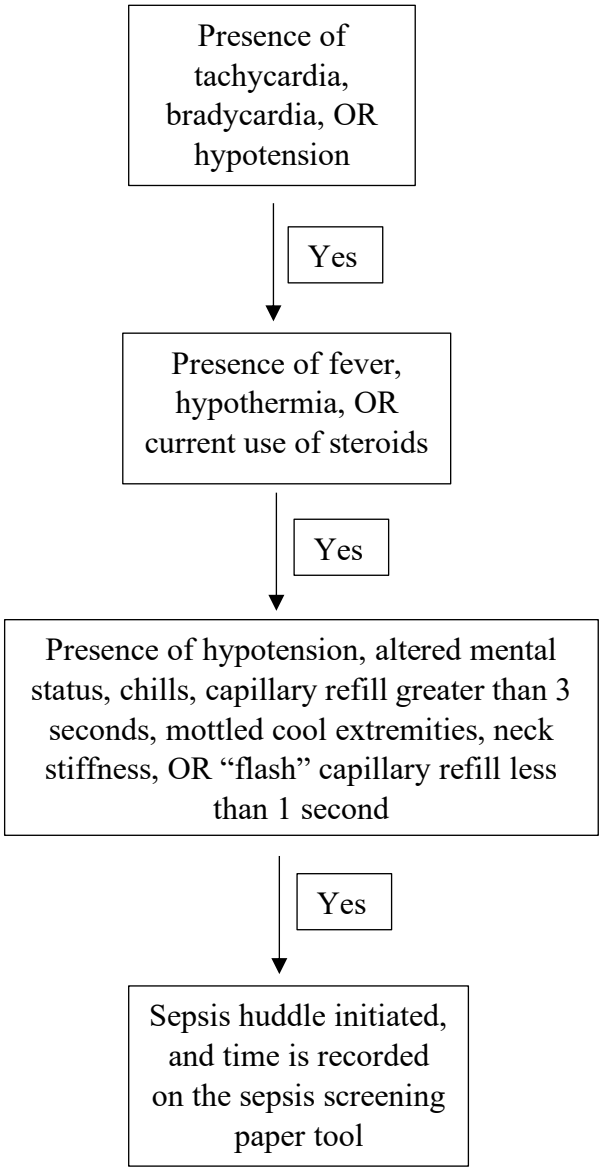
Appendix J. Table of Measures. *See Appendix K. **See Appendix L.

Appendix K

Age	Hypotension Systolic BP	Tachycardia	Bradycardia	Temperature
0 – 1 Months	< 50 mmHg	> 180	< 100	≥ 38.5
>1 – 2 months	< 50 mmHg	> 180	< 90	≥ 38.5
3 – 11 Months	< 70 mmHg	> 170	< 90	≥ 38.5
1 year – 3 years	< 75 mmHg	>150	N/A	≥ 38.5
4 years – 11years	< 80 mmHg	>130	N/A	≥ 38.5
12 years and older	< 85 mmHg	>120	N/A	≥ 38.5

Appendix K. Organization's definition of hypotension, tachycardia, and bradycardia to inform completing of screening tool for sepsis

Appendix L



Appendix L. Triggers for a sepsis huddle at project organization.

Appendix M

Pediatric Sepsis Screening Factor:	**Evidence to Support in Literature:**
Tachycardia	Davis (2017); Randolph (2014)
Bradycardia	Davis (2017); Randolph (2014); Dellinger (2013)
Hypotension	Davis (2017); Randolph (2014); Dellinger (2013)
Fever	Davis (2017); Randolph (2014); Dellinger (2013)
Hypothermia	Davis (2017); Randolph (2014); Dellinger (2013)
Current use of Steroids	Dellinger (2013)
Altered Mental Status	Davis (2017); Sepanski (2014); Dellinger (2013)
Chills	CDC (2017); NHS UK (2016)
Capillary Refill > 3 seconds	Davis (2017); Sepanski (2014)
Mottled cool extremities	Dellinger (2013)
Neck Stiffness	CDC (2017); NHS UK (2016)
"Flash" Capillary Refill < 1 second	Dellinger (2013)
Neutropenia (ANC <500)	Sano (2017)

Appendix M. Evidence to support factors within the pediatric sepsis screening tool at CHM

Appendix N

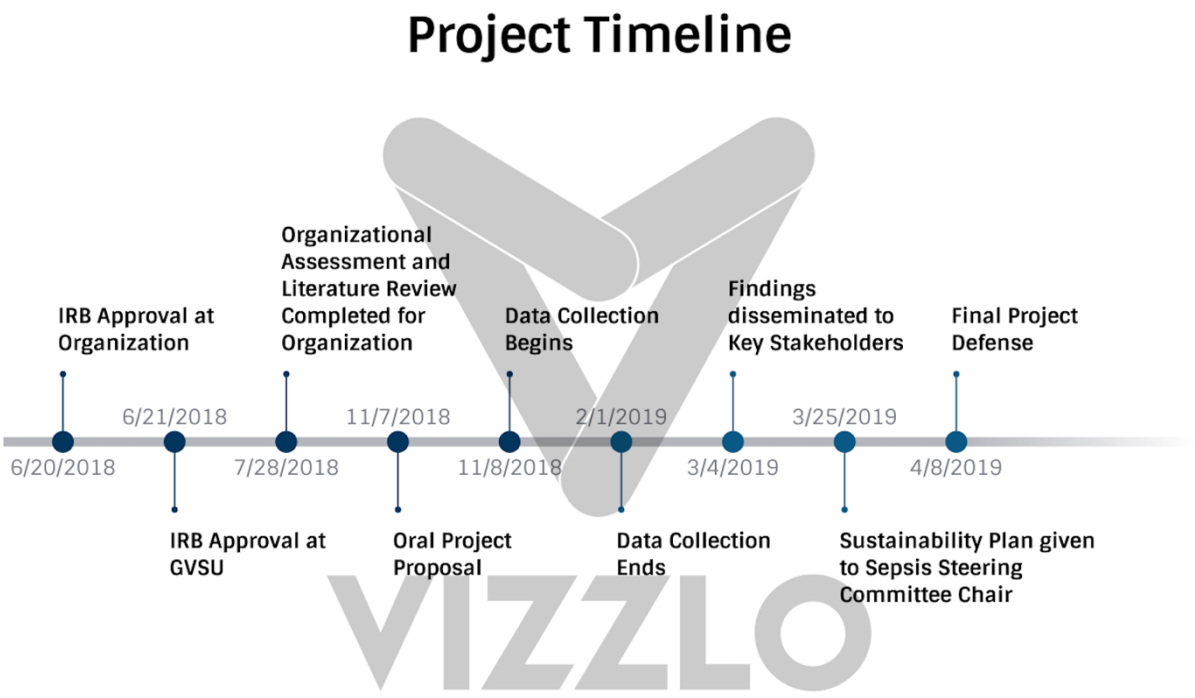
Budget

Doctor of Nursing Practice Project Financial Operating Plan	
Sepsis Screening Tool Assessment at a Freestanding Children's Hospital in the Midwest	
Revenue	
Project Manager Time (in-kind donation)	6,200.00
Consultations	
Statistician (in-kind donation)	100.00
Cost mitigation	
Prevention of 1 case of Severe Sepsis-related ventilator care / per year	40,878*
Prevention of 1 case of Severe Sepsis that required a ventilator for < 96 hours / per year	11, 794*
TOTAL INCOME	58,972.00
Expenses	
Project Manager Time (in-kind donation)	6,200.00
Team Member Time:	
Clinical Nurse Specialist (1)	2,000.00
Registered Nurse (1)	3,500.00
Consultations	
Statistician (in-kind donation)	100.00
Laptop	1,200.00
Cost of print/copy/fax	3,672.00
TOTAL EXPENSES	16,672.00
Net Operating Plan	42,300.00

*O'Brien & CDC. (2015). *The cost of sepsis.* Retrieved from https://blogs.cdc.gov/safehealthcare/the-cost-of-sepsis/

Appendix O

Timeline



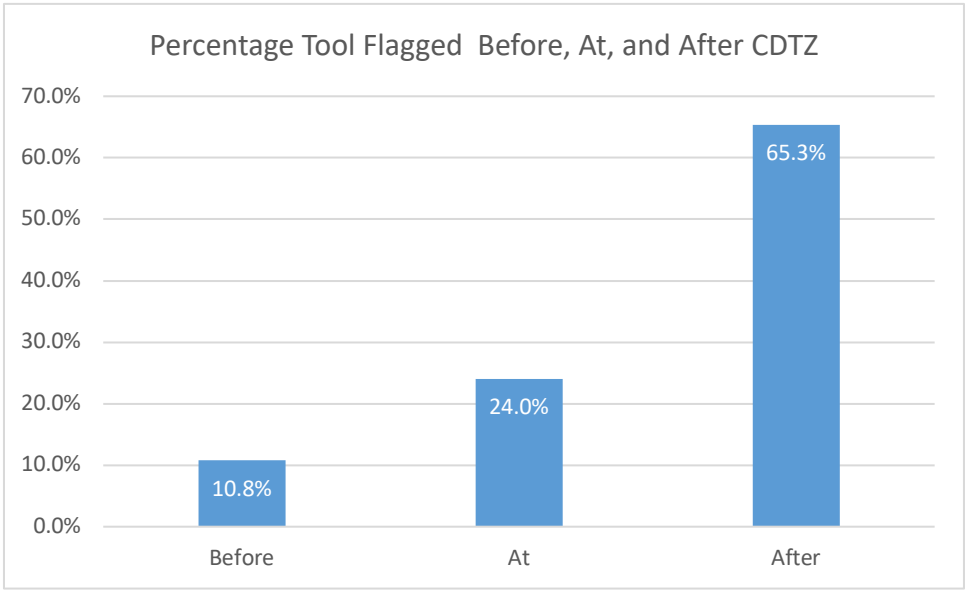
Appendix P

Characteristic	
	Mean (SD) range
Age	7.05 (6.05) 0.02-20.57
	% (n)
Gender	Female 44.3% (74) Male 55.7% (93)
Race	Caucasian 60.5% (101) African American 16.2% (27) Other 17.4% (29) Not Documented 6% (10)
Ethnicity	Hispanic 13.8% (23) Non-Hispanic 79% (132) Not Documented 7.2% (12)
Hospital Acquired Sepsis	Yes 6% (10) No 94% (157)
	Median (IQR)
Length of stay	10.05 (4.94 –19.14)

