12-12-2014

Implementing and Evaluating a Clinical Information Interface between an Electronic Medical Record and a Patient Classification System

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Abstract

As a result of the Affordable Care Act and the Institute of Medicine's initiatives, hospitals are challenged to improve outcomes as efficiently as possible. How does the national initiative of RNs partnering with other healthcare professionals to improve the quality of patient care at a lower cost, cascade down to individual organizations? One answer may come by focusing on nurse staffing in acute care hospitals. Considering the impact RNs have on patient quality outcomes and the bottom line of hospitals, appropriate management of the RN workforce is one of the most important areas hospitals can focus on in order to meet the goals of ACA and the IOM.

The aim of the project is to create and implement a clinical information interface between two software solutions, by different vendors, that allows electronic medical record (EMR) data to provide source data for the patient classification system (PCS). The end result will be a classification system that is fully automated. The creation and implementation of a clinical interface between software solutions from different industry partners is a very new and innovative approach for advancing the use of software. No template for this work is available. This computerized information interface (CII) will allow Nurse Managers to use timely, accurate and consistent data to make informed decisions to manage the nursing workforce in the in-patient setting.

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Introduction

Background Knowledge

Signed by President Barrack Obama in March of 2010, the Patient Protection and Affordable Care Act (PPACA) was enacted with the goals of improving the quality and affordability of health insurance, decreasing insurance rates and lowering cost of healthcare for individuals and the government. The PPACA's anticipated outcomes include value-based purchasing, financial incentives to hospitals for improving the quality of care, publically reporting performance and bundled payments (Key features of the PPACA, 2014); resulting in the challenge hospitals now face: to improve quality outcomes while reducing expenses.

The 2011 Institute of Medicine's report on The Future of Nursing (Institute of Medicine, 2011) suggested registered nurses (RN), as the largest component of healthcare workers, with over three million in the United States (US), must play a vital role in helping realize the objectives of the PPACA. Nurses must partner with other healthcare professionals in the effort to redesign the US healthcare system and be accountable for their own contributions to deliver high-quality care as efficiently as possible.

How does the national initiative of RNs partnering with other healthcare professionals to improve the quality of patient care at a lower cost, cascade down to individual organizations? One answer may come by focusing on nurse staffing in acute care hospitals. The relationship between appropriate nurse staffing levels in hospitals to improvements in quality of patient care, nurse engagement and patient satisfaction has been well documented (Aiken, Clarke, & Sloane, 2002). Additionally, RNs have a significant relationship with the cost of care. Labor costs eat up over 50% of the revenue in hospitals (Herman, 2013), with the majority of that cost going to RN labor. Considering the impact RNs have on patient quality outcomes and the bottom line of hospitals, appropriate management of the RN workforce is one of the most important areas hospitals can focus on in order to meet the goals of ACA and the IOM.

Influencing factors

Nurse to patient (RN: PT) ratios and staffing to acuity are methods of attempting to appropriately staff for positive patient outcomes. RN: PT ratios have been introduced into legislation in an effort to prevent understaffing in hospitals and improve patient outcomes. In

1999, Governor Gray Davis signed RN staffing ratios into law, making California the first state in the nation to require mandatory RN: PT ratios in all acute care facilities. Five years later, in 2004, after a long fight, the law was implemented (Coffman, Seago, & Spetz, 2002). A study published in 2010 compared patient outcomes in the state of California, with RN: PT ratios and Pennsylvania and New Jersey, states without mandated ratios. The study linked lower RN: PT ratios to significant lower likelihood of in-patient, preventable and surgical deaths (Aiken et al., 2010). Conversely, studies have indicated correlations between outcomes and RN: PT ratios (Bolton et al., 2007). RN: PT ratios ensure RNs are not assigned more than a specific number of patients and has shown to be beneficial in organizations with the practice of assigning large numbers of patients to RNs. The reality is that in-patient nursing units in the acute care setting are complex, dynamic environments where patient care needs is highly variable. Staffing decisions based solely on RN: PT ratios are likely to result in less efficient staffing and could have a negative impact on patient outcomes. Mandating ratios may help improve care by limiting the number of patients each nurse is assigned. However, appropriate workforce management must take into consideration more than numbers of nurses and patients. Strategies, processes, tools to maximize productivity, containing labor costs and ensure compliance with labor rules, laws and contracts are needed in order to effectively manage the RN workforce and are much more complicated than mandated staffing ratios. Lombardi, (2013) describes the primary pressures driving workforce management initiatives in today's businesses include marketplace demands for a workforce that is flexible (i.e. change staffing ratios), rapidly changing business conditions that require ready access to data to drive decision-making and economic conditions that require improved control over labor costs.

A component of RN workforce management is the skill mix and number of nursing staff required to safely provide patient care and can be referred to as acuity. As early as the 1950s, researchers have attempted to develop methods to provide an accurate number of nurses required to provide safe and quality care (Abdellah & Levine, 1954). Every patient has different needs and in order to determine the number of nurses required, patients need to be classified by needs and the time required meeting those needs. To define as simply as possible, patient classification systems (PCS) is a workforce management tool used to match the supply (RN numbers and time available to provide care) to the demand (of the patient, in terms of care needs). PCS attempts to measure the work the nurses must do to maintain patient safety and predict patient requirements

for care; the acuity. Determining the number of hours for care required in order to provide safe patient care is the goal of a PCS (Malloch, 2012). Most organizations use some PCS methodology, whether home grown or purchased, paper or electronic, in order to generate a guide to staff each day. If a consistent, reliable PCS were available, hospitals would be a step closer to meeting the national initiative of decreasing costs and improving patient outcomes.

Local Problem

RN: PT ratios and traditional PCS are helpful in the effort to determine appropriate staffing because they solve part of the puzzle by limiting the maximum number of patients assigned to each nurse. Staffing ratios are not the entire solution; however, as every patient's needs are different. One RN with five patients may have quite a different workload than another RN with five patients, therefore ratios and the acuity should be used in tandem when staffing. RN: PT ratios can be considered the foundation for long term scheduling while the acuity provides essential information for shift staffing.

Classifying patients by their needs moves a step closer to determining the appropriate number of nurses required for patient care. Either on paper or electronically; accuracy, consistency and timeliness are required to ensure the data entered into the PCS will provide reliable information to make projections for staffing that enhance patient safety and are cost effective. *Accuracy* requires that nurses entering data have the knowledge of and clearly identify all care needs required by the patient in the upcoming time period, for example, the number of RNs required for the next shift. Errors affecting accuracy include the nurses' knowledge deficit regarding all the patient care needs, for example, the RN is not aware that a physician wrote an order for additional medication. The knowledge deficit may be related to mental lapse or lack of awareness of new orders or a change care the patient needs.

Consistency requires each patient have data, regarding needs, entered into the PCS. Errors may occur if patients are omitted, for example, one RN assigned to care for three patients does not enter the data into the PCS. With data of three patients missing, inaccurate staffing decisions could be made. Errors of omission may occur if a RN is busy and did not have the time to enter the data. Errors can also occur if nurses enter data inaccurately in an attempt to increase staffing levels.

Timeliness requires that the PCS data is entered prior to the time staffing decisions are made. In order to make staffing decisions for the upcoming timeframe, organizations typically

assign a time for data to be entered into the PCS. In order to accurately project the number of RNs required, all patients must be rated and all data must be entered before a specific time. Timeliness errors may occur when the data is entered after the identified deadline or after staffing decisions are made.

Traditional PCS, either on paper or electronic, require the RNs to enter the data, thus increasing the odds of errors in consistency, timeliness and accuracy. Entering data into the PCS is not exceptionally time consuming, never the less, adds to the RN's workload and may take time away from patient care. Even if all patient data is entered by the specified time, the information provided is for a specific point in time and can't account for changes in patient condition, patient flow or additional orders that occur after the time of data entry. PCS takes the patient's condition into consideration, improve accuracy of staffing decisions and are better than RN; PT ratios alone; yet opportunities for improvement remain.

Predicting the volume and complexity of work and matching it up to the right staff ratio can be complicated and time consuming. When variables are added such as differing skill and experience levels, and staff absences the challenge is even more complicated. To achieve the balance of providing high quality care at an affordable cost, hospitals must be sure to match the right number of nurses to the number of patients requiring the care. Staffing by using current practices has shown gains in staffing accuracy; however, more can be done. Limiting these barriers of the traditional PCS is one way to improve staffing accuracy in hospitals.

Salinas Valley Memorial Hospital (SVMH) is a 252 bed acute care hospital, located in California's Central Coast. SVMH has utilized an electronic medical record (EMR) to capture information about patient's status for decades. The EMR includes the documentation of the care the RN and other healthcare professionals provide to each patient and include computerized physician order entry (CPOE) and electronic medication administration records (eMAR). Each shift, busy nurses must turn their attention away from their patients to enter data into the PCS; data that is used to assist nurse managers, staffing clerks and administrative supervisors to make staffing decisions for the upcoming shift. SVMH utilized a purchased, electronic PCS which required RNs to manually enter data, by a specific time each shift. That information was then to be used, by the Staffing Office clerks, Nursing Supervisors and Managers to make staffing decisions for the upcoming timeframe. This process was in place for approximately two

years. The results were minimal compliance by the RNs to enter the data accurately, consistently and timely and no one used the PCS to make staffing decisions.

This author was designated the project lead for SVMH's PCS approximately eighteen months ago. As part of gaining an understanding the PCS the author conducted assessments of the system, the RNs who entered the data and the managers who were to make staffing decisions, based on the PCS. Results of the PCS assessment included the following: compliance rate was 38%, frequently the RNs reported the data inputted were inaccurate and just as often the data were entered later than the time required to make staffing decisions. RNs and managers were assessed via survey Appendix A (End User Questionnaire). RNs, who provided direct patient care in the different specialty areas, were referred to as DCPs in order to differentiate from other RNs (such as managers and informaticists). Most responses by the DCPs identified obstacles to timeliness, accuracy and consistency and included requesting not to have to log out of on application (EMR) and into another (PCS) and back again. This was the rationale provided by most DCP for low compliance rate. Nurse Managers/ Supervisors requested a way to have accurate data, in order to make reliable decisions. The current situation resulted in poor user satisfaction and efficiency with the PCS.

Intended Improvement

Triggers for the change

Primary triggers for the change were the hope to leverage technological advancements to meet the requests of the end user (DCPs and Nurse Managers/ Supervisors) and breakdown the obstacles to timeliness, accuracy and consistency. The primary request of the DCPs was to automate the PCS. Automating the PCS would remove barriers regarding accuracy, compliance and timeliness of data entry, decrease the DCPs' workload as well as provide real time information for Nurse Managers/ Supervisors to base staffing decisions.

Technology has advanced in everyday life, improving communications, research, shopping, entertainment and travel. Technology has also had an impact in health care. The late 1960s and early 1970s saw the introduction of technological solutions within hospitals in accounting and finance. In the 1980s, computerized nursing documentation systems began to emerge. Between 1990-2013 technological solutions available to hospitals has increased at an alarming rate and include smart intravenous pumps, eMAR, bar coding medications, CPOE, electronic documentation systems and picture archiving and communication systems (PACS).

As a consequence of these advancements, healthcare reform advocacy groups and governmental agencies have urged the advancement of healthcare information technologies (HIT). By 1999, the Institute of Medicine (Institute of Medicine, 2000) study, To Err is Human, had recommended the use of CPOE as a strategy to decrease medical errors. In 2008 a report by the Congressional Budget Office states CPOE can reduce prescribing errors by 95%. In addition to patient safety, expectations of the consistent use of HIT includes improvement in quality of care and patient satisfaction, decreasing the expense of care, maintaining a healthy workplace environment an improving staff engagement. The Health Information Technology for Economic and Clinical Health Act (HITECH) was signed into law by President Barrack Obama in 2009. The HITECH Act provided $17 billion of Medicare and Medicaid funding for adopting HIT prior to 2015 (Gordon, 2009).The accelerated rate of advancing technology, the encouragement of advocacy groups and governmental incentives has resulted in technology implementation in hospitals now being the norm and allowed for the opportunity to link the EMR and the PCS.

Project aim

A change project will be implemented to improve the timeliness, accuracy and consistency of the PCS. The aim of the project is to create and implement a clinical information interface between two software solutions, by different vendors, that allows EMR data to provide source data for the PCS. The end result will be a classification system that is fully automated. DCPs will no longer be required to enter data into the PCS and timely, accurate and consistent, patient data will be available for decision-makers to determine acuity, allowing for accurate staffing decisions and equitable assignments.

Malloch and Meisel (2013) state reliability, validity and sensitivity are requirements of an effective PCS. The PCS, implemented at SVMH in 2011, required the DCP to manually enter the data in order to obtain the level of acuity. Compliance with manual data entry averaged 38%, as most DCPs chose not to enter data into the PCS. As a result of low compliance, the data from the PCS was not reliable; subsequently, a staffing matrix, based on census was utilized to staff units. Leaders at SVMH recognized the value of the PCS, but needed to develop a reliable method of inputting the data. The CII, an automated of data entry solution, was the innovation implemented to eliminate poor compliance and other barriers to optimal use of the PCS.

To achieve the project goal a series of conditional and logical expressions that interprets clinical charting, physician order, and medication administration data and translates this information into one of five intensity levels for each of the eight PCS care categories (Cognitive, Self-Care, Emotional/Social/Spiritual, Pain & Comfort, Family, Treatments & Procedures, Transition, and Care Coordination) must be developed. The process is called Clinical Information Interface (CII).

Review of the Evidence

While interfaces between products are common in the industry, clinical interfaces within PCS solutions are not. No template for this work existed. It is for that reason, the literature review focused on general topics around PCS and technology acceptance. The following key words, as individual terms and combination, were used in the literature review: Nurse to patient ratios, patient classification systems, acuity, acuity and patient outcomes, nurses' acceptance of technology and nurse staffing. Search parameters included articles in English that were published within the last five years. In assessing the research the following four areas stood out: RN: Pt ratio, acuity related to patient outcomes, technology and technology acceptance by nurses and patient classification systems. For a summary of the evidence, please refer to Appendix B (Evidence Table).

Nurse to patient ratios

Studies attempting to understand the impact of California's RN: PT ratio are non-experimental, comparing like datasets before and after the legislation was put in place. Studies targeted in the evidence review focused on assessing the commonly used data sets, determining if the legislation had the desired impact (increasing the number of RNs in acute care hospitals) and if a positive relationship exists between mandated RN: PT ratios and outcomes.

