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Process Improvement to Reduce Route of Medication Administration Errors in Patients with Enteral Feeding Tubes

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Abstract

Advances in health information management in the form electronic health records, computerized provider order entry systems, and clinical decision support systems and tools have enhanced the productivity, effectiveness, and efficiency of healthcare. However, the cost of these positive effects does come at the expense of other factors. Along with the introduction of Clinical Provider Order Entry (CPOE) systems, organizations have experienced new possibilities for medication errors and risks to patient safety. Factors associated with these errors should be evaluated in detail in order to mitigate the causes of these types of errors and to plan strategies for prevention. Continued research into how to improve the quality of these systems is necessary to promote the usability and acceptance of CPOE systems by prescribers and to continue to make an impact on the frequency of medication errors within health care organizations.

Health care organizations must develop strategies to improve the rate of medication errors caused by CPOE systems. Strategies may vary from organization to organization, and depend upon organization-specific resources. Ideally, a plan to improve patient safety and prevent errors related to CPOE systems would include stakeholders such as the clinical team and providers, involve a system that can audit the frequency of errors, and include ongoing education about the problem and the proposed solution. A plan to prevent errors and improve patient safety that is not-dependent upon the intricacies of a specific electronic medical record is ideal. A strategy that can carry-over from one electronic medical record system to the next and that can address the central problem with accuracy, efficiency, and evidence-based research will be proposed.

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Introduction

Technological advances have improved the delivery and efficiency of health care in many

ways. Electronic medical records have made it possible to have necessary patient information at

a provider's fingertips, and has improved the efficiency by which tasks are completed. However,

the use of electronic medical record systems has "changed traditional communication and

collaboration workflows among health care professionals. Previously, synchronous

communications that occurred face to face or by phone are often replaced by asynchronous

communications through the technology" (Harrington, Hardison, Coates, Wickham, Norris, &

Kane, 2014, p. 55). Unfortunately, this asynchrony leaves room for errors. Medication errors

often happen because the focus becomes the hardware and software systems rather than the

social systems needed to incorporate new technology into daily work (Briggs, 2003, p. 22). A

breakdown in communication between the members of a clinical team can inadvertently

contribute to medication errors. With this in mind, it is important to develop processes to prevent

errors that work with the available technology but that are not dependent upon the technology.

Since medication errors are related to contextual issues within the organization, an organizational

assessment can be helpful to determine causes and solutions.

The purpose of this DNP project was to identify the nature and frequency of medication

errors that occur for patients with a nothing by mouth status on two inpatient nursing units within

the organization. Further, in order to understand the contexts of the organization and develop

meaningful and sustainable change, a thorough assessment of the organization was completed.

Assessment of the Organization

Framework for Assessment

The assessment of the organization was completed from two vantage points. First, the

Lean Transformation Framework, was used to help understand the phenomenon of interest-

medication errors related to incorrect EMR entry (LEI, 2019). Secondly, the organization as a

whole was assessed using the Universalia Institutional and Organizational Assessment Model

(Universalia, 2018).

Phenomenon Organizational Theory.

The Lean Transformation Framework (LTF) is a well-known quality improvement

framework. A lean organization recognizes customer value and directs its key processes to

continuously improve it. The Lean Enterprise Institute (LEI) identifies that the ultimate goal is to

provide perfect value to the customer through a perfect value creation process that has zero waste

(2019). See Appendix A for an example of the primary principles of Lean Transformation. The

Lean Transformation Framework was chosen because the fundamental idea of maximizing

customer value while minimizing waste accurately reflects the work that needed to be

accomplished within this organization; limiting errors in medication prescribing, administration,

and documentation for patients with restrictive diet orders on the inpatient nursing units. By

focusing on the linkage between value and waste, specific steps were identified and appropriated

to make changes to transform the process of medication prescription, administration, and

documentation within this organization. Overall, this transformation benefited all customers

involved in the change, including patients, clinical staff, and leadership. Utilization of this

framework allowed for a true appraisal of the healthcare organization and the healthcare

organization's processes, procedures, and people, as well as assisted in the identification of

strategic solutions to the problem. The LTF was chosen to describe the phenomenon in question (medications errors) and the Universalia Institutional and Organizational Assessment Model guided the Organizational Assessment.

Organizational assessment.

To guide the organizational assessment, the Universalia Institutional and Organizational Assessment Model (IOA Model) was utilized (Universalia, 2018). The IOA model was chosen because Organizational Performance, Organizational Motivation, Organizational Capacity, and External Environments are all explored in depth for this assessment (see Appendix B for visual depiction of model). A deeper analysis of these four constructs identifies factors that allow for evaluation of both internal and external influences that impact an organization's short- and long-term outcomes. Increasingly, organizations and their key stakeholders are interested in knowing how well they are meeting the needs of the organization's clientele, adapting to changes in the organization's external and internal environments, and identifying the organization's added-value or niche in the competitive global environment. Likewise, stakeholders and organizations concentrate on identifying and addressing the risks and challenges that may affect the organization's future effectiveness, viability, and relevance (Universalia, 2018).

Utilization of the IOA Model included assessment of both external or environmental forces and forces from within the organization. The factors influencing External Environment included: administrative and legal, political, social and cultural, economic, technological, ecological, and stakeholder concerns. Whereas the elements that comprise the mission, history, culture determine the Organizational Motivation, factors affecting Organizational Performance included effectiveness, efficiency, relevance, and financial visibility. Finally, Organizational Capacity is comprised of assessing the financial, program, and process management of an

organization as well as the inter-organizational linkages, strategic leadership, human resources, structure and infrastructure (Universalia, 2018).

Organizational motivation.

The organizational motivation was driven by the organizational mission and culture. In the next sections, the mission and vision of this organization is described as it applies to XXXX as an organization and on the inpatient nursing units at XXXX.

Mission.

The mission statement for the organization is "We serve together in the spirit of the Gospel as a compassionate and transforming healing presence within our communities" (XXXX, 2019a). Colleagues of this organization demonstrate their belief in the organizational mission in several ways. The organization sponsors many different patient populations in a charitable way with foundation funds designed to meet the basic and complex needs that many of the patients treated in the organization experience. Likewise, colleagues participate in several different opportunities to give back to the community and the patients served in the community through partnerships with organizations such as The United Way as well as other organizations designed to provide school lunches and school supplies to children in the community.

Culture.

Colleagues in the organization have an understanding of the mission and values of the organization and recognize their role in supporting them. Personal interviews and an analysis of the organization's website indicate that the organizational and individual program culture are widely driven by the organization's six Guiding Behaviors, five Core Values, Excellence in Action Principles, and a strong emphasis on Diversity. The six Guiding Behaviors of the organization include:

"We support each other in serving our patients and communities; we communicate openly,

honestly, respectfully and directly; we are fully present; we are all accountable; we trust and

assume goodness in intentions; we are continuous learners. (XXXX, 2019a)"

A theme of accountability is emphasized from leadership, clinical, and ancillary staff through the

organization's Excellence and Action expectations. These expectations include colleagues:

 "delivering on the promise of providing a safe environment, exceeding customer needs,

providing unwavering respect, offering an uncompromised positive environment, promoting and

enabling healing, and valuing inclusion" (XXXX, 2019b).

The core values of the organization are based on the solid principles of reverence, commitment

to those who are poor, justice, stewardship, and integrity (XXXX, 2019b).

Diversity is an essential feature of the organization's culture. The organization values

having a team with members from diverse backgrounds because it brings creativity and vitality

to the environment, and it allows the organization to more effectively serve the diverse west

Michigan community. The organization recognizes the importance of acknowledging the mix of

cultures in the area, and have implemented diversity training, and continue to work to increase

minority vendors and recruitment and retention of colleagues from diverse cultures (XXXX,

2019b).

The organization has a well-developed Stroke Action Team which highlights these values

and beliefs. The Certified Nurse Leader (CNL) for Heart & Vascular at the organization, stated

that employees reflect the culture of the organization because "all patients and staff are treated

with compassion and respect" (survey response, March, 2019). Similarly, the neuroscience

Clinical Nurse Specialist for the inpatient neuroscience team, stated that "our stroke program

mission directly aligns with the hospital mission" (survey response, March, 2019) in response to

a question about how the culture of the organization affects the care given by the stroke team.

Incentives and rewards.

Recruiters in the Human Resources Department at XXXX describe motivation as an intrinsic principle that can be encouraged but not created. Therefore, it is a quality that is sought after when hiring new colleagues. Organizational leadership members attend various seminars and trainings during their tenure on how to inspire and cultivate motivation utilizing various techniques for both individuals and groups. Frequent positive feedback and the development of individualized performance plans for improvement are two ways that leadership staff cultivate and support a spirit of motivation and excellence in colleagues. The clinical nurse specialist for the neuro step-down unit responded in a recent survey that performance data is reviewed monthly with staff, and recognition celebrations occur after organizational surveys have been completed (survey response, March, 2019).

Attainment of professional certifications and continuing education is highly supported by leadership and is a key motivator for colleagues. Personal interviews with staff support that attainment of these professional accomplishments is highly recognized both on individual units and within the organization as a whole. For instance, within the stroke team, all staff are NIHSS (National Institutes of Health Stroke Scale) certified and there are six nurses with cardiovascular certification (CNL for Heart and Vascular, survey response, March, 2019). The organization produces a weekly email discussing what is going well with the organization including recognition of outstanding staff, and individual unit management sends unit specific emails about what is going well on each unit. Both publications include recognitions of staff attaining awards or specialty certifications.

Huddle boards are present on each unit and are updated daily to include announcements as well as acknowledgements of colleagues' excellence in action. In more detail, huddle boards are an organizational tool that are used to communicate important changes within the organization, information regarding dashboards and Press Ganey scores, and unit-specific information and updates. Likewise, there are several opportunities for patients and peers to nominate staff for excellence in practice, including the Daisy Award, the Friends of Nursing Award, and Colleague Awards for demonstrating guiding behaviors in practice. Colleagues report feeling supported by leadership, and do not feel that reporting negative experiences results in punitive actions, rather these circumstances are utilized as arenas for improvement and growth.

Organizational capacity.

Organizational capacity inspires the performance of a particular organization. It is the assessment of the strengths and weaknesses of the organization's financial management, inter-organizational linkages, strategic leadership, human resources, and organizational infrastructure.

Financial management.

This organization is a not-for-profit organization that undertakes great responsibility to be accountable to many groups and individuals, including those who grant them tax exemption because of their status as a "charitable, community-oriented organization." Without this exemption, XXXX could not continue to deliver the same level of community benefits that are so essential and depended upon. The federal government recently declared that health care organizations like XXXX formally report their community benefit programs. These reports include a wide array of activities and services that need to be categorized and explained in detail on the IRS form called "990 Schedule H." This document requires that the organization account

for: charity care (financial assistance) and other community benefits, community building

activities, Medicare, bad debt and collection practices, management companies and joint

ventures, and facilities comprising the organization. The link to the organization's 990 Schedule

H forms can be found on the Trinity Health website, along with information that will assist with

interpretation of the document (XXXX, 2019a1).

Similarly, the colleagues on the inpatient units demonstrate fiscal responsibility in the

identification of problems that affect the efficiency of work flow. A significant problem that

impacts every member of the clinical team is the lack of a specific process of communication

between team members when a restrictive diet order has been prescribed for a patient, and

medication orders are required to reflect that change.

Inter-organizational linkages.

The organization's efforts to collaborate with other healthcare service providers and

community resources demonstrates the organization's willingness to meet the needs of the

patients and the community they serve. The organization has partnered with a local acute

rehabilitation hospital on a number of efforts to improve the care patients receive. Likewise,

inter-organizational linkages exist between several specialty offices that are not part of the

organization, such as surgical specialists, cardiologists, and gastroenterologists, among others.

Finally, the organization has strong alliances in the community with charitable organizations

such as The United Way and Kids Food Basket.

Strategic leadership.

The organization's leadership structure can be found on the organization's website.

Direction for nursing staff comes from Vice President of Patient Care Services/Chief Nursing

Officer (CNO). The Chief Medical Officer and Medical Director for the health care organization,

and the Chief Medical Officer and Medical Director of the associated medical group, direct

medical care. The Chief Safety Officer, and the President of the organization round out the

administrative team. Together with key community members, these leaders collaborate to guide

the future direction of the organization. They develop strategies to create stronger alliances and

shared opportunities for partner organizations that will benefit patients and communities (XXXX

2019d).

The Medical Director of the Neurology Department at the organization is a board-

certified neurologist and specializes in multiple sclerosis and neuroimmunology. For the Stroke

Team specifically, a highly skilled vascular neurologist provides leadership and direction for the

team as the medical director of vascular neurology for the organization. He practices clinically

by rounding in the hospital and seeing patients in the outpatient clinic. He is also committed to

activities involving stroke research. This team also contains leadership in the form of certified

nurse leaders, clinical nurse specialists, charge nurses, the physician residency program, on-call

vascular neurologists, neuro-interventionalists, as well as others. Working together as a team is

the key to providing excellent care to patients in this organization. The organization's Stroke

Coordinator illustrates this by stating, "the team approach is strength. Everything is not on the

shoulders of one individual" (survey response, March, 2019).

Human resources.

Colleagues report that frequent educational in-services are offered in addition to

Healthstream® online learning modules. The organization offers support to colleagues in areas of

professional development through tuition reimbursement for continuing education for talent-in-

demand positions. Likewise, the organization provides 100% reimbursement for specialty

certification opportunities for all registered nurses. For instance, on the inpatient floors where

stroke patients are cared for, "80% of the eligible RN's are certified as stroke certified registered nurses" (survey response, Clinical Nurse Specialist for the neuro step-down unit, March, 2019). Finally, individuals in leadership positions are often visually available throughout the hospital and contact information for all colleagues and departments is available on the organization's intranet.

   Infrastructure.

The health care organization utilizes the Professional Practice Model for care delivery which places emphasis on relationships. This model ensures appropriate coordination, communication, continuity, and personalization of care that is quality-based. The CNL for the Heart and Vascular Department states this is made possible by "constant communication and feedback" between leadership and team members (survey response, March, 2019). Medical staff participate in shared decision-making initiatives that allow for participation in shared governance which encourages autonomy and increased professional growth. "XXXX is committed to being the most trusted health partner for life by building strong, genuine, long-term patient relationships through patient-centered, personalized primary care; coordinated specialty services and care management; and convenient access to the health system" (XXXX, 2019e).

   Organizational performance.

Organizational performance is the organization's efforts to meet goals utilizing the resources available while endeavoring to ensure sustainability for the future. Whether an organization has successfully adapted its mission, remained financially viable, met stakeholder needs, and maintained excellent performance in programs and services are all elements of organizational performance.

Efficiency and effectiveness.

Interviews with leadership and colleagues demonstrated a perception of the mission and strategy that is consistent throughout the organization and reflects the organization's commitment to excellence. Nursing staff understand their role within the organization is to provide timely and quality care for the best possible patient outcomes using the most current evidence available. Unit-specific efficiency and effectiveness is maintained with utilization of a staffing calculator, accountability of team members, and detailed attention to length of stay work (CNS on the neuro step-down unit, survey response, March, 2019). This perception includes addressing the costs of care provided while providing exemplary experiences for patients, families, and colleagues. Leadership and nursing staff also place significant emphasis on the utilization of evidence-based-practice in the care of patients. LEAN process excellence strategies are incorporated throughout the organization, as well as tools to cultivate an environment of continuous improvement.

Colleagues identify that there are areas for improvement in regard to the efficiency and effectiveness of medication prescription, administration, and documentation on the inpatient units. There are a variable set of factors that contribute to the problem and several perspectives from the clinical team. Providers writing orders note that pre-checked medication order sets default to oral administration regardless of the patient's diet restrictions. This EMR function that is meant to be a time-saving and efficient way to prescribe medication orders then becomes a source of the problem for patients with an enteral only route of administration. Likewise, providers note that when placing orders for individual medications, the drop-down menu for route includes too many choices, i.e.: per PEG, enteral, GT, OGT, among many others, making the ordering process for enteral administration very clumsy (personal communication, PA-C for

the vascular neurology program, April, 2019). Finally, when the patient diet does change,

providers must manually change the route of administration for medications in the patient EMR

to avoid administration and documentation errors. Manually changing the route of administration

for each of the orders for each medication can be a time-consuming process on a busy inpatient

unit.

Nursing staff recognize that not all providers who place medication orders on the units

are aware that administration route for medications is an issue. They note that lack of provider

awareness of the problem is the source of the issue and causes a great deal of re-work on the part

of other clinical staff (pharmacists and nurses) when orders are placed incorrectly. Nursing staff

also agree that providers are given too many choices when ordering in the drop-down menu for

route of administration which makes the process clumsy and confusing. Finally, nursing staff

recognize that if medications are not ordered correctly, the last point of contact and chance for

correction is at the bedside when they are administering the medication. They are not able to

document the correct route of administration, even if the med is ordered incorrectly, however

they are still required to contact the provider or a pharmacist to have the order changed to reflect

the correct route of administration (personal communication, RN, BSN in the neuro ICU, April,

2019).

Clinical pharmacists on the units note that there is no formal process in place to notify

them of a change in the diet restrictions for a particular patient. Clinical pharmacists are present

on the units Monday through Friday from 7am to 3pm, and if changes are made to a patient's

diet either making it necessary for meds to be administered enterally, or freeing them to have

meds orally, pharmacists are not formally notified by any specific process. The current process is

for the nursing staff to touch base with the pharmacist to change the route of administration, or

for the nursing staff to touch base with the provider to change the route of administration.

Finally, the clinical pharmacists on the unit note that the inpatient pharmacy has no way of

knowing, in real-time, what changes have been made to a patient's diet that will impact

medication administration, and therefore dispensing of medication from the inpatient pharmacy

cannot be corrected in a timely manner to reflect enteral or oral administration (personal

communication, PharmD in the neuro ICU, April, 2019).