Appendix P. Age, gender, race, ethnicity, and length of stay of patients in audit

Appendix Q

Audit of clinically derived time zero	Tool flagged % (n)
Before	10.8% (18)
At	24.0% (40)
After	65.3% (109)



Appendix Q. Clinical status flagged before, at, and after clinically derived times zero overall

Appendix R

High risk factor	% (n)		
	Yes	No	Not documented/unclear
CNS dysfunction	42.5% (71)	54.5% (91)	3% (5)
Leukopenia, Leukocytosis, or Bands >10% in the last 12 hours	40.1% (67)	16.2% (27)	43.7% (73)
Central Line	28.7% (48)	42.5% (71)	28.7% (48)
Immunodeficiency	19.8% (33)	21.6% (36)	58.7% (98)
Malignancy	15.6% (26)	-	84.4% (141)
Patient ≤ 60 days old	9.6% (16)	90.4% (151)	-
Bone Marrow or Solid Organ Transplant	7.8% (13)	1.8% (3)	90.4% (151)
Asplenia	1.20% (2)	-	98.8% (165)

Appendix R. High risk factor frequency occurrence documented in health record

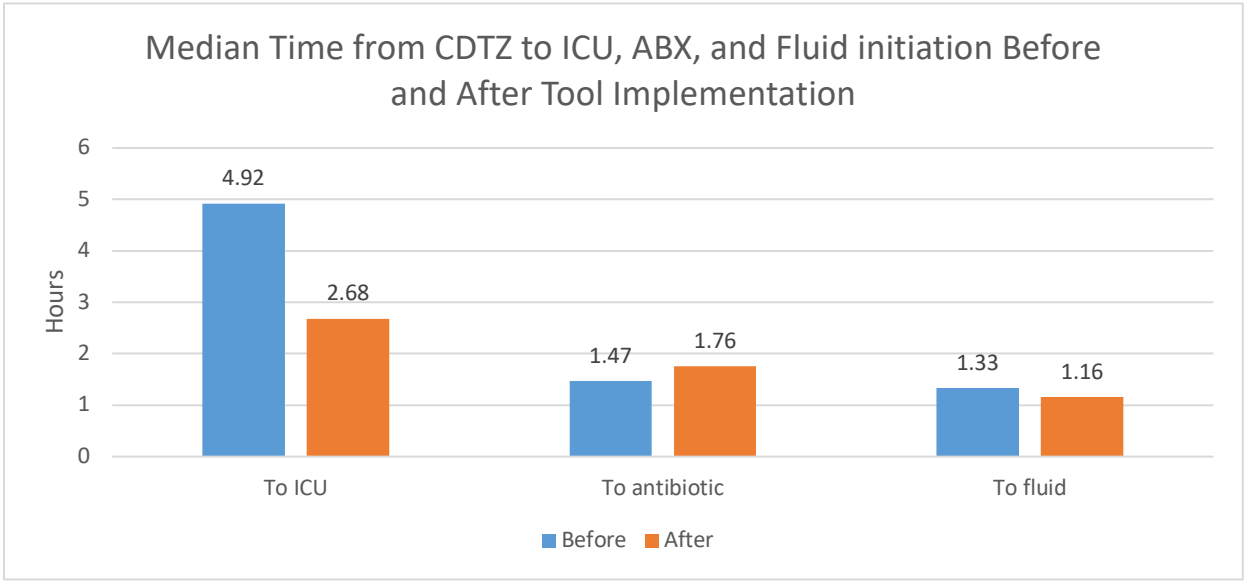
Appendix S

Clinical problem	Median (IQR) n
Neutropenia (ANC <500)	35.57 (0.0 – 717.42) 47

Appendix S. Abnormal high-risk condition clinical problems

Appendix T

	Median (IQR)		
Time (hours)	Before	After	Difference
To ICU	4.92 (1.30 – 12.0)	2.68 (1.58 – 6.30)	2.24
To antibiotic	1.47 (0.35 – 5.37)	1.76 (0.78 – 4.45)	-0.29
To fluid	1.33 (0.02 – 121.8)	1.16 (0.47 – 2.70)	0.17
	Mean (SD)		p-Value
Overall	-0.65 (23.72)	1.35 (6.42)	0.19

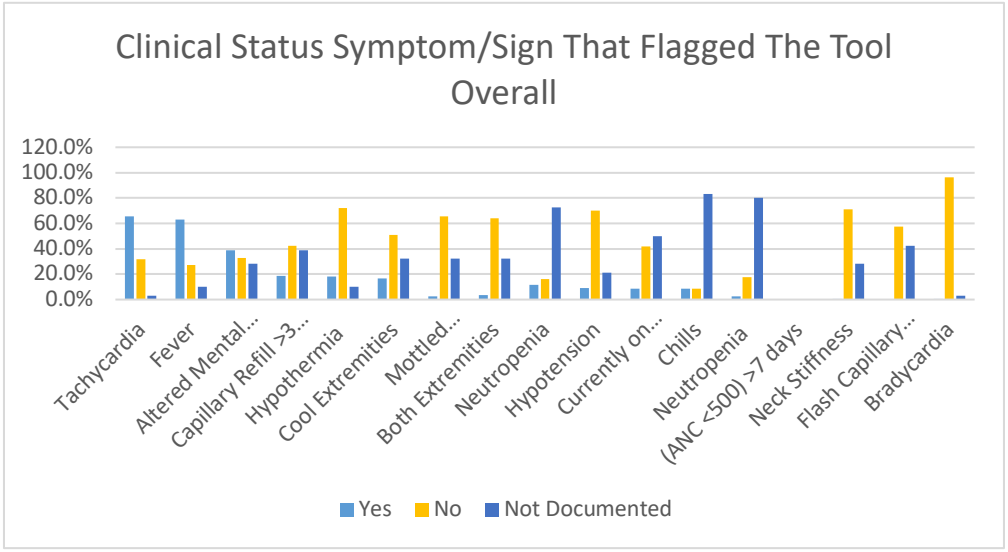


Appendix T. Time from status change to ICU admission, antibiotic, and fluid

Appendix U

Status	% (n)				
	Yes			No	Not Documented
Tachycardia	65.3% (109)			31.7% (53)	3.0% (5)
Fever	62.9% (105)			27.0% (45)	10.2% (17)
Altered Mental Status	38.9% (65)			32.9% (55)	28.1% (47)
Capillary Refill >3 seconds	18.6% (31)			42.5% (71)	38.9% (65)
Hypothermia	18.0% (30)			71.9% (120)	10.2% (17)
Mottled/Cool Extremities	16.8% (28) cool	2.4% (4) mottled	3.6% (6) both	44.9% (75)	32.3% (54)
Neutropenia	11.4% (19)			16.2% (27)	72.5% (121)
Hypotension	9% (15)			70% (117)	21.0% (35)
Currently on Steroids	8.4% (14)			41.9% (70)	49.7% (83)
Chills	8.4% (14)			8.4% (14)	83.2% (139)
Neutropenia (ANC <500) >7 days	2.4% (4)			17.4% (29)	80.2% (134)
Neck Stiffness	0.6% (1)			71.3% (119)	28.1% (47)
Flash Capillary Refill <1 second	-			57.5% (96)	42.5% (71)
Bradycardia	0.6% (1)			96.2% (161)*	3.0% (5)

*4 of 161 patients or 2.4% of the 96.2% were above the age range



Appendix U. Clinical status symptom/sign that flagged the tool

Appendix V

Age groups	Mean (SD) n			
	Heartrate	Fever	Systolic	Diastolic
0 – 1 Months	181.9 (24.0) 7	36.2 (1.7) 8	95.3 (20.2) 4	58.3 (24.0) 4
>1 – 2 Months	178.8 (36.1) 9	36.7 (3.31) 8	91.2 (14.7) 5	53.2 (12.2) 5
3 – 11 Months	154.2 (30.0) 13		95.8 (21.0) 10	51.9 (8.8) 10
1 – 3 Years	176.0 (28.3) 44	39.0 (1.6) 39	95.9 (20.1) 35	53.1 (22.3) 35
4 – 11 Years	137.5 (35.0) 47		99.6 (19.0) 43	54.5 (16.4) 43
≥12 Years	127.6 (26.5) 42		106.4 (19.1) 35	56.2 (16.7) 35
	Median (IQR)			
3-11 Months		39.0 (35.9 – 40.5) 11		
4 – 11 Years		38.9 (32.1 – 39.5) 47		
≥12 Years		38.8 (33.7 – 40.2) 37		