Aiken, et al. (2010) compared RN workloads across three states; examining how RN staffing and patient outcomes, including patient mortality and failure-to-rescue, are affected by the differences in RN workloads across the hospitals of the three states. To perform the comparison, the researchers used surveys two years after the start of the mandatory ratios. Nearly 80, 000 RNs in California, New Jersey and Pennsylvania participated in the survey. Principal findings were California hospital RNs cared for one less patient on average than nurses in the other states and two fewer patients on medical surgical units. Lower ratios are associated with

significantly lower mortality. When RNs' workloads were the same as the California-mandated ratios in all three states, RN burnout and dissatisfaction on the job were lower and the RN's believed the quality of care was improved. The study concluded that the California-mandated, hospital RN: PT ratios are associated with lower mortality and patient outcomes and are predictive of improved RN retention rates. The researchers point out that data obtained regarding workloads was derived from self-reporting and may be prone to biases, however, prior research by the same researchers, using the same methods have shown the results to be predictable and accurate.

Bolton et al., (2007) used post-mandated ratios data from 2004 and 2006 to conduct a study in order to assess trends in staffing and outcomes two years after the implementation of California-mandated RN: PT ratios. The authors compared the California Nursing Outcomes Coalition (CalNOC) data from 252 medical surgical and step down nursing units, in 108 hospitals, representing greater than 500, 000 patient days to determine the difference between pressure ulcers, nurse staffing and patient falls before and after RN: PT ratios. The study was not able to establish a positive relationship between improvements anticipated in RN-sensitive patient outcomes.

Mark, Harless, Spetz, Reiter, & Pink's, (2013) studied whether, following implementation of California's RN: PT ratio legislation, changes in acuity-adjusted nurse staffing and quality of care in California hospitals outpaced similar changes in hospitals when compared with states without mandated ratios. Data from multiple, reputable sources were used to group hospitals into quartiles based on staffing levels before the mandate. Comparison of the staffing levels and quality of care between California hospitals over the same time period in hospitals and 12 comparison hospitals without ratios was undertaken. With a few exceptions the study found, post-regulation, California's RN staffing had increased significantly over the comparison hospitals; mixed effects were noted on quality.

Spetz, Donaldson, Aydin, & Brown, (2008) examined two commonly used datasets and unit-based data to compare nurse staffing measurements and assess the relative strengths and limitations of each measure. The authors used primary and secondary data from the American Hospital Association, California Office of Statewide Health Planning and Development, CalNOC and the California Workforce Initiative Survey in this non-experimental study. The

study concluded unit-level data collection is likely more precise, though difference between databases may account for variability in research findings. This study is important, as most studies regarding RN: PT ratios include one or more of the datasets assessed.

Serratt, Harrington, Spetz, & Blegen, (2011) utilized data from California Hospital Annual Financial Disclosure Reports from 273 acute care hospitals to identify and describe changes in nurse and non-nursing staffing likely to have occurred as a result of the RN: PT ratio legislation. The study concluded that most hospitals increased the number of RN staff; however, decreases in support staff and other non-nurse staff was not evident. This indicated the mandated ratios had the desired effect of increasing the number of nurses in acute care hospitals.

Nurse staffing to patient outcomes

A plethora of literature, from many different countries, exists exploring the relationship between higher RN hours to improved patient outcomes and survival rates of hospitalized patients. Research has ranged from focusing on data from the RNs' perspective to reviewing national databases to determine patient outcomes. The literature strongly recommends collaboration between RNs and Managers and policy makers to achieve safe staffing levels.

In order to examine the effects of RN staffing and organizational support for nursing care on RN's dissatisfaction with their jobs, RN burnout and RN reports of patient care, Aiken et al., (2002) conducted a multisite, cross-sectional survey of 10, 319 RNs employed on medical and surgical units in hospitals in the United States, Canada, England and Scotland. Dissatisfaction, burnout and concerns about the quality of patient care were universal findings; however, in hospitals with low RN staffing, RNs were three times as likely to imply poor care quality.

By combining longitudinal retrospective and concurrent cross-sectional methods, Duffield et al., (2011) analyzed five years of administrative data and one overlapping year of primary unit data to investigate if nurse staffing, increased workload and unstable nursing unit environments were linked to negative patient outcomes. The authors reviewed workforce data from 27 hospitals, totaling 286 different in-patient hospital units. Results from the longitudinal sample revealed that higher numbers of RN hours were associated with significantly decreased rate of decubiti, pneumonia and sepsis ($p \leq .01$). The cross-sectional study resulted in increased errors, specifically medication errors, with fewer RNs.

Hinno, Partanen, & Vehvilainen-Julkunen, (2011) used a cross-sectional, descriptive questionnaire in a qualitative study to investigate relationships between nursing activities, nurse staffing and adverse patient outcomes in hospitals in Finland and the Netherlands. The authors' results were consistent with previous research: the higher number of RNs, the better patient outcomes. A significant association exists between nurse staffing and adverse patient outcomes. Limitations of the study included the lack of a national register in Finland, resulting in the need for RNs to rely on memory to recall the frequency of adverse events over the past three months.

The population growth and the low number of skilled RNs in Singapore was the impetus for Lin's 2013 study to understand what relationship between RN staffing and patient outcomes, if any. Lin completed an integrative review, examining the empirical evidence on the relationship between RN staffing and quality of care in acute care settings in different countries, by reviewing the literature and extracting data from primary sources. The evidence strongly associated higher numbers of RNs with better quality of patient care.

West et al., (2014) studied whether the size of the workforce (RNs, doctors and support staff) impacted the chances of survival of critically ill hospitalized patients. The cross-sectional, retrospective, risk adjusted observational study used statistical controls to assess relationships between specific independent variables and dependent variables. Participation was voluntary; however, the participating units were reflective of the population. Data from 61 hospitals, six months before and after the date of the study was used. The strongest evidence indicated that higher number of nurses and doctors were associated with better patient outcomes. No evidence supported the number of support staff working on a unit effecting patient survival. A high workload was associated with higher mortality. The study found the availability of medical staff had no relationship with survival across the range of acuity. However, a statistically significant association between the number of RNs and patient's risk of mortality at high levels of acuity was observed.

Patient classification systems

Many different PCS are in use throughout the world in an effort by hospitals to determine the appropriate numbers of RNs are needed for their patients. Much is written about PCS; however, no consensus for any specific tool exists and the literature seems heavy on opinion and anecdotal evidence and discussions on the topic and sorely lacking in research. That may partly

be due to the uniqueness of each patient's needs, each DCP's skill set/experience and each environment. Each set of circumstances being so different, the time and cost researching individual PCS would be difficult. In spite of this, efforts continue in the search to find an objective method for predicting RN workloads. The judgment of the expert RN will continue to be taken into consideration when making staffing decisions.

Fasoli & Haddock, (2011), using an integrative review of the literature, aimed to identify current practices related to PCS and determine if a "gold standard" PCS exists that could be adopted or adapted for use by RN leaders in practice. The authors reviewed sixty-three articles from 1983-2010. Many criticisms from earlier articles remained in recent articles and while specific characteristics of some PCS were shared, no consensus exists about PCS. The recommendation of the authors is to use a combination of PCS and RN judgment.

Hurst et al., (2008) describe a major study out of the United Kingdom which aimed to overcome weaknesses in patient classification and RN workload assessments by developing an easy-to-used method. The goal was to strengthen the current process which was highly subjective and dependent upon RN judgment, something that cannot be validated independently. 2,756 patients in three hospitals were sampled, exceeding recommendations for validity. Ward RNs in the three hospitals scored patients at least daily using two different classification instruments. The authors developed a tool with a ten step algorithm for calculating direct care hours per patient day. The authors concluded; however, that to develop a simple tool requires large datasets that are expensive to collect and maintain. Extrapolating from existing information in order to contain cost and time may be required; however, in doing so, validity and reliability principles should not be abandoned.

The Zebra Index (ZI) was the focus of a 2011 study by Levenstam & Bergbom. The aim of the study was to describe an approach for developing an RN index that was based on the patients' needs of RN care and enables costs to be calculated. An index and a calculation of the ZI, which shows the intensity of the RN care, were developed. The Zebra system consists of patient classification, staffing monitoring and estimations, quality monitoring and an activity study. The ZI provided reliable information about the changing RN situations over a period of time. The authors concluded the ZI could assist in projecting staffing needs.

Technology and technology acceptance by nurses

Located in California, SVMH follows the RN: PT ratio legislation, when making staffing decisions. SVMH also used an electronic PCS system, which was essentially not being used to facilitate staffing decisions. Studies relating RNs to improved patient outcomes strengthened this author's belief that a PCS that provides accurate and timely data could be used to support organizations to make appropriate staffing decisions. Enhancing the PCS by implementing the CII would achieve that goal. A major concern was whether the DCP's would trust the CII to lead the decision making about staffing. Implementation of any PCS would not be successful if the end-user, the DCP, did not trust or accept the system. This question led the author to include technology and technology acceptance by RNs in the review of the evidence.

Huryk, (2010) completed a literature review to examine current trend in RN's attitudes toward healthcare information technology (HIT). Several major databases were used to find thirteen articles to review. If projects involving HIT were to be deemed successful, RNs must recognize that that incorporating electronic health records into their daily practice is beneficial to patient outcomes. Huryk concluded the most common detractors were poor system design, system slowdown and system downtime and RNs were concerned that the use of technology would dehumanize patient care. In spite of this, the attitudes of RNs towards HIT were positive. Implications of the study included the need to involve RNs in system design in order to improve post-implementation satisfaction.

Ingebrigtsen et al., (2014) conducted a review of literature of major databases (Medline, Cinahl, Embase and Business Source Premier), to examine evidence associating clinical leadership and successful information technology (IT) adoption in healthcare organizations. Results of the study demonstrated important associations between the attributes of clinical leaders and IT adoption. Specifically, leaders who possess technical informatics skills and prior experience with IT project management influenced long-term commitment to the use of IT.

Kua, Liu, & Ma, (2013) used a questionnaire to collect 665 responses investigating personality traits of RNs in regard to technology readiness toward mobile electronic medical record systems. RNs were found to be optimistic, innovative and secure but uncomfortable about technology. The authors conclude that continuous educational programs focused on RNs improving their IT literacy, minimizing stress and discomfort about IT and focusing on recruiting more optimistic RNs go a long way in supporting HIT implementation and usage. The

friendliness of user interfaces of the EMR will greatly enhance the RNs' engagement with HIT. The authors caution implementers against ignoring the effects of personalities on technology and recommended personality traits should be included in organizational personnel databases. Implementation of this recommendation would come with legal and ethical challenges and is therefore not likely to be taken seriously by any organization.

Rivard & Lapointe, (2012) used questionnaires to study the response by the implementers of IT to resistance of the end user. The study sought to answer the two questions: "What are implementers' responses to user resistance?" and "What are the effects of these responses on user resistance?" The first question led to a creation of a taxonomy that included four categories of implementers' responses to user resistance: inaction, acknowledgement, rectification and dissuasion. The answer to the second question depended on the response to the first, offering a theoretical explanation of the effects of implementers' responses on user resistance behavior. For example, inaction by the implementer results in increase resistance by the end user. The study concluded that implementers of IT solutions can predict the outcome of the implementation, by understanding the impact of different responses the implementer has on the end user.

Conceptual/Theoretical Framework

An electronic PCS, which required DCPs to manually enter data, had been implemented eighteen months earlier at SVMH lacked the desired accuracy, timeliness and consistency and was not used to facilitate staffing decisions. DCPs reported the data entry was "busy work" and most did not enter the data at all. Even more disconcerting; nursing leaders continued to use a census-based staffing grid as the primary method for making staffing decisions, never taking acuity into consideration. In addition to the staffing matrix, decisions for additional staff were based on requests by the DCPs. Typically, any additional staff requested was provided.

Studies relating RNs to improved patient outcomes strengthened this author's belief that a PCS that provides accurate and timely data could be used to support organizations to make appropriate staffing decisions. The CII would allow the accurate and timely data needed, but would the DCP's trust the CII to lead decision making about staffing? Implementation of any PCS will not be successful if the end-user, the DCP, does not trust or accept the system. Providing the proper framework to facilitate implementation was vital to achieving positive adaptation of PCS using the CII.

The Technology Acceptance Model (TAM) was considered as a framework for the implementation of the project. The TAM provides a model of how users come to accept and use technology (Davis, 1989). The TAM focuses on the user's perception of usefulness of the technology and the ease of use. The CII would be used to guide staffing decisions; however, the concern this author had is regarding the DCPs trusting the information. Technically, the CII won't require the DCPs to use the system; instead, they must trust the system is working. It is for that reason; the TAM was not selected.

A theory that attempts to explain how, why and at what rate new ideas, such as technology, are embraced, would be a better theory to use as a framework for the development and implementation of the CII. The Diffusion of Innovations theory (Rogers, 2010), which includes four elements (the innovation itself, communication channels, time and a social system), that influence the spread of a new idea appeared to be a more appropriate framework to ensure adaptation and may also facilitate priming a culture that can more easily accept change.

Diffusion is the movement of a material from an area of higher concentration to an area of lower concentration. In his Diffusion of Innovation theory, Rogers (2010) explains how the innovation spreads through an area of high concentration to a level of lower concentration. The innovation, or change, will go through five stages (knowledge, persuasion, decision, implementation and confirmation) of diffusion.

The *knowledge* stage is the point at which people experience "selective perception" and either recognize the need or gap before change can be considered. The change agent, a champion of the innovation who is respected by those likely to be affected by the change, must be identified during the knowledge stage, if the innovation is to be implemented. The gap at SVMH was the inability to use the PCS effectively due to poor compliance. This author functioned as the change agent to drive the innovation, the CII, forward.

During the second stage in the process of diffusing innovation, *persuasion*, the end user's attitudes toward the innovation must be acknowledged. The end user becomes involved in the change and makes decisions that affect the success of the project. Rogers cautions that even when the user has positive feelings related to the innovation, there is no guarantee of successful diffusion. The majority of the DCPs participating with the build of the CII associated positive

feelings. A few DCPs, while not completely negative about the CII, were highly skeptical; an attitude that could lead to the failure of the project.

Critical to the successful diffusion of an innovation is the *decision* stage. This third stage is the point in time the decision is made to adopt or reject the innovation. Innovations may be rejected, even after the initial decision to adopt is made. Small tests of change can be used to test, or pilot, an innovation in an effort to minimize the impact of failure. The CII was implemented in one area at a time, to ensure success in on area before implementing throughout the organization.

The fourth stage, *implementation*, includes the initial use of the innovation and is designed to test the innovation in the live environment. Once the innovation is implemented, the innovation's success is dependent upon acceptance and may take time and revision before becoming successful. Time allotted to step back, make adjustments, reeducate and reorganize may be required for a successful implementation. Several changes were made before the CII functioned properly.