In discussions with providers, nurses, clinical leadership, and pharmacists on the inpatient

units, the consensus seems to be that the greatest weakness and source of the problem is in the

incorrect prescribing of medications, particularly by providers who do not frequently order

medications on the units via the EMR. "Serious errors occur at any point of treatment although

most originate during prescribing, even with the use of electronic ordering systems" (Horsky,

Aarts, Verheul, Seger, van der Sijs, & Bates, 2017, p. 1). If providers are educated about the

problem, specifically addressing the "fallouts", meaning providers who are not frequently on the

inpatient units ordering medications, the problem could be significantly reduced (personal

communication, CNL in the neuro ICU, April, 2019). Similarly, a clinical nurse specialist in the

neuro ICU agrees that this lack of awareness on the part of providers does create extra steps for

the nurses during administration and documentation of medications (personal communication,

April, 2019). See Appendix C for an example of the current state map.

Relevance.

The organization has been certified as a Comprehensive Stroke Center by the DNV-GL

for healthcare and has also been recognized as the only hospital in Michigan to obtain the

American Heart Association/American Stroke Association's Gold Plus award for four

consecutive years. Medication route errors threaten the endorsement of the organization with

these prestigious evaluators and accrediting bodies. Most importantly, comprehensive care for stroke patients provided by the organization is threatened when medication route errors occur.

The organization's Board of Trustees and Senior Leadership Team are tasked with working together with key community members to guide the future direction of the organization. The not-for-profit status of the organization requires these individuals to rely heavily on their culture and core values to accomplish their mission presently and in the future. Likewise, the mission and culture guide the actions of the clinical staff on the units, as demonstrated by the desire for process improvement of medication prescription, administration, and documentation.

Financial viability.

The Board of Trustees at XXXX govern policies regarding the welfare and growth of the organization. The governing board is comprised of members who are passionate and dedicated to the health of west Michigan and the surrounding communities. They are tasked with raising the funds required to meet the functional requirements to maintain the inflow of financial resources greater than the outflow (XXXX, 2019c).

External environment.

External environment refers to the administrative and legal, political, social and cultural, economic, technological, and ecological forces that influence an organization. These elements can shape the performance of an organization for the better, or be a distressful barrier for the change an organization seeks to obtain.

Administrative and legal.

Customers may contact the Customer and Patient Relations Department to file a compliment or complaint anonymously regarding their experience with the organization. If unsatisfied after this action is taken, customers may contact The Joint Commission or The

Michigan Bureau of Community and Health Systems whose contact information can be found on the organization's website.

Political.

Additional external drivers for change include the increasing aging population, governmental changes to insurance coverage and access, and government mandated advances in technology in healthcare. With Americans living longer, growth in the number of older adults is unprecedented. In 2014, 14.5% (46.3 million) of the United States population was aged 65 or older. This number is projected to reach 23.5% (98 million) by 2060. Elderly adults experience increased risk of chronic diseases, including neurovascular and cardiovascular diseases. In 2012, 60% of older adults managed two or more chronic conditions such as heart disease, cancer, emphysema, stroke, diabetes mellitus, or Alzheimer's disease [Office of Disease Prevention and Health Promotion, (ODPHP), 2018].

Patients have increasing access to insurance and healthcare coverage because of the implementation of the Affordable Care Act signed in 2010 [Administration on Aging (AOA), 2011]. The Affordable Care Act strived to lower costs for services while maintaining high-quality and reforming payment systems (AOA, 2011). Through reforms mandated by this legislation, XXXX has continued to undergo changes in practice and structure, as with ICD-10 coding and changes in billing and reimbursement. The organization is faced with providing care that is cost-efficient and high-quality, while utilizing only the most current evidence and best talent available.

Social and cultural.

Every three years the organization performs a Community Health Needs Assessment, to assess the health needs of the communities in which they serve. The information is then used to

advise the organizational strategic planning in an effort to live the organization's mission of improving the health of the surrounding community (XXXX 2019f). The organization provides opportunities for several patient and caregiver support groups as well to meet the needs of the community. The Stroke Support Group as well as several stroke community education events provided by the organization demonstrate a commitment to the community and this particular patient population. Information about the specific support groups offered by the organization can be found on the organization's website. For instance, the Stroke Support Group is described as a place to "meet to discuss stroke education, peer support, and caregiver support. Includes blood pressure checks, and an open discussion about lifestyle changes, concerns and coping" (XXXX, 2019g).

Economic.

The organization is situated in west Michigan and is geographically located near 3 other hospitals within the same city. This close proximity intensifies the organization's need to remain competitive in quality care and outcomes. Recently, the organization was named one of the nation's 100 Top Hospitals by Truven Health Analytics®, which is a leading provider of data-driven analytics and solutions to improve the cost and quality of healthcare (XXXX, 2019h).

Technological.

Currently, the organization utilizes two different electronic medical record (EMR) systems: Athena™ and Cerner™. The primary EMR used in the outpatient setting in primary care and specialty care offices is Athena™. This program allows for centralized access to patient information for all providers on a patient's care team. Historical records, physician notes, and diagnostic results are all located in one program which allows providers from different offices to interact and deliver the patient a more streamlined continuity of care.

Cerner™ is the older of the two EMR programs and is utilized in the inpatient setting for this organization. Nursing documentation, physician notes, and essential patient information is all found in this record along with results from diagnostic tests and lab results. Unfortunately, these two programs do not sync and therefore information from an inpatient stay must be manually added from Cerner™ to Athena™ in order for it to be available to providers who work outside of the hospital setting.

In January 2020, the entire organization will be transitioning to EPIC™ as the only EMR program. This transition highlights new and different challenges that await the organization in the training and implementation of a new EMR program. It will be important for colleague behaviors to adapt with the utilization of LEAN principles in the current state in order to ensure success for the future state and transition to EPIC™.

Ecological.

The Community Health Needs Assessment that is performed every three years illustrates the organization's commitment to the community and to service. The 2017 Kent County Community Health Needs Assessment was approved by the Board of Trustees in June of 2017 and has selected four priority health concerns to focus efforts on in the years 2018-2021. These four priority health concerns include improving mental health services in the community, and focusing on treatment initiatives for substance abuse, obesity, and diabetes (XXXX, 2019f). The organization, and other community agencies, will partner with the Kent County Health Department's Community Health Improvement Strategy work groups to address the needs of the public and find solutions to improve the health of the community. This stewardship is a reflection of the core values of this organization to honor their heritage and be accountable for the human, financial, and natural resources entrusted in their care (XXXX, 2019a).

Ethics and Human Subjects Protection

The DNP student served as the project manager and had competed CITI training and certification. Descriptive data was captured for this quality improvement project. Data regarding the frequency that an inappropriate order set was initiated was collected. Once the data was collected it was analyzed using SPSS software and a statistician from Grand Valley State University assisted in analysis. Identifiable patient data was minimal and included visit-specific financial numbers (FIN) only. To deidentify medical records and protect patient information, all FIN numbers were cataloged in reverse order.

Stakeholders

The organization has a wide variety of stakeholders from colleagues and volunteers to community partners and affiliate organizations. Due to the not-for-profit status the organization holds, donors make up a large portion of stakeholders in regard to the welfare of the organization. The Family of Supporters includes a wide variety of entities including corporate sponsors, the philanthropy of private individuals and families, gifts made in the honor or memory of a loved one, gifts made as the result of an estate or financial plan, endowments, and gifts equal to days of paid time off from employees. The list of stakeholders and their level of contribution to the organization can be found on the organization's website (XXXX, 2019i).

The stakeholders involved in the success of the organization include individuals and departments hospital-wide, as well as from outside the organization. For instance, members of the Stroke Team all work as quickly and efficiently as possible to establish the best possible outcomes for stroke patients in acute situations and for on-going chronic care. The emergency department, neuro-residency program, on-call vascular neurology service, neuro-interventional department, heart and vascular department, radiology department, laboratory services, inpatient

nursing staff, pharmacy services, social work services, rehabilitation services, dietary services, outpatient clinic staff, the family, and the patient all work together to establish achievable goals that begin the minute the patient enters the hospital. These actions are important for the community as The American Stroke Association states "immediate treatment may minimize the long-term effects of a stroke and even prevent death" (ASAa, 2019). A concentrated effort to deliver quality care that aligns with the culture, mission, and values of the organization brings these stakeholders together for this common purpose.

SWOT

Strengths.

The organization has several strengths to build upon. The organization itself is Magnet-recognized which indicates the level of highly qualified, motivated, and patient-focused nursing staff that provide care to patients throughout the organization. Furthermore, the organization has been designated as a Comprehensive Stroke Center and is the only hospital in Michigan to obtain the American Heart Association/American Stroke Association's award for four consecutive years demonstrating the commitment to the community and attempts to improve the health of the populations served in the area. This designation as a Comprehensive Stroke Center speaks to the quality of the organization's well-established Neurological Stroke Program and Team. Clinical teams such as the Stroke Team meet monthly as a group and decisions are made regarding quality improvement efforts and barriers to efficiency that need to be addressed. Finally, the focus on patient-centered care and quality improvement can be seen in many areas throughout the organization. The efforts of the clinical teams to identify barriers to excellent care such as medication prescription, administration, and documentation errors and the efforts made to develop a process to resolve the problem is just one example.

Weaknesses.

The primary weakness for this organization is the lack of efficiency and effectiveness of medication prescription, administration, and documentation on the inpatient floors. This makes it a possibility that medication errors may occur. Likewise, the inefficiency that colleagues experience and the amount of re-work that must occur when a problem with medication prescription, administration, or documentation occurs is a source of frustration for all members of the clinical team. The current state and need for process improvement is highlighted when patients on the inpatient floors transition from one diet order to an alternate diet order and medication route administration must reflect that change.

Opportunities.

The organization has many opportunities to demonstrate the excellent care that is provided to patients. As the organization will be transitioning to a new electronic medical record system in January 2020, this process improvement initiative has the possibility of influencing the prescriptive, administrative, and documentation processes with regard to that transition. Similarly, an improved process will improve patient safety as well as patient, clinical staff, and leadership satisfaction. Finally, improved efficiency with a new process within the workday for all staff involved will reduce the need for chart audits when documentation is incorrect.

Threats.

Organizational threats include the presence of competing organizations and acute stroke providers in the west Michigan area. Although this organization is certified as Magnet recognized and a Comprehensive Stroke Center, there are other choices for patients and families in the area. Finally, ensuring that there was time to complete provider education of a new process for ordering medication to guarantee understanding of what is expected was a threat to the

success of the implementation of a new process. Likewise, there are multiple providers from

several different practices/groups that required awareness training and education, ensuring that

ALL providers receive the same information was essential to improve the outcomes of a new

process for ordering medication. Finally, what process would be utilized to track compliance?

An example of the SWOT analysis for this organization can be found in Appendix D.

Clinical Practice Question

In order to tackle this clinical problem, a clinical practice question was developed. "Will

process improvement aimed at prescribers and communication about the organization's current

state cause a change in prescription practices for enteral tube medications?" In order to

determine the most effective method to address this problem, the following review of the

literature was conducted.

Review of the Literature

Current research studies have discovered that medical errors are the third leading cause of

death in the United States, following heart diseases and cancers (Luna, Rizzato-Lede, Otero,

Risk, Gonzalez, & de Quiros, 2017, p. 204). One strategy to combat this issue in health care is

the implementation of electronic medical records to improve quality and patient care. As part of

the American Recovery and Reinvestment Act, all public and private healthcare providers and

other eligible professionals have been required to adopt and demonstrate meaningful use of

electronic medical records in order to maintain existing Medicaid and Medicare reimbursement

levels. Although numerous studies have been conducted to investigate the impact that health

information systems have had on healthcare organizations since implementation, few have

reaped all the benefits (Bove, Humbrecht, Kristiniak, Thompson, & Sullivan, 2014, p. 2). The

complex nature of the field of health informatics requires systems that are efficient and effective

to assist and not hinder users with workflow. Therefore, it is important to gauge the views and opinions of users when designing and implementing new systems "because users have a unique ability to pick up problems and suggest ideas for improvement that system developers sometimes overlook" (Missiakos, Baysari, & Day, 2015, p. 596).

Computerized physician ordering systems (CPOE), with clinical decision support tools are increasingly being adopted as an essential aspect of electronic medical records. CPOE systems are able to overcome problems encountered with paper charting such as illegible handwriting and prevention of prescription errors. "The ultimate goal of CPOE systems is to improve the safety, quality, and value of patient care" (Korb-Savoldelli, Boussadi, Durieux, & Sabatier, 2018, p. 112). Implementation of CPOE systems has decreased the frequency and impact of many types of medication areas for health care organizations. However, the rise in the occurrence of new unexpected medication prescription errors has also been found to be directly related to the use of CPOE systems in other research studies (Korb-Savoldelli, Boussadi, Durieux, & Sabatier, 2018, p. 113).

Aims of Literature Review

The objective of this literature review is to identify and examine the factors that contribute to medication errors associated with the use of computerized provider order entry systems, as well as to provide recommendations regarding how use of computerized provider order entry systems can be improved to increase patient safety.

This review aims to answer the following questions:

- What quality indicators should be collected to measure improvement in patient safety with the use of CPOE systems?

- What barriers exist to prevent the successful implementation of an improved CPOE system?

- What factors will improve the likelihood of acceptance by prescribers of changes to a CPOE system?

- How will changes to the current CPOE system alter the workflow for prescribers, pharmacists, and nurses?

Search Methods/PRISMA

PRISMA, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines were utilized for this review (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). Comprehensive electronic searches were conducted in the Cochrane, PubMed and CINAHL databases and were limited to reviews in the English language between 2014 and 2018. Keywords were computer order entry, medication error, medication alert, electronic prescribing, enteral tubes, and patient safety. Analogous search terms were listed by using *(wild card) and boolean operators (OR, AND) to expand the searches to include all pertinent articles.

Evidence Used for Project

      Content.

The contents of these articles demonstrate many similarities and three primary themes were identified. First, the investigators sought to identify how alerts within electronic medical records (EMR) affect prescribers in specific ways. The investigators invited physicians to participate in studies exploring alert fatigue, whether medication orders were corrected/changed due to alerts in the EMR, and whether the usability, efficiency, and effectiveness of an EMR alert system improved when providers had input into the design. The second theme identified was the prevalence of studies that included the observation of administration and documentation of medication by nurses. Nurses in these studies were randomly selected based upon the shift they were working and time of day that medication administration occurred. The final theme that

was observed in the criteria portion of this review, was the prevalence of chart reviews to observe for medication errors. In most cases, the chart reviews included a random selection of charts from an EMR for review. Investigators reviewed the charts for prescribing, administration, and documentation errors.

Intervention.

There are several intervention strategies described in this collection of articles. Investigators found that development of clinical decision support tools and involving users in the design of CPOE systems allowed for greater acceptance of changes (Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017; Luna, Rizzato Lede, Otero, Risk, Gonzalez, de Quiros, 2017; Missiakos, Baysari, & Day, 2015). Likewise, enhancing the relevance of EMR alerts and the development of customized lists for drop-down menus in the CPOE systems improved efficiency and effectiveness (Abraham et al., 2017). Similarly, prescribers found that having relevant information about the status of current patients available at the time of decision-making improved efficiency by limiting the need to search the chart for information (Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017). Finally, the utilization of effective leadership strategies within organizations was found to foster the acceptance of CPOE systems and changes to these systems (Harrington, Hardison, Coates, Wickham, Norris, & Kane, 2014).

Comparison.

Articles evaluated for this review span several countries and include studies from 2014 to 2019. Although they demonstrated great variety in some ways, they were very similar in other aspects. A theme that many of these papers focused on was patient safety and determining the best evidence to prevent medication errors when utilizing CPOE systems. (Tolley et al., 2018). Medication errors were evaluated throughout the entire process from prescribing, to

administration, to documentation. Further, investigators sought to develop strategies to decrease alert fatigue for prescribers, improve alert specificity, and to improve the relevance of medication alerts within CPOE systems. (Page, Baysari, & Westbrook, 2017). Finally, the articles focused on factors that contribute to the successful implementation of CPOE systems within organizations.

Outcomes.

The articles included in this review yielded a variety of outcomes. Some, investigators found that CPOE systems encouraged some medication errors but mitigated others. (Schiff et al., 2015; Jheeta & Franklin, 2017; Idemoto, Williams, Ching, & Blackmore, 2015). Similarly, others found that poor application design had a negative effect on prescriber behavior and usability of the CPOE system (Korb-Savoldelli, Boussadi, Durieux, & Sabatiier, 2018; Bove, Humbrecht, Kristiniak, Thompson, & Sullivan, 2014). Finally, investigators determined that development and utilization of clinical decision support tools has led to decreased dosing and prescribing errors, improved patient care and safety, and in some cases financial savings (Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017).

Search Outcomes

The search yielded 197 Cochrane, CINAHL, Medline, and PubMed reviews. Twenty-five duplicates were found. Each review was screened using inclusion and exclusion criteria according to PRISMA standards (Moher et al., 2009) and can be seen in Appendix E. Review of titles and abstracts resulted in removal of 131 articles that did not meet the inclusion criteria. In addition, 20 articles were excluded after in-depth examination of content because they did not meet inclusion criteria. The remaining 21 articles were included in this review.