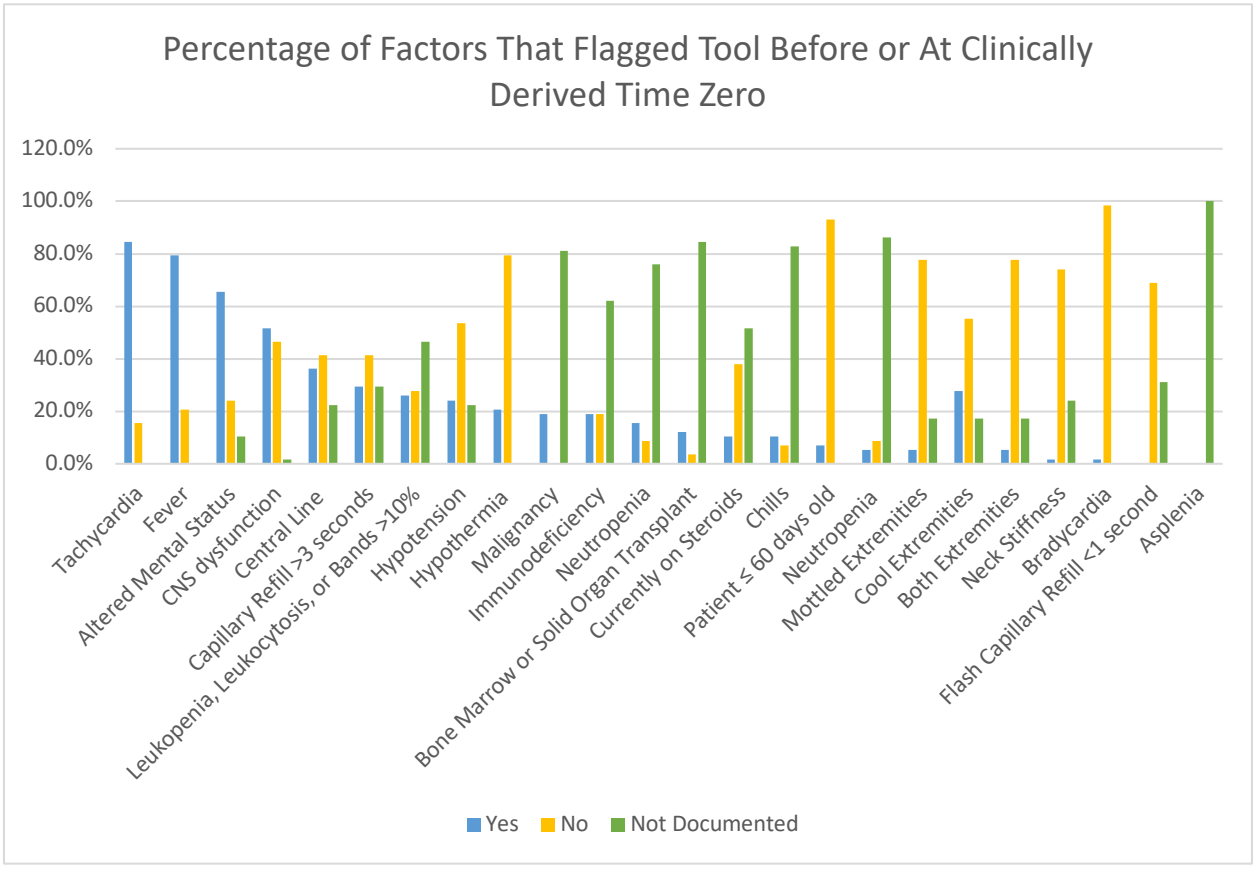
Appendix V. For patients in age range

Appendix W

High-Risk Factor or Status	% (n)		
	Yes	No	Not Documented
Tachycardia	84.5% (49)	15.5% (9)	-
Fever	79.3% (46)	20.7% (12)	-
Altered Mental Status	65.5% (38)	24.1% (14)	10.3% (6)
CNS dysfunction	51.7% (30)	46.6% (27)	1.7% (1)
Central Line	36.3% (21)	41.4% (24)	22.4% (13)
Capillary Refill >3 seconds	29.3% (17)	41.4% (24)	29.3% (17)
Leukopenia, Leukocytosis, or Bands >10% in the last 12 hours	25.9% (15)	27.6% (16)	46.6% (27)
Hypotension	24.1% (14)	53.5% (31)	22.4% (14)
Hypothermia	20.7% (12)	79.3% (46)	-
Malignancy	19% (11)	-	81.0% (47)
Immunodeficiency	19% (11)	19% (11)	62.1% (36)
Neutropenia	15.5% (9)	8.6% (5)	75.9% (44)
Bone Marrow or Solid Organ Transplant	12.1% (7)	3.5% (2)	84.5% (49)
Currently on Steroids	10.3% (6)	37.9% (22)	51.7% (30)
Chills	10.3% (6)	6.9% (4)	82.8% (48)
Patient ≤ 60 days old	6.9% (4)	93.1% (54)	-
Neutropenia (ANC <500) >7 days	5.2% (3)	8.6% (5)	86.2% (50)
Mottled/Cool Extremities	Both 5.2% (3)	44.8% (26)	17.2% (10)
	Cool 27.6% (16)		
	Mottled 5.2% (3)		
Neck Stiffness	1.7% (1)	74.1% (43)	24.1% (14)
Bradycardia	1.7% (1)	93.1% (54)	-
		5.2% (3) Above age range	
Flash Capillary Refill <1 second	-	69.0% (40)	31.0% (18)
Asplenia	-	-	100% (58)

Appendix W. Percentage of factors that flagged tool before or at clinically derived time zero

Appendix X



Appendix X. Percentage of factors that flagged tool before or at clinically derived time zero

Sepsis Screening Tool Assessment at a Freestanding Children's Hospital in the Midwest

Cassandra Cummings, DNP Student

DNP Project Defense

April 8, 2019

Grand Valley State University
Kirkhof College of Nursing

Acknowledgements

- **Advisor**
  - Sandra Spoelstra, PhD, RN, FGSA, FAAN
- **Advisory Team**
  - Kimberly Lohr, DNP, RN, NNP-BC, PPCNP-BC,
  - Lynn Stachel, MSN, RN, CPON
  - JoAnn Mooney BSN, RN, CPN, CPPS
- **Children's Hospital Association**
  - The authors gratefully acknowledge the Children's Hospital Association's Improving Pediatric Sepsis Outcomes collaborative, a multi-hospital multiyear collaborative which provided centralized resources to support pediatric sepsis quality improvement work from 2016 onward.

Objectives for Presentation

1. Present the clinical problem within the context of the organizational assessment
2. Review evidence supporting solution
3. Review the QI project and results
4. Discuss project sustainability and dissemination
5. Reflect on DNP Essentials

Introduction

- Sepsis is a major contributor to morbidity and mortality (Schlapbach & Kissoon, 2018).
- The prevalence of pediatric severe sepsis in critically ill patients is 8.2% globally, with a hospital mortality rate of 25% (Weiss et al., 2015).

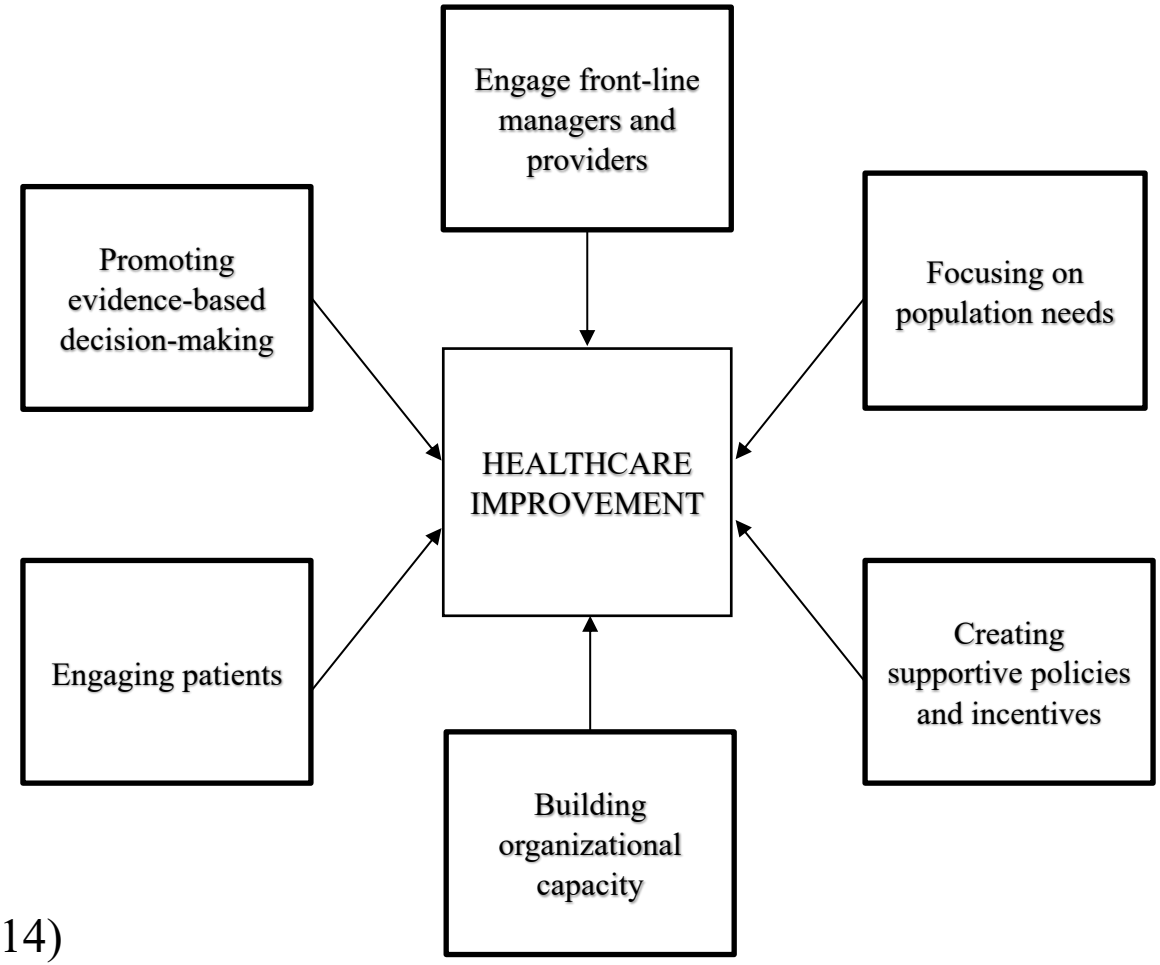
Introduction

- Tools for predicting sepsis in pediatrics:
  - Poor predictive ability
  - Not validated
    - (Schlapbach & Kissoon, 2018).
- Systemic inflammatory response syndrome (SIRS) used to define and predict sepsis in pediatrics.
  - Criterion had low specificity
  - Limited use to clinicians
    - (Schlapbach & Kissoon, 2018).
- An evidence-based pediatric sepsis screening tool is needed
  - To initiate early diagnosis
  - To treat earlier