Continued use of innovation occurs during the *confirmation* stage. During this fifth stage users seek reinforcement that the innovation has been successfully diffused and metrics of success are met. Regret and discontent with the end product is a possibility regardless of preventative efforts put in place. The CII is relatively new; however, with the use of reports and audits, the success of the project can be determined in time. Reports can reflect the improvement that is made as a result of the CII. The work of nursing is often difficult to illustrate and nursing can be seen as only an expense by some in hospitals. When the CII/PCS is fully functioning and being used to manage the workforce, cost effective care that improves patient outcomes will be the result.

The goal of the project is not only to develop the CII, but to also have the DCPs trust in the validity of the data that will be used to guide staffing decisions. Rogers (2010) cautions that diffusion and acceptance of new ideas does not happen quickly, especially in social systems made up of many different people with different rates of acceptance to change. A primary reason for selecting the Diffusion of Innovation theory for the implementation of the CII is the theory's consideration of the differences in the rate of acceptance by providing five categories of adopters. In order to obtain a critical mass of individuals, or diffusion, a series of phases, taking

each individual on their own, personal journey through first hearing of the change to acceptance, must occur. In an organization, such as a hospital, with hundreds of nurses, of different generations and life experiences, different rates of acceptance and proficiency are to be expected.

To address those variables, Rogers posits five adopter categories: Innovators, early adopters, the early majority, the late majority and laggards. *Innovators* are willing to take risks, have the highest social standards and are quick to adopt new technologies. The innovators were important to the project, and included the RN informaticists, programmers and others who would make up the core of the project team. *Early adopters* have a high degree of leadership and social status than other adopters and have a greater discretion about adoption choices than the innovator group. Early adopters were targeted by the project team to make up the majority of the DCPs recruited to work on the project and participant of the Acuity Committee. Additionally, early adopters were tasked with supporting their colleagues as the CII is rolled out.

The *early majority* include staff adopting the innovation early on, but after the innovators and the early adopters. Early majority members also have "above average social status, contact with early adopters and seldom hold positions of opinion leadership in a system" (Rogers, 2010, p. 283). The charge RNs and Nursing Supervisors will be targeted as the early majority and as such, were included in the initial group to be educated.

The *late majority* has below average social status, little opinion leadership and adopts an innovation after the average participant and only with skepticism. *Laggards* are the last to adopt innovation, showing no opinion leadership and usually hold on to traditions and dislike change. Nurse Managers will need to hold both late adopters and laggards accountable for completing the education and compliance.

Implementation of the CII will involve all the patients in a particular patient care area. Application of the Diffusion of Innovation, will involve early adopters and early majority using their influence to promote interest and increase the rate in which the CII is accepted and trusted by their colleagues.

Methods

Ethical Issues

The aim of the project was to implement change that meets the requirements for a performance improvement project and not a research project. No intention for using the data for

research exists. Approval as a performance improvement project was provided for the application of evidence within change process and the achievement of an accurate, consistent and timely process for PCS from SVMH leadership and the University of San Francisco's Doctorate in Nursing Practice department. See Appendix C (DNP Project Approval Form) for the DNP Project approval form.

Data reviewed during part of the project t included patient information. For that reason, aggregated data with no identifiers was used prior to view of project participants. Additionally, participants working on the project who were employees of SVMH followed current organizational patient privacy policies.

Setting

Location

The project was conducted at SVMH, a 252 bed acute care, district hospital that opened in 1953. SVMH's services include Critical Care (CC), an Emergency Department (ED), diagnostic imaging, Medical Surgical (M/S) and Women's and Children's Services. The CC consists of a 13 bed Intensive Care Unit, a 15 bed heart center and a 40 bed telemetry unit. The ED provides care to approximately 44, 000 patients each year. The three M/S units have the capacity to provide care to 84 patients. The five unit Women's and Children's' areas includes a Level III Neonatal Intensive Care Unit. SVMH's Regional Stroke Center, Regional Heart Center, Regional Spine Center and Stroke Centers have all received certification by the Joint Commission (TJC). SVMH employs approximately 1600 people, approximately 600 are RNs providing direct patient care.

Key roles

The project required the expertise of several disciplines and an industry partner and therefore required several work teams be established to achieve scheduled deliverables and gain acceptance for a successful change project. RN's who provide direct patient care, RNs from informatics, IT staff, nurse leaders and leaders and IT experts from the industry partner were enlisted in the project design and rollout. Participation from each of the teams was essential in creating a well-orchestrated project plan, timeline and agreed upon milestones, to move the project forward. The level of commitment varied among individual team members. All team members were required to champion the project, facilitate trouble shooting and solution finding,

when appropriate. The general responsibilities (Appendix D Responsibility Matrix) are defined as follows:

- *Project Lead, Nursing (PLN):* Fulltime administrative leader within SVMH system, tasked with coordinating the CII project from both nursing and IT's point of view. The PLN will need to communicate with SVMH's Chief Nursing Officer (CNO) and Chief Financial Officer (CFO), project team members, RN staff, leaders of the RN union and others as the project evolves; be accountable for the expense of the project; maintain records of the project; develop or facilitate the development of education plans and other not yet defined responsibilities.
- *Project Lead, Informatics (PLI):* Fulltime administrative leader within SVMH system tasked with coordinating the CII project from the point of view of the IT side.
- *Nurse Informaticists (RNI):* Fulltime, permanent RN, with clinical and IT experience and a comprehensive understanding of the nursing documentation system. The RNI will need to work closely with the DCPs in order to interpret the work of the DCPs into the language of the RN documentation. The RNI would also be called upon to assist with audits and other tasks, as needed.
- *Programmers*: Full and part-time, permanent employees of SVMH's IT department. Programmers will need to be available, as needed, to support the writing of the expressions for the CII during the building of the M/S instrument and will be expected to write the expressions for subsequent CIIs.
- *Functional Systems Analyst (FSA):* A fulltime, employee of SVMH's Informatics department. The FSA is the expert on the PCS software for SVHM and is an integral member of the team, coordinating and educating team members on the software as well as acting as the go between for SVMH and the industry partner.
- *Direct Care Provider (DCP):* RNs expert representing each specialty areas in which the CII instruments were built and implemented. DCPs were required to use clinical judgment to assist the informaticists, FSA and the Programmers to understand care required for each dimension, allowing for the mapping and

expression building needed for the CII. The majority of the DCPs selected to work on the project identified as informal leaders with a positive history of working their own work processes. The PLN requested each group of DCP include a member who was an informal leader identified as having a history of presenting barriers to change.

- *Industry Partner Project Lead (IPPL):* RN Informaticists employed by the industry partner. The IPPL will lead the team from API and communicate with PLN to ensure required resources are available to complete the project.
- *Industry Partner Programmers (IPP):* IT specialists tasked with building the expressions that will result in the interface.
- *Instrument Expert*: A PhD, educated RN builder of the traditional PCS used by SVMH and consultant to the industry partner. The Instrument expert guided the PLN throughout the build and implementation of the CII. Additionally, the Instrument Expert provided support to the project by assisting with communication with the CNO/CFO, union leadership and others.

Work completed 18 months earlier building the traditional PCS system (requiring manual data input), yielded a PCS for the specialty areas of M/S, CC and Women's and Children's. An interface would need to be developed for each area of specialty, utilizing three different groups of DCPs. The balance of the team members would be required to participate in the development of the interfaces in all the specialty areas. While the DCPs will be removed from their normally scheduled shifts when working on the project, the other team members will be adding the work required for the CII to their already busy workloads. For these two reasons, team leaders decided to build each instrument consecutively; rather than concurrently. Additionally, because much of the care provided in the M/S areas would be the same in CC and Women's and Children, the team decided the M/S instrument would be the first instrument to build and implement.

Planning the Intervention

Purpose and process

The creation and implementation of a clinical interface between technological solutions is a very new and innovative approach for advancing the use of software. No template for this work exists. A clinical interface between the EMR and the PCS will be a benefit to SVMH. The EMR

includes the orders, via CPOE, the eMAR and nurses' documentation. SVMH will collaborate with an industry partner specializing in innovative workforce management solutions, including a PCS system. The goal of PCS is to "quantify categories of care in order to measure and/or predict the required nursing hours/effort for direct patient care" (Malloch & Meisel, 2013, p. 35). A primary function of the PCS is to assist nurse managers with projecting the number of nurses required to provide patient care for upcoming shifts.

The aim of the project is to develop a series of conditional and logical expressions that interprets clinical charting, physician order, and medication administration data and translates this information into one of five intensity levels for each of the eight PCS care categories (Cognitive, Self-Care, Emotional/Social/Spiritual, Pain & Comfort, Family, Treatments & Procedures, Transition, and Care Coordination). The process is called Clinical Information Interface (CII).

The CII mapping process is as follows:

I. Select a Care Category
II. Identify the patient care needs for each Intensity Level
III. Discuss with the Expert Nurse panel (DCP) those interventions, orders, or medications that support each of the care needs for that level.
IV. Try to not only identify single events (disoriented, BMI score, Morse Fall risk), but event combinations and frequencies.
V. Talk through how DCPs would look at the EMR documentation to reflect the care needs.
VI. Write down the discussion as logical Boolean expressions. (e.g. If Level of Consciousness is Restless or Orientation is Disoriented **AND** Physical Behavior = Resistive to care, or impulsive or anxious, then the Intensity Level is 4)
VII. Identify the EMR mnemonics for each of the items in the expression (e.g. NEURO.LOC is the patient's Level of Consciousness, NEURO.ORIE is the patient's orientation)
VIII. Add the above mnemonics to a list for IT so they can download the values to the CII
IX. Repeat Steps 1-8 for all intensity levels and Care Categories

X. Write the actual logical expressions in the CII software for all expressions (i.e. NEURO.LOC = "Restless or NEURO.ORIE = "Disoriented" **AND** (NEURO.B = count group of 1 of ("Resistive to care", "impulsive", "anxious"))
XI. As the expressions are written for a dimension, start testing the expressions to confirm they are being read, understood, and interpreted as desired. Remember, computers do exactly what they are told, so if the expression is stated one way (the desired intent), but written another way (the way the computer was programmed), the result will be what was expected. Be especially clear on the logical grouping, i.e., where the parenthesis are used. Also, spelling counts. If the programmer search for a "Yes" value, but the EMR sends over a "Y", the program will not evaluate the expression as True.

CII's goal is to provide safe, accurate, cost- effective staffing decisions for adult in-patient and adult critical care nursing units and provide a method of allowing charge nurses to make equitable assignments for DCPs.

A strengths, weaknesses, opportunities and threats (SWOT) analysis was completed to assess the strengths and weakness, within SVMH, and opportunities and threats, outside SVMH, with regard to the CII implementation (Appendix E SWOT Analysis). Internal strengths of the project included the strength of the IT department, the commitment of the core project team and the relationship with the industry partner. SVMH has a history of being an early adopter of technology having had an electronic documentation system for two decades. The IT department at SVMH supports most systems in the organization. Very little support is provided by outside entities. Expected weakness the team recognized were the challenge of gaining acceptance of a new process by the end users and the lack of a template for creating the CII. External opportunities included the potential for improving working relationships with industry partners and the potential for developing a blueprint for integrating separate technology solutions from different vendors. The most pressing external threat was lack of clarity around the amount of support SVMH would receive from their industry partners to develop the CII.

Leadership needs

To understand the importance of any PCS, nurse leaders must understand that, while the midnight census may frequently be used as a standard for budgeting, the midnight census is rarely accurate enough to be used for planning staffing needs on a busy, acute care nursing unit.

The midnight census is based on volumes of patients in bed, on a specific unit, at a specific time and does not consider the number of patients transferred into or out of the unit or admitted and discharged. Additionally, the midnight census makes the assumption that all patients have the same care requirements; not reflecting any of the nursing interventions or professional services delivered to the patients.

A PCS attempts to measure the actual workload, based on previously validated criteria. As a result, improved staffing decisions, based on objective data can be made by leaders; thus, the PCS supports improved patients and caregiver satisfaction, budgets and effective staffing plans. The primary need a PCS meets, for leaders, is the ability to use data to make proactive decisions about staffing. The result should promote consistent, repeatable practices that improve the quality of care and provide accurate data for budgeting purposes; concepts most valued by the DCPs and leadership alike.

Past system changes

Acuity can be defined as the level of nursing care requirements that guides projected nursing staff resources. Patient classification is a methodology that groups patients according to their need. Patient need is based on the patient acuity. A PCS should take into consideration only direct time, hours of care or service provided directly to the patient. Hours for those staff working to support direct caregivers, such as the nurse manager and unit secretary, should not be considered in the acuity.

The PCS SVMH had in place prior to the CII was developed by a nationally recognized expert in leadership and the development of effective evidenced-based processes and systems for patient care. Each area, M/S, CC and Women's and Children's, utilized DCPs to build an instrument specific to the respective specialty area. Each instrument included dimensions of care, for example, Cognitive Status. Each dimension included patient care needs and interventions the patient required to meet the needs. For each of these dimensions, a 1 to 5 level was determined, (Appendix F Patient Care Needs Intervention Matrix). Once the levels of intensity were developed, the instruments were taken to the individual nursing units where DCPs validated their workload by rating the amount of time required to complete each patient intervention. The data was used to develop an individual instrument for each specialty area.

Cost/Benefit analysis

The first opportunity SVMH's industry partner would have to implement the CII in a hospital setting would be with this project. For that reason, the industry partner chose to bear a portion of the costs of the project, by providing the programmers for the expression building and RN experts as team leads. Team members employed by SVMH were authorized to work on the project, as a portion of their regular duties; therefore, no true project budget was developed prior to the onset of the project. The SVMH IT department; considered a support department by the organization, had the overall departmental cost paid out of overhead dollars collected from each cost center.

While the PLN was not required to develop a budget for the project, efforts to associate all costs of the project for later analysis were made. All team members providing support to the project, other than the industry partners, were considered in the cost of the project. In considering the costs and benefits of implementing the CII the team leader determined that if Nurse Managers used data to improve staffing decisions a significant reduction in costs related to day to day overstaffing would result.

Expenses

SVMS did not pay the industry partner fees normally associated with the implementation of the CII. Eight RNs were approved for 80 hours of work for a total of 640 hours. At an average rate of $65/hour that equaled $41,600 (Appendix G Cost Benefit of CII Implementation). To keep them separate from unit budgets, the labor hours associated with nurses was charged to the Nursing Administration budget. These hours were approved for the development of the Adult In-patient and Adult Critical Care instrument. Much of the support of implementation was provided by the industry partner and had no financial impact on SVMH.