Results

Twenty-one papers are included in the review (see Appendix A). Of the twenty-one documents reviewed there were: two opinion papers, one diffusion of innovation study, one qualitative observational study, one qualitative study utilizing semi-structured interviews, two retrospective studies, six studies utilizing a quasi-experimental design, one cross-sectional study, three comprehensive literature reviews, one experimental cross-over study, and one randomized controlled trial. Two opinion articles were included in the review. Opinion papers, although considered low-level evidence, are relevant to this subject because very often medication route errors occur as a result human action. With this in mind, it is important to gain the perspective of individuals who are users and designers of electronic medical records. The first opinion paper was written by several nursing informatics officers from the perspective of their expertise and education in both nursing and informatics (Harrington, Hardison, Coates, Wickam, Norris, & Kane, 2014). The authors describe a multidisciplinary approach to the implementation and use of a CPOE system to ensure that the needs of patients are met in a comprehensive and efficient manner. The article highlights workflow and structured governance as necessary to the successful implementation of a CPOE system. The second opinion article was written by two pharmacists and discusses the impact of utilizing clinical alerts to reduce adverse drug events related to high-risk medications in older adults. This article includes discussion about the challenges and benefits of implementing clinical alerts. Three challenges that are discussed in detail are alert fatigue experienced by prescribers, lack of prescriber buy-in, and the lack of capital that some organizations experience impacting the implementation and maintenance of clinical decision support tools. The authors conclude that although clinical decision support tools have "led to decreased dosing and prescribing errors, decreased high-risk medication use, fewer

side effects and improved patient care, several barriers to implementation still exist (Lord-Adem & Brandt, 2017, p 11).

A quality assurance project in the form of a diffusion of innovation study is the subject of the third article. The article focuses on the pre/post evaluation of a standard implementation of real-time point of care documentation to help reduce medication administration errors, utilizing diffusion of innovation concepts (Bove, Humbrecht, Kristiniak, Thompson, & Sullivan, 2014, p. 2). Several barriers to implementation were identified that fell into the two categories of computer-related characteristics and nursing-related characteristics. Nursing staff struggled with computer availability, as well as having a computer in working order, and available support staff to mediate computer-related issues. Several nursing staff were concerned that documentation at the bedside took away from patient interaction and felt that they were making patients feel like a task rather than a person (Bove, Humbrecht, Kristiniak, Thompson, & Sullivan, 2014, p. 8). The next article was written to document the results of an observational study directed at exploring the "implementation of an electronic prescribing and medication administration system on the safety of medication administration in an inpatient hospital setting (Jheeta & Franklin, 2017, p. 1). Nurses' medication administration rounds were observed before and after the implementation of the electronic prescribing and medication administration system. The study found no difference in medication error rate, although the study did support that electronic prescribing and medication administration systems do encourage certain types of medication errors and assuage others (Jheeta & Franklin, 2017, p. 1).

One of the qualitative studies included in this review utilized semi-structured interviews to determine the opinions of both experts (clinical pharmacists and clinical pharmacologist) as well as prescribers (physicians) regarding the implementation of computerized strategies to assist

in the identification and prevention of drug interactions. The authors include that implementation of computerized strategies is more successful when prescribers are involved in the drug interaction strategy design. Likewise, the authors found that the pharmacist group were more confident in their ability to recognize drug interactions than the physician group, and therefore the physician group found more benefit from the implementation of the computerized system. One warning that the authors include related to the difference in levels of confidence between the two groups, was to ensure that prescribers "are not being 'over-alerted' or becoming too reliant on alerts to identify all potential errors" (Missiakos, Baysari, & Day, 2015, p. 598).

Two qualitative studies utilizing retrospective design are included this review. The first paper evaluated medication ordering errors based upon voided orders in the CPOE. The purpose of the study was to investigate the accuracy by which prescribers identify and intercept medication ordering errors and to examine the reasons and root contributors for prescribing errors (Abraham et al., 2018, p. 299). Utilizing chart reviews and prescriber interviews, the study did demonstrate that ordering errors did effectively capture medication errors, and in some cases, prescribers utilized an intentional ordering error as a mechanism to notify the pharmacy service of their need for assistance. The second retrospective article included in this review was written by three pharmacists who sought to develop a medication review service within a hospital setting for patients with enteral tubes in an effort to improve patient safety. The authors found that pharmacists were not aware of when patients were placed on enteral tubes, and therefore did not know to contact physicians to recommend alternative medications when necessary. After implementation of the medication review service, pharmacists were able to utilize an automatically generated task list to see which patients had enteral tubes and needed a medication review (Li, Eisenhart, & Costello, 2017, p. S50).

Six articles included in this review were quasi-experimental studies. The authors of the first article developed a clinical decision support tool and summarized strategies to guarantee the specificity of alerts. Drug interaction alerts were classified as dynamic or static and then examined according to relevance. The alerts were further classified in an effort to reduce drug interactions and minimize alert fatigue for prescribers. With refinement of drug interaction alerts, the authors demonstrate how promising increasing specificity of alerts and decreasing alert burden for prescribers can be in improving prescribing quality (Seidling et al., 2014, p. 285). The second study with a quasi-experimental design examined behavioral changes in prescribers and non-prescribers measured in "think time" required to resolve an alert before and after suppression of specific drug alerts. The authors found that improved specificity of alerts that target specific drug interactions can reduce alert burden overall and improve efficiency as measured by "think time". This improved efficiency and decreased "think time" was seen more often for prescribers than non-prescribers (Schreiber, Gregoire, Shaha, & Shaha, 2017, p. 59). A third quasi-experimental study explored how CPOE systems have demonstrated success in preventing medication errors but also examined how these systems may also facilitate new errors. Some of the primary reasons for these errors included: "errors in narrative reports, miscommunication issues between multiple electronic or hybrid paper-electronic systems, user issues such as failure to follow established protocols, inexperience or lack of training in using the CPOE system, typing and pull-down menu errors, medication reconciliation issues, ignoring or over-riding alerts, and confusion related to or arising from comment fields" (Schiff et al., 2015, p. 268).

The fourth quasi-experimental study sought to improve the patient safety of neonates through the automated detection of medication administration errors by comparing automated algorithms used to identify errors with incident reporting. Utilizing automated algorithms, the authors were able to identify factors that contribute to high error rates. The study demonstrated that automated detection of medication administration errors through an EHR performed better, with higher sensitivity and precision, than other error detection systems including incident reporting (Li et al., 2015, p. 132). Quasi-experimental study number five in this review examined the implementation of a custom alert to prevent medication-timing errors associated with the use of CPOE systems. The need for solutions to the problems caused by CPOE systems was highlighted by a 2012 report from the Institute of Medicine's Committee on Patient Safety and Health Information Technology and the federal government's creation of a health information technology safety center that provides a learning environment, facilitates the reporting of problems, and promotes the sharing of adverse events and lessons learned (Idemoto, Williams, Ching, & Blackmore, 2015, p. 1481). The intervention studied for this study was a custom alert that forced prescribers to "self-inspect with pause" prior to signing an order that would result in a medication error. Interrupted time series before and after analysis of the intervention was performed. The results of the study demonstrated that the proportion of orders that were modified by a prescriber because of an alert increased from 12% prior to the intervention to 29% after the intervention. The final quasi-experimental study sought to analyze reasoning patterns of prescribers responding to drug interaction alerts in an effort to understand the role that patient-specific information has in the decision-making process and the risks and benefits of medication therapy. The authors define a clinical decision support system as a system that automatically critiques submitted orders and intervenes when a potentially unsafe prescription is detected

(Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2016, p. 1). When responding to high and low risk drug interaction alerts, prescribers were asked to "think out loud" and verbalize their thoughts. These sessions were recorded and analyzed to try to reveal patterns concerning patient-risk assessment and strategies to avoid and mitigate risk. The researchers found that "declining an alert suggestion was preceded by sometimes brief but often complex reasoning, prioritizing different aspects of care quality and safety, especially when the perceived risk was higher" (Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2016, p. 1).

One cross-sectional study is included in this review. Structured observations were recorded before and after medication administration and patients' medication record reviews and these observations were analyzed to detect errors. The purpose of the study was to describe the frequency, types, and severity of medication errors and the associated factors that contribute to these errors (Harkanen, Ahonen, Kervinen, & Turunen, 2014, p. 297). Factors that increase and decrease medication errors were identified and the authors concluded that medication errors in the inpatient setting are frequent and improvements to increase patient safety are essential.

Three articles reviewing the available literature on CPOE systems and medication errors are included in this review. The first review sought to identify the factors that contribute to medication errors associated with the use of CPOE systems in pediatric populations and what steps may be taken to improve CPOE systems to increase patient safety. The authors reviewed 47 articles and determined five primary factors that contribute to medication errors in CPOE systems. These factors include: lack of drug dosing alerts that fail to detect calculation errors, inappropriate drug dosing alerts based upon incorrect drug indications, inappropriate drug duplication alerts as a result of CPOE systems failing to recognize administration route, drop-down menu selection errors, and system design issues such as a lack of dosing options for

medications (Tolley et al., 2017, p. 575). The second literature review sought to assess the

evidence of different categories of medication alerts used in CPOE systems to change prescriber

behavior and improve patient outcomes. Following a review of 23 studies, the authors

determined that there is no current evidence that demonstrates a clear indication that particular

types of alerts are more effective than others; some alerts were shown to improve patient

outcomes and others did not improve outcomes. The final literature review included 14 studies

and sought to highlight the impact of CPOE systems on prescription safety in the presence of

certain types of persistent prescription errors. The authors found that all fourteen studies reported

"wrong dose" and "wrong drug" errors. "The prevalence of CPOE systems-related medication

errors relative to all prescription errors ranged from 6.1-77.7%" (Korb-Savoldelli, Booussadi,

Durieux, & Sabatier, 2017, p. 112). The authors concluded that reporting of prescription errors

should continue because weaknesses in CPOE systems remain potential sources of error.

Two prospective studies are included in this literature review. Investigators in the first

study, investigated medication error incidence rates found with CPOE systems in the

prescription, administration, and documentation phases of the medication process. Overt

observations and chart reviews were used to identify errors in the medication process within

CPOE systems. The study results indicated that errors in each phase of the medication process

are high within CPOE systems, but that "the main causes of administration errors and

documentation errors were prescription errors and verbal order processes" (Cho, Park, Choi,

Hwang, & Bates, 2014, p. 1). The second prospective study examined the effect of customizing

medication alert override options in CPOE systems based upon the appropriateness of the

override selection. Prescribers were randomized into two cohorts for this study, and the results

demonstrated that appropriateness of overrides was significantly higher in the customized alert

group when compared to the non-customized alert group. Therefore, the authors determined that customizing alerts for medication overrides can affect provider behavior when responding to alerts (Dekarske, Zimmerman, Chang, Grant, & Chaffee, 2015, p. 1085).

The final two articles in this review include a study utilizing an experimental crossover design and a randomized controlled trial. The experimental cross-over study compared rate of alert override using traditional software CPOE systems with user-centered design CPOE systems. The results indicated that user-centered design CPOE systems were more efficient, more effective, and more satisfying for prescribers to use; this indicates that user-centered design techniques can generate more usable alerts than traditionally designed CPOE systems. "The participatory design approach enabled the usability and development teams to work with end users to understand the tasks and complexity of the process and to improve the software quality (Luna, Rizzato-Lede, Otero, Risk, Gonzalez, & Quiros, 2017, p. 204). Finally, the randomized controlled trial included in this review sought to determine the risk factors and rate of medication administration errors by exploring medication administration records and data recorded in a closed-loop medication administration system using barcodes and radio-frequency identification. Researchers determined that medication error alerts "were significantly related to administration time, order type, medication route, the number of medication doses administered, nurse's employment duration, and working schedule" (Hwang, Yoon, Ahn, Hwang, & Park, 2016, p. 1387). This study demonstrated that alert data may be used as real-time feedback as well as monitoring patient safety in practice through the use of a CPOE system.

Study Characteristics

The study characteristics for these papers varied greatly, but also some very close similarities. Although the two opinion papers discuss different aspects of CPOE systems, both articles were written by experts in the fields of health care informatics and CPOE systems. Both articles discuss CPOE system implementation challenges and offer possible solutions to these challenges. However, the first article focuses on nontechnical issues encountered with CPOE systems and the recommendations from the authors on mitigating those issues. There is no evidence-based support referenced within the article. In contrast, the second opinion article includes data on clinical decision support systems, challenges that have been encountered in previous studies, and steps for successful implementation of CPOE systems.

Several of the qualitative studies utilized observation techniques and interviews with clinicians to gather data. Prescribers were asked to "think out loud" to determine patterns of clinical reasoning when prescribing medications and reasons for overriding medication alerts within CPOE systems. The study that explored the impact of implementing an electronic prescribing and medication administration system required researchers to observe nursing staff for changes in behavior pre and post intervention. Three of the five qualitative studies included in this review required researchers to interview participants to collect data. The study that utilized diffusion of innovation techniques conducted interviews with nursing staff prior to implementation of the intervention and after the intervention to gauge effectiveness of point of care documentation. Similarly, the qualitative study comparing drug safety experts and prescribers in relative confidence in their ability to detect a drug interaction and need for alerts required researchers to interview both groups. Finally, the retrospective study that utilized voided orders to identify possible patterns in medication error rates required researchers to interview

prescribers to determine contributing factors.

Three of the six quasi-experimental studies included in this review discuss medication alerts utilized in CPOE systems. These articles highlight the many factors involved in poor utilization of CPOE systems including increased alert burden and lack of buy-in from prescribers due to poor system design. Another similarity found within the quasi-experimental group of papers was the idea of user-centered design and utilizing knowledge and input from end-users in the development of CPOE systems. Finally, customization features of alerts within CPOE systems was a focus for three of the six quasi-experimental studies. The results indicate that customization of alerts may prevent alert fatigue for prescribers and improve efficiency, effectiveness, and patient safety.

Similarly, three of the six quasi-experimental studies pursued the behaviors and behavior changes of prescribers before and after interventions. The study comparing drug safety experts and providers evaluated the "think time" required to complete a task prior to and after medication alerts. Similarly, the study that analyzed CPOE-related medication errors asked typical users to test potential causes of errors within a CPOE system. The final quasi-experimental study discussed in this review asked prescribers to verbalize their clinical reasoning behind overriding a medication alert to determine reasoning patterns.

Two of the three literature reviews included in this paper sought to determine the factors that contribute to medication errors in CPOE systems. The first review identified five factors within CPOE systems that may cause medication errors to occur. The second explored the factors influencing the prevalence of medication prescribing errors. The final literature review included in this paper determined that there are three primary categories of medication alerts: drug-condition alerts, drug-drug alerts, and corollary order alerts.

The prospective studies included in this review differ in their purpose and objectives. The first prospective study attempted to identify the nature of medication errors in CPOE systems related to the three phases of the medication process. The purpose of the second prospective study was to determine if customization of medication alerts improved the behavior of prescribers when responding to alerts. Similarly, the cross-over study demonstrated that user-centered design alerts in CPOE systems are more efficient and effective when compared to CPOE systems with traditional alert designs. Researchers noted faster resolution of medication alerts and less medication errors with the customized user-centered design. Finally, the randomized controlled trial included in this review determined the risk factors associated with medication errors in CPOE systems. The alerts produced by the real-time closed-loop medication administration system using radio frequency and barcodes improved patient safety and reduced errors associated with nursing practices.

Intervention and Comparison Characteristics

There were several important themes within this diverse collection of articles regarding interventions within CPOE systems. Interventions aimed at improving the behavior of clinicians (prescriber and nurses) with regard to medication alerts within CPOE systems were identified in multiple studies (Schreiber, Gregoire, Shaha, & Shaha, 2016; Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017; Page, Baysari, & Westbrook, 2017; Dearske, Zimmerman, Chang, Grant, & Chaffee, 2015). Similarly, employing end users and prescribers to participate in the development of CPOE systems was an intervention theme that demonstrated promise (Luna, Rizzato Lede, Otero, Risk, Gonzalez, & de Quiros, 2017; Missiakos, Baysari, & Day, 2015). The development and implementation of customizable alerts to improve patient safety and prevent alert fatigue was an implementation technique studied in several of the articles (Seidling et al.,

2014; Idemoto, Williams, Ching, & Blackmore, 2015; Page, Baysari, & Westbrook, 2017;

Dekarske, Zimmerman, Chang, Grant, & Chaffee, 2015). Finally, the development of clinical

decision support systems and tools demonstrated effectiveness in preventing errors and

improving patient care in several studies as well (Horsky, Aarts, Verheul, Seger, van der Sijs, &

Bates, 2017).

Measures

Primary measures evaluated in this literature review were very similar for most of the

articles and focused on reduction of medication errors and improved patient safety. Factors

contributing to medication errors were identified and often categorized to direct interventions

(Abraham et al., 2017; Li, Eisenhart, & Costello, 2017; Schiff et al., 2015; Harkanen, Ahonen,

Kervinen, Turunen, & Vehvilainen-Julken, 2014; Tolley et al., 2018; Cho, Park, Choi, Hwang, &

Bates, 2014). Likewise, the presence, frequency, and severity of alert fatigue was measured in

many of the studies included in this review (Seidling et al., 2014; Dekarske, Zimmerman, Chang,

Grant, & Chaffee, 2015). Finally, assessment of patterns found to trigger medication alerts were

measured in order to develop focused interventions to address the alerts with more specificity

(Schreiber, Gregoire, Shaha, & Shaha, 2017; Idemoto, Williams, Ching, & Blackmore, 2015;

Page, Baysari, & Westbrook, 2017).