Assessment of Organization

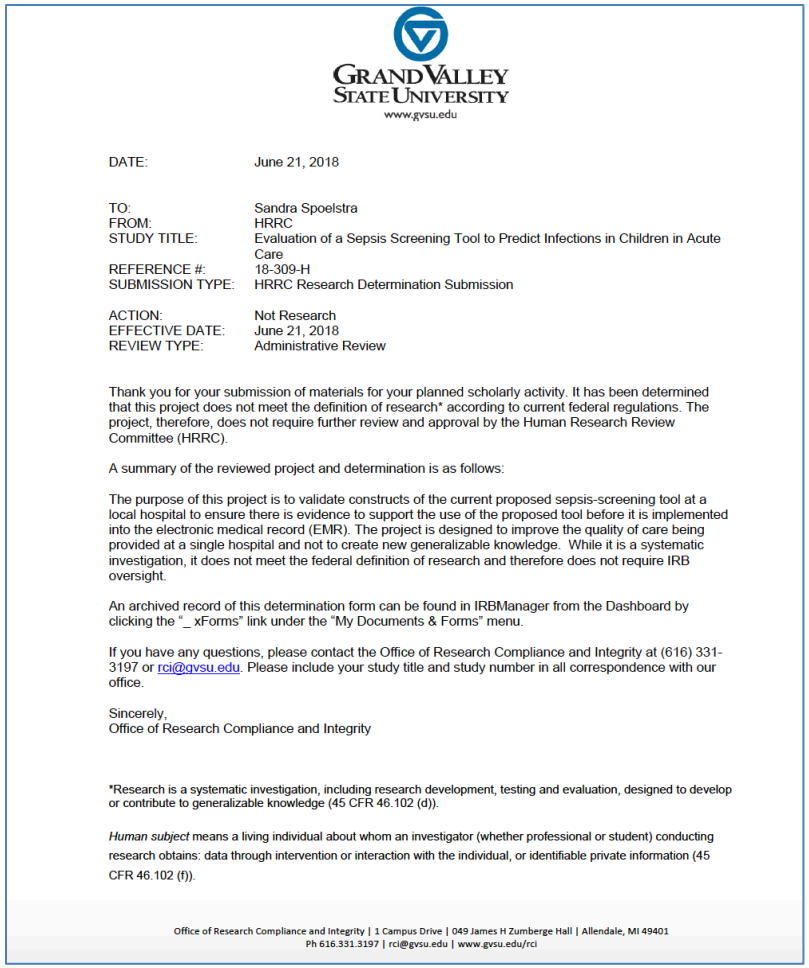
- Systematic process to evaluate the workflow and factors that affect organizational performance (Reflect & Learn, n.d.).
- Purpose of assessment:
  - Use a framework to analyze organization.

Framework: The Canadian Foundation for Healthcare Improvement (CFHI)



(CFHI, 2014)

IRB Approvals



GRAND VALLEY STATE UNIVERSITY
www.gvsu.edu

DATE: June 21, 2018

TO: Sandra Spoelstra
FROM: HRRC
STUDY TITLE: Evaluation of a Sepsis Screening Tool to Predict Infections in Children in Acute Care
REFERENCE #: 18-309-H
SUBMISSION TYPE: HRRC Research Determination Submission

ACTION: Not Research
EFFECTIVE DATE: June 21, 2018
REVIEW TYPE: Administrative Review

Thank you for your submission of materials for your planned scholarly activity. It has been determined that this project does not meet the definition of research* according to current federal regulations. The project, therefore, does not require further review and approval by the Human Research Review Committee (HRRC).

A summary of the reviewed project and determination is as follows:

The purpose of this project is to validate constructs of the current proposed sepsis-screening tool at a local hospital to ensure there is evidence to support the use of the proposed tool before it is implemented into the electronic medical record (EMR). The project is designed to improve the quality of care being provided at a single hospital and not to create new generalizable knowledge. While it is a systematic investigation, it does not meet the federal definition of research and therefore does not require IRB oversight.

An archived record of this determination form can be found in IRBManager from the Dashboard by clicking the "_ xForms" link under the "My Documents & Forms" menu.

If you have any questions, please contact the Office of Research Compliance and Integrity at (616) 331-3197 or rci@gvsu.edu. Please include your study title and study number in all correspondence with our office.

Sincerely,
Office of Research Compliance and Integrity

*Research is a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge (45 CFR 46.102 (d)).

Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains: data through intervention or interaction with the individual, or identifiable private information (45 CFR 46.102 (f)).

Office of Research Compliance and Integrity | 1 Campus Drive | 049 James H Zumberge Hall | Allendale, MI 49401
Ph 616.331.3197 | rci@gvsu.edu | www.gvsu.edu/rci

Site IRB available upon request.

Stakeholders

- Site mentors
- Healthcare providers i.e., physicians, physician assistants, nurse practitioners, and nurses
- Patients
- Sepsis Steering Committee
- Electronic health record technical employees
- Organization

SWOT

Strengths	Weaknesses
• Interprofessional Collaboration • Sepsis Steering Committee • Collaboration with CHA • Collaboration within the organization of CHM in other populations (i.e. adult and neonatal) • Best Children's Hospital in 6 specialty areas for 2018	• Current paper screening tool • Tension with RNs over adding another task • Collating paper documents in order to generate reports • Inaccurate timestamp on paper tool • RN confusion and increased errors related to many changes occurring at once
Opportunities	**Threats**
• CHA sepsis collaborative • Working alongside new EHR to implement a clinical decision support tool within the EHR • Customization options within the new EHR	• Deadlines within CHA collaborative • Difficulty retrieving data from old EHR at CHM • Current lack of evidence to support a pediatric sepsis screening tool

Clinical Practice Questions

1. “Did the current pediatric sepsis screening tool in use at CHM identify patients at risk for sepsis?”
2. “Did the sepsis screening tool use initiate intervention (i.e. fluid boluses and antibiotics) sooner than when compared to no tool?”

Literature Review

- **Purpose:** Examine tools that identify pediatric sepsis.
- **Aim:** Answer the questions:
  - "Will a sepsis screening tool adequately aid in early identification of pediatric sepsis?"
  - "What are the specific constructs needed for a pediatric sepsis screening tool?"
  - "Is there evidence to support use of a pediatric sepsis screening tool?"

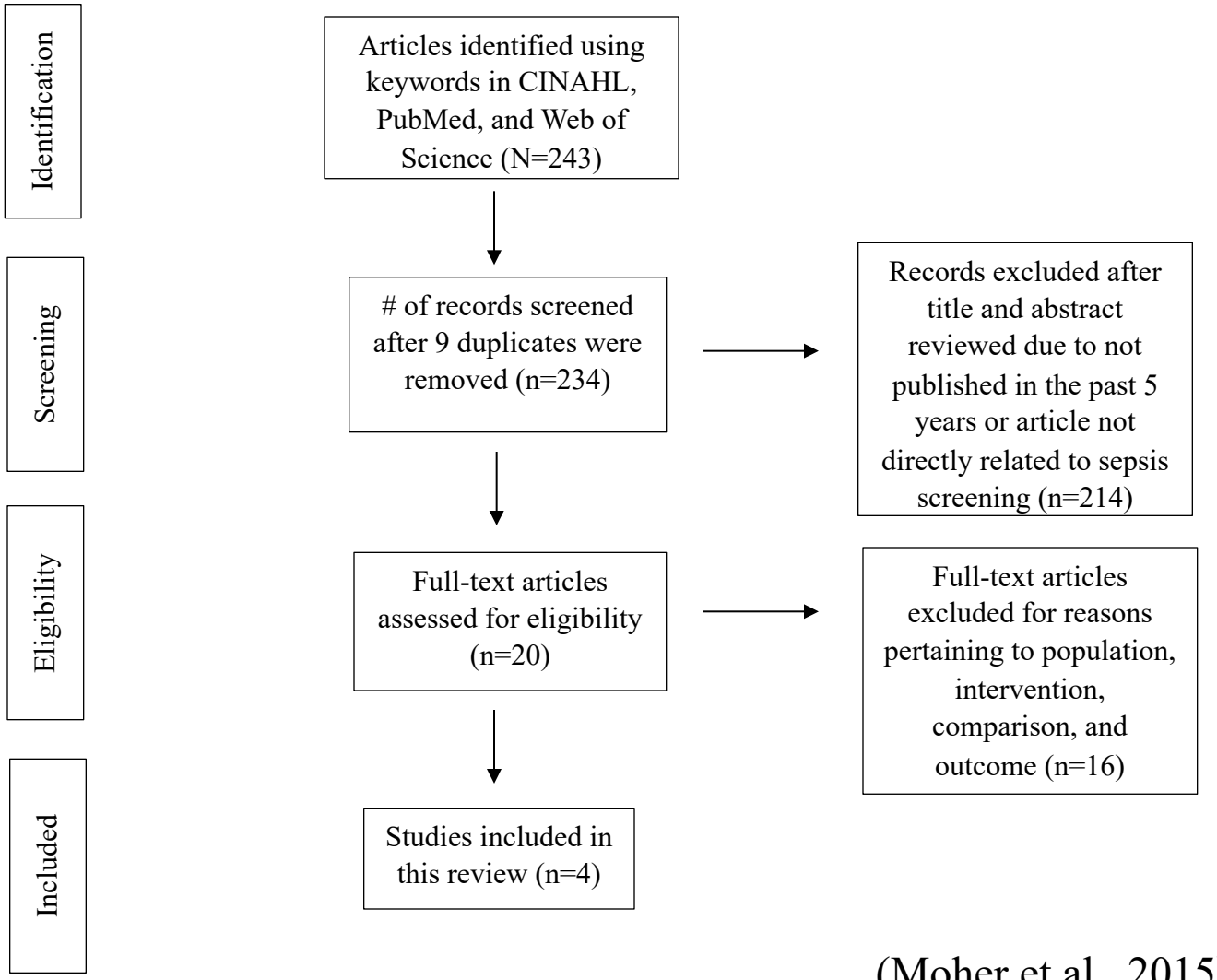
Review Method

- CINAHL, PubMed, Web of Science search:
  - English in 2013 to 2018.
- Keywords:
  - Sepsis
  - Tool
  - Pediatric, neonate, and child
  - Early warning score.
- Inclusion Criteria:
  - Meta analyses, randomized control trials (RCT), and systematic reviews
  - Peer-reviewed journals

Results: Literature Review

- Four papers met inclusion criteria.
  - Three systematic reviews
  - One RCT.
- Analyzed screening: earlier detection of sepsis.
  - One examined heart rate activity in neonatal infants as a marker for neonatal sepsis
    - (Lake, Fairchild, & Moorman, 2014).
  - Three reviewed sepsis protocol screening tools for neonatal, pediatric, and adult populations
    - (Davis et al., 2017; Roney et al., 2015; Paliwoda & New, 2015).