Additional costs anticipated after implementation of the CII were based on the outcome of the acuity committee meetings, required updates and auditing. In the event additional work was required by the direct care provider group, additional costs were likely to be incurred. Nurse informaticists, nurse manager, director of clinical informatics and nurses completing the open chart audits have all been included at the amount of hour's required and average rate of pay over the next three years of the project. Direct care nurses and auditing nurses were members of the unions and contractually, have annual 2.5% pay increase. The pay increase will need to be taken into consideration as part of the cost of the program. Though team members that were not

union members were not guaranteed a pay increase, a 2.5% pay increase was reflected in the budget. At the start of the project, the cost of the build was expected to be approximately $90,217.

Savings

Cost savings estimates were based on an expected decrease in incremental overtime, amount of the Nurse Manager's time devoted to making staffing decisions and/or investigating and explaining productivity variances, decreasing accidental overstaffing and time no longer needed to meet with state regulatory bodies (Appendix G Cost Benefit of CII Implementation). The CII/PCS implementation included an upgrade of the Assignment Screen. Upon project implementation, charge nurses will be required to assign patients in the PCS using the assignment screen. The PCS associates the acuity hours of need by patient. The DCP has a specific amount of time to provide care to patients. Typical nursing shifts were eight or twelve hours long. As each patient was assigned to a DCP, the remaining amount of time the DCP has available to provide care to additional patients during the shift decreases. A DCP scheduled to work from 7:00 a.m. until 3:00 p.m. had the capacity to provide eight hours of care to patients. The capacity of the DCP to provide care decreased as more patients were assigned. The upgraded assignment screen will allow the charge nurse to visualize the amount of hours of care for each assignment, facilitating the charge nurse's ability to make safe, equitable assignments. The concept of equitable assignment was an important change in the culture at SVMH. Prior to the CII/PCS assignments were often made by location (patients in rooms in close proximity were assigned to one DCP) or by DCP's convenience (the DCP was assigned the group of patients assigned the day before) and workload was not taken into consideration. Frequently, assignments were not equitable and resulted in incremental overtime (IOT) by DCPs with the heavier workload. The upgraded assignment screen allowed the charge nurse to visualize the workload of each DCP and make equitable assignments resulting in decreased IOT.

IOT was approximately 40 hours/pay period on each of the six units where the CII would be implemented. The average nurse at SVMH earned $65/hour. IOT was paid at a premium; averaging $97.6/ hour or $3,904/unit/pay period or $101, 504 annually, for each nursing unit. The total cost of IOT of the six units was $609,024. Additional causes for IOT include late admissions and changes in patient conditions and not all IOT could be attributed to inequitable

assignments. A review of how assignments were made by the charge nurses revealed that the majority of the charge nurses made assignments based on the location of the patients and DCP preference. Rarely was the condition of the patients and equitable assignments taken into account when assignments were made. An assumption was made by the PLN that approximately 20% of the IOT could be related to inequitable assignments, causing DCPs to stay past the expected length of their shift in order to complete work. An annual decrease in IOT by 20% or $121, 805 was predicted as a result of the CII implementation.

Frequently, overstaffing was related to errors in projecting the staffing needs for the previous shift by Nurse Managers and others making staffing decisions. The CII/PCS was expected to provide data the Nurse Managers required in order to improve staffing decisions and decrease the amount of overstaffing errors. One RN overstaffed on an eight hour shift, each pay period, due to imprecise staffing estimations, at the average nurse's salary equates to $520 a pay period. Applying this over 26 pay periods and six units results in potential of $81,120 savings. Conservatively, 20% annual savings related to overstaffing or $16,224 was predicted.

An informal survey of the Nurse Managers from M/S and CC estimated spending ten hours a pay period attempting to predict staffing. At the average Nurse Manager $75/hour, pay rate, ten hours equaled $750/pay period. Over 26 pay periods and six managers, was the potential of to $117,000 savings. An annual 20% savings or $23, 400 was predicted.

In late 2013, the California Department of Public Health (CDPH) visited SVMH, following an anonymous complaint. The complaint claimed SVMH did not meet the California regulatory standard for hospitals to implement a PCS reflecting patient care needs which are based on the RN's assessment. Nurse leaders searched through six months of paper staffing records to show that SVMH had complied with the law. Claims of unsafe staffing were unsubstantiated. Through the experience SVMH's nursing leadership recognized the automation of the PCS would provide improved method for record keeping and improve the ease in which records could be retrieved in the future. The CDPH visit was another impetus for SVMH to implement the CII

Without an upgrade or change in the way the PCS is used, SVMH could anticipate another visit from CDPH. The time needed for the previous survey was approximately three hours and involved the CNO and several directors for a total cost (of salaries) of $1,218. This

cost would be saved during the first year of the CII. Total cost savings over the next three years is $497,330, for a net savings of $407,113 over the course of the first three years of the project (Appendix G Cost Benefit of CII Implementation).

Implementation of the Project

The aim of the project was to develop a series of conditional and logical expressions that interprets clinical charting, physician order, and medication administration data and translates this information into one of five intensity levels for each of the eight PCS care categories (Cognitive, Self-Care, Emotional/Social/Spiritual, Pain & Comfort, Family, Treatments & Procedures, Transition, and Care Coordination). The patient classification instrument data elements were mapped to the appropriate EMR data elements by the DCP. Missing data elements were identified within the EMR. Those data elements were subsequently configured for mapping so that the instrument could provide appropriate acuity. Once mapping was complete, expressions were developed by programmers to allow the data elements mapped from the EMR to be interpreted into a specific amount of time required for each element and represented by a number in PCS.

Upon completion of the build, the PLN and industry partners led a team of DCPs, different from the ones who participated on the build, in completing open chart audits. Results from the CII and the open chart audits were compared. Discrepancies were reviewed by the FSA, RNI, PLN and industry partners to understand the rationale and appropriate changes were made.

The work breakdown structure (WBS) defined the discrete work elements necessary to organize the scope of this project starting with the design of the project charter and approval by the executive sponsor (Appendix H Work Breakdown Structure). The project charter described statement of work, the scope of the project and the authority framework authorizing this project. As no template existed for this work, an additional tool used as a time line, entitled CII Implementation Check list was also used in order to track additional deliverables not accounted for in the WBS.

The next phase included the preparation and planning for the project. The project required the work of several disciplines and an industry partner and therefore required several work teams be established to achieve scheduled deliverables and gain acceptance by the end-users. RN's who provide direct patient care, RNs from informatics, IT staff, nurse leaders and

leaders and IT experts from the industry partner must all be included in this project design and rollout. Participation from the teams was essential in creating a well-orchestrated project plan and timeline with agreed upon milestones (Appendix I Gantt Chart) to achieve success. Executive team approval was required prior to commencement on the project.

The majority of the initial work required to implement a system that provides data that was being continuously received from the EMR, including orders from CPOE, medications from the eMAR and relevant nursing documentation, was performed by the DCPs (RN experts), informatics RNs and industry partner experts. Preparatory time was spent in meetings with the project leads and various team members, in the form of teleconferences during the length of the project. Each team member was required to identify the barriers to achieving the milestones necessary to achieve the implementation timeline.

The PLN was ultimately responsible for the project including the timeline, quality assurance and any risk management and mitigation strategies. Disseminating information with a change of this magnitude was essential. To ensure the project had the support of the leaders, Nursing Managers and Directors from the three areas were made aware of the process improvement strategy during a "boot camp" led by the industry partner (Appendix J Boot Camp Agenda). The goal of the boot camp was to inform Nurse Manager/Director stakeholders of the proposed CII, including the anticipated benefits. The first of quarterly scheduled meetings of the Acuity Committee meeting, held shortly before the implementation of the project, was focused on education. At least half of the Acuity Committee's members were DCPs. The goal was to initiate education of the end user; essentially developing super users. Additional education was provided in the form of small group and 1:1 sessions for all end users (direct care providers, nursing supervisors and nurse managers).

The go live date for the M/S instrument was December 18, 2013. The industry partner committed to being on site from December 16-18th. In preparation for the go live, on December 16, 2013, a required upgrade of the system and testing was completed. SVMH's industry partner assisted with the live install and provided support during and after the install. Once the install was complete, the clinical elements and expressions needed to be extracted from the test environment and imported into the live environment. The industry partner assisted with the copy process. When the clinical elements and expressions were in the live environment, the CII feed

from the EMR was directed to the live PCS. Once the data feed from the EMR the industry partner monitored the CII feed and population of data into the PCS for the next twenty-four hours. The CII/PCS was initiated, the go-live, after confirmation of the systems functionality. At this point the DCPs no longer needed to manually enter data into the PCS; however, charge nurses could manually override the automated classifications, if the DCPs disagreed with the rankings.

As much of the CII/PCS data came as a result of the RN documentation; concern from the DCPs participating on the project that missed documentation would cause missed data elements in the CII/PCS. Those missing elements could result in inaccuracies in the classifications. A messaging campaign targeting the DCPs was initiated prior to the go live date. The messaging included documentation teaching points identified by the DCPs involved in the mapping process. Included in the messaging was a reminder that, as a new system, the PCS was imperfect and needed to be in the live environment in order to assess the accuracy and effectiveness and ultimately make improvements.

Planning the Study of the Intervention

Planning the study of the intervention required strong organizational skills and flexibility of the team members for several reasons. The DCPs on the team were removed from their schedules in order to participate on the team. Arranging schedules for the DCP's participation often caused the timeline to change. For all other team members, the project was in addition to already busy schedules. On several occasions, the CII project did not take priority, causing multiple delays in the timeline. Though the industry partners were facilitating the development of the CII having part of the team located across the country and the need to submit requests for any work to be completed (work orders) also added delays.

After several changes in the implementation dates, the PLN and the IPPL made a commitment to implement the CII before the end of the calendar year, regardless of any necessary upgrades. Once that commitment was made, the team was able to stay close to the timeline. The PLN regularly collaborated with the industry partner expert to determine the best methods for evaluating the project.

The allocated time frame was ten months from inception to final evaluation. The Project Plan and the CII Implementation Checklist were employed to set milestones and monitor

progress. The possibility of the CII was discussed by the organization and industry partner project leads during April and May 2013. The *preparatory* phase of the project was completed in October 2013, including presentations by project leaders to organizational union leadership and nurse leaders, including the boot camp. *Phase1*of the project included the development of expressions in four of the eight dimensions of care, requiring labor time by RN experts and informatics staff which was completed in November, 2013. *Phase II* included building the remainder of the expression for the Adult In-patient instrument and was completed in December 2013. A "soft go-live" occurred on December 18, 2013. The soft go live was defined as the Adult In-patient tool being active in the live environment; however, the data were not used as a reference to make equitable assignments or to make staffing decisions. The team monitored the data, conducted manual chart audits and initiated staff education. Specific timeline information was outlined in the Accountability Table (Appendix K).

Methods of Evaluation

Creating evaluation metrics and process measures for data capture and analysis was crucial to determining the success of the program. Metrics were captured and periodically analyzed for trends. Metrics included manual chart audits; CII and DCP cross -comparing acuity rankings, reports generated from the PCS, productivity data, face validity and Acuity Committee member feedback. Nurses participating with the mapping were surveyed, to understand their perceptions of benefits of participating in the mapping. DCPs were to be surveyed to understand their perception of assignments after CII was implemented.

Manual chart audits

Much of the work for the project was completed in a test environment. The test environment was generated by creating patients with similar diagnoses, orders, and documentation requirements as the typical patients admitted on the M/S and CC units. The test environment simulated the real environment and was beneficial for trialing the effectiveness of the CII without causing disruption in the actual environment. However, the simulated environment had limitations to its usefulness. For example, data entered in the simulated environment were all entered at a single time. Actual hospital patient charts were episodic in the rate information is entered; doctors were likely to enter orders at any time; while the RN

documented several times during a shift. The CII needed to be made active in the live environment, "turned on", to allow the team to assess its functionality on real patients.

Upon going live with the CII a group of DCPs were asked to complete chart audits to determine the patient's acuity. In an effort to prevent bias, different DCPs participated in the chart audits from those participating in the mapping. The acuity rankings of the CII were compared to the acuity rankings of the manual audits.

Reports

Four reports: Comparison, Assignment, Unit Workload and Inter-Rater Reliability are reports the PCS offers that were to be used to assess the effectiveness of the implementation. The *Comparison* Report (Appendix L) presents the hours of need, as predicted by the PCS, in comparison with the amount of hours that were scheduled and/or worked. The hours were grouped by coverage period and skill. Assessment of the CII/PCS using the Comparison Report would be completed by comparing the hours projected versus the actual hours scheduled and/or worked. The numbers should be very similar, if staffing decisions were made using the hours of need as a guide.

The *Assignment* Report (Appendix M) lists the patients assigned to DCPs and which DCPs and patients were left unassigned. Upon project implementation, charge nurses were required to enter the DCP's assignments in the PCS. The PCS associates the acuity hours of need by patient. The DCP was scheduled a specific amount of time to provide care to patients. Typically, the shifts were eight or twelve hours long. As the patients were assigned to a DCP, the amount of time the DCP had left available during the shift decreased. A DCP scheduled to work from 7:00 a.m. until 3:00 p.m. had the capacity to provide eight hours of care to patients. The capacity of the DCP to provide care decreased as more patients are assigned. The Assignment Report shows the amount of hours of care for each assignment, allowing for an assessment of the charge nurse's proficiency in making safe, equitable assignments. Assessment of the CII/PCS upgrade using the Assignment Report would be completed by noting equitable assignments were consistently made by the charge nurse. The numbers should be very similar, if staffing decisions were made using the hours of need as a guide.

The *Workload Summary* Report (Appendix N) was run for a specified period of time to provide a summary of the workload, grouped by coverage period, for the unit chosen. Census

information, admits, discharges, the unit's classification percentage, projected need and a view of how the scheduled and actual hours line up in comparison was included in the report. Prior to the implementation of the CII/PCS, staffing decisions were made by using a census based staffing guide and requests made by DCPs. The result was a suspected misalignment between the hours of DCPs required based on the acuity of the patients and the mandated RN: PT ratio and the actual DCP hours used. When staffing decisions are based on the CII/PCS data, an alignment of the number of acuity hours needed and the total number of hours required should result.

The *Inter-rater Reliability* (IRR) Report (Appendix O) was run for a specified period of time and depicted the percentage of agreement among two DCPs rating the same patient through the IRR process. Details include which of the eight specific dimensions, if any, were rated differently through the separate classifications. Prior to the implementation of the CII, IRR was used on a regular basis to assess the validity of the PCS instrument. Upon the implementation of the CII, the PLN and industry partner expert determined that, with the automation, a different methodology for assessing the PCS's validity was required.

Productivity reports, face validity and cross-comparison

Productivity reports used by the Nurse Managers will be used to assess the effectiveness of the CII/PCS. Improved accuracy in staffing should decrease the amount of overtime and over usage of DCPs. The productivity of each area was expected to be more in alignment with budgetary expectations.