Efficacy of Implementation

The decline in medication error rates was measured most frequently to determine the

success of interventions. Twelve of the twenty-one studies measured the decline in error rates as

a primary outcome of a specific intervention (Bove, L.A., Humbrecht, Kristiniak, Thompson, &

Sullivan, 2014; Jheeta & Franklin, 2017; Seidling et al., 2014; Li et al., 2015; Idemoto, Williams,

Ching, & Blackmore, 2015). Behavior change demonstrated by prescribers and nurses after

intervention implementation was observed and measured in five of the twenty-one papers reviewed (Missaiakos, Baysari, & Day, 2015; Schreiber, Gregoire, Shaha & Shaha, 2017; Idemoto, Williams, Ching, & Blackmore, 2015; Harkanen, Ahonen, Kervinen, Turunen, & Vehvilainen-Julkunen, 2014; Page, Baysari, & Westbrook, 2017). Improved efficacy, efficiency, and clinician-use satisfaction of CPOE systems were primary outcome measures in four of the twenty-one studies (Abraham et al, 2017; Tolley et al., 2017; Korb-Savoldelli, Boussadi, Durieux, & Sabatier, 2018; Dekarske, Zimmerman, Chang, Grant, & Chaffee, 2015. Likewise, improvements to CPOE systems due to user-centered designs was listed as an outcome in three of the studies (Abraham et al., 2017; Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017; Luna, Rizzato Lede, Otero, Risk, Gonzalez, & de Quiros, 2017). Finally, data regarding improved patient safety was gathered as evidence of effective intervention implementation in three of the twenty-one articles (Li, Eisenhart, & Costello, 2017; Hwang, Yoon, Ahn, Hwang, & Park, 2016).

Limitations

Limitations of the included studies were varied, but there were several themes. Small sample size and single-center study design were two of the most frequently occurring limitations. Small sample sizes conducted in one single center led to studies that were underpowered and failed to allow data to be generalized (Jheeta & Franklin, 2017; Missiakos, Baysari, & Day, 2015; Page, Baysari, & Westbrook, 2017). Of the included twenty-one articles reviewed, nine were conducted in a single center and five had relatively small sample sizes (Abraham et al., 2018; Idemoto, Williams, Ching, & Blackmore, 2015; Cho, Park, Choi, Hwang, & Bates, 2014; Luna, Rizzato Lede, Otero, Risk, Gonzalez, & de Quiros, 2017; Hwang, Yoon, Ahn, Hwang, & Park, 2016).

Likewise, exclusion of specific departments and shifts from study data, as well as evaluation of a single CPOE system were limitations that were demonstrated in this group of articles (Idemoto, Williams, Ching, & Blackmore, 2015; Cho, Park, Choi, Hwang, & Bates, 2014; Hwang, Yoon, Ahn, Hwang, & Park, 2016). Exclusion of data was demonstrated in four studies and evaluation of only one CPOE system was found to be a limitation in two of the reviewed articles (Abraham et al., 2018; Seidling et al., 2014; Li et al., 2015; Korb-Savodelli, Boussadi, Durieux, & Sabatier, 2018; Dekarske, Zimmerman, Chang, & Grant, 2015). Similarly, one study listed a narrow selection of provider types as a limitation and included only physicians as prescribers (Dekarske, Zimmerman, Chang, & Grant, 2015). Finally, "direct observation effect" was identified as a limitation in three of the twenty-one articles (Cho, Park, Choi, Hwang, & Bates, 2014; Harkanen, Ahonen, Kervinen, Turunen, & Vehvilainen-Julkunen, 2014; Jheeta & Franklin, 2017). Direct observation effect is the possibility that the number of errors increased because the observer made the nurses nervous or the amount of errors could decrease because the observer's presence made nurses more cautious.

Relevance to Clinical Practice

In the future, CPOE systems should be designed with an understanding of clinician workflow and human factors (Horsky, Aarts, Verheul, Seger, van der Sjis, & Bates, 2017; Tolley et al., 2018). Likewise, the design of CPOE systems and medication alerts should ensure essential patient information is available and easily noticed upon prescribing and at the point of medication administration (Horsky, Aarts, Verheul, Seger, van der Sjis, & Bates, 2017; Tolley et al., 2018). Users should be aware of any limitations in CPOE systems and alerts that may make medication errors more likely (Missiakos, Baysari, & Day, 2015; Schiff et al., 2015.

Timely follow-up with clinicians regarding contributing causes for medication errors may

help in the development of interventions that can mitigate CPOE system challenges. Further

focus on process changes may improve the adoption of CPOE systems and alerts (Lord-Adem &

Brandt, 2017). Enlisting input from clinicians during design and implementation stages may

improve user adaptability and improve clinician satisfaction with clinical decision support tools

within CPOE systems (Page, Baysari, & Westbrook, 2018; Dekarske, Zimmerman, Chang, &

Grant, 2015; Luna, Rizzato Lede, Otero, Risk, Gonzalez, & Quiros, 2017; Lord-Adem & Brandt,

2017; Schreiber, Gregoire, Shaha, & Shaha, 2016).

Uitlizing the evidence discovered in the literature review, and the organizational context

revealed in the organzational assessment, a project plan was developed. The project plan is

described in detail in the next section.

Project Plan

Purpose of Project and Objectives

Utilizing the Lean Transformation Framework (LTF), a process by which to maximize

customer value and minimize waste was developed. By utilizing the principles of Lean

philosophy, the first step in the action plan was to identify what the value is from the customer's

perspective. As the patients, clinical staff, and leadership may all be considered customers in this

process improvement plan, the value was ensuring a safer, more efficient process for medication

prescription ordering in the electronic medical record. In doing so, much of the waste that was an

aspect of the current state could become obsolete. A second identifiable value to the customers

for this project, was to identify a process that would fluidly transition to the new EMR when it is

implemented in January 2020.

Setting

The setting for this project was an urban west Michigan hospital system, which is a

certified Comprehensive Stroke Center. Patients who have had strokes often have diet

restrictions that mandate enteral medication administration. Therefore, the population of focus

for this assessment was the care of patients admitted to one of two inpatient units caring for

stroke patients and patients who have had a traumatic injury or illness.

Participants

Participants in this process improvement plan included the clinical leadership staff, the

bedside nursing staff, pharmacists, and providers.

Model Guiding Implementation

The Lean Transformation Framework (LTF) is a quality improvement framework that is

utilized in many different arenas of business. A lean organization recognizes customer value and

directs its key processes to continuously improve it. The Lean Enterprise Institute (LEI)

identifies that the ultimate goal is to provide perfect value to the customer through a perfect

value creation process that has zero waste (2019). The Lean Transformation Framework was

chosen because the fundamental idea of maximizing customer value while minimizing waste

accurately reflects the work that needed to be accomplished within this organization; limiting

errors in medication prescribing, administration, and documentation for patients with restricted

diet orders on the inpatient nursing units. By focusing on the linkage between value and waste,

specific steps were identified and appropriated to make changes to transform the process of

medication prescription, administration, and documentation within this organization. Overall,

this transformation benefited all customers involved in the change, including patients, clinical

staff, and leadership. Utilization of this framework allowed for a true appraisal of the healthcare

organization and the healthcare organization's processes, procedures, and people, as well as assisted in the identification of strategic solutions to the problem. Process improvement in the form of Lean projects is embraced throughout the organization. Key stakeholders are encouraged to take part in quality and process improvement efforts throughout the organization from unit-specific projects to large scale organizational improvement efforts.

Process improvement.

A core concept in the LTF is the need for development of a process to improve the way work is done (Lean Enterprise Institute, 2019). This concept encourages users to seek out practical changes that can be utilized on a continuous basis to solve a specific problem. The problem being addressed in this situation was the cascade of medication errors that occur or could occur when medications are prescribed inappropriately by providers. To improve the current process illustrated in Appendix C, change of behavior of prescribers needed to occur.

Management system.

Another core concept in the LTF is the identification of the management systems and leadership behaviors that are currently in place, and how these systems and behaviors can support the process improvement. The organization has a strong leadership structure and management team for the inpatient units. Certified Nurse Leaders (CNL) and Clinical Nurse Specialists (CNS), act in leadership roles to ensure quality, efficiency, and accountability on the inpatient floors. Likewise, the management team works closely with senior leadership in the organization to ensure that the organizational mission, beliefs, and values are upheld. CNL's and CNS's practice Gemba walks on the inpatient floors routinely to gather information and discuss problems and issues with clinical staff in order to gain better understanding of issues that are affecting productivity and efficiency. Six Sigma Daily states "the translation of the term

[Gemba] is from the root Japanese word the real place. It also is known as the place where value is created. In the practice of Lean and Six Sigma, it means taking the time to watch how a process is done and talking with those who do the job" ("What is a Gemba," 2018).

Capability development.

The LTF describes capability development as the presence of "sustainable improvement capability in all people at all levels" (Lean Enterprise Institute, 2019). The organization is fortunate to have process improvement teams and individuals that are well-versed on Lean principles to guide the work that needs to be done to develop and sustain an improved process. Likewise, the organization has tools in place that can be utilized to ensure success of a new process. Technological advances allow clinical teams to connect with providers quickly and efficiently. Combined, these resources make the development, implementation, and sustainability of a new process very feasible for the organization.

Value-driven purpose.

Finally, a value-driven purpose requires a situational approach to a specific problem. Once a problem is identified, specific steps need to be taken to address the problem in order to add value to the work being done. The value in addressing the problem for this organization was the improvement in patient safety, the reduction of waste in workflow, and the lesser likelihood that the organization would be cited for errors by accrediting bodies. The problem was situation-specific, as it affected the patients, providers, and clinical teams that care for patients with NPO (nothing by mouth) status on two inpatient units within the organization. Identifying the specific problem and developing an improved process to address the problem gave the work being done value and enhanced the efficiency, productivity, and satisfaction of all the individuals affected by the problem.

Strategic A3.

The Lean philosophy can be applied to a problem utilizing different tools. A strategic A3, is a Lean tool that assists in the identification of a specific problem through analysis of the current condition and setting of goals for the target condition. A Strategic A3 also includes the development and implementation of an improvement plan, the collection of key metrics, and the completion of a review of the plan. Utilization of a Strategic A3 was appropriate to address this particular problem, as Lean philosophy attempts to eliminate waste and re-work to develop more efficiency and productivity for the organization. See Appendix F for an example of an A3 report.

Background.

Review of the background of the current state was necessary to assist in the identification of the problem. The background of the problem for this organization focused on the volume of rework and waste created when an enteral tube medication was prescribed inappropriately. The organization currently utilizes an EMR system that is cumbersome and overloads providers with numerous choices for administration route when a medication order is entered. Prescribers may choose enteral, NG, OG, peg tube, among others when looking to prescribe medications for a specific patient via a tube. Likewise, when prescribing medications for patients with enteral tubes (order sets), the default administration route for medications is by mouth (po). Patients who have had a stroke or other traumatic injury in this hospital system must demonstrate that they are safely able to swallow in order to have their medications administered orally. Therefore, a default setting to by mouth for prescription medications places these patients in danger for incorrect medication administration.

Until recently, bedside nurses were able to change the route of administration prior to administering and documenting the medication in the medication administration record (MAR). This allowed nurses to document the appropriate administration of a medication according to the patient's diet order, even if the medication was prescribed incorrectly. Nurses were then required to contact the prescribing physician to have the provider amend the chart and change the order. This process also allowed for nurses to inadvertently administer and/or document a medication that contradicted the diet order causing an error or "fall out". This fallout was then detected by CNL's who were then required to communicate with the prescriber about the error and the administering nurse. Charts could then be amended and the fallout was addressed in this manner. With a recent upgrade to the EMR, amendments to patient charts is now impossible. Nurses may not amend the administration route in the patient chart at the bedside prior to administration of the enteral tube medications, nor are they able to amend the chart if a fallout in medication administration and/or documentation occurs. Nurses must contact the prescriber directly via the phone or doc Halo paging system and have the prescriber remedy the error in administration route in the chart prior to administration of the medication. If the prescriber does not respond, the nurse can contact the pharmacist on the unit, or the inpatient pharmacist to amend the administration route in the patient's chart.

Current condition.

With this collection of errors that occurred, the organization was placed at risk for citations from certifying bodies. As the organization is a Certified Comprehensive Stroke Center recognized by the DNV, and a Magnet®-recognized organization due to the excellence in nursing practice, fallouts such as these enteral tube medication errors put the organization at risk for losing these recognitions. The current process involved a great deal of re-work and wasted time

to resolve errors that occurred. Interviews with clinical staff and providers conducted on the

inpatient units revealed a great deal of frustration surrounding this problem. These interviews

were conducted as part of a Gemba walk to determine the specific conditions that promote the

existing problem. Individuals that were interviewed as part of the Gemba walk expressed varying

perceptions of the intricacies of the problem. However, all agreed that the source of the problem

was the inappropriate prescription of enteral tube medications.

Likewise, varying thoughts about how to address the problem were expressed by clinical

staff and providers during the on-site interviews. All agreed that it may be possible that an alert

within the EMR system that prompts providers to order medications enterally for patients with

nothing by mouth diet orders might address the source of the problem. However, with research

into the capabilities of the current EMR system, it was determined that inserting this alert would

not be possible. The future replacement of the current EMR system with a new system in January

2020 initially provided some hope that an alert may be imbedded in the new system that would

address this problem. However, research into the capabilities of the new EMR system revealed

that this would not be a possibility either. With this information in hand, it was determined that a

new process that is not dependent upon a specific EMR system, but that could be utilized with

any EMR system was proposed.

Challenge goal.

The organizational goal related to this problem centered on elimination of these enteral

tube medication errors in order to improve patient safety and patient care, reduce waste, and

prevent citations from certifying bodies.

Analysis.

Analysis of the problem involved determination of the operational, cultural, and systemic organizational barriers that existed and opposed the achievement of the challenge goal. The patterns and trends that contributed to the current state were analyzed as well. Key stakeholders, that were affected by the problem, identified obstacles and behavior and performance gaps that were necessary to address in order to attain a solution to the problem. Likewise, best practice and anticipated improvement of performance standards were analyzed to gain a deeper understanding of which solutions would and would not be effective.

Target condition.

A target condition is a vision for future performance and development of the steps required to reach and maintain problem resolution. The target condition for this particular problem was that all providers would prescribe enteral tube medications appropriately 90% of the time. Attainment of this scenario would eliminate the problem, and in doing so make a large impact on patient safety, efficiency, and job satisfaction for the clinical teams.

Actual condition.

Actual condition refers to the reality of a particular situation. This is the evaluation of how close stakeholders come to achieving the challenge goal and creating the target condition. The actual condition for this particular problem should be determined after completion of provider awareness education and chart audits.

Key metrics.

Collection of key metrics consisted of examining what process metrics needed to be gathered and are known to have an impact on outcomes. The key metrics for this problem were identified by CNL's and CNS's on the two inpatient floors and the project manager. The team

identified the measures that would need to be collected in order to measure the change in behaviors and the process to evaluate progress and movement toward the target condition.

Review plan.

A review plan is necessary to evaluate progress toward the target condition, how barriers are being addressed, and the special circumstances or issues that contribute to the gaps in performance. This review allows stakeholders the opportunity to anticipate complications and to discuss alternative approaches to addressing the problem.

Implementation Steps and Strategies

Evidence-based interventions.

Awareness education and compliance of providers in prescription of enteral medications was the key to an improved process. Evidence has demonstrated that providers are prone to alert fatigue if too many alerts appear in a medication record. "The high proportion of alerts that clinicians consider to be uninformative or only marginally useful indicates that Clinical Decision Support (CDS) is not yet a fully mature technology" (Horsky, Aarts, Verheul, Seger, van der Sijs, & Bates, 2017, p. 2). This alert fatigue fosters an environment where providers disregard alerts, sometimes without reading the entire message; this practice has caused errors in the past and has demonstrated EMR alerts to only be a partially effective solution. Evidence has also demonstrated that more specific and personally directed information is more effective in the modification of behaviors for providers. Therefore, the improved process would be directed at specific providers who order enteral medications inappropriately in order to encourage change.

Likewise, education about the specific problem was required. Without the knowledge about how these fallouts threaten patient safety, encourage citations from certifying bodies, and generally increase workload for bedside nurses, pharmacists, and clinical leadership, it is

difficult to hold providers responsible for these prescription errors. Evidence has demonstrated that direct and specific education about a problem encourages a change in behavior and improves outcomes. An awareness plan that was specific to the problem, clear about expectations for future behavior, relevant to current practice, encouraged changes in prescriptive performance of providers, was timely, and reflected respect for the providers' busy schedule was ideal.

Implementation strategy.

As the core of the problem was identified as the inappropriate prescribing of enteral medications for patients on the inpatient floors, who have a diet status of nothing by mouth, the strategy focused on the change in provider behavior when prescribing medications. Awareness education of all prescribers regarding the current problem and the proposed solution was proposed. This education included the specific details of the problem including the risk to patient safety, how the inappropriate prescription of medications negatively affected the workload of clinical staff, and the possible citations from certifying bodies that may be accrued if the problem was not addressed. Likewise, education of the inpatient nursing staff and pharmacy staff about the severity of the problem and the proposed solution was completed.

Meetings with nursing leadership, physician leadership, and pharmacy leadership were key to highlighting the severity of the problem and the risk to patient safety that these errors promote. Meeting with these stakeholders occurred at the request of the DNP student and project manager. Evaluation of the data and the implications of this increased error rate for patients with diet restrictions on these two inpatient units was enlightening for the physician and pharmacy leadership in particular. This awareness education was then shared by physician and pharmacy leadership through departmental meetings with their particular services to bring greater attention to the issue. Likewise, nursing leadership was able to revisit the issue with nursing staff on the

two units through the utilization of huddle boards and email correspondence.

Prior to awareness education of the prescribers, pharmacists, and clinical staff, chart audits of patients on the inpatient nursing units took place in order to gather data regarding the current state of the problem. Data from approximately 50 patients with enteral tubes, with a nothing by mouth status who were admitted to one of the two inpatient floors, was gathered. Once gathered, the data was used as part of the awareness education material discussed above.

The DNP student acted as the project manager for this process improvement project. Chart audits prior to the educational portion of the plan were completed by the DNP student as well. Further, the DNP student was tasked to identify the fallouts that occurred, gathered data about the specific fallouts, and contacted the nursing leadership for each unit regarding specific provider/provider groups that prescribed the enteral medication via an inappropriate route. If an error was identified by nursing or pharmaceutical staff, the clinical staff was asked to notify the provider of the error via doc Halo message and requested rectification of the order as soon as possible.