PRISMA Figure



(Moher et al., 2015)

Summary of Evidence

- Davis (2017) – a bundle containing trigger of tool for rapid identification of patients with sepsis
- Lake (2014) – Heart rate monitoring a validated risk marker for sepsis
- Paliwoda (2015) – Need for validity of sepsis screening tools
- Roney (2015) – Development of sepsis screening tool needed to improved outcomes

Results: Literature Review

- Evidence supports use of sepsis screening tool
- Designed for pediatric population
  - Gold standard for clinical practice
  - In the acute care hospital setting.
- Use of tool has the potential to:
  - Improve patient outcomes
  - Reduce mortality rates.

Evidence for Project

- Use of a screening tool for identification of sepsis and initiation of interventions improves patient outcomes.
- Factors included in tool:
  - Respiratory rate
  - Heart rate
  - Blood pressure
  - Temperature (hypothermia or hyperthermia)
  - Altered mental status
  - Capillary refill
    - (Davis et al., 2017; & Roney et al., 2015).

Model to Examine Phenomenon: CDC's Infectious Disease Framework (IDF)

Element 1. Strengthen public health fundamentals, including infectious disease surveillance, laboratory detection, and epidemiologic investigation.

Element 2. Identify and implement high-impact public health interventions to reduce infectious diseases.

Element 3. Develop advanced policies to prevent, detect, and control infectious diseases.

(CDC, 2011)

Project Plan

Project Purpose & Objectives

Purpose: Detect pediatric sepsis using a screening tool.

- Current tool had expert review/content validity.
- Tool needed construct validity

Objectives:

1. Examined if tool detected sepsis when compared to before the tool was implemented
2. Examined time to intervention with tool compared to no tool

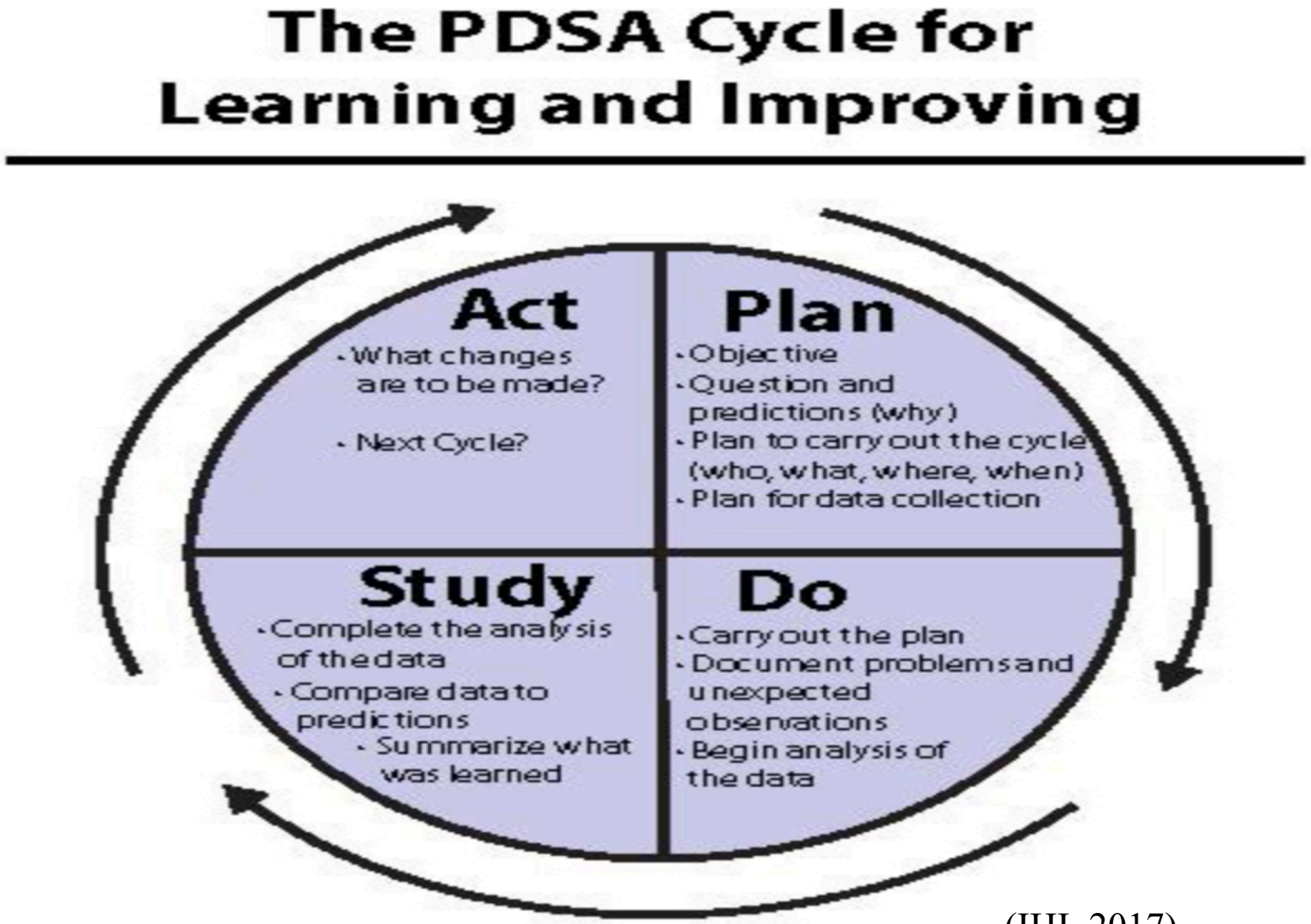
Design

- Quality Improvement project
  - Validate a sepsis risk assessment tool
- The project:
  1. Examined a cohort of patients diagnosed with severe sepsis prior to use of the tool.
  2. Evaluated if the tool identified risk for sepsis prior to the sepsis diagnosis occurring.
  3. Time to interventions (fluid boluses, antibiotics) was examined comparing those who used screening tool to those who did not use the tool.

Setting & Participants

- Setting:
  - Freestanding children's hospital
  - Midwest (CHM)
  - Units: hematology, oncology, cardiology, respiratory, surgical, and behavioral health
- Participants:
  - Patients with severe sepsis diagnosis

Implementation Model



(IHI, 2017)

Implementation Strategy #1
Readiness and Identifying Barriers

- Organizational Assessment and SWOT
- Discovered strategies for project:
  - Capturing and sharing knowledge
  - Creating a learning collaborative
  - Organizing implementation team meetings
  - Using an implementation advisor
    - (Powell et al., 2015)

Implementation Strategy #2

Capturing and Sharing Knowledge Creating a Learning Collaborative

- CHM is part of sepsis collaborative
  - Children's Hospital Association (CHA).
    - Goal: reduce hospital-acquired severe sepsis and sepsis mortality by 75% by the year 2020 (CHA, 2018).
- By joining this collaborative:
  - CHM part of all-teach, all-learn interdisciplinary team
  - Allowed to view research of what other hospitals are doing to see what works.

Implementation Strategy #3

Organizing Implementation Team Meetings & Using an Implementation Advisor

- CHM created a sepsis steering committee
  - Driving force for organization
  - Appointed an implementation advisor to direct the group meetings

Implementation Strategy #4
Re-Examination & Ongoing Consultation

- Purposely re-examined implementation:
  - Of risk-assessment tool
  - CHM initially implemented the risk assessment tool without first ensuring it was evidence-based.
- Provided ongoing consultation with CHM
  - Findings in literature
  - Results of chart audits
  - Results of risk assessment tool validation.

Implementation Strategy #5:
Develop Tools for Quality Monitoring

- Developed tools for quality monitoring
  - Measures/codebook for chart audits.
- Distributed to CHM
  - After project completion
  - For use in
    - Organization
    - Collaborative

Evaluation & Measures

	Item	Measurement Level	How Time Measured/Assessed	When Measured/Assessed
System	Did patient go to ICU?	Yes, No (Categorical)	Time (Military)	After sepsis diagnosis occurred
	Time to ICU	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to antibiotic initiation	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to fluid bolus	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
	Time to "trigger" tool	Minutes (Numeric)	Time (Military)	From admission to when sepsis was declared from tool
	Time to sepsis huddle	Minutes (Numeric)	Time (Military)	From when sepsis was declared from tool
Pediatric patient	Tachycardia*	Numeric	Time (Military)	At time of SEPSIS Huddle**
	Bradycardia*	Numeric	Time (Military)	
	Hypotension*	Numeric	Time (Military)	
	Fever*	Yes, No (Categorical)	Time (Military)	
	Hypothermia	Yes, No (Categorical)	Time (Military)	
	Current use of Steroids	Yes, No (Categorical)	Time (Military)	
	Altered Mental Status	Yes, No (Categorical)	Time (Military)	
	Chills	Yes, No (Categorical)	Time (Military)	
	Capillary Refill > 3 seconds	Yes, No (Categorical)	Time (Military)	
	Mottled cool extremities	Yes, No (Categorical)	Time (Military)	
	Neck Stiffness	Yes, No (Categorical)	Time (Military)	
	"Flash" Capillary Refill < 1 second	Yes, No (Categorical)	Time (Military)	
	Neutropenia (ANC <500)	Yes, No (Categorical)	Time (Military)	