A primary concern for the team was acceptance of the data by the DCPs. A methodology to determine if the DCPs agreed with the acuity ratings from the CII/PCS was developed. The tool was called the Face Validity Survey (Appendix P) and required the auditor, the charge nurse and the DCP to use their judgment to rate each assignment on a scale of light, average or heavy. Each response was compared to one another and to the acuity rating from the CII/PCS to determine how closely the RN's judgment was aligned with one another and the CII/PCS.

When the DCP disagreed with the automated acuity ranking and manually classified the patient, the team would need to investigate the cause of the discrepancy. A cross-comparison of the two rankings was required to determine what dimension the discrepancy occurred. Once the dimension was identified, further drill down to determine the cause of the discrepancy was identified. One cause for the automated ranking to be low, found during a cross comparison was

documentation lapses by the DCP, resulting in the CII/PCS not taking into account required elements of care. An example of cause for the automated ranking to be too high, found during a cross-compare was discontinued medications continuing to be included in the patient's needs. Appendix Q illustrates an example of a cross-compare.

Analysis

At the time of this writing, the CII/PCS was implemented in three M/S and three CC units and the DCPs have access to view the data. However, the data were not being used by the Nurse Managers to guide staffing decisions. It was for that reason only a portion of the evaluation methods were analyzed.

Qualitative evaluation methods, such as the chart audits and the face validity were analyzed and can help to determine if the DCPs feel the CII/PCS accurately rates the patient's needs; however, most quantitative assessments which were based on using the CII/PCS to guide staffing decisions were not yet assessed. Initial chart audits reflected the CII/PCS ranking higher acuity levels than the DCPs rankings. Upon reflection, the team believed that since the mapping was done prospectively, the DCPs involved in the mapping, concerned that the CII/PCS "give credit" for all the care that may be required, over ranked many elements, causing rankings to be artificially high. After the chart audits, the team reviewed the expressions and made the appropriate edits. The open chart audit was repeated, with results appearing to be more in alignment with the CII/PCS.

Face validity audits were conducted. DCPs were used as auditors. Using an audit form which identified the unit, the DCPs and assignments listed, the auditor was directed to assess the unit and the DCP and rank the assignment as light, average or heavy. Next the charge nurse assessed each assignment, followed by the individual DCPs, using the same descriptors. Sixty-eight assignments were reviewed during the face validity audits. Of the 68, 44 of the assignments had the same rankings from all three nurses and the acuity system. Twenty-two assignments had two of the three nurses agreed and the CII and two assignments had no agreement between the nurses and the CII. The charge nurse disagreed with the CII fifteen of the twenty-two times a disagreement between a nurse and the CII was noted. Typically, the DCP and the auditor agreed with the CII. Of the seven instances in which the DCP did not agree, one or more of the patients

in the assignment was noted to be confused and/or agitated. The DCP's impression of the patient being "heavy" was apparent even if a sitter was in attendance.

The education for the charge RNs was completed immediately prior to the submission of this paper. The Assignment Report reflects a greater than 90% compliance rate by the charge RNs for making assignments. Charge RNs understand how to make the assignments in the PCS. Analysis of the Assignment Report indicates that DCPs continued to be assigned patient loads that require more time than the length of the shift. Minimal change in the way charge RNs make assignments had occurred in spite of the ability for the charge RN to see the patient's needs in a particular assignment requires more time than the DCP had during the shift.

The Comparison and Workload Summary reports were reviewed to determine probable future savings when staffing decisions were made using the PCS as a guide. The reports reflect overstaffing averaged one RN and one nurse assistant (in areas that used nurse assistants) every shift, every day. The total overage for all six areas totaled 17 RNs and 15 nurse assistants for every 24 hour period. The PCS considers the amount of care required by the patients and equates that number to the amount of staff required. For example, on October 10, 2014 the Intensive Care Unit (ICU) had a census of 10 patients who required at total of 44.3 hours of care during the 12 hour day shift. The ICU is an all RN staff. The PCS indicated the need for 3.01 RNs, yet seven RNs worked that shift. Why were four additional RNs working that day?

The PCS does not take California's RN'PT ratios, which limits RNs in an ICU to no greater than two patients, into consideration. With a census of 10 a minimum of five RNs were required. Once ratios were taken into consideration, the actual overstaffing was now two RNs, not four. Aside from RN; PT ratios, organizational and unit standards needed to be considered. SVMH's standard was to have a charge RN, not assigned to patients, on every unit. With that taken into consideration, the ICU required six RNs for that shift and were only over by one RN. Another example of unit standards that needed consideration was types of patients, despite the time of care calculated by the PCS, the unit considers should be staffed at a higher RN; PT ratio.

In SVMH's ICU RNs caring for patients immediately out of surgery after having open heart surgery and patients receiving continuous renal replacement therapy were only assigned one patient. Nurse Managers indicated that often the overstaffing occurred as a result of anticipated patient admissions. Anticipated admissions could be real (patients scheduled for

surgery and will be admitted afterward) or potential (assumptions that the Emergency Department will be busy). None of these instances occurred on October 10th. The conclusion was that the ICU was overstaffed by one RN on that shift.

After similar analysis of all the units over a month's time, the conclusion was that SVMH overstaffed an average of six RNs and five nurse assistants each day. Calculations were made using an average RN salary of $65 per hour and nurse assistant salary of $22 per hour. The ICU RNs worked 12 hour shifts and the calculation s for each shift was based on 12 hours. In all the other areas, the staff worked eight hour shifts and the calculations were based on eight hours. The cost savings to be realized by not overstaffing one RN and one nurse assistant each day totaled $1, 554, 900 (Appendix R Revised Cost Savings of CII). Based on this calculation, the PLN and industry partner leads scheduled a meeting with the CNO and CFO to review potential benefits of using the CII/PCS to the full potential.

Results

Program Evaluation and Outcomes

The settings spanned the second year of the University of San Francisco's Executive Leadership Doctor of Nursing Practice program and the six in-patient nursing units at SVMH described earlier. The goal of the project was to implement the CII/PCS and the upgraded assignment screen on the three M/S and three CC nursing units. The initial plan was to implement the CII/PCS in M/S first, analyze the outcome and then implement in CC. The plan changed shortly after the CDPH visit. The team believed that it to be prudent to implement the CII in the live environment as soon as possible. Educating staff and completing analysis would be more efficient if all areas could be done at the same time.

The change in the scheduled roll out (from implementation and analysis in M/S then implementation analysis in CC to implementation in both areas then analysis of both areas) was not the only change that occurred during the project's implementation. Other changes from the original plan included longer than expected time from start to implementation, SVMH took on a greater than expected role in developing the instruments, leadership changes and the determination that more education was necessary than initially planned. The assumption was the CII/PCS would be complete in six months. The project took almost one year.

The industry partner and SVMH did not have a formalized understanding regarding expectations of how much of the workload each side would carry. Expression writing of the M/S instrument was completed by the industry partner. When the CC instrument was to be completed, the industry partner stated the work was to shift to SVMH. The team at SVMH understood that the industry partner was to complete the mapping on both instruments. Two months went by until the FSA was available to complete the work. Additionally, though a template from the M/S development was made, information of changes and corrections that were made was not available. The FSA and the RNI collaborated to develop a template and a method to ensure all updates were documented.

As the timeframe extended beyond the initial expectations the team became increasingly concerned about lack of acceptance and trust in the system by the DCPs. The PNL engaged the Department of Education to assist with developing a structured education plan that included a skills check list (Appendix S) and a Frequently Asked Questions (Appendix T). Additional education classes were planned specifically to improve Nurse Manager/Director understanding and support of the CII/PCS.

This author was designated lead of the PCS project in April of 2013. Work on the CII/PCS started in October 2013. The CII/PCS went live in the M/S areas in December 2013 and in the CC areas by July 2014. SVMH's Nursing Department underwent three changes in twelve months between the projects inception and this writing. With each change, work slowed while the new leader was educated on the plans and anticipated outcomes. At the start of the project, the team had no budgetary constraints. Following the second leadership change for Nursing, DCP hours approved for the project were eliminated. All further work needed of the DCPs was to be completed while on duty. This was a difficult task as most DCP were too busy with patient care to complete audits. SVMH experienced organizational changes in leadership that resulted in changes in reporting structure and changes in the PLI also slowed the project implementation.

The CII/PCS was created and implemented in the live environment. Two separate technological solutions supported by different vendors were able to communicate and the result was that data from the EMR was translated by the PCS to provide a guide for the number of staff needed to adequately provide care to the patients on each unit. Though the charge RNs enter the DCPs assignments in the PCS, additional support will be needed in order to have charge RNs

make equitable assignments. When the CII/PCS is used to its full-potential SVMH should see improved patient safety and improved staff engagement related to equitable assignments and cost savings related to staffing decisions based on the data provided.

An alternative change strategy was to revert back to the manual entry by the DCPs and discontinue the CII. The idea was briefly discussed when the Nursing Leadership was evolving. Meetings with the PNL, industry partner leadership and SVMH's leadership and union leaders assured all parties involved that the benefits of the CII/PCS was worth continuing with the project's implementation.

Discussion

Summary

Key successes/Key challenges

Key successes of the project included a sense of urgency by SVMH's leadership, Organizational commitment to improve productivity outcomes, strong industry partner relationship and the commitment of the project implementation team. The SVMH RN union leadership verbalized concerns that staffing decisions were based on census. Regulatory standards require staffing be based on the acuity of the patients. This was a topic at monthly Labor-Management meetings for several months. The concern was not entirely factual. The foundation of staffing at SVMH was based on census-driven matrices put in place in 2012. The staffing matrix wasn't the only component involved in staffing decisions. Also true was the practice of the staffers to overstaff each unit in case additional patients were admitted. The overstaffing practices resulted in high overtime percentages with most Nurse Mangers reporting overages in productivity metrics. The California mandated RN: PT ratios coupled with the overstaffing, resulted in units rarely being staffed efficiently. In fact, most often, units were overstaffed. SVMH's leadership could show regulatory compliance with paper staffing records; however, collecting the paper work was labor intensive and on rare occasions, pages were misplaced. Nursing leaders felt a sense of urgency for an easier way to maintain and retrieve evidence of regulatory compliance, explain the process to union leadership and improve staffing efficiencies.

Two additional key successes in implementing the CII/PCS were the strong industry partnership and the enthusiasm and commitment to the project by many of the project team

members. SVMH and the industry partner involved had a history of positive working relationships and collaboration. Implementing the CII was a natural part of that partnership. The industry partner was interested in the implementation of the CII/PCS and needed a hospital to do so. For that reason the industry partner was willing to assist SVMH with the implementation without charging for the CII process. As the project neared implementation all team members participated in weekly and then daily phone calls to review reports and make corrections. The PLI, RNI and many of the DCPs were excited and committed to the project from the onset. Though the implementation of the project took longer than expected, success came in large part due to the commitment of the team members. In spite of very busy schedules, team members continued to make time to work on the development of the CII.

Key challenges to the project's success included the lack of a template for the work, lack of a project manager/project plan and the lack of consistent organizational leadership. Implementation of the CII was an alpha project for both SVMH and the industry partner. While the idea of how to develop the CII was in place, the fact that no one on the team had actual experience and no guide existed elsewhere made the implementation challenging, required parts of the development to be done by trial and error. As a result of the expertise of the industry partners and the commitment of the team members, delays related to this were limited.
The lack of a true project manager/project plan was challenge and was the major cause of the timeline delays. The previous lead of the PCS project at SVMH reported many obstacles with nurse leader engagement and understanding expectations of the PCS. This author faced the same obstacles.

During the length of the project, nursing leadership changed three times. Each change resulted in a delay in the project implementation while the new CNO met with union leadership and the implementation team and was informed of the current implementation plan. With each leadership change, the delay was approximately two months before the PLN was able to confirm approval for DCPs to continue work on the project. In addition to the leadership change in nursing, other changes took place that caused delays. Oversight of SVMH's Informatics department changed two times during the project's implementation. At the start of the project, the PLI reported to the CNO, who supported the project. Immediately after the initiation of the development of the M/S instrument, the PLI began to report to the COO. The COO required a

briefing about the project. A few months later, the PLI was transferred back to the Nursing Department. By that time, the third CNO was in place and explanations were required to obtain approval for prioritizing the CII/PCS project implementation. No template for the work existed, a project lead with little formal project management experience and multiple leadership changes were significant barriers that caused the project to be delayed, taking twice as long as expected to implement the CII.

Lessons learned

Over the course of the year spent developing and implementing the CII/PCS project, several lessons were learned. Implementation of a project such as the CII/PCS could have been completed in six months, rather than one year, if the following existed: clear responsibilities and expectations, a project manager and clear definitions of success to all parties involved. The most important and perhaps the most obvious lesson learned by the PLN was ensuring the clarity of work to be completed by the industry partners and the organization and has been discussed in earlier sections. A project manager, someone whose responsibility it was to create clear and obtainable project objectives, build project requirements and manage the constraints (including timelines, costs and scope) would have been helpful and perhaps mitigated much of the other issues that caused project delays. A project manager would have better understood the processes requiring completion before project implementation objectives could be met. A project manager's skills were especially needed when projects involving several disciplines and organizations were involved.

The American Organization of Nurse Executives' (AONE) Guiding Principles for Defining the Role of the Nurse Executive in Technology Acquisition and Implementation (AONE, 2009) recommends integrating patient safety and quality into the return on investment analysis, to insure staff understand the benefits and objectives and assuring the objectives are measurable prior to the start of the project. The project leads would have benefited from AONE's recommendation of clearly defining success before work on the project started. Each participant had their own perception of success. The FSA saw success when the CII/PCS was implemented. The PLN, IPPL and industry partner expert saw success as the CII/PCS was implemented, the data were used as a guide to workforce management (with supporting data) and the DCPs trusted the system. Many DCPs stated success to them was when the CII/PCS reflected additional DCPs

were required. The CFO saw success as an improvement in productivity in the nursing departments using CII/PCS. The CNO saw success when the DCP union leaders no longer made PCS an agenda item at Labor/Management meetings. The vision of success may not have changed for each party concerned. However, understanding the motivation for each stakeholder's interest in the project and clarity by the team members of what was needed for success would have helped the PLN when discussing the project with the different groups.

Sustain/Replicate gains

Improved accuracy, consistency and timeliness of data entered into the PCS to facilitate efficient staffing decisions were the primary gains from implementation of the CII. The implementation of the CII/PCS was intended to improve patient outcomes, staff engagement and productivity outcomes. Additional time was required to before the CII/PCS was developed and implemented. Keeping in mind the lessons learned from SVMH, the industry partners would be able to replicate the CII in other organizations, using the same and different EMR.

Structures that SVMH did not have and were created during the process would facilitate an increased rate of implementation as the CII/PCS is replicated elsewhere. An example was the "Expressions Configuration Instrument" which was a record keeping tool used to track expressions as they were created or changed.