A one-page document was distributed to illustrate the gravity of the problem in an effort to bring awareness. The document was shared with nursing pharmacy, and provider leadership. See Appendix O for an example of the one-page document.

Barriers and facilitators.

A primary barrier to the project implementation included a current lack of provider knowledge regarding the problem and possible unwillingness of providers to change practice behaviors after being made aware of the problem. Without clear understanding of the problem, providers did not understand the severity of the consequences of not changing their behavior in relation to ordering medications via the appropriate route. Citations from certifying bodies may

occur if inappropriate administration route for medications of patients with NPO status continued

to occur. More importantly, patient safety was risked when medications were prescribed via the

wrong route.

Another barrier included the incapability of the current electronic health record to allow

for chart amendment if a fallout or error occurred. Nurses were not only unable to change the

route of administration of a medication at the bedside prior to administering medications, but

should an error in documentation occur, nurses were unable to later amend the chart to reflect

that a medication was given appropriately. Likewise, clinical leadership were unable to make an

amendment to patient charts either. The current electronic medical record requires nurses to

contact the ordering provider or a pharmacist to change the order in the patient's chart prior to

administration. Although this is an ideal solution, the reality of a busy inpatient unit makes this

task clumsy and time-consuming. Likewise, the new electronic health record that will be

implemented in January 2020 will not allow amendments to patient charts either, which leaves

the organization facing the same problem with implementation of the new system.

Fortunately, facilitators to the project included a highly motivated clinical leadership

team, as well as a skilled and experienced group of nurses who work on the inpatient floors and

are affected by this problem on a daily basis. Bedside nurses are excellent candidates for

recognition of errors and completion of a sustainability plan to prevent future errors and fallouts.

Errors in medication prescribing affect bedside nurses tremendously, as it is the workflow of the

nurses that is interrupted when an error in prescribing occurs. Likewise, members of clinical

leadership have encountered this loss of time as well during chart audits and with mandatory

inquiry into fallouts that occur due to prescription, administration, and documentation errors.

Finally, pharmacists facilitate the improved process. Pharmacists are able to change

orders that are inappropriate if a bedside nurse is unable to connect with the ordering provider.

Encouragement of an improved and leaner process for medication prescribing can prevent

pharmacists from having to take the time to correct orders that are inappropriately prescribed.

Implementation outcomes.

Measures

A strategic plan that encompasses all patient charts on the two inpatient floors, and not

just stroke patients, allowed more fluidity to the project plan and addressed the need for a

standard process for all patients with a diet order of nothing by mouth that are admitted to these

units. Therefore, all charts of patients admitted to the intensive care unit, as well as patients

admitted to the neuro step-down unit were included in the data collection. This inclusivity

allowed for a larger sample size and encouraged the sustainability plan in the future.

Measures collected included: the total number of enteral medications ordered for each

patient, the number of enteral medications ordered correctly, the unit where the error occurred,

whether the error occurred on a weekday (Monday-Friday) or weekend (Saturday-Sunday), the

time of day that the error occurred (7am-7pm or 7pm-7am), the date the NPO order was placed,

the date that diet allowed PO meds, the name of the provider and provider group that prescribed

the medication inappropriately or the name of the nurse who entered the incorrect order from a

verbal/telephone order, and the date, time, and nurse who administered doses to the patient if the

medication was ordered incorrectly.

Data Collection Procedures

Once the institutional review board (IRB) quality improvement approval was granted

from the organization, data collection began. Chart audits were completed by the DNP student

from GVSU, and consisted of examination of charts of patients admitted to one of the two

inpatient units. The data collection tool was used to gather the data from each patient chart. See Appendix G for an example of the data collection tool.

Data Management and Analysis

Descriptive data was captured for this quality improvement project. This data was collected by DNP project manager as part of a quality improvement project for the organization. Once the data was collected it was analyzed using SPSS software and the assistance of a statistician from Grand Valley State University. Identifiable patient data was minimal and included patient financial identification number (FIN) only. In order to assist in deidentifying medical records, all FIN were recorded on the spreadsheet in reverse order. For example, if the patient's FIN was 234567, it was recorded as 765432 on the spreadsheet.

Resources & Budget

Possibilities for the resources and budget for the project consisted of the time accrued by clinical staff and providers to perform specific tasks in combination with the relative wage that each provider and clinical team member acquires for their time. For instance:

- RN tracking; Number of minutes to contact the provider and wait for a reply prior to the administration of medication multiplied by the dollar/hour wage multiplied by the number of charts.

- Provider order entry; the number of minutes to enter an order in the EMR multiplied by the provider wage multiplied by the number of charts.

- Provider time to correct an error when it occurs.

- Pharmacist time to correct an error if provider does not respond to doc Halo notification.

For this project, relative expenses were calculated by how much the organization would save in time and wages when the provider, pharmacist, or RN do not have to take steps to amend

an error. Likewise, of interest is the amount of time and relative cost savings the organization

would save when the provider enters the order correctly and no amendments are required. Please

see appendix H for an example of a cost savings chart.

Timeline

The initial goal was to conduct provider awareness education regarding the problem and

expectations for prescribing enteral medications after the Quality Improvement Determination

from the organizational IRB, and the completion of data collection was completed. The plan

included communication to be completed with a multi-modal approach such as an email

announcement to providers, information provided at departmental meetings, and personal

communications. Follow-up communication occurred during departmental meetings. Data

collection was expected to be done retrospectively for approximately 50 charts of patients with

an NPO order and a tube on H2 and H3. The data was analyzed and utilized for quality

improvement purposes at the organization, as well as for project development and project

defense purposes for DNP student.

Results

Utilizing the data collection tool, data was gathered over seven weeks and included

evaluation of 56 individual charts from the organization's intensive care unit and neuro step-

down unit. In the next sections, a clear breakdown of how and where the errors occurred will be

discussed.

Description of orders.

Within the 56 charts audited, 949 medication orders were prescribed via enteral route,

including oral, peg tube, NG, or OG. Of the 949 medication orders entered, 658 were entered

correctly with the patient's diet or diet restrictions congruent with the route that the medication

was prescribed. This is an average of 69.3% of medication orders were written correctly for

patients with diet restrictions. See Appendix J for the data regarding the total orders written.

Incorrect orders.

Medication orders that were prescribed incorrectly were broken down in to several

categories; time of day the error occurred, weekday or weekend, and whether the order was

entered in opposition to the diet order by a provider, nurse, or pharmacist. The data revealed that

189 medication prescriptive errors were entered on day shift (7am-7pm), and 102 errors were

entered on night shift (7pm-7am). Likewise, 243 of these prescriptive errors were entered on a

week day (Monday-Friday), and 48 were entered on a weekend (Saturday-Sunday). The vast

majority of prescriptive errors were entered by providers (physicians, residents, physician

assistants, and advanced practice nurses). The provider group was responsible for 275 of the

prescriptive errors. In contrast, 13 prescriptive errors were entered by pharmacists, and three

were entered by nurses from a telephone or verbal order. See Appendix K for the totals of the

data collection over the seven-week chart audit and Appendix L for the errors by discipline.

Errors that reach the patient.

Additionally, an important measure to consider in terms of patient safety in regard to

collecting the data, is how often did an error reach a patient? Charts were audited for this data as

well, and medication errors related to prescribed medications, in contrast to the diet order,

reached patients 113 times over 7 weeks. The data was then broken down further to reveal that

individual doses were given by mouth to patients with a nothing by mouth diet order 509

individual times. This data reflects that in some cases, medications were documented as having

been given to a patient for multiple doses on multiple days prior to the administration route being

corrected in the medication administration record. Likewise, some errors were found to proceed

through the entire length of the patient stay, or until the patient's diet order was no longer restricted. In some instances, a restricted diet order and a by mouth medication order were placed in the same time frame by the same individual. See Appendix M for a representation of errors that reached the patient.

Source of errors.

Prescriptive errors entered by providers into the EMR occurred most frequently. Of the 291 errors that occurred, the greatest number of errors were entered by the Intensivist group with 78 of the total. Hospitalists were responsible for 47, Internal Medicine were responsible for 26, Neurology for 22, Family Practice for 22, Pulmonology for 17, and Palliative Care for 13. The remaining 50 were entered by Vascular Surgery, Bariatric Surgery, Anesthesiology, Infectious Disease, Neurosurgery, and Ear Nose and Throat, among others. See Appendix N for a visual representation of the errors by provider service.

Hardwiring Success

A process improvement plan that provided a sustainable way to track medication route errors related to diet restrictions was developed. In order to encourage compliance and decrease the frequency of these errors, chart audits and follow up with clinicians needs to continue. A solution that provides leadership opportunities for inpatient nurses and that promotes an efficient and sustainable resolution to this problem was developed.

Inpatient nurses employed in the organization are encouraged to partake in leadership and quality improvement activities to promote professional development. This process improvement plan provides an opportunity for nurses to earn Clinical Advancement System (CAS) points through participation in a long-term quality improvement project. Nurses may advance from Level I (novice nurse) to Level V (expert nurse) in the CAS system by earning CAS points. The

CAS system is based upon the Benner Model and has been in place in the organization since 1982. This system "evolved from a taskforce of RN colleagues who were passionate about identifying opportunities to reward and promote the professional nursing practice for clinical nurses" (XXXX, 2019j, p. 4). Generally, the CAS point system promotes professional development, encourages continued education, and provides leadership opportunities for nurses on the inpatient units.

The process improvement plan implemented provides an opportunity for inpatient nurses to continue the work of auditing charts for errors in an effort to monitor improvement in the medication route error rate related to diet restrictions. Nurses interested in earning CAS points by participating in the quality improvement plan will commit to auditing charts for four hours a month for six months. Information collected during these chart audits will include: the total number of enteral orders prescribed, the total number of enteral orders prescribed correctly, the date and time that the prescriptive error occurred, the provider and provider service involved in the error, and whether the error was corrected and/or reached the patient. When monthly chart audits are complete, nurses will share this information with clinical leadership on the inpatient units. This process will allow clinical leadership staff to follow-up directly with nurses on the units who administered or documented a medication route incorrectly, and will provide an opportunity for dialogue with specific providers and medical leadership regarding specific errors.

Upon completion of this long-term quality improvement project, participating nurses will provide a written narrative of their participation in the project to the CAS committee and clinical leadership on the inpatient units. This narrative will include information about the purpose of the quality improvement project, insights into trends observed, and a description of how this project improves clinical practice in the organization.

Add a paragraph here about how distributing the one page AND the new intensivist priority.

Cost of Errors

A general estimation of the cost of these errors to the organization was calculated. Salary estimations for providers, pharmacists, and nurses in west Michigan were gathered from Salary.com. Average salary for a physician in west Michigan ranges from $175, 000 - $228, 000 per year. Average salary for a pharmacist in west Michigan ranges from $124,000 - $140,000 per year. Finally, the average hourly wage for a Bachelor's prepared RN in west Michigan ranges from $29.95/hour - $40.95/hour. With these averages in mind, total cost to the organization estimates were obtained. For the purposes of this project estimates for each discipline were applied based on the above ranges; physician salary was based on an average of $200,000 per year, pharmacist salary was based on an average of $130,000 per year, and the average hourly wage for a Bachelor's prepared RN was based on an average of $35.00. From these numbers an average hourly wage for each discipline was calculated; physicians at $96.00 per hour, pharmacists at $63.00 per hour, and nurses at $35.00 per hour as listed above. Likewise, an estimation of time taken to correct errors was based on a five-minute average per error.

Based on the seven weeks of data gathered regarding prescriptive errors, providers were responsible for 275 prescriptive errors, pharmacists were responsible for 13 errors, and nurses were responsible for 3 errors. Breaking down the wage per hour (60 minutes), each discipline was given an average wage per minute: physicians $1.60 per minute, pharmacists $1.04 per minute, and nurses $0.58 per minute. If each error takes approximately five minutes to correct, the cost per error for each discipline can be calculated: physicians $8.00 per error, pharmacists $5.20 per error, and nurses $2.90 per error. From these averages, the average cost per error for

each discipline over the seven-week time frame can be calculated: physicians $2,200, pharmacists $67.60, and nurses $8.70. The average total cost of these errors over the seven weeks is equal to $2276.30. This value divided by seven (for the seven weeks of data gathered) reveals an average cost of $325.00 per week. The estimated cost per year (52 weeks) to the organization for this type of error can then be calculated as $16,900 per year.

Change in Organizational Priorities

The upcoming transition to a new electronic medical record will occur at the end of January 2019 and has caused a shift in priorities within the organization for the time being. Many staff members have been allocated as super users for this new system and have been asked to step away from the general responsibilities of their positions to train and prepare. All staff are involved in this preparation and must attend classes to learn to utilize the new system. The focus on this transition has made the completion of some aspects of this project challenging. Post-data collection should occur eventually, but should occur when the organization is ready in effort to gather accurate data regarding the frequency of these types of errors.

Meetings with pharmacy leadership and the medical director for the intensivist program in the organization have transpired and an evaluation of the data with these individuals has been completed. The pharmacy leadership and the medical director have both committed to expanding efforts to prevent these errors in the future, and have been made aware of the process in place to continue to audit charts and follow-up with the individuals and provider services that are most often responsible for prescriptive errors. Likewise, clinical leadership on the inpatient floors have committed to follow-up with nurses responsible for administration and documentation errors that may occur. Although the change in priorities does present a challenge to the current project, future projects may develop with this foundation in place.

Discussion

      This data highlights the importance of correct and detailed CPOE in this organization. Although the frequency of errors appears very high, it does not appear that any patients came to harm as a result of these medication route errors. Providers and clinical staff have a responsibility to ensure safe patient care practices within organizations. A highly important safe practice is the caution and attention that is required when prescribing, administering, and documenting medications for patients who have diet restrictions.

      Moving forward, important aspects of this process change include continued chart audits to identify errors and close follow-up with providers and provider service groups who produce errors. Strong support of these providers and provider groups is needed to allow awareness of error rates and steps that can be taken to prevent medication route errors in the future. The data gathered reveals that specific focus on providers from intensivist, hospitalist, internal medicine specialist, family practice, and neurology groups will promote the prevention of errors in a tremendous way.

Limitations

      Limitations to this process improvement plan include a limited amount of time to collect data after the awareness education was completed. Data that may demonstrate meaningful change may not be available for months, and will require continued chart audits to identify fallouts and errors. Furthermore, the organizational focus is shifting to the planned implementation of a new electronic medical record system in January 2020. This shift in focus has caused some distraction, with good reason, on the part the key stakeholders involved in the project.

Likewise, if this project was to be completed again, data regarding how many enteral orders were written and by which provider/provider service would be collected as well. In doing so, a more accurate representation of the percentage of errors written by each provider service could be determined. As the Intensivist group within this organization are likely to have prescribed a greater number of orders in total, it is easy to determine that this group has written a greater number of errors in total. However, if data was available that was able to determine the percentage of errors in comparison to the total number of orders written for each group, other provider groups may in fact have greater percentages than the intensivist group.

Similarly, data regarding how many total enteral orders were written on weekdays vs. the weekends should be gathered if this project were to be completed again. In doing so, a better understanding of the amount of errors that occur on the weekday vs. the weekend could be gathered. With the current project, the number of errors gathered on the weekday appear too much greater than on the weekend. Assumptions can be made that the total number of orders written on the weekday is greater than the number of orders written on the weekend, and therefore this data is somewhat skewed.

Conclusion

Accurate medication prescription, administration, and documentation are essential practices for the delivery of safe patient care. This organization identified a specific problem with regard to these practices and has sought a solution to address the problem now and that will sustain into the future. Audits of patient charts highlight the severity of the problem of medication errors for patients with enteral tubes and diet restrictions. In an effort to provide awareness of the problem for clinical staff and to address the need for future evaluation of the status of the problem, increased awareness education and chart audits will continue. This plan

provides opportunities for nurses to engage in outcome-driven and leadership activities that will provide a sustainable solution to this problem. As identified in the review of the literature, frequent follow-up with providers and nurses will bring continued awareness of the problem within this organization and encourage changes in behavior regarding the prescription, administration, and documentation of medications for patients with enteral tubes and diet restrictions.

Implications for Practice

Implications for clinical practice include an improved and more efficient solution for monitoring medication route errors. Providers who are aware of the extent of which errors involving medication administration route occur are more likely to use caution when prescribing medications for patient with diet restrictions. This awareness will promote a decrease in the occurrence of these errors and promote patient safety. Further, a system that provides feedback to nurses and providers when errors do occur is an effective way to promote compliance.

Likewise, evidence to support prevention of medication route errors has been demonstrated through the cost savings to the organization that may occur. Prevention of medication route errors has been estimated to save the organization over $16,000 per year. Fiscal responsibility is an excellent example of the organization's core value of stewardship. Responsible utilization of resources, including human resources, speaks to the organization's pledge to provide effective and efficient patient care experiences.

Sustainability Plan

Maintaining the possible improved performance of providers in the prescription of enteral medications will continue to be necessary after completion of this project. New providers, residents, and medical students will need to incorporate appropriate prescription of enteral

medications into their practice for this population of patients. With this in mind, a process improvement strategy has been developed.

As CNL's were responsible for all chart audits and communication with providers and nursing staff after errors occurred in the past, a new process is recommended that will benefit patients, nurses, providers, and the clinical leadership. Nurses employed by the organization are offered clinical advancement opportunities for varying types of activities including leadership, professional development, educational opportunities, coaching/mentoring, and participation in quality improvement projects. Through completion of these activities, nurses are able to earn Clinical Advancement System points, or CAS points. Earning CAS points to advance professionally within the organization is encouraged, not only by personal development of the profession and improved quality of care for patients, but also with increased compensation. Nurses traverse through five levels of professional practice expertise within the organization. "The primary focus of the CAS is to ensure that each nurse is allotted opportunities for personal and professional growth across the continuum and to reward them for their talent" (XXXX, 2019j, p. 5). Level I nurses include novice nurses and new graduates. Level V nurses are considered experts in the field of nursing "whose intuition and skill are based upon comprehensive knowledge and experience" (XXX, 2019j. p. 7). Advancement through the levels is earned with time spent practicing in a clinical setting to gain experience and knowledge, and for Level IV and V nurses, completion of various activities to advance and/or sustain their level of competency.