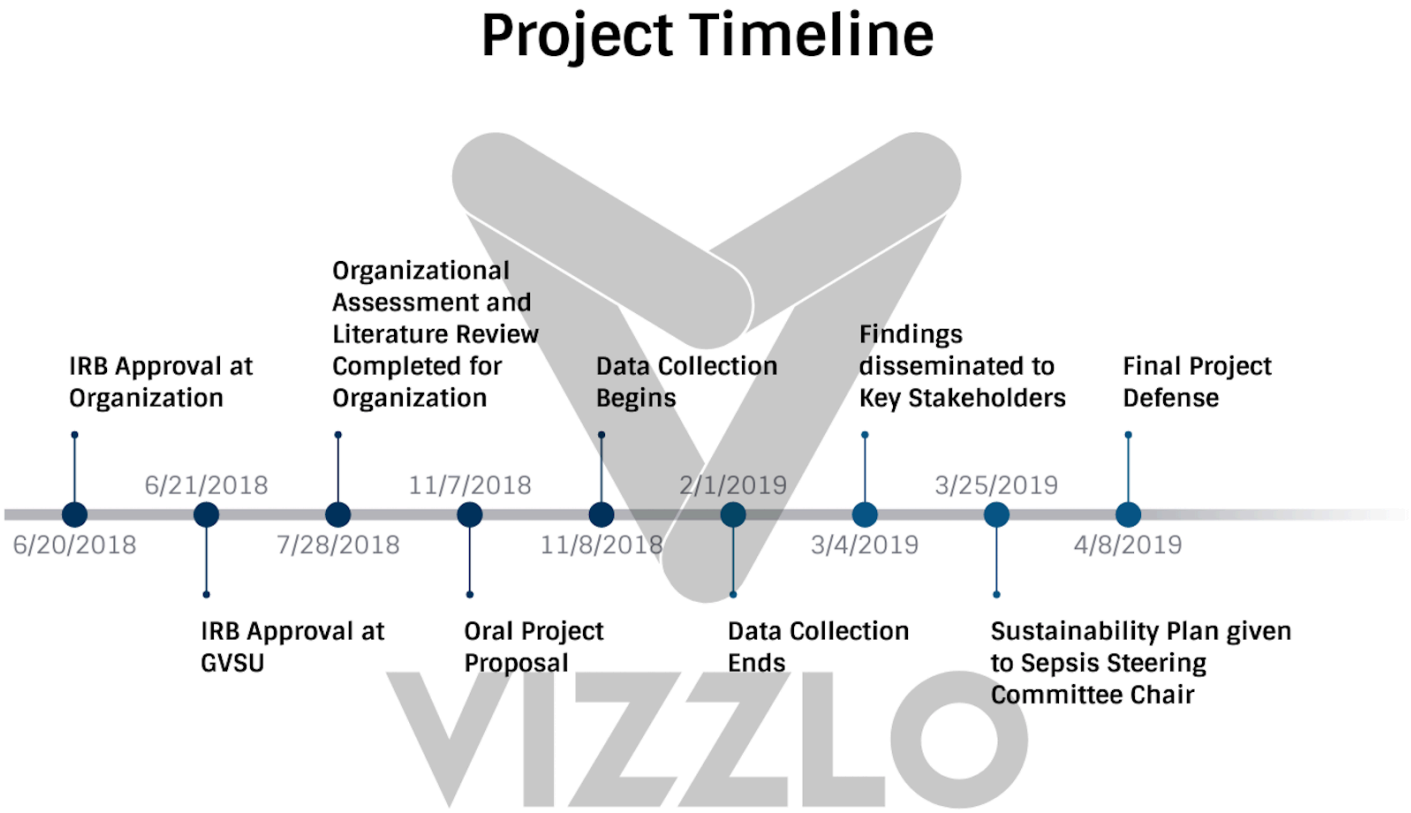
Evaluation & Measures

Age	Hypotension Systolic BP	Tachycardia	Bradycardia	Temperature
0 – 1 Months	< 50 mmHg	> 180	< 100	≥ 38.5
>1 – 2 months	< 50 mmHg	> 180	< 90	≥ 38.5
3 – 11 Months	< 70 mmHg	> 170	< 90	≥ 38.5
1 year – 3 years	< 75 mmHg	>150	N/A	≥ 38.5
4 years – 11years	< 80 mmHg	>130	N/A	≥ 38.5
12 years and older	< 85 mmHg	>120	N/A	≥ 38.5

Analysis Plan

- Compare pre-/post-tool audit
  - Patients with severe sepsis diagnoses.
- Before use of the screening tool:
  - When fluid boluses and antibiotics were given
  - Recorded vital signs to see if sepsis would have been identified sooner based on the items the tool evaluates.
  - Measure when sepsis was diagnosed
  - How long before a patient with sepsis went to ICU
- Patients identified for sepsis by the screening tool
  - Used to compare time to sepsis diagnosis
  - Between pre-/post patients

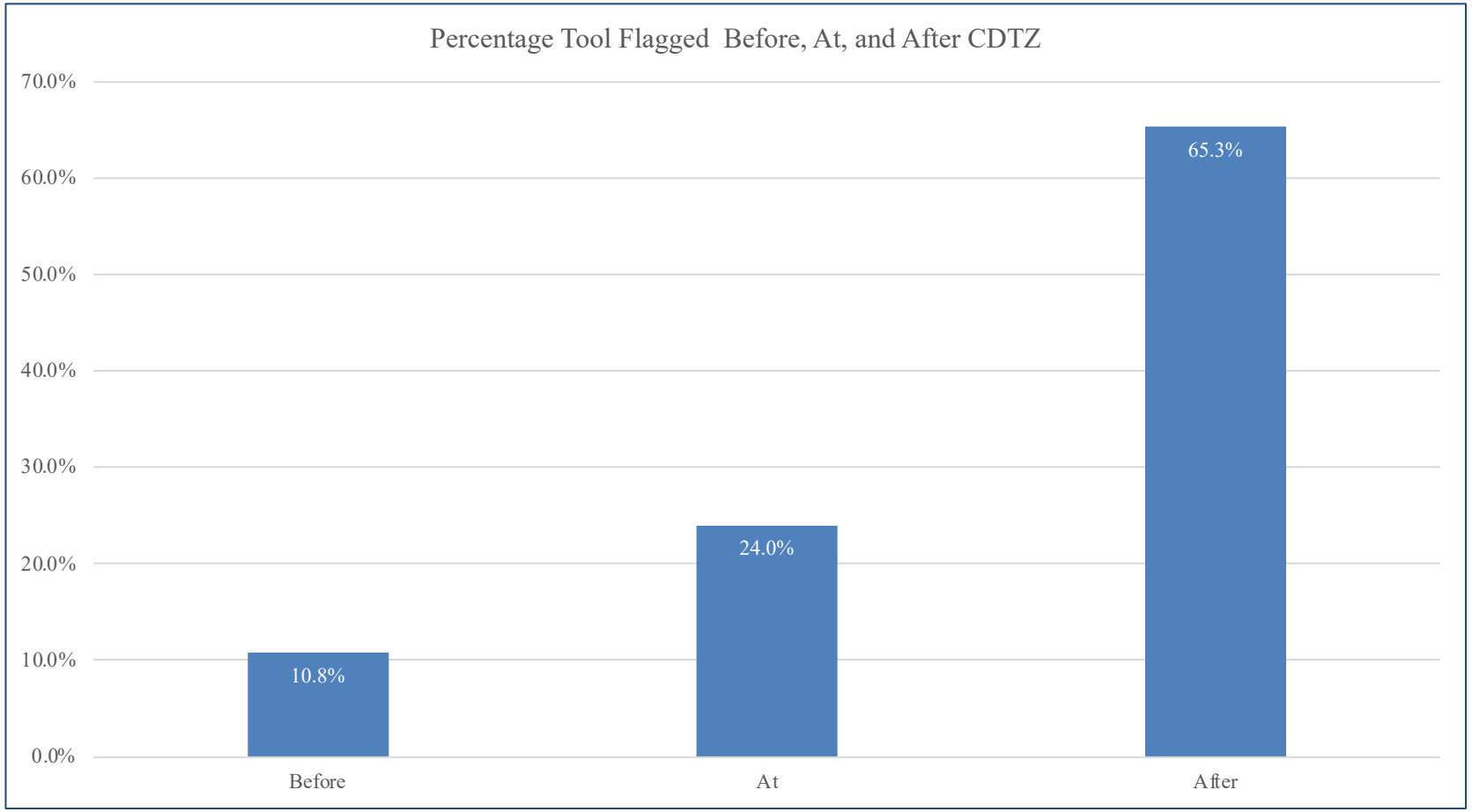
Timeline


Project Timeline
IRB Approval at Organization
6/20/2018
6/21/2018
IRB Approval at GVSU
Organizational Assessment and Literature Review Completed for Organization
7/28/2018
11/7/2018
Oral Project Proposal
Data Collection Begins
11/8/2018
2/1/2019
Data Collection Ends
Findings disseminated to Key Stakeholders
3/4/2019
3/25/2019
Sustainability Plan given to Sepsis Steering Committee Chair
Final Project Defense
4/8/2019

Results

Characteristic	
	Mean (SD) range
Age	7.05 (6.05) 0.02-20.57
	% (n)
Gender	Female 44.3% (74) Male 55.7% (93)
Race	Caucasian 60.5% (101) African American 16.2% (27) Other 17.4% (29) Not Documented 6% (10)
Ethnicity	Hispanic 13.8% (23) Non-Hispanic 79% (132) Not Documented 7.2% (12)
Hospital Acquired Sepsis	Yes 6% (10) No 94% (157)
	Median (IQR)
Length of stay	10.05 (4.94 –19.14)

Results


Percentage Tool Flagged Before, At, and After CDTZ
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
10.8%
24.0%
65.3%
Before
At
After