Implications for advanced nursing practice

The PPACA (2010) becoming law challenged hospitals to improve quality outcomes while reducing the cost of care. The Institute of Medicine's Future of Nursing report (2011) suggested RNs partner with other healthcare professionals in an effort to redesign the US healthcare system and be accountable for their own contributions to deliver high-quality care as efficiently as possible. RNs are uniquely positioned to have an impact on both the quality and cost of healthcare. The CII project's goal was an example of how nurses can not only partner, but take the lead, in meeting the challenges healthcare faces. The CII project was an effort to integrate the EMR and the PCS, each supported by a different vendor, to improve workforce management at SVMH. Additional possibilities as a result of the project include setting a template for others to continue work on the integration of the multiple technological solutions within hospitals and improved working relationships between organizations and their industry partners.

Relation to Other Evidence

Hospitals have many technological products and from different vendors. The CII project was an effort to integrate the EMR and the PCS each supported by a different vendor to improve workforce management at SVMH. Evidence was sought to gain a full understanding regarding how to integrate two different technological solutions; however, no template for the work existed. The review of the evidence focused on better understanding RN: PT ratios and nurse staffing's relationships to patient outcomes, patient classifications systems and the how nurses accept technology.

A plethora of literature, from many different countries, existed exploring the relationship between higher RN hours to improved patient outcomes and survival rates of hospitalized patients. Research has ranged from focusing on data from the RNs' perspective to reviewing national databases to determine patient outcomes. The literature strongly recommended collaboration between RNs and Managers and policy makers to achieve safe staffing levels. Many different PCS were in use throughout the world in an effort by hospitals to determine the appropriate numbers of RNs were needed for their patients. Much was written about PCS; however, no consensus for any specific tool existed and the literature seemed heavy on opinion, anecdotal evidence and discussions on the topic and sorely lacking in research. That may partly be due to the uniqueness of each patient's needs, each DCP's skill set/experience and each environment. Each set of circumstances being so different, the time and cost researching individual PCS would be difficult. In spite of this, efforts have continued in the search to find an objective method for predicting RN workloads. The judgment of the expert RN continued to be taken into consideration when making staffing decisions. Appendix B summarizes major contributions in the literature.

Located in California, SVMH followed the RN: PT ratio legislation, when making staffing decisions. SVMH also used an electronic PCS system, which was not used to facilitate staffing decisions. Studies relating RNs to improved patient outcomes strengthened this author's belief that a PCS that provides accurate, consistent and timely data could be used to support organizations to make appropriate staffing decisions. Enhancing the PCS by implementing the CII would achieve that goal. A major concern was would the DCP's trust the CII to lead the decision making about staffing? Implementation of any PCS would not be successful if the end-

user, the DCP, did not trust or accept the system. This question led the author to include technology and technology acceptance by RNs in the review of the evidence.

The development of the CII/PCS added to the evidence in several ways. First, the implementation of the CII improved the quality of the data used for workforce management by decreasing the barriers of timeliness, accuracy and consistency of traditional PCS. As the RN documented, orders were entered and medications entered into the eMAR. The information was available for PCS interpretation of a specific level of acuity. Second, the CII/PCS project team agreed with Fasoli & Haddock's (2011) recommendation to use a combination of PCS and RN judgment in making staffing decisions. Better decision-making for staffing was a result of the CII/PCS; however, hospital, in-patient nursing units were dynamic, busy places. The status of a patient changed at any time. If the DCPs were busy providing care to patients and had not yet documented, those data elements would not be available to the CII and the data may be inaccurate. RNs were required to use their judgment in addition to the CII/PCS to ensure proper staffing was provided. Finally, Huryk's (2010) study implied the need to involve RNs in system design in order to improve post-implementation satisfaction. DCP RNs participated in the development and implementation of the CII/PCS. In fact, the PLN specifically engaged two DCPs considered being in what Rogers' defined as the early majority or late majority group as team members. Their participation on the team may have had a positive impact with some of the DCPs when the CII/PCS was implemented.

Barrier to Implementation/Limitations

Many barriers to the implementation of the CII/PCS existed. Some barriers were known prior to the onset of the project and some were not fully understood until after the project commenced.

Known barriers

Barriers to the project's implementation that the team was aware of prior to the start included no template for the work being done, lack of clarity regarding the amount of time required and lack of acceptance of the end-user.

No template for the work: There was consensus among the project team that Rogers' Diffusion of Innovations theory could guide the implementation of the CII/PCS. The team had a clear understanding of the aim of the project: to create and implement a clinical information

interface between two software solutions, by different vendors, that allowed EMR data to provide source data for the PCS. The end result was envisioned to be a fully automated classification system where DCPs would no longer be required to manually enter data into the PCS. In addition, timely, accurate and consistent, patient data would be available for decision-makers to determine acuity, allowing for accurate staffing decisions and equitable assignments. However, no template for the work existed and neither did an alternate plan for that potential barrier.

The SVMH team members were to develop the CC instrument, after the industry partner completed the work on the M/S instrument. At that point, the SVMH team realized no template existed for the work that the industry partner completed. The FSA created a document entitled "Expressions Configuration by Instrument" which was to be used as a tracking mechanism for expressions as they were created or changed. This document was used as a guide for the duration of the project to use as a reference for what expressions were used and where and to eliminate redundancies.

Lack of clarity regarding the amount of time required: While time was approved for the project and approval obtained to place the cost of the DCPs in an alternate cost center, the actual time required for the project was unknown. With the industry partners writing the expressions, the SVMH team member's expected the development and implementation of the CII would be a few months. Additionally, the SVMH team assumed the industry partner would develop both the M/S and the CC instruments. The industry partner understood their commitment to be to develop only one instrument. This misunderstanding increased the length of time of the project. An estimated amount of time was approved and assurance of continued support, if needed, by the industry partner was obtained. The alternate plan for uncertainty about the time required was a verbal agreement with industry partners to provide additional assistance, if needed.

Lack of acceptance by the end user: Implementation of the CII was not the only measure of success for the project. DCPs and Nurse Managers must trust that the data from the CII was timely, accurate and consistent with the resulting decisions made based on the data benefiting patient care and the organization's bottom line. Education on the PCS, the CII and regulatory implications were provided in a mandatory boot camp for Nurse Managers/Directors. The

rationale for the boot camp was to expand the knowledge base of the nurse leaders in order to support their staff. Education was also presented during the Acuity Committee meetings.

Unknown barriers

Barriers to the project's implementation that the team was not aware of prior to the start included lack of a tracking mechanism for the expressions, unclear understanding of work from industry partners and SVMH and poor communication between project team and the end users.

Lack of a tracking mechanism for the expressions: Almost immediately after taking the lead in the development of the CC instrument, the SVMH team learned there was no method to track what testing and changes had been made during the development of the M/S instrument. As the components of the CII were tested and changes were made, a method for logging the tests and changes was required. A record of what changes were made and why was needed. A document entitled "Expressions Configuration by Instrument" was created by the FSA. The document was used as a tracking mechanism for expressions as they were created or changed. An additional goal of the document was to eliminate redundancies.

Unclear understanding of work expected from each partner: An understanding of work that was expected from the organization and the industry partner was vital to completion of the project. Additionally, expectations of work completed by specific teams within the organization should have been clearly defined. They were not. Again, as no template for the work existed, lack of clarity around work expectation of each partner was anticipated. Unfortunately, the clarity regarding the expectations of the work should have been discussed and contracted to the extent that was known prior to the start of the project. Assumptions were made by both SVMH and the industry partner. As the work continued with the development the CC instrument, role expectations became clearer. For example, the first instrument was developed with a significant amount of support from the industry partner. Additional instrument development was expected to be developed primarily by SVMH.

Poor communication of project to end users: An announcement went out via the Acuity Committee members at the initiation of the soft go live. Due to low compliance, the soft go live did not impact most DCPs. However, DCPs who had manually entered data into the PCS verbalized concern about a system change without previous knowledge. The team members, Acuity Committee members and nurse leaders were encouraged to communicate with DCPs.

This experience made the PLN understand the need to improve communication with the actual project goes live. The Education Department was engaged to develop a formalized education process, including a skills checklist and sign in sheet, to ensure every DCP was educated on the CII/PCS. Additionally, an extra class was provided for nurse leaders and educators. Keeping in mind the Diffusions of Innovation theory focuses heavily on communication, the early adopters, many of them on the Acuity Committee, will be given speaking points to use to educate other DCPs. Greater than 50% of the Acuity Committee team were DCPs and represented all in-patient nursing units. In addition to the formal education, flyers, emails and word of mouth will be used to communicate the CII/PCS process.

Interpretation

To say that the CII/PCS project has ended is to imply that alone, implementation of an innovation makes a difference. What makes a difference is how people use the innovation. When innovations do not have the outcomes expected, adjustments must be made to bridge that gap and make the innovations user friendly. Many differences between expected and actual outcomes were noted by the project team. Length of the project, changes in planned and actual use of the assignment screen, additional reports required and the development of a new process were all differences noted from the expected outcomes. The project time line was initially six months and extended to one year. Reasons for the delays have been mentioned in previous sections of this paper.

The Assignment Screen, (Appendix V) is the screen used by the charge RN to assign patients to DCPs. The summary portion of the screen allows the viewer to visualize a summary of the assignments made, staffing and skill mix required, admissions, discharges and transfers and the classification summary. The expected use for the Staffing Summary was that it would provide the user a quick glance at the amount of staff required for the patients. While the Summary Screen does provide the number of FTEs required for the amount of time required for patient care, the charge RNs and Nurse Managers don't use the screen because it does not provide an accurate reflection of staffing needs in a specific environment.

Aside from the amount of time required by the patient, state, organization and unit level standards need to be considered when making staffing decisions. California's RN: PT ratios mandate the minimum number of patients assigned to each RN in a patient care area. SVMH's

standard is for every nursing unit to have a charge nurse that is not assigned to patients. Not all nursing units at SVMH accommodate patients requiring intravenous insulin and the units that do accommodate these patients require a RN: PT ratio of 1:3.

The Assignment Screen (Appendix U) depicts an in-patient unit with a census of 14. The Staffing Summary indicates a need for 2.64 RNs. Based on the patient need alone, an assumption could be made that this unit could be staffed with three RNs for the entire shift. The unit is a telemetry unit. The mandated RN: PT ratio for a telemetry unit is 1:4. Taking mandated ratios into consideration, the unit requires four RNs. SVMH's standard is to have a charge RN without a patient assignment on each unit. Taking the patient's needs, the mandated ratios and the standard of the organization, five RNs are required for this unit during this shift. More RNs could be required, if patients were receiving insulin via intravenous drips. To use the Assignment Screen's Staffing Summary as effectively as possible, enhancements to allow for screen to be individualized for a specific environment is required.

Another difference in the expected and the observed outcome is how variances in the CII/PCS ranking and the DCP's rankings are viewed. When the DCP disagree with the automated acuity ranking and manually classified the patient, the team would need to investigate the cause of the discrepancy. A cross-comparison of the two rankings is required to determine what dimension the discrepancy occurred. Once the dimension is identified, further drill down to determine the cause of the discrepancy was identified. Appendix Q illustrates an example of a cross-compare. The CII ranked the amount of patient education the patient as a moderate intervention, while the DCP ranked it as a minimal intervention. The result of this and several other areas of misalignment between the CII and actual acuity was the patient was rated a level four by the CII. The DCP manually classified the patient and the rating was a level two.

Once the variances are identified members of the team will need to investigate to determine the root cause of the variance. A variance could be related to one of three reasons. The first cause of variance is related to the DCP's documentation. Elements for the classification are taken from CPOE, eMAR and the DCP's documentation. If the DCP does not document specific elements, the CII cannot accurately rate patients. The second cause of variance is related to the system itself. The system may be the PCS or the EMR. For example, each data element in the EMR is unique. An upgrade of the EMR that results in a change in any data element will not be

identifiable by the PCS. If the EMR has changed any data elements, the CII cannot accurately rate patients. The third cause of variance is related to changes that will need the Acuity Committee's direction to resolve. In the case of the cross-compare example in Appendix Q, the DCP rated the patient education required as a minimal intervention. The CII takes into account each documentation entry of the DCP. The patient was being discharged and the DCP reviewed all education the patient was provided during the entire admission. The DCP stated the patient understood all the education provided. The CII is programed to account for each documentation entry and rated the education as a moderate intervention. The Acuity Committee would need to meet to determine how to accurately capture education provided into the acuity. Developing an algorithm to determine the best method for resolution, the responsible party and an expected timeline for resolution may facilitate the speed in which improvements are made.

An additional challenge with the cross comparison is that the only way to know if a DCP manually entered a classification is to check each individual DCP's assignment. This is a labor intense process. The team has requested a Cross-Compare Summary Report that allows the user to easily visualize any manually classified patients. Further, the report would identify the percentage of variances per dimensions and expressions.

The IRR was run for a specified period of time and depicted the percentage of agreement among two DCPs rating the same patient through the IRR process. Details include which of the eight specific dimensions, if any, are rated differently through the separate classifications. Prior to the implementation of the CII, IRR was used on a regular basis to assess the validity of the PCS instrument. Upon the implementation of the CII, the PLN and industry partner expert determined that, with the automation, a different methodology for assessing the PCS's validity was required. The cross-compare summary report could be that new methodology. A summary report can be run periodically in order to identify the percentage of patients with manual classifications. The variances can be identified. The Acuity Committee can meet to collaborate on a resolution. Nothing can be done to change the time taken to implement the CII/PCS; however, other improvements can help overall user acceptance.

Finally, the Cost/Benefit Analysis required a review and updating. The original assumption was that using objective data to guide staffing would result in using one less registered nurse in a 24 hour period. After the CII was in place an analysis of the data reflected

that the organization overstaffed by a minimum of one registered nurse and one C.N.A. each shift on each unit implementing the CII. That data resulted in a revision of the Cost/Benefit Analysis (Appendix V).

Conclusion

Using the CII to overcome the barriers of timeliness, accuracy and consistency of traditional PCS solutions will allow decision makers in hospitals to improve workforce utilization. Expectations from this application include overtime reduction resulting from improved staffing and higher productivity. The benefit of the CII/PCS is noted in the in-patient nursing units; however, requests have been made by DCPs in the Emergency Department and surgery areas for a classification system to help determine appropriate patient placement from outpatient areas into in-patient areas.

Continued work developing the CII/PCS include moving to other hospitals with other EMRs, improving and standardizing the implementation process and further developing the integration of technological solutions from different vendors to improve the communication of healthcare records. This experience was helpful in that such a large group of DCPs were involved in making decisions that ultimately impact the hospital's bottom line. RN partnering with hospital leadership and other healthcare professionals to manage the workforce is essential to the national initiative of improving the quality of patient care and decreasing healthcare costs.