Therefore, the proposed sustainability plan will involve a quality improvement activity designed around auditing charts for enteral tube medication errors and communication of this data to clinical leadership. Nurses will be given the opportunity to audit patient charts, using the

data collection tool, to detect these medication errors for a long-term outcome-driven project (at least 6 months) worth four CAS points. Nurses involved with this outcome-driven project will be required to complete four hours of inpatient chart audits per month, for at least 6 months, utilizing the data collection tool. Upon completion of the four hours of chart audits each month, data collection tools will be given to CNL's for review. Clinical leadership on the units (H2 and H3) will then follow-up with individual providers/provider groups regarding any medication prescription errors, and with individual nurses regarding any administration or documentation errors. This quality improvement activity will be offered to Level IV and V nurses, as well as Level III nurses wishing to advance to Level IV. If the activity is completed correctly, nurses will be granted points for their participation. As per the Clinical Advancement System Guidebook, and to support achievement and sustainment of Level IV or V clinical behaviors, nurses must write a clinical narrative describing the activity and how the activity affects outcomes within the organization (XXXX, 2019j, p. 32).

The data gathered via chart audits will be analyzed by CNLs and communication with providers or clinical practice leaders will occur if errors are detected. The communication will consist of a review of the problem, and the expectation that enteral tube medications will be prescribed appropriately according to each patient's diet/diet restrictions. This communication will also be used as a time to evaluate any barriers or special circumstances that may contribute to the occurrence of the error.

Initially, CNLs will be responsible for follow-up with nursing staff regarding administration and documentation errors that occur on the inpatient units. In the future, nurses involved in this outcome-driven project may be asked to communicate with nurses regarding medication administration and documentation errors as part of the CAS project. These activities

demonstrate nursing leadership and investment in patient outcomes with the potential to impact the entire organization. Success and improvement in prescriber behavior and patient outcomes on these two units, may inspire similar quality improvement projects throughout the rest of the organization.

In the future, opportunities for additional graduate projects may develop from this process improvement plan. Initiatives to develop a more advanced provider awareness campaign highlighting medication route errors, opportunities to improve communication between the inpatient pharmacy and clinical staff regarding patient diet restrictions, efficiency projects focused on length of time to correct medication errors, or development of a task force to prevent medication errors on the inpatient units are just a few possibilities. As the process improvement plan moves forward, graduate nursing opportunities will develop and require leadership to commence.

Of note, it is important to recognize that this project has made an impact on and will promote practice change in the future for the organization. Upon being made aware of the amount of errors that are made in regard to medication route prescriptions, the intensivist group within the organization has selected "correct route of medication administration" as their 2020 quality improvement goal. This work has highlighted a need for change in practice and has laid a foundation for additional quality improvement projects for this organization in the future.

Dissemination Plan

Although barriers do exist with the current project including time constraints and the pending transition to an alternate electronic medical record system, further opportunities to continue this work do exist. Using Lean principles further process improvement opportunities will arise. A root cause for medication errors for a particular population was identified, and a

process by which to prevent future errors from occurring was proposed. With this in mind, further projects may stem from this plan that may include investigation into other sources of medication/documentation errors, improved processes for clinical staff to communicate with providers, or development of educational materials to name a few. In the future, CNL's may examine the data post-implementation in an effort to determine the need for more graduate students and project ideas.

Similarly, the transition to a new electronic medical record system in January 2020 may inspire other challenges related to medication prescription, administration, and documentation. However, the development of a process improvement plan to detect medication errors that is not dependent upon a specific EMR system, and also provides nurses with opportunities for professional growth will aid in the navigation of future problems.

Reflections on DNP Essentials

The American Association of Colleges of Nursing define the purpose of the DNP Essentials is to "address the foundational competencies that are core to all advanced nursing practice roles" (AACN, 2006, p. 8). Within the eight core competencies identified by the AACN, the DNP student is guided in concentration and application by the particular role for which he/she is preparing. The preparation, implementation, and review of this process improvement project required concentration and application of several DNP Essentials.

DNP Essential II focuses on leadership in organizations and includes a focus on quality improvement and systems. By focusing on a quality improvement initiative, the process of evaluating medication errors for patients with restricted diets is achieved. Keeping in mind that "improvements in practice are neither

sustainable nor measurable without corresponding changes in organizational arrangements, and organizational and professional culture" this process improvement project provides opportunities to improve clinical practice within the organization as well as opportunities for professional development for nurses. Continued audits of inpatient charts will provide accountability and the chance to improve professional practice for clinical staff by encouraging a dialogue about medication errors and any barriers that exist in the prescriptive process. Likewise, the impact of medication errors on patient safety in the organization are addressed. Finally, professional development in the form of a CAS point activity allows inpatient nurses an opportunity to advance professionally and demonstrate leadership skills.

Essential III of the core competencies identifies the need for clinical scholarship and utilization of analytical methods to disseminate and integrate new knowledge to solve a particular problem. The development of this project began with the identification of a problem on two of the inpatient nursing floors in the organization. Prescriptive, administrative, and documentation errors caused the need for a great deal of rework for clinical leadership, nursing staff, and providers. Chart audits and follow-up with individual nurses, pharmacists and providers was very time-consuming for clinical leadership, in particular when trying to focus on the day-to-day needs of a busy inpatient unit. By recognizing this problem and the amount of waste and rework that the current process created, a new process was proposed.

Essential IV requires the DNP student to have knowledge of information systems and technology. "Knowledge and skills related to information systems/technology prepare the DNP graduate to apply new knowledge, manage individual and aggregate level information, and assess the efficacy of patient care technology" (AACN, 2006, p. 12). Understanding the limitations of the current EMR and the prospective new EMR did guide the development of this process improvement project. Neither system, present nor future, will allow the insertion of an alert in the chart to notify providers of a prospective conflict between the diet order and the medication route being prescribed. With this knowledge, an alternate plan was developed that would not be limited by a specific EMR system. This perspective is important for this organization in particular with the pending transition to a new system in January 2020.

Finally, interprofessional collaboration to improve health outcomes for patients and populations is Essential VI. The process improvement project requires the collaboration of many disciplines in order to be successful. Nurses, pharmacists, providers, and clinical leadership must all have a good understanding of the problem, and what steps are being taken to eliminate the problem. Without buy-in from all the professionals involved in prescribing, administering, and documenting medications, this problem cannot be addressed properly. Essential VI mandates that the DNP student be prepared to play an essential role in establishing interprofessional teams and practice effective leadership of these teams (AACN, 2006, p. 14). These are essential skills necessary for the success of the project.

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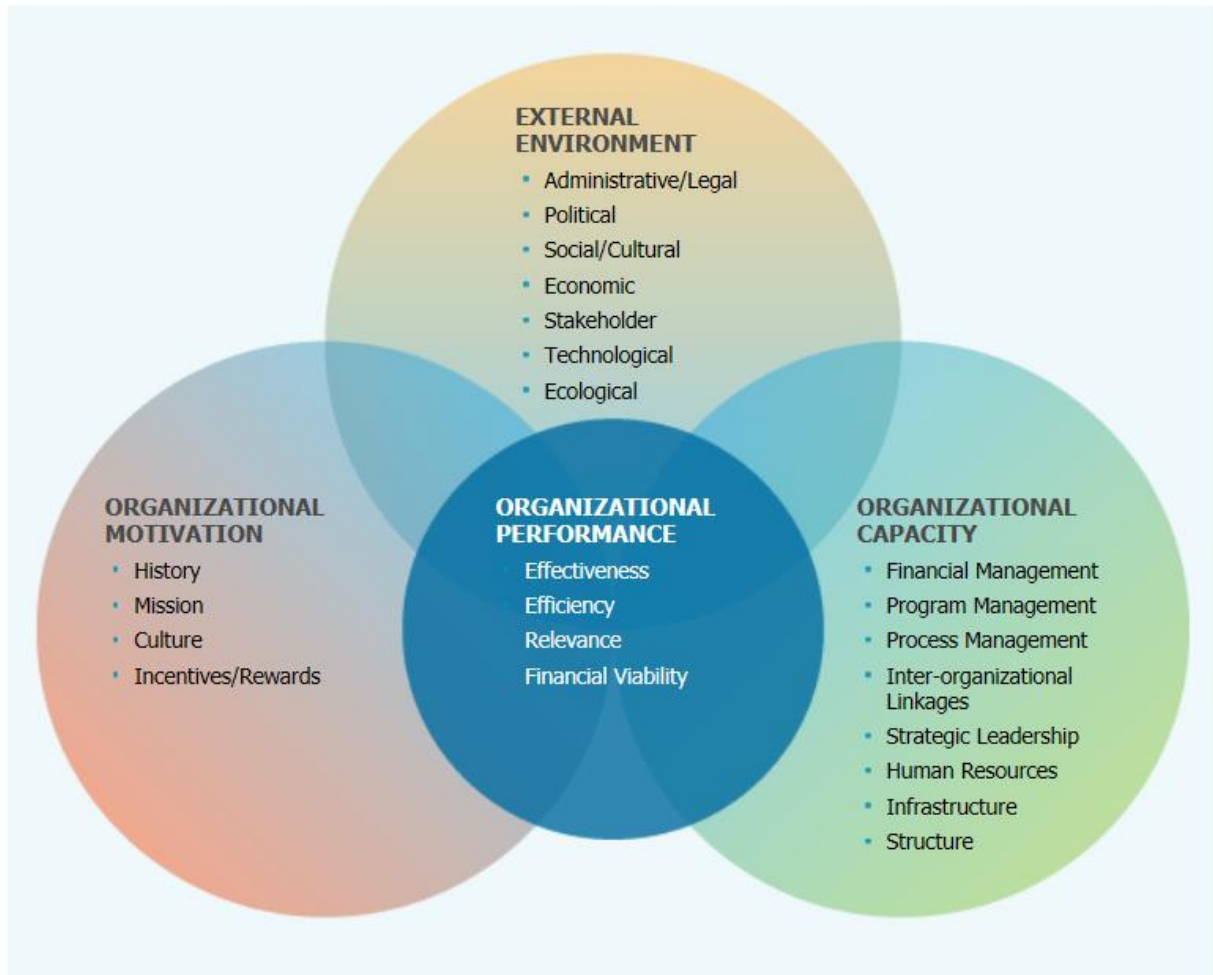
PROJECT DEFENSE

Appendices

Appendix A

Questions of the Lean Transformation Framework

1. What is the purpose of the change–what true north and value are we providing, or simply: what problem are we trying to solve?
2. How are we improving the actual work?
3. How are we building capability?
4. What leadership behaviors and management systems are required to support this new way of working?
5. What basic thinking, mindset, or assumptions comprise the existing culture, and are driving this transformation?
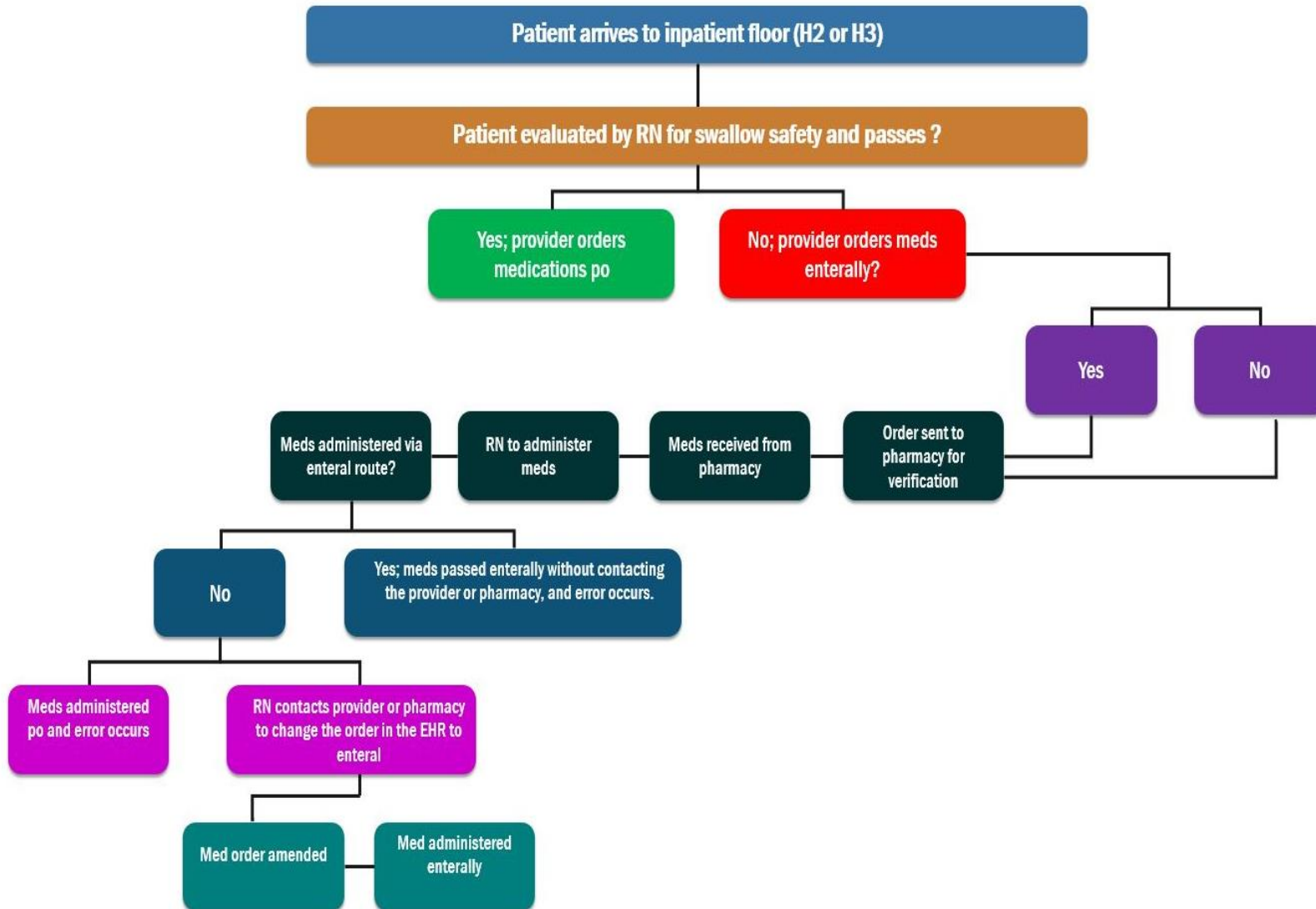
Lean Enterprise Institute, 2019.

PROJECT DEFENSE

Appendix B

Universalia Institutional and Organizational Assessment Model (IOA Model)

PROJECT DEFENSE

Appendix C

Current State Map

Patient arrives to inpatient floor (H2 or H3)

Patient evaluated by RN for swallow safety and passes ?

Yes; provider orders medications po

No; provider orders meds enterally?

Yes

No

Meds administered via enteral route?

RN to administer meds

Meds received from pharmacy

Order sent to pharmacy for verification

No

Yes; meds passed enterally without contacting the provider or pharmacy, and error occurs.

Meds administered po and error occurs

RN contacts provider or pharmacy to change the order in the EHR to enteral

Med order amended

Med administered enterally

PROJECT DEFENSE

Appendix D

SWOT Analysis

Strengths

- Organization is Magnet-recognized indicating highly qualified, motivated, and patient-focused nursing staff
- Focus on quality improvement
- Team approach (Comprehensive Stroke Certification)
- Patient-centered care
- Established Neuro/Stroke Program and Team
- Stroke Team meets monthly as a group and decisions are made regarding quality improvement and barriers to be addressed- very engaged team.

Weaknesses

- Inconsistent orders for nursing assessment and documentation and no standards per policy.
- Previous habits of nursing assessment and documentation may be difficult to break
- Variable factors involved that contribute to the problem:

1. **Physicians**: Pre-checked order sets default to po meds administration. There are too many administration choices for medications in the drop-down menu making the process clumsy
2. **Nurses**: Lack of physician education regarding the problem and this is the "source" of the issue. It's a "Systems Issue". There is no alert in the current system to remind the providers of the patient's diet restrictions when medications are being ordered. Providers are given too many choices for route administration when ordering medications.
3. **Pharmacists**: Inpatient pharmacy has no way of knowing in real-time what changes to diet restrictions have been made on the floor. There is no official system in place to notify clinical pharmacists on the unit that diet restrictions have changed and medication administration routes need to change as well. Unit clinical pharmacists are only on the units on Monday through Friday from 7am to 3pm.

Opportunities

- Possibility of influencing the prescriptive, administrative, and documentation processes with regard to the transition of EMR from Cerner™ to Epic™ in January 2020.
- Improve patient safety and satisfaction
- Improve satisfaction of process for clinical staff and leadership
- Improve efficiency within the workday for all staff involved with the reduction in the need for chart audits and amendments to charts when documentation is incorrect.

Threats

- Competing acute stroke providers in the west Michigan area
- How to ensure education of ALL provider staff that may come to the units and order medications?
- How to track conformity of staff to new protocol for medication prescription, administration, and documentation? What process is in place?
- Finding time to educate ALL providers.
- There are multiple providers. This makes it harder to keep track of the multiple groups that may be ordering medications on the units.