Results

High risk factor	% (n)		
	Yes	No	Not documented/unclear
CNS dysfunction	42.5% (71)	54.5% (91)	3% (5)
Leukopenia, Leukocytosis, or Bands >10% in the last 12 hours	40.1% (67)	16.2% (27)	43.7% (73)
Central Line	28.7% (48)	42.5% (71)	28.7% (48)
Immunodeficiency	19.8% (33)	21.6% (36)	58.7% (98)
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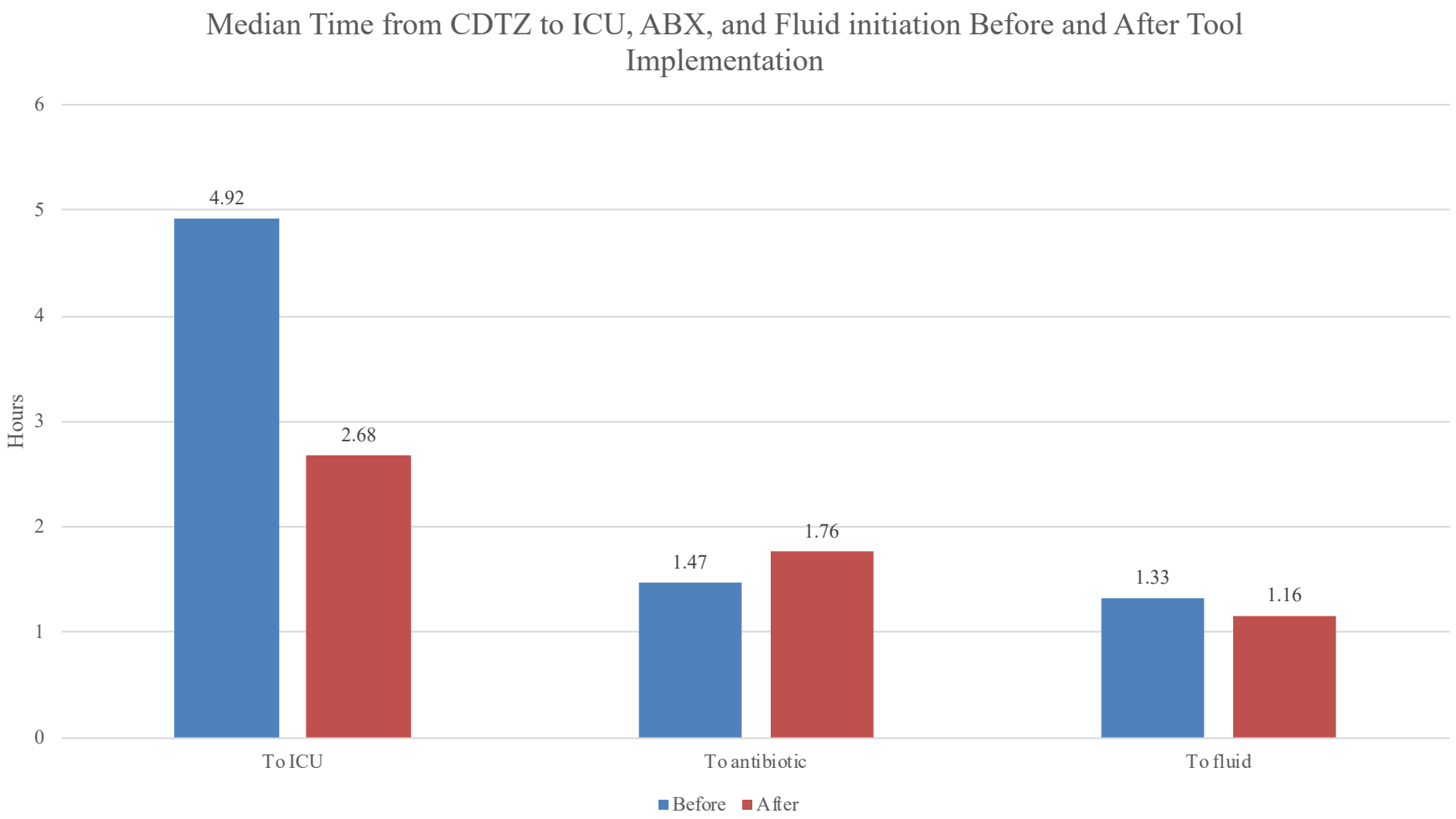
Patient ≤ 60 days old	9.6% (16)	90.4% (151)	-
Bone Marrow or Solid Organ Transplant	7.8% (13)	1.8% (3)	90.4% (151)
Asplenia	1.20% (2)	-	98.8% (165)

Results

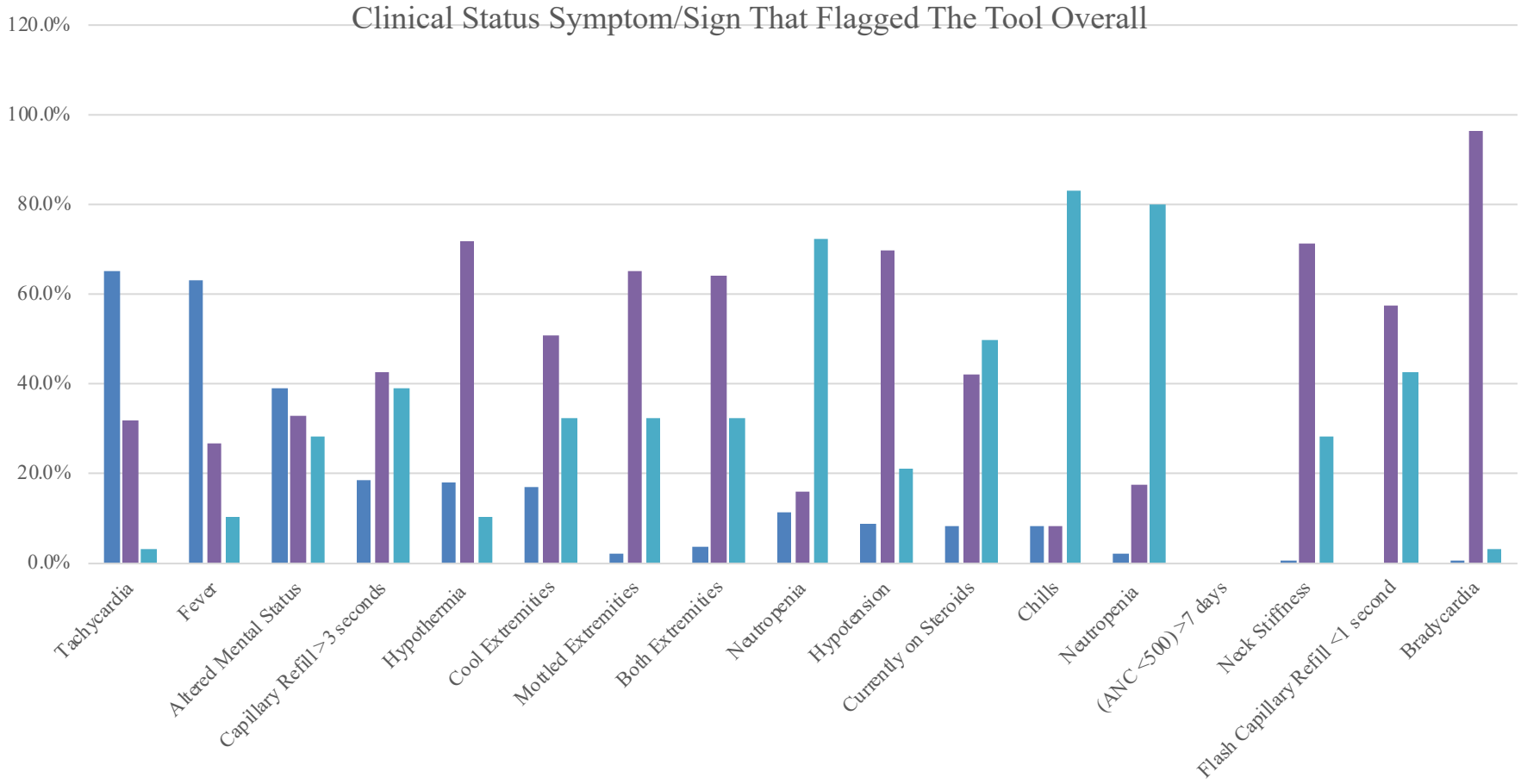
Clinical problem	Median (IQR) N = 47
Neutropenia (ANC <500)	35.57 (0.0 – 717.42)

Results


Median Time from CDTZ to ICU, ABX, and Fluid initiation Before and After Tool Implementation
Hours
6
5
4
3
2
1
0
4.92
2.68
1.47
1.76
1.33
1.16
To ICU
To antibiotic
To fluid
Before
After

Results

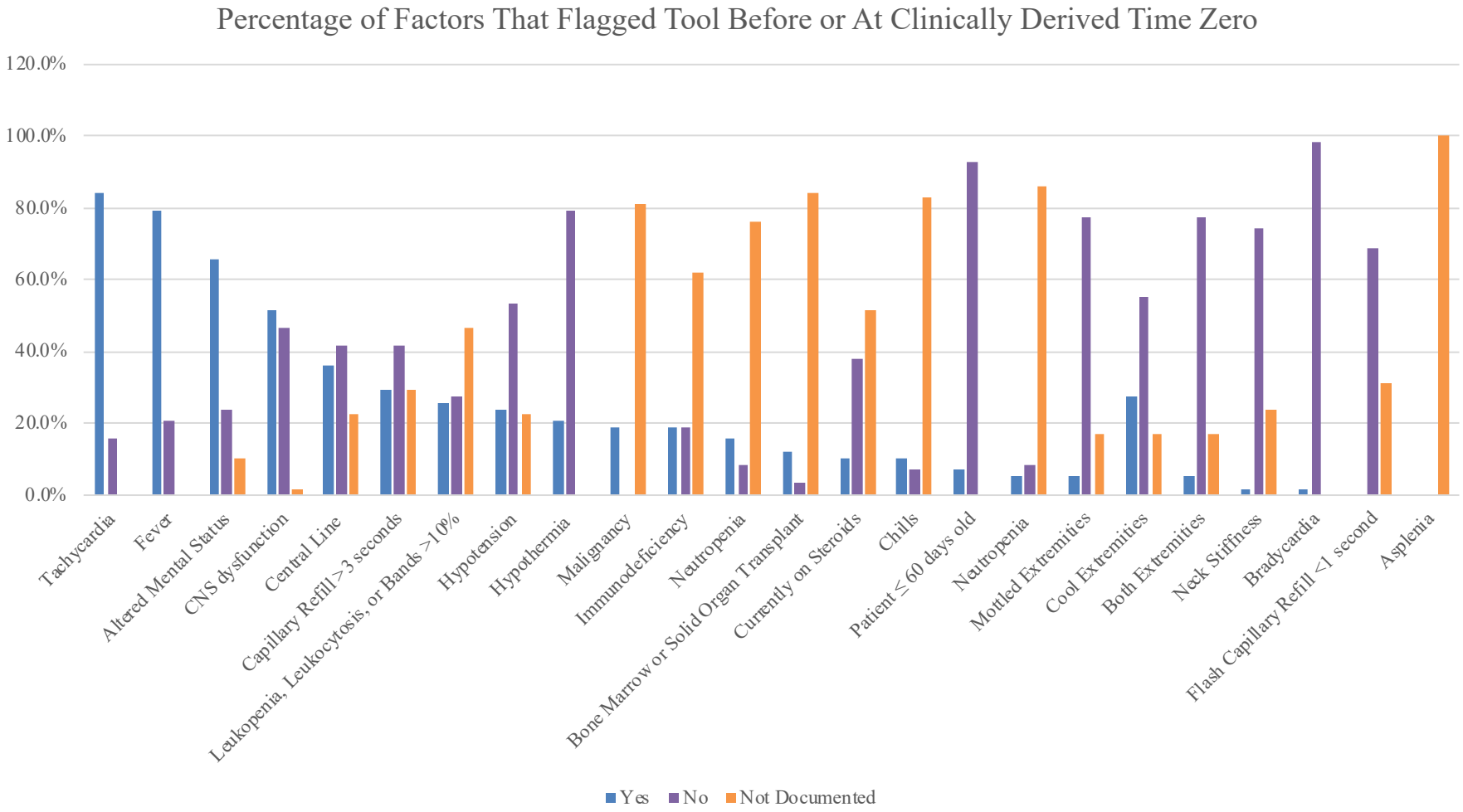
*4 of 161 patients or 2.4% of the 96.2% were above the age range