Other Information

Funding

No funding sources were obtained in the design, implementation, interpretation and publication of the project.

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Appendix A

End-User Questionnaire

Name: _____ Unit: _____

Title: _____

Thank you for your assistance. Please complete and return to Tanya Osborne-McKenzie in Nursing Administration.

What one thing would you like changed with our acuity system?

_____

_____

_____

_____

_____

Appendix B

Evidence Table

RN: PT Ratios

Author/ Article	**Study Design (Validity/ Methods)**	**Study Results**	**Study Conclusions Pertinent Findings**	**Relevance to Care (Significance)**	**Evidence Rating**
Aiken, L.H., et al. (2010) Implications of the California nurse staffing mandate for other states Health Research and Educational Trust	Nurse workloads are compared across the three states and examined how nurse and patient outcomes, including patient mortality and failure-to-rescue, are affected by the differences in nurse workloads across the hospitals in these states.	California hospitals nurses cared for one less patient on average than nurses in the other states and two fewer patients on medical and surgical units. Lower ratios are associated with significantly lower mortality. When nurses' workloads were in line with California-mandated ratios in all three states, nurses'	Hospital nurse staffing ratios mandated in California are associated with lower mortality and nurse outcomes predictive of better nurse retention in California and in other states where they occur. Although attempts to minimize bias were implemented, the use of the same	This paper describes the implications of California's mandated nurse staffing to three other states. Implications for nursing in informing other states that are debating nurse ratio legislation.	Evidence Level: 3 Non-experimen-tal Quality Rating: A

		burnout and job dissatisfaction were lower, and nurses reported consistently better quality of care.	nurses to assess the impact of the California legislation and to report on quality of care and job satisfaction may be a study limitation.		
Bolton, L.B., et al. (2007) Mandated nurse staffing ratios in California: A comparison of staffing and nursing-sensitive outcomes pre- and postregulation Policy, Politics & Nursing Practice	Post-regulation ratios data from 2004-2006 were used to assess trends in staffing and outcomes two years after implementing in California. The authors compared the California Nursing Outcomes Coalition (CalNOC) data from 252 Medical Surgical and step down nursing units, in 108 hospitals, representing greater than 500, 000 patient days to determine the difference	Exploratory examination of the relationship between staffing and nursing sensitive patient outcomes was completed.	Anticipated improvements in nursing sensitive patient outcomes were not observed. Limitations of the study included the CalNOC database, in 2005 were based on data from a convenience sample of California hospitals. The data does not represent hospitals that did not participate.	This report contributes to the growing understanding of the impacts of regulatory staffing mandates on hospital operations and patient outcomes.	Evidence Level: 3 Non-experimental Quality Rating: B

	between pressure ulcers, nurse staffing and patient falls before and after RN: PT ratios				
Mark, B.A., et al. (2013) California's minimum nurse staffing legislation: Results from a natural experiment Health Research and Educational Trust	Data from the American Hospital Association Annual Survey of Hospitals, the California Office of Statewide Health Planning and Development, the Hospital Cost Report Information System, and the Agency for Healthcare Research and Quality's Health Care Cost and Utilization Project's State Inpatient Data-bases from 2000-2006 were grouped into four quartiles based on pre-regulation staffing levels. The difference-in-	California hospitals increased nurse staffing levels over time significantly more than did comparison state hospitals. Failure to rescue decreased significantly more in some California hospitals, and infections due to medical care increased significantly more in some California hospitals than in comparison state hospitals. There were no statistically significant changes in either respiratory failure or postoperative sepsis.	Following implement-ation of California's minimum nurse staffing legislation, nurse staffing in California increased significantly more than it did in comparison states' hospitals, but the extent of the increases depended upon pre-regulation staffing levels; there were mixed effects on quality. The study had several limitations including the timing placed the study prior to Medicare's	With mixed reviews regarding improvements in quality and mandated and research relating the cost of nursing care is related to mandated ratios, the larger and so far, unanswered question is whether the incremental increases in quality are worth the cost.	Evidence Level: 3 Non-experiment-al Quality Rating: C

	difference approach was used to compare changes in staffing and in quality of care to changes over the same time period in hospitals in 12 comparison states without minimum staffing legislation.		requirement that all secondary diagnosis codes in the patient discharge record be coded as to where they were present on admission, reliance on nurse staffing data from the American Hospital Association (which do not distinguish staffing from inpatient and outpatient services) and the use of the Nursing Intensity Weights to adjust for patient acuity has not been evaluated for reliability.		
Spetz, J., e al. (2008) How many nurses per patient? Measurements of nurse	Hospital-level and unit-level data were compared using summary statistics, t-test and	The greatest differences in staffing measurement arise when unit-level data are compared with hospital-	Unit-level data collection may be more precise. Differences between databases	This study is important, as most studies regarding RN: PT ratios include one or more of the databases.	Evidence Level: 3 Non-experiment-al Quality Rating: B

staffing in health services research Health Research and Educational Trust	correlations.	level aggregated data reported in large administrative databases. There is greater dispersion in the data obtained from publicly available, administrative data sources than in unit-level data; however, the unit-level data sources are limited to a select set of hospitals and are not available to many researchers.	may account for differences in research findings.		
Serratt, T., et al (2011) Staffing changes before and after mandated nurse-to-patient ratios in California's hospitals Policy, Politics & Nursing Practice	Examined two years of date from California Hospital Annual Financial Disclosure Reports in primarily general acute care hospitals in order to identify and describe changes in nurse and	The study concluded that most hospitals increased the number of RN staff and decreases in support staff and other non-nursing staff were not evident.	Mandated ratios had the desired effect of increasing the number of nurses in acute care hospitals as evidenced by the mean productive hours per patient day of RNs and registry nurses in California	The study's focus was on the changes in nurse and non-nurse staffing during the early implementation phase of RN: PT ratios. Continued exploration is required to determine ongoing and long-term staffing changes since the	Evidence Level: 3 Non-experiment-al Quality Rating: B

	non-nursing staffing that were likely to have occurred as a result of the RN: PT ratio legislation.		hospitals increased between fiscal year 2000 and 2006, hospitals staffing above minimum 1:5 nurse-to-patient ratio in fiscal year 2000 and 2006 compared to hospitals staffing at or below the minimum and unit-based support staff and other non-nurse staff mean productive hours per patient day or per service were not reduced.	mandated ratios took effect.	

Nurse Staffing to Patient Outcomes

Author/ Article	Study Design	Study Results	Study Conclusions Pertinent Findings	Relevance to Care	Evidence Rating
Aiken, L.H., et al. (2002) Hospital staffing,	Multisite cross-sectional surveys of 10, 319 RNs in	Dissatisfaction, burnout, and concerns about quality of care were common	Adequate nurse staffing and organizational/ Managerial	RN reports of low quality of care were three times	Evidence Level: 3 Qualitative

organization, and quality of care: cross-national findings International Journal for Quality in Health Care	adult acute-care hospitals in the United States, Canada, England and Scotland.	among hospital nurses in all five sites. Organizational/ Managerial support for nursing had a pronounced effect on nurses' dissatisfaction and burnout, and both organizational support for nursing and nurse staffing were directly, and independently, related to nurse-assessed quality of care.	support for nursing are key to improving the quality of patient care, to diminishing nurse job dissatisfaction and burnout and, ultimately, to improving the nurse retention problem in hospital settings. Study limitations included: a convenience sample, hospitals with fewer than ten survey responses were removed, only RNs employed in medical surgical nursing units were surveyed.	as likely in hospitals with low staffing and support for nurses as in hospitals with high staffing and support.	Quality Rating: A
Duffield, C., et al. (2011) Nursing staffing, nursing workload, the work environment	Longitudinal retrospective and concurrent cross-sectional methods were used to analyze five	Results from the longitudinal sample revealed higher number of TN hours were associated with significantly	Nurse staffing (fewer RNs), increased workload, and unstable unit environments were linked to negative patient	Unit-level data including staffing would not be difficult to obtain for analysis at the	Evidence Level: 3 Non-experiment-al Quality Rating: B

and patient outcomes Applied Nursing Research	years of administrative data and one overlapping year of primary unit data to investigate if nurse staffing, increased workload and unstable nursing unit environments were linked to negative patient outcomes. Workforce data from 27 hospitals, totaling 286 different in-patient hospital units were reviewed.	decreased rate of decubiti, pneumonia and sepsis. The cross-sectional study resulted in increased errors, specifically medication errors, with fewer nurses.	outcomes including falls and medication errors on medical and surgical units in a mixed method study combining longitudinal data and primary data collection. Combining the two studies; longitudinal and cross-sectional, was much more difficult than anticipated by the researchers. Only 43 of the 80 units were able to be studied. The data was limited by the medical record coding. It is unclear if all adverse patient events were recorded on the patient records.	individual hospital level in most counties. Additional research to identifying the data to assess relationships among nurse staffing and workloads in terms of case-mixes, patient acuity and turnover.	
Hinno, S., et al. (2011) Nursing activities,	A cross-sectional, descriptive questionnaire survey was	The study's results were consistent with previous research: the	Significant associations were found between nurse staffing and	The findings provide insight into the potential effects of	Evidence Level: 3 Non-experimental

nurse staffing and adverse patient outcomes as perceived by hospital nurses Journal of Clinical Nursing	used to investigate relationships between nursing activities, nurse staffing and adverse patient outcomes in hospitals in Finland and the Netherlands.	higher number of RNs, the better patient outcomes.	adverse patient outcomes in hospital settings. Compared to the Netherlands, in Finland, nurses appear to have higher workloads, there are higher patient-to-nurse ratios, and these adverse staffing conditions are associated with higher rates of adverse patient outcomes.	major changes or reductions in nursing staff on the occurrence of adverse patient outcomes in hospital settings.	Quality Rating: B
Lin, C.H., (2013) The impact of nurse staffing on quality of patient care in acute care settings: An integrative review paper Singapore Nursing Journal	A literature search was conducted; extracting data to determine the impact of nurse staffing on quality of patient care.	The evidence largely associated elevated nurse staffing levels and higher RN proportions with better quality of patient care.	The findings can assist hospital administrators in nurse staffing planning and nurse administrators in developing an appropriate staffing model to achieve quality patient outcomes. A limitation of the study was that all	Findings of reviewed studies indicated that reducing RNs numbers significantly decrease the quality of patient care.	Evidence Level: 3 Meta-synthesis Quality Rating: B

			researches reviewed were from Western countries, with only one from Asia.		
West, E., et al., (2014) Nurse staffing, medical staffing and mortality in intensive care: An observational study International Journal of Nursing Studies	Cross-sectional, retrospective, risk adjusted observational study	After controlling for patient characteristics and workload researchers found that higher number of RNs per bed and higher number of consultants were associated with higher survival rates.	The study supports claims that the availability of medical and nursing staff is associated with the survival of critically ill patients. Limitations to the study include the fact that the data are cross-sectional which limits the extent to which causal claims can be made, the data was also several years old and the workload was measured for the intensive care unit as a whole, not at the patient level.	The workload of the unit has an impact on patient mortality in addition to the number of clinical staff on the unit establish-ment.	Evidence Level: 3 Non-experimental Quality Rating: B

Patient Classification System

Fassoli & Haddock	Integrative review of the	The authors reviewed 63	No consensus	The implication	Evidence Level: 3

(2011) Results of an integrative review of patient classification Systems Annual Review of Nursing Research	literature aimed to identify current practices related to PCS and determine if a "gold standard" PCS could be adopted or adapted for use by RN leaders in practice.	articles from 1983-2010, finding many criticisms from earlier articles remained in recent articles and a few specific characteristics of some PCS.	exists about PCS.	for nursing is the need for continued balancing of PCS and nursing judgment.	Quality Rating: B
Hurst, K. et al., (2008) Calculating staffing requirements Nursing Management	Attempt to develop an easy-to-use patient classification system. 2, 759 patients in three hospitals were sampled.	The authors developed a tool with a ten step algorithm for calculating direct care hours per patient day.	To develop a simple tool requires large datasets that are expensive to collect and maintain.	Extrapolating from existing information in order to contain cost and time may be required; however, in doing so, validity and reliability principles should not be abandoned.	Evidence Level: 2 Quasi-experimental Quality Rating: B
Levenstam & Bergbom (2011) The zebra index: one method for comparing units in terms of nursing care Journal of Nursing	The index and calculation for classifying patients was developed.	The index shows the intensity of nursing care. The index makes possible to follow changes in the nursing care given over a period of time and it can have a totally different	The index obtains reliable information about the changing nursing situations over a period of time.	The approach described can be used in different settings and is not bound to on country, but can be looked upon as a general method.	Evidence Level: 2 Quasi-experimental Quality Rating: B

Management		workload situation.			

Technology and Technology Acceptance by Nurses

Huryk (2010) Factors influencing nurses' attitudes towards healthcare information technology Journal of Nursing Manage-ment	A search of PubMed, CINAHL and Medline databases and reviewed 13 articles to examine current trends in RN's attitudes towards healthcare information technology (HIT).	The attitudes of nurses toward HIT are positive. Increased computer experience is the main demographic indicator for positive attitudes.	The most common detractors was poor system design, system slowdown and system downtime and RNs were concerned that the use of technology would dehumanize patient care, the attitudes of RNs towards HIT were positive.	Implications of the study included the need to involve RNs in system design in order to improve post-implementation satisfaction.	Evidence Level: 3 Non-experimental Quality Rating: B
Ingebrigtsen et al., (2014) The impact of clinical leadership on health information technology adoption: Systematic review Internationa	Review of the literature of the major databases to examine evidence associating clinical leadership and successful IT adoption in healthcare organizations.	The results demonstrate important associations between the attributes of clinical leaders and IT adoption.	Leaders who possess technical informatics skills and prior experience with IT project management were related to a long-term commitment to the use of	Proactive leadership behaviors and partnerships with IT professionals that is associated with successful organizational and clinical outcomes.	Evidence Level: 3 Non-experimental Quality Rating: B

l Journal of Medical Informatics			IT.		
Kua, Lui & Ma, (2013) An investigation of the effect of nurse' technology readiness on the acceptance of mobile electronic medical record systems BMC Medical Informatics & Decision Making	Self-administered questionnaire used to collect 665 valid responses from a large hospital in Taiwan to investigate personality traits of RNs in regard to technology readiness toward mobile electronic medical record systems.	The authors conclude that continuous educational programs focused on RNs improving their IT literacy, minimizing stress and discomfort about IT and focusing on recruiting more optimistic RNs to champion HIT implementa-tion and usage.	The friendliest of user interfaces of the EMR will greatly enhance the RN's engagement with HIT.	The authors caution implementers ignoring the effects of personalities on technology and recommends personality traits be included in the personnel databases of organizations.	Evidence Level: 3 Non-experimental Quality Rating: B
Rivard & Lapointe, (2012) Information technology implement-ters' responses to users resistance: Nature and effects MIS Quarterly	Question-naires used to study the response by implementers of IT to resistance of the end user. The study wanted to answer two questions: "What are implement-ers' responses to user	A taxonomy that included four categories of imple-menters' responses to user resistance was developed. The effects of these depended on the response to the first question.	The researchers provided a theoretical explanation of how implementer's responses may affect the antecedents that earlier research found to be associated with user resistance	Implementers can predict the effect the response of the implementer to resistance has on the end user.	Evidence Level: 3 Non-experimental Quality Rating: C

	resistance? "What are the effects of these responses on user resistance?		behaviors.		