PRISMA 2009 Flow Diagram
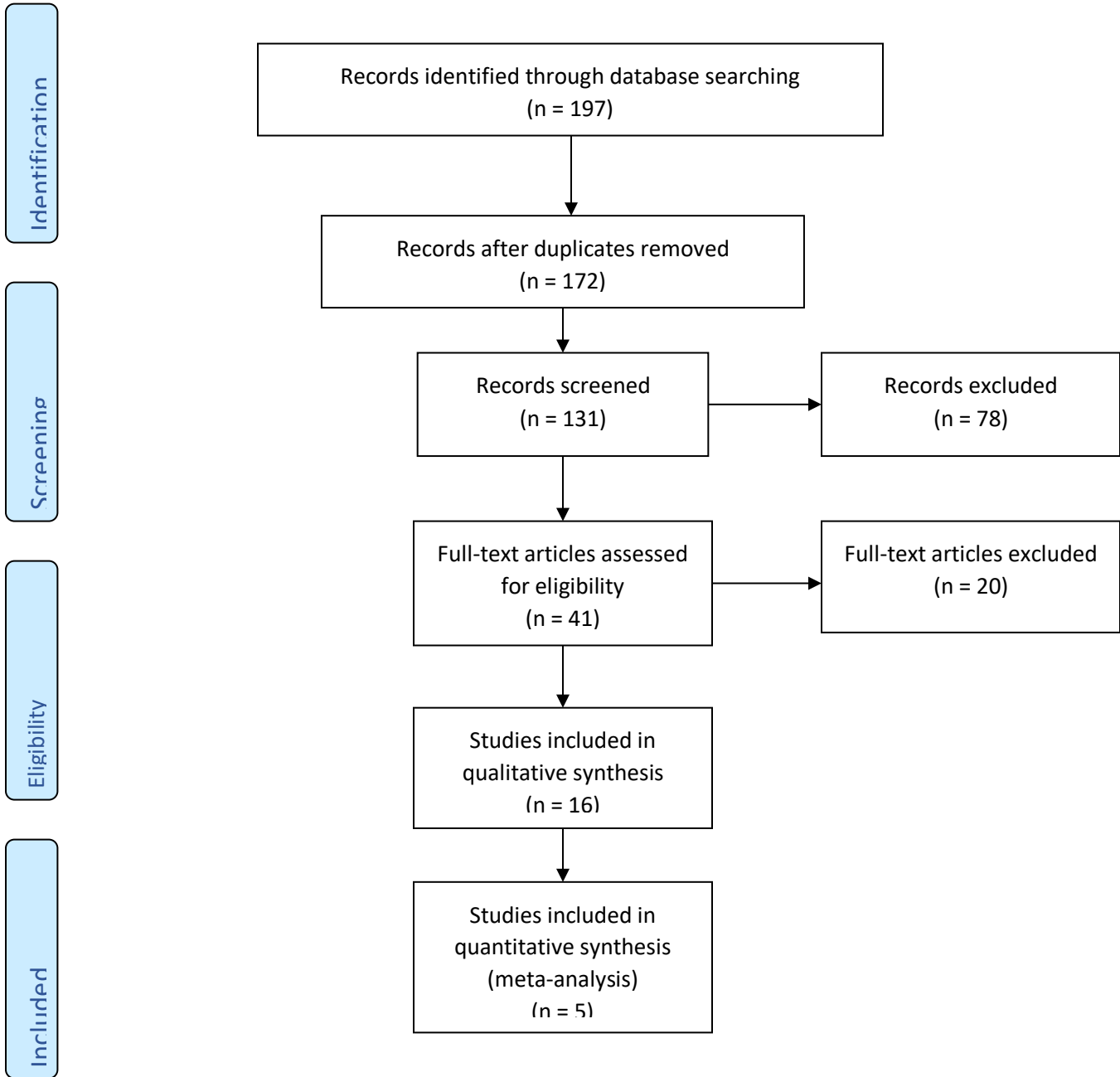
Appendix E: Flow diagram of search selection process. Adapted from "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement," by D. Moher, A. Liberati, J. Tetzlaff, D. Altman, and PRISMA Group. Copyright 2009 by PLoS Medicine.

PROJECT DEFENSE

Appendix F

Strategic A3

FOCUS: Get rid of re-work and waste related to medication prescription, administration, and documentation for patients with diet restrictions on H2 and H3

PLAN: Background	DO, CHECK, ACT
• Comprehensive Stroke Certification attained by organization • Magnet Certification attained	• Complete chart audits to determine the severity of the problem • Analyze collected data and display sensibly to make comprehension of the problem and severity clear. • Meet with key stakeholders (nursing leadership, physician leadership, and pharmacy leadership) to discuss results and findings of data collection. • Develop a plan to allow continuation of the chart audits and further follow-up of medication prescription errors • Meet with CAS leadership to gain approval of a long-term outcome-drive project for staff nurses to participate in to earn CAS points and pursue personal and professional goals within the organization.
Plan: Current Condition • Considerable rework required to track amend medication errors • No longer able to correct errors in current EMR, nor will the future EMR allow errors to be amended. • "Fall-outs" remain and leave organization at risk for citations from certifying bodies • Patient safety is at risk under current process. • Providers are not aware of the severity of the problem and the amount of rework it causes, how it places patient safety at risk, and the risk for losing recognition from certifying bodies due to the frequency/severity.	
Plan: Goal • Decrease the frequency of medication prescription errors. • Prevent cascade of errors that occur due to medication prescription errors.	**Follow-up and unresolved issues** • Transition to a new EMR has caused some distraction from the current problem • Post-implementation data should be collected in the future.
Plan: Root Cause Analysis • Lack of knowledge by providers related to the problem has exacerbated the problem • Poor understanding of the problem has led to the need for an education campaign.	

PROJECT DEFENSE

Appendix G

Data Collection Tool

Project ID: _____   Location of patient: H2: _____   H3: _____

Diet NPO, no exceptions beginning: Date_____   Time_____

Diet allows PO meds beginning: Date_____   Time_____

Total number of PO/enteral/OG/NG medications ordered: _____

Number of PO/enteral/OG/NG medications ordered with the correct route: _____

If there were any medications ordered with the incorrect route, when was the order placed? When did the prescriptive error occur?

Day shift (7am-7pm): _____   Night shift (7pm-7am): _____

Weekday (Mon-Fri): _____   Weekend (Sat-Sun): _____

If there were medications ordered with the incorrect route, who ordered the medication?

Provider: _____   Provider Service: _____

Nurse via verbal or telephone order: _____   Pharmacist: _____

If the order was corrected, who corrected it?

Name: _____   Date: _____   Time: _____

Corrected: _____   Discontinued: _____   Cancelled: _____

If there were any medications ordered with the incorrect route, were any doses administered to the patient?

Yes   No

PROJECT DEFENSE

Medication: _____

If "yes" list the date, time, and RN below

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Medication: _____

If "yes" list the date, time, and RN below

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Medication: _____

If "yes" list the date, time, and RN below

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Medication: _____

If "yes" list the date, time, and RN below

PROJECT DEFENSE

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Medication: _____

If "yes" list the date, time, and RN below

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Date: _____   Time: _____   RN: _____

Barriers/Special Circumstances:

_____

_____

_____

_____

- **Total number of enteral medications ordered includes orders for by mouth or via tube (Do not include IV, topical)**

- **Day shift is defined as errors occurring between 7am and 7pm**

- **Night shift is defined as errors occurring between 7pm and 7am**

- **Weekday is defined as errors occurring between Monday and Friday**

- **Weekend is defined as errors occurring on Saturday and Sunday**

PROJECT DEFENSE

Appendix H

Sample Table to Predict Time and Cost Savings				
Provider time to enter an order	5 minutes times amount provider may make per hour, multiplied by the number of med orders	Total in $$		
Provider time to amend an incorrect order	5 minutes multiplied by the number of errors entered.	Total in $$		
RN time to contact provider through doc Halo to amend order and wait for order to be corrected before medications can be administered to patient	5 minutes multiplied by the number of errors	Total in $$		
Pharmacist time to amend the incorrect order if provider does not respond to doc Halo page.	However long it takes to fix it times number of errors	Total in $$		
TOTAL		Total costs pre-implementation		
Estimated Post-implementation Expenses/Resources				
Provider time to enter order	5 minutes times amount provider may make per hour, multiplied by the number of med orders	Total in $$		
Provider time to amend an incorrect order	5 minutes multiplied by the number of errors entered.	Total in $$		
RN time to contact provider through doc Halo to amend order and wait for order to be corrected before medications can be administered to patient	5 minutes multiplied by the number of errors	Total in $$		
Pharmacist time to amend the incorrect order if provider does not respond to doc Halo page.	However long it takes to fix it times number of errors	Total in $$		
Total		Total costs post-implementation		

*Cost savings determined by totals from the old process minus the totals from the new process.

PROJECT DEFENSE

Appendix I

Measures for Project

LTF Element	How measured (tool, survey, variable)	When measured	Who measures
Process Improvement			
Management System			
Capability Development			
Value-Driven Purpose			

Appendix J

Total Enteral Orders Written Data

Orders Written Correctly	Orders Written Incorrectly
685	291

Summary of Orders over a Seven Week Time Frame (9/1 to 10/13)

Total Orders: 949

Correct Orders: 685

Incorrect Orders: 291

Total Enteral Orders over 7 Weeks

31%

69%
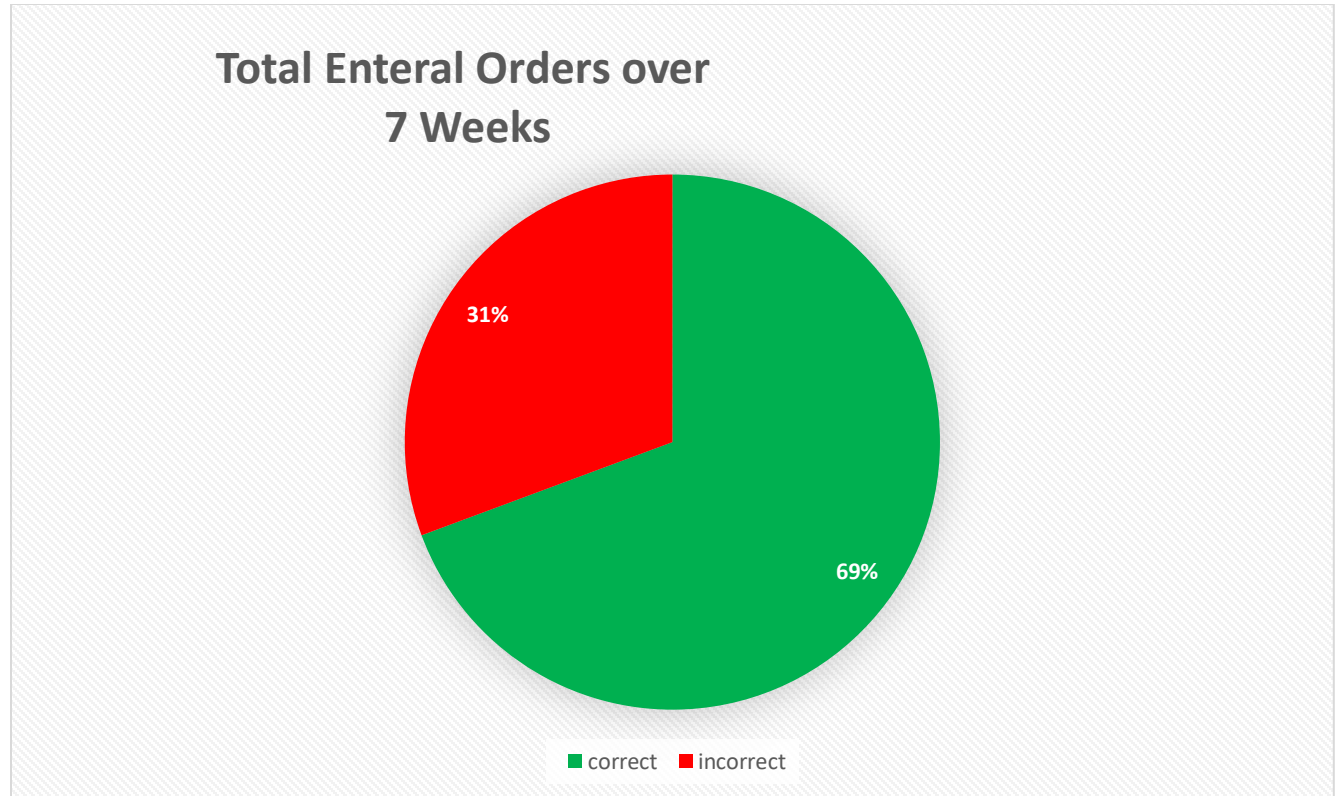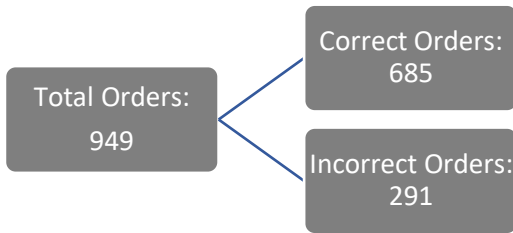
correct   incorrect

Appendix K

Order Errors Data by Week

Week	Total Orders	Correct Orders	Incorrect Orders	Daytime Errors	Night Errors	Weekday	Weekend	Physician	Pharmacy	RN	Errors to Patient
9/1/19	135	89	46	44	2	42	4	46	0	0	54
9/8/19	125	97	28	17	11	24	4	28	0	0	22
9/15/19	159	107	52	28	24	47	5	46	4	2	69
9/22/19	114	78	36	16	20	34	2	34	2	0	238
9/29/19	21	10	11	11	0	9	2	11	0	0	7
10/6/19	197	135	62	44	18	41	21	59	2	1	54
10/13/19	198	142	56	29	27	46	10	51	5	0	65
7-week totals	949	658	291	189	102	243	48	275	13	3	509

Note. Individual errors that reached the patients totaled 509 errors. Errors that reached each individual patient at least once totaled 213.
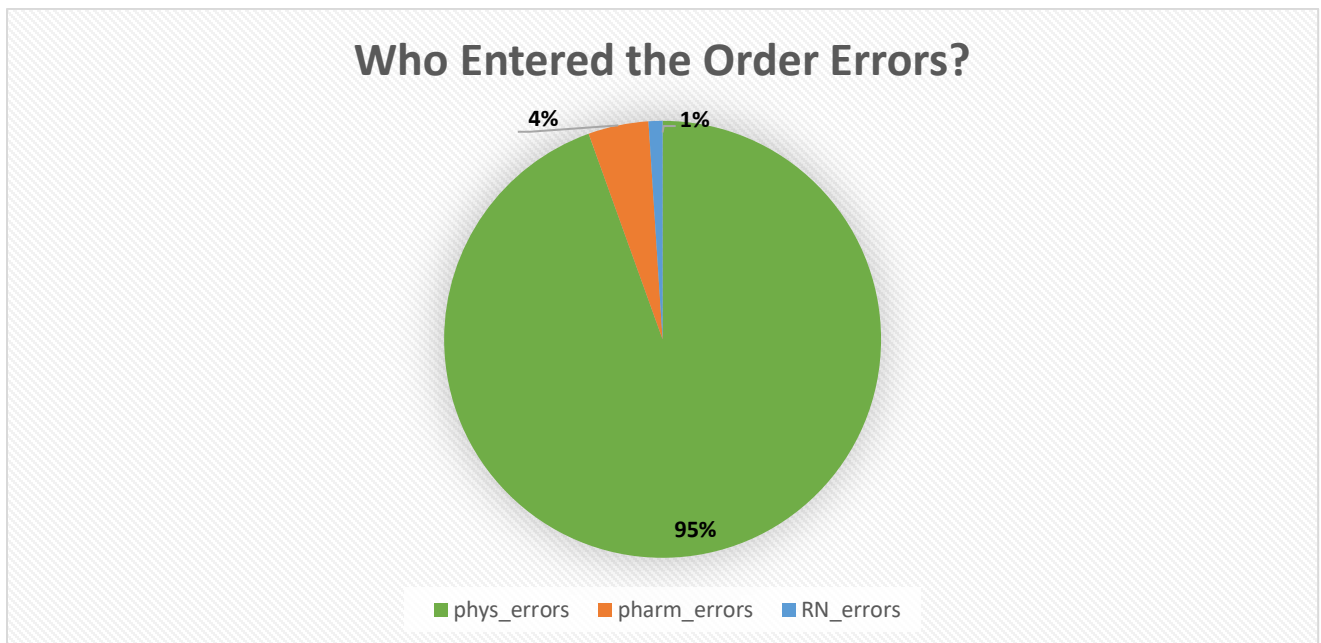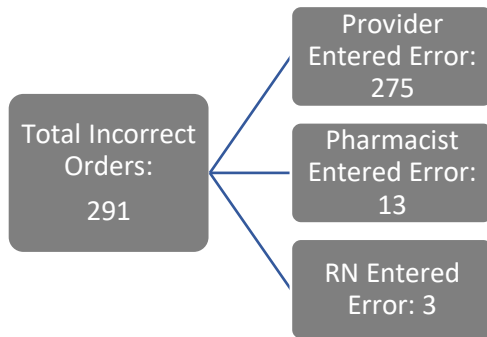
Order Errors Data by Week
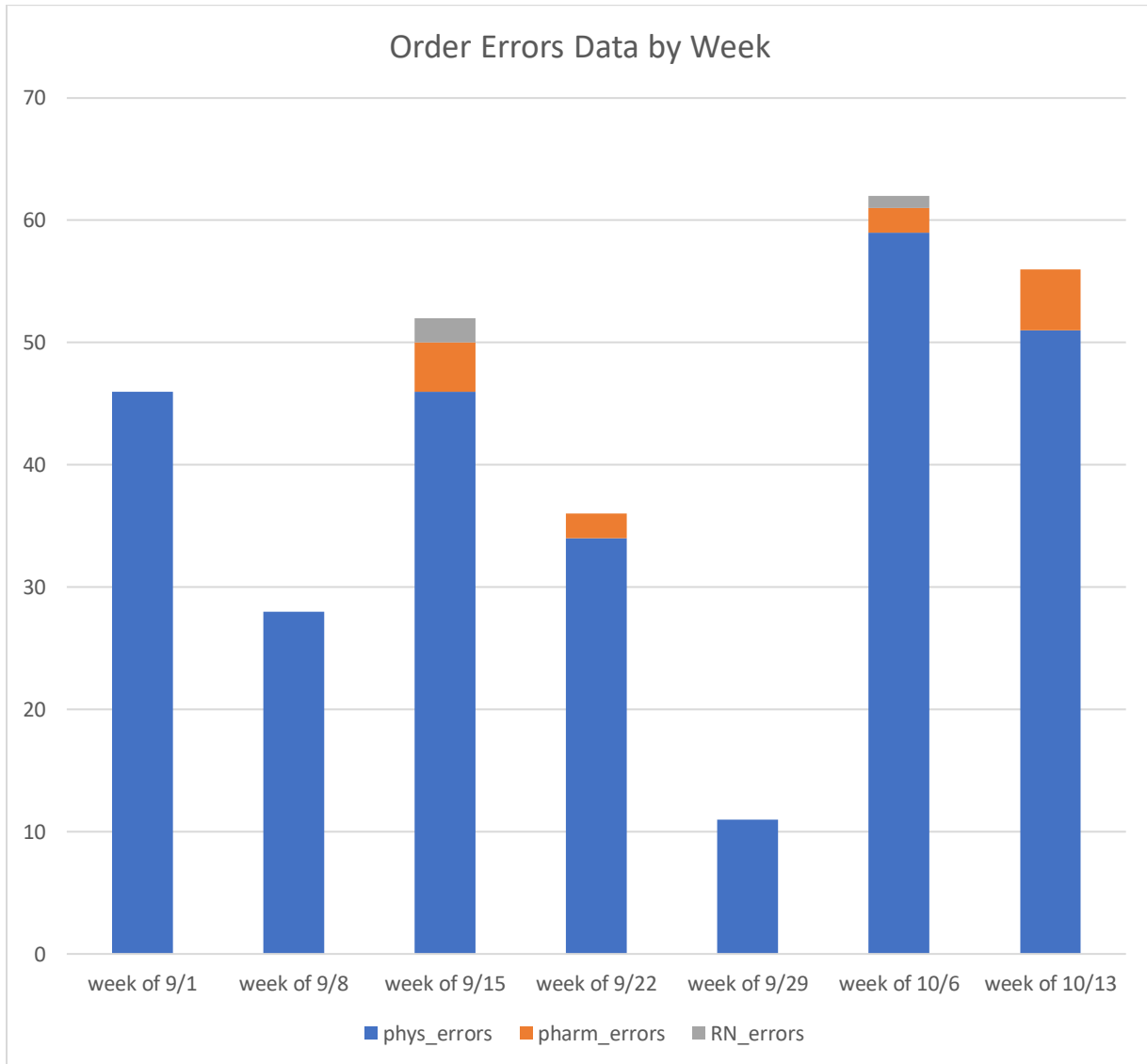
PROJECT DEFENSE