Results

Age groups	Mean (SD) n			
	Heartrate	Fever	Systolic	Diastolic
0 – 1 Months	181.9 (24.0) 7	36.2 (1.7) 8	95.3 (20.2) 4	58.3 (24.0) 4
>1 – 2 Months	178.8 (36.1) 9	36.7 (3.31) 8	91.2 (14.7) 5	53.2 (12.2) 5
3 – 11 Months	154.2 (30.0) 13		95.8 (21.0) 10	51.9 (8.8) 10
1 – 3 Years	176.0 (28.3) 44	39.0 (1.6) 39	95.9 (20.1) 35	53.1 (22.3) 35
4 – 11 Years	137.5 (35.0) 47		99.6 (19.0) 43	54.5 (16.4) 43
≥12 Years	127.6 (26.5) 42		106.4 (19.1) 35	56.2 (16.7) 35
	Median (IQR)			
3-11 Months		39.0 (35.9 – 40.5) 11		
4 – 11 Years		38.9 (32.1 – 39.5) 47		
≥12 Years		38.8 (33.7 – 40.2) 37		

Results


Percentage of Factors That Flagged Tool Before or At Clinically Derived Time Zero
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
Tachycardia
Fever
Altered Mental Status
CNS dysfunction
Central Line
Capillary Refill >3 seconds
Leukopenia, Leukocytosis, or Bands >10%
Hypotension
Hypothermia
Malignancy
Immunodeficiency
Neutropenia
Bone Marrow or Solid Organ Transplant
Currently on Steroids
Chills
Patient ≤ 60 days old
Neutropenia
Mottled Extremities
Cool Extremities
Both Extremities
Neck Stiffness
Bradycardia
Flash Capillary Refill <1 second
Asplenia
Yes
No
Not Documented

Discussion

- Project found that the current tool use at CHM to detect risk of sepsis needs further testing of validity and reliabilty.
- Supported by the current state of the literature:
  - No evidence-based sepsis screening tools are tailored for pediatric populations
  - Only content-reviewed factors to screen for when evaluating for sepsis in pediatrics
  - (Davis et al., 2017; Lake, Fairchild, & Moorman, 2014; Paliwoda & New, 2015 & Roney et al., 2015).
- Creation and testing of a tool to detect risk of Sepsis is needed before a tool will be validated for evidence-based use.

Key Findings

- This is a much-needed area of study → any research findings to add to the current state of literature aid in shaping a future tool validation.
- A decrease in median time to ICU transfer and fluid bolus initiation were found when comparing pre- to post- tool implementation.
  - This shows an improvement in a critical time-sensitive component of treating sepsis that is dependent on initially detecting sepsis through a screening tool.

Key Findings

- This study spoke to what the top clinical status signs/symptoms were in severe sepsis patients,
  - This is useful information when deciding where to go next in configuring a tool that has construct validity.
- Finally, this project also was able to evaluate age-specific parameters for clinical status signs/symptoms such as heart rate, fever, and blood pressure.
  - This information is also useful when determining next steps for a sepsis screening tool and could be used in future research.

Limitations

- This project had a fairly short implementation period and small sample size.
  - Although 20 months of data were used, there were still only 167 patients that met criteria of a severe sepsis diagnosis included in this project.
  - Due to this, SEM analysis was not able to be performed, which could have been an advantageous statistical analysis to run for this type of project.
- Relatively small sample size of post-tool implementation patients (n=45).
  - Time constraints for data collection
  - Not enough collated data on severe sepsis diagnosed patients
- Lack of current evidence in literature to support any pediatric sepsis screening tool, let alone this specific tool.

Implications for Practice

- Top five clinical status that flagged the tool
  - Tachycardia, fever, altered mental status, capillary refill in greater than 3 seconds, and hypothermia.
  - Most useful in identifying pediatric sepsis
- Other factors may need to be considered
  - Both systolic and diastolic blood pressure values
  - Respirations
  - Peripheral capillary oxygen saturation (Sp02)
- Consider combining risk assessment tools in the pediatric population into one cohesive tool

Conclusions

- CHM sought to validate a sepsis screening tool currently in use for evidence-based use.
- Organizational Assessment and Literature Review Performed
- Two theoretical frameworks and one theoretical model were used to understand the phenomenon and conduct a plan to validate the sepsis screening tool.
- Pre- and post-tool chart audits were performed to implement this tool validation plan.
- Data collection occurred over two months including patients from January 2017 through August 2018.

Conclusions

- Despite being unable to provide construct validity for this pediatric sepsis screening tool, individual factors within the tool were able to be evaluated and future studies should build upon this research in order to work towards validating a pediatric sepsis screening tool for evidence-based use.

Resources & Budget

Doctor of Nursing Practice Project Financial Operating Plan	
Sepsis Screening Tool Assessment at a Freestanding Children's Hospital in the Midwest	
Revenue	
Project Manager Time (in-kind donation)	6,200.00
Consultations	
Statistician (in-kind donation)	100.00
Cost mitigation	
Prevention of 1 case of Severe Sepsis-related ventilator care / per year	40,878*
Prevention of 1 case of Severe Sepsis that required a ventilator for < 96 hours / per year	11, 794*
TOTAL INCOME	58,972.00
Expenses	
Project Manager Time (in-kind donation)	6,200.00
Team Member Time:	
Clinical Nurse Specialist (1)	2,000.00
Registered Nurse (1)	3,500.00
Consultations	
Statistician (in-kind donation)	100.00
Laptop	1,200.00
Cost of print/copy/fax	3,672.00
TOTAL EXPENSES	16,672.00
Net Operating Plan	42,300.00

*(O'Brien & CDC, 2015)

Sustainability Plan

- Sepsis steering committee chair
  - Monitor the effectiveness of the screening tool.
- Sepsis screening tool was embedded in EHR.
  - January 3, 2019
  - Made for easier monitoring:
    - Tool effectiveness
    - Sepsis detection.

Dissemination

1) Tools for quality monitoring (table of measures and codebook used to conduct chart audits) and findings were distributed to CHM for use within the organization and collaborative.
2) Findings presented at the student's oral defense on April 8, 2019.
3) Final project defense paper posted on Scholarworks
4) Findings will be presented at the organization's research council poster presentation on April 9, 2019
5) Findings will be presented to the sepsis steering committee at the May 6, 2019 meeting

The American Colleges of Nursing (AACN) requires proficiency from DNP students in the following 8 competencies which make up the foundation for advanced practice nursing roles.

Each are reviewed on the following slides.

DNP Essentials Reflection

- **Essential I: Scientific Underpinnings for Practice**
  - This essential was achieved through this project by performing a literature review and using the knowledge gained from this review to improve care.
  - Additionally, frameworks were utilized for implementing and guiding change.
- **Essential II: Organizational and Systems Leadership**
  - This essential was achieved through this project by evaluating a tool that enhances care provided to the pediatric population.
  - Furthermore, developing and evaluating cost-effectiveness is another aspect of this essential that was met by developing a budget for this project and monitoring the project's cost effectiveness

DNP Essentials Reflection

- **Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice**
  - This essential was achieved through this project by using analytic methods to evaluate literature regarding the best evidence for sepsis screening in pediatric populations.
  - The project included designing a process to evaluate the effectiveness of the current sepsis screening tool in place.
  - Furthermore, relevant findings were disseminated to improve practice guidelines for use of the tool.
- **Essential IV: Information Systems Technology**
  - This essential was met by utilizing and navigating two different EHRs to gather pre- and post-tool data. E-mail was used for communication with key stakeholders for progress updates and additional resources.
  - Excel was used for organizing and analyzing data.
  - Strict confidentiality of any identifiable patient data was maintained, and all ethical guidelines were followed during the course of this project.

DNP Essentials Reflection

- **Essential V: Advocacy for Health Care Policy**
  - Although no formal policy was changed through this project, education and advocacy for implementation of evidence-based policies at an organizational level were performed through this project.
  - Additionally, this essential was met through attendance of Advocacy Day and meeting with state legislatures regarding policies that advocate for the expansion of the advanced practice registered nurse role.
- **Essential VI: Interprofessional Collaboration**
  - This essential was met through collaborating with multiple different healthcare roles in the development, implementation, and evaluation of this project.
  - Collaborative healthcare professionals included RNs, managers, CNSs, educators, pharmacists, providers, IT/quality improvement data specialists, and statisticians.
  - Incorporating a diverse collaborative group allowed for better understanding of the current practice, assessing barriers, and evaluating necessary practice changes.

DNP Essentials Reflection

- **Essential VII: Clinical Prevention and Population Health**
  - This project was focused on prevention for better population health.
  - Sepsis is a leading cause of hospital-related deaths – this not only causes poor patient outcomes but also costs both the patient and the healthcare system substantial amounts of money.
  - Validating a tool in use to ensure it is actually detecting sepsis rates sooner allows the hospital to evaluate how well they are doing with detecting and treating sepsis in their patients.
- **Essential VIII: Advanced Nursing Practice**
  - This essential encompasses the competencies that are necessary for all DNP-prepared specialties and act as a foundation for DNP practice.
  - An organizational assessment of current practice was performed and systems thinking was used to design and implement a plan to evaluate the sepsis screening tool for evidence-based use.
  - In order to carry out this project, many relationships with various stakeholders, primarily consisting of the sepsis steering committee members, were developed and sustained

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