Appendix L

<div align="center">Total Errors by Discipline</div>

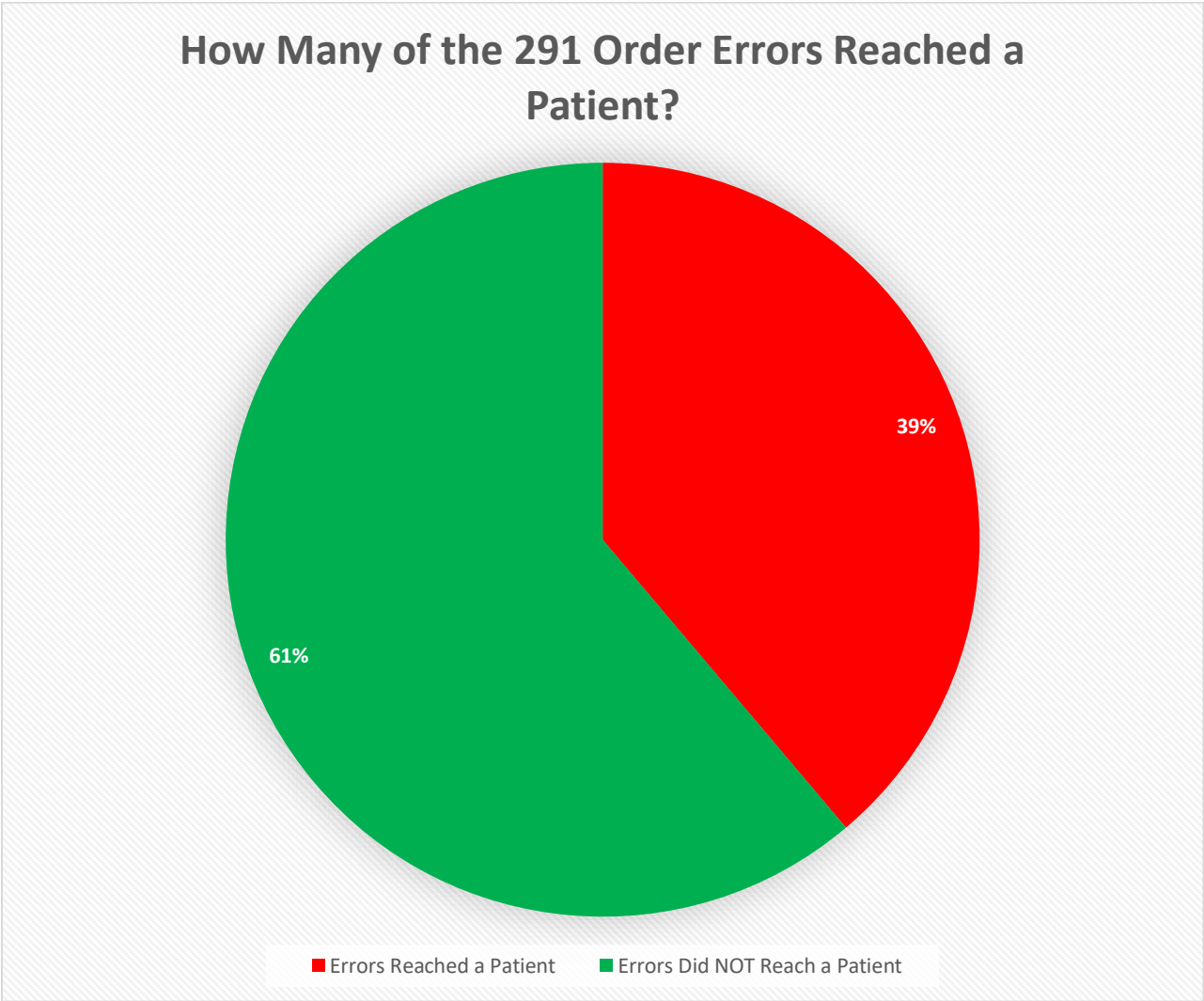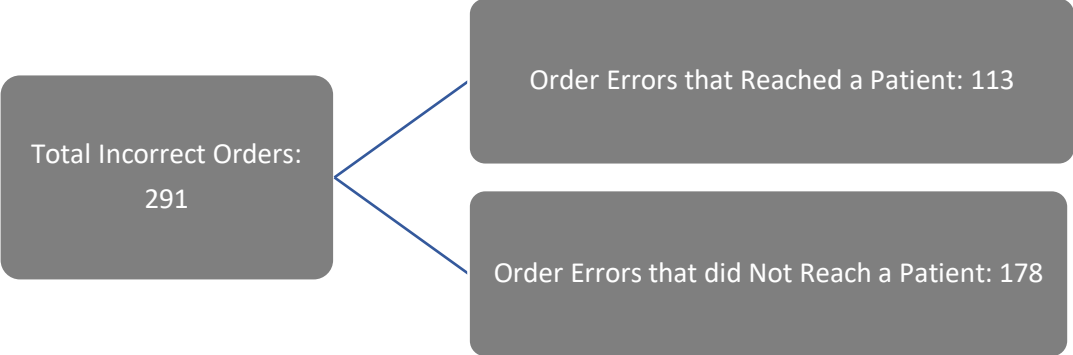|	
Provider Errors	275
Pharmacy Errors	13
Nursing Errors	3

Note. There was a total of 291 errors. Breaking the errors down by discipline demonstrates that the vast majority of errors were provider errors.

Total Errors by Discipline

PROJECT DEFENSE

Appendix M

Summary of How Many of the 291 Order Errors Reached a Patient

Total Incorrect Orders: 291

Order Errors that Reached a Patient: 113

Order Errors that did Not Reach a Patient: 178

How Many of the 291 Order Errors Reached a Patient?

39%

61%

■ Errors Reached a Patient ■ Errors Did NOT Reach a Patient

Appendix N

Errors by Provider Service

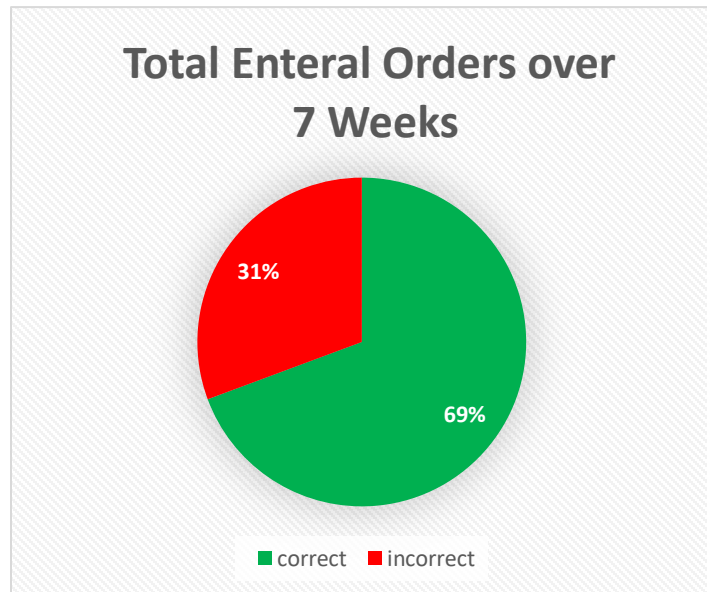|	
Intensivist	78
Hospitalist	47
Internal Medicine	26
Neurology	22
Family Practice	22
Pulmonology	17
Palliative Care	13
Vascular Surgery	6
Bariatrics	5
G.S.	5
Anesthesiology	4
Infectious Disease	2
Neurosurgery	1
ENT	1
Unable to Identify	26

Note. Some providers could not be identified in the organization's directory and have been placed under the Unable to Identify category for this reason.

ERRORS BY PROVIDER SERVICE

- Unable to Identify — 9%
- Other — 9%
- Palliative — 5%
- Pulmonology — 6%
- Family Practice — 8%
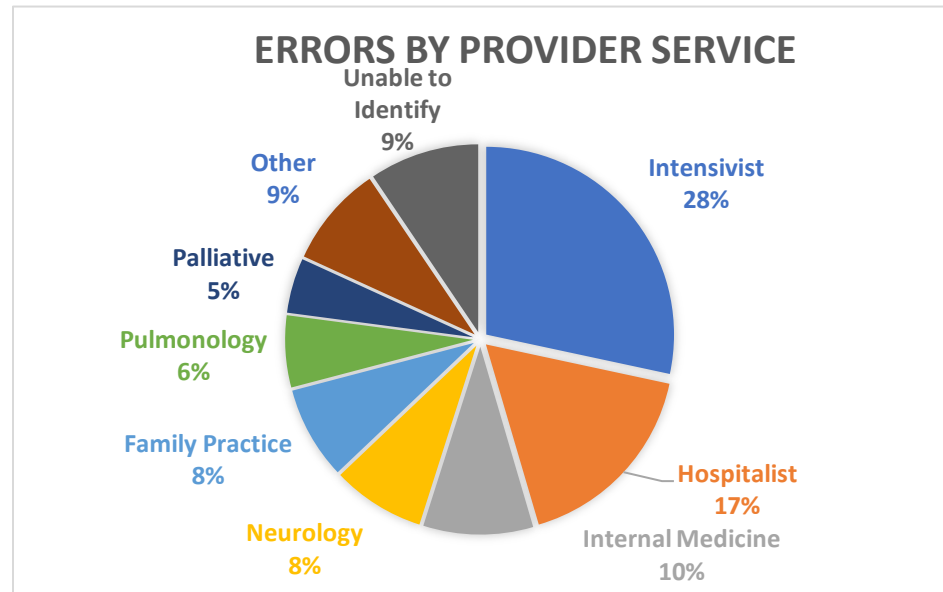- Neurology — 8%
- Intensivist — 28%
- Hospitalist — 17%
- Internal Medicine — 10%
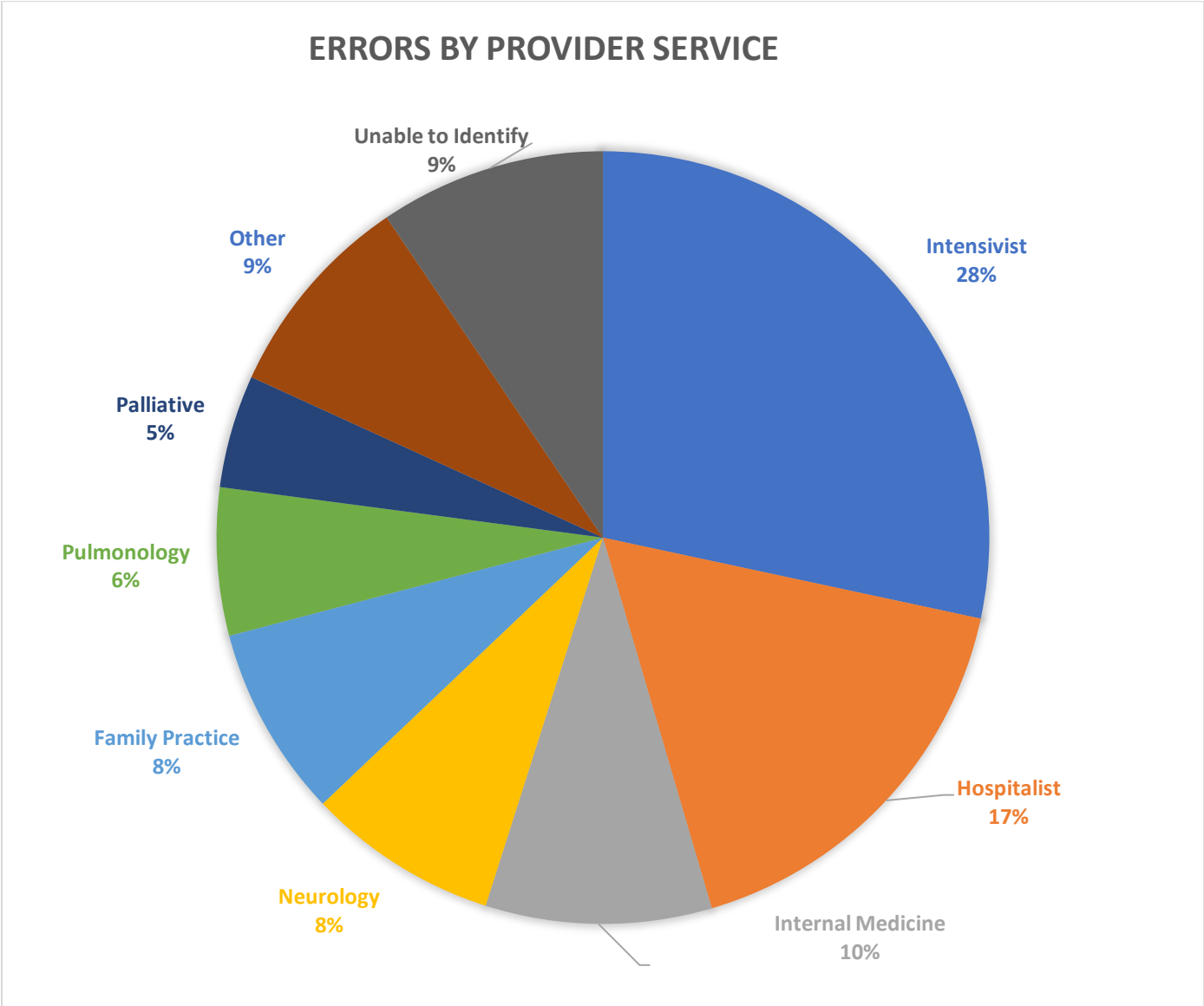
*Other includes vascular surgery, bariatric, G.S., anesthesiology, infectious disease, neurosurgery, and ENT

PROJECT DEFENSE

Appendix O

Prescription Errors Place Patients with Diet Restrictions at Risk!

*DATA GATHERED OVER 7 WEEKS FOUND THAT 275 ERRORS WERE PRESCRIBED TO PATIENTS WITH NPO STATUS

Total Enteral Orders over 7 Weeks

31%

69%

■ correct ■ incorrect

ERRORS BY PROVIDER SERVICE

Unable to Identify 9%

Other 9%

Palliative 5%

Pulmonology 6%

Family Practice 8%

Neurology 8%

Intensivist 28%

Hospitalist 17%

Internal Medicine 10%

*Total orders compared to errors entered   ***Errors by provider service**

IN AN EFFORT TO PREVENT ERRORS FROM OCCURRING AND TO MAINTAIN PATIENT SAFETY, PLEASE BE SURE TO CHECK YOUR PATIENT'S DIET RESTRICTIONS BEFORE PLACING A MEDICATION ORDER TO ENSURE THAT THE MEDICATION WILL BE ADMINISTERED VIA THE CORRECT ROUTE.

Data was gathered on H2 and H3 as part of a QI and process improvement project for Mercy Health Saint Mary's and a DNP project for GVSU.