Appendix C

DNP Project Approval

Student Project Approval: Statement of Determination

Student Name: _Tanya Osborne-McKenzie_____

Title of Project: Implementation of a Clinical Information Interface (Atomization of a

Patient Classification System)

Brief Description of Project: Patien

t classification systems (PCS) are commonly used to predict patient requirements for nursing care. The requirements, or patient acuity, is then used to manager nursing staffing plans, developing budgets and are foundational for patient satisfaction, nursing satisfaction and making daily staffing decisions. PCSs have many limitations, including the validity and reliability of the tools are infrequently monitored, often the tools used are complex and require considerable time to complete and the tools lack credibility of staff nurses and administrators.

Opinion-based acuity systems must be replaced by evidenced-based systems. Evidenced-based PSCs are available in today's market. A limitation of these systems is the time needed by the user (nurse) to enter the data and the knowledge the user needs to ensure the accuracy of the data that is entered. Evidenced-based systems must be enhanced by systems that are not time consuming. Many hospitals have electronic medicine administration records (eMAR), computerized physician order entry (CPOE and electronic nursing documentation systems. Ultimately, the automation of an evidenced-based PCS system can support the decisions made to manage nursing personnel resources, costs and quality.

A) Aim Statement: To implement a Clinical Information Interface (an automated Patient Classification System) of an acuity system that is objective, reliable, valid and intuitive into in-patient areas of an acute care hospital.

B) Description of Intervention: A multi-disciplinary team, will develop, test and implement an automated version of the PCS currently used. The upgrade will allow for data from CPOE, eMAR and nursing documentation screens to be expressed into the PCS.

C) How will this intervention change practice? Data is continuously received by PCS from EMR solution(s). This includes orders from CPOE, medication and IV administration data from your EMAR source, and relevant nursing documentation as well. Compliance of the acuity system will be increased, as the acuity will no longer be dependent upon the RN to enter data. Accuracy will be increased as the acuity system will no longer be dependent on the RN's knowledge.

D) Outcome measurements:

- Implementation by March 31, 2014
- Staffing decisions made by referring to PCS.
- Positive feedback from staff survey

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used:
(http://answers.hhs.gov/ohrp/categories/1569)

☐ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐ This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

Project Title:	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	**x**	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	**x**	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	**x**	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does **NOT** develop paradigms or untested methods or new untested standards.	**x**	
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	**x**	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	**x**	
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	**x**	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	**x**	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: *"This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."*	**x**	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. **IRB review is not required. Keep a copy of this checklist in your files.** If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print): Tanya Osborne-McKenzie_____

Signature of Student:_____DATE__12/10/2013_____

SUPERVISING FACULTY NAME (Please print):_____

Signature of Supervising:
_____DATE_____

Appendix D

Responsibility Matrix

Responsibility Matrix

Responsibilities / Roles	Champion Project	Coordinate Staff, Obtain Budgetary Approvals	Develop Timeframe for Implementation	Lead Communica-tion to Stakeholders	Audit	Go-live Support	Training	Mapping Expression Writing	Post Implemen-tation Evaluation
Administration	1	3	3	2	3		3		
Project Lead, Nursing	1	1	1	1	1	1	1	2	1
Project Lead, Informatics	1	2	1	1	2	2		2	2
RN Informaticists	1				2	1	2	1	2
Programmers	1							1	
Functional Systems Analyst	1	2	1	2		1	2	1	2
Direct Care Providers	1			2	1		1	1	2
Industry Partner, Project Lead	1			1	2	2		1	2
Industry Partner, Programmers	1							1	
Instrument Expert	1			2	1	2		2	2

Responsible	1
Support	2
Approval	3

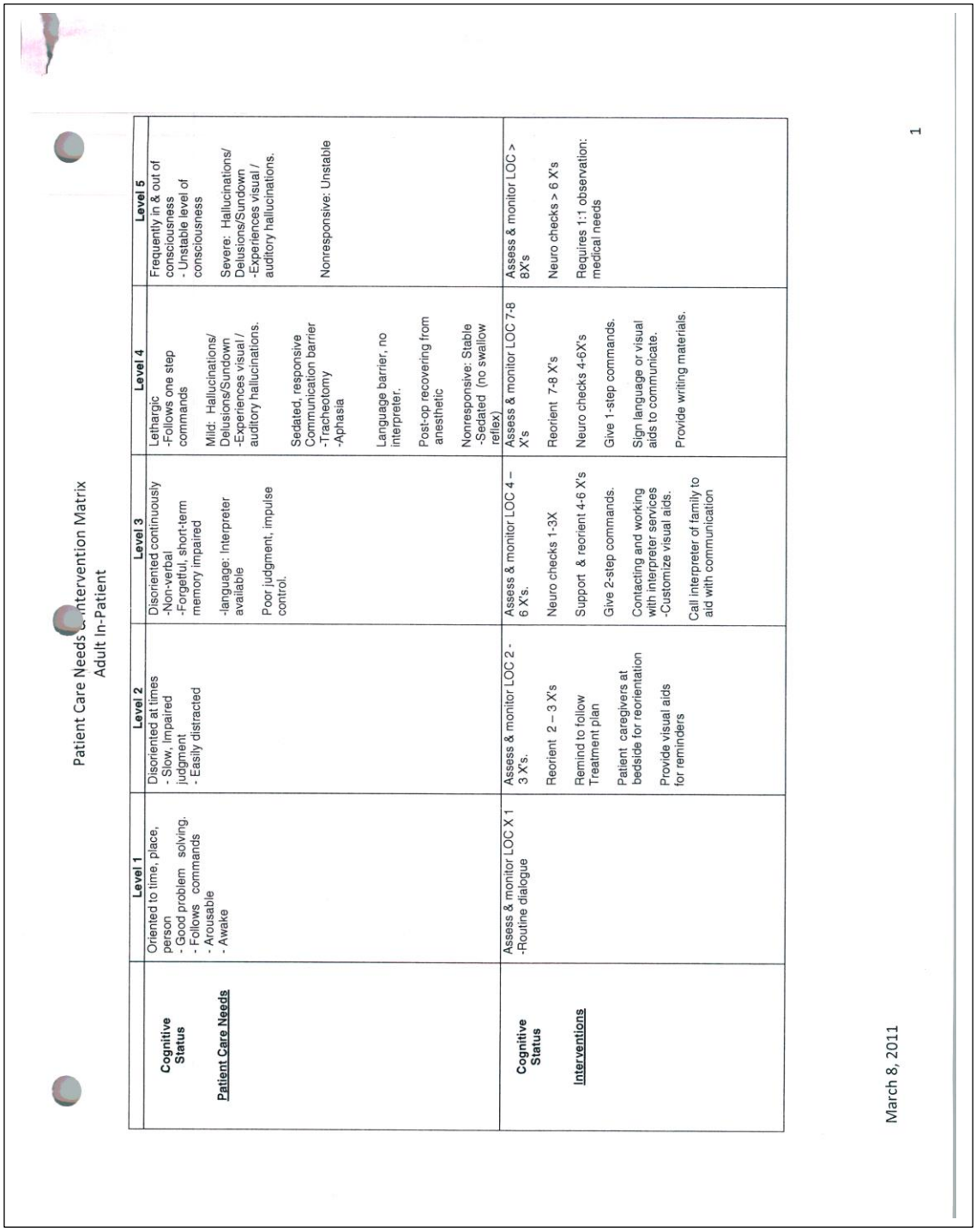
Appendix E

SWOT Analysis

Strengths • Strong IT Department • IT Infrastructure • Interdisciplinary team • Strong relationship with industry partner	Weaknesses • Buy-in/acceptance of end user • No template for work involved to create and implement
Opportunities • Enhance team communication • Decrease end user workload • Improve accuracy of staffing decisions • Create a template for interfaces between other technology solutions	Threats • Adoption • Uncertain timeframe; therefore, cost, to create and implement • Must maintain timeline for completion • Staff proficiency

Appendix F

Patient Care Needs Intervention Matrix



Patient Care Needs Intervention Matrix
Adult In-Patient

	Level 1	Level 2	Level 3	Level 4	Level 5
Cognitive Status **Patient Care Needs**	Oriented to time, place, person - Good problem solving. - Follows commands - Arousable - Awake	Disoriented at times - Slow, impaired judgment - Easily distracted	Disoriented continuously -Non-verbal -Forgetful, short-term memory impaired -language: Interpreter available Poor judgment, impulse control.	Lethargic -Follows one step commands Mild: Hallucinations/ Delusions/Sundown -Experiences visual / auditory hallucinations. Sedated, responsive Communication barrier -Tracheotomy -Aphasia Language barrier, no interpreter. Post-op recovering from anesthetic Nonresponsive: Stable -Sedated (no swallow reflex)	Frequently in & out of consciousness - Unstable level of consciousness Severe: Hallucinations/ Delusions/Sundown -Experiences visual / auditory hallucinations. Nonresponsive: Unstable
Cognitive Status **Interventions**	Assess & monitor LOC X 1 -Routine dialogue	Assess & monitor LOC 2 - 3 X's. Reorient 2 – 3 X's Remind to follow Treatment plan Patient caregivers at bedside for reorientation Provide visual aids for reminders	Assess & monitor LOC 4 – 6 X's. Neuro checks 1-3X Support & reorient 4-6 X's Give 2-step commands. Contacting and working with interpreter services -Customize visual aids. Call interpreter of family to aid with communication	Assess & monitor LOC 7-8 X's Reorient 7-8 X's Neuro checks 4-6X's Give 1-step commands. Sign language or visual aids to communicate. Provide writing materials.	Assess & monitor LOC > 8X's Neuro checks > 6 X's Requires 1:1 observation: medical needs

March 8, 2011

1

Appendix G

Cost/Benefit of CII Implementation

	2013	2014	2015	2016
ANTICIPATED SAVINGS				
Overstaffing	0	16,224	16,630	17,046
Incremental Overtime	0	121,680	124,722	127,840
Nurse Manager Time	0	23,400	23,985	24,585
CDPH Survey	0	1,218	0	0
Net Savings	0	162,522	165,337	169,471
OPERATING EXPENSES				
Direct Care RNs	26, 000	15,600	4,264	4,371
Auditing RNs	0	4,480	2132	2185
Informaticists	5,600	5,600	0	0
Director, Informatics	3,600	3,600	0	0
Misc. IT	1,300	1,300	0	0
Clinical RN Manager	3,600	3,600	1474	1511

Total Expenses	$40,100	30,580	7,870	8,067
NET SAVINGS	($40,100)	131,942	157,467	161,404

Appendix H

Work Breakdown Structure

Salina Valley CII Implementation Plan110513

ID	ID	Task Mod	Task Name	Duration	Start	Finish	Predecesso	Resource Names
1	1		**Salinas Valley CII Implementation**	**162 days**	**Wed 8/21/13**	**Fri 4/11/14**		
2	2		**Project Initiation**	**1 day**	**Wed 10/2/13**	**Wed 10/2/13**		
3	3		Define project team, key stakeholders	1 day	Wed 10/2/13	Wed 10/2/13		Correen W,Mike M,Rick R,SVMH
4	4		**Project Execution**	**82 days**	**Wed 8/21/13**	**Mon 12/16/13**		
5	5		Obtain client data repository	1 day	Wed 8/21/13	Wed 8/21/13		SVMH,API
6	6		PCS Boot Camp	1 day	Tue 10/1/13	Tue 10/1/13		SVMH,Rick R,Mike M
7	7		Project Plan review and sign-off	1 day	Wed 10/2/13	Wed 10/2/13		Mike M,Rick R,SVMH
8	8		**Nursing Documentation**	**63 days**	**Wed 8/21/13**	**Fri 11/15/13**		
9	9		Define download process	1 day	Wed 10/2/13	Wed 10/2/13		Mike M,Rick R,SVMH IT,API Engineering
10	10		Initial nursing documentation mapping review	1 day	Thu 8/29/13	Thu 8/29/13		SVMH,Mike M
11	11		Obtain client data repository	1 day	Wed 8/21/13	Wed 8/21/13		SVMH,API
12	12		**Phase 1 (4 dimensions)**	**33 days**	**Wed 10/2/13**	**Fri 11/15/13**		
13	13		First nursing documentation mapping meeting	1 day	Wed 10/2/13	Wed 10/2/13		Rick R,Mike M,SVMH
14	14		Build expressions for identified data mappings	1 day	Wed 10/2/13	Wed 10/2/13		SVMH,Rick R,Mike M
15	15		Identify nursing documentation tables required for CII	7 days	Mon 10/28/13	Tue 11/5/13		Katherine,Tim
16	16		Build expressions (Without order data)	1 day	Wed 11/6/13	Wed 11/6/13	15	API Engineering
17	17		Develop database view of the required data elements (orders and EMAR data)	15 days	Mon 10/28/13	Fri 11/15/13		Katherine,Tim

Salina Valley CII Implementation Plan110513

ID	ID	Task Mod	Task Name	Duration	Start	Finish	Predecesso	Resource Names
32	32		Build expression look-back ability (Breathing and Ostomy Care)	19 days	Thu 11/7/13	Thu 12/5/13		API Engineering
33	33		Add required fields to Meditech (Family, Wound Care, Developmental Delay, Referrals, Discharge)	6 days	Tue 11/5/13	Tue 11/12/13		Katherine,Lillia
34	34		Deliver instruments to API	2 days	Fri 11/8/13	Mon 11/11/13		SVMH
35	35		Write Equations	2 days	Wed 11/13/13	Thu 11/14/13		API Engineering
36	36		Code expressions	3 days	Wed 11/13/13	Fri 11/15/13		API Engineering
37	37		**Test CII with actual SVMH nursing documentation data**	**5 days**	**Mon 10/28/13**	**Fri 11/1/13**		**Rick R,API Engineering**
38	38		API Testing	12 days	Mon 11/18/13	Thu 12/5/13	36	API Engineering
39	39		SU 9.3.1 shipment/install to Test	1 day	Fri 11/15/13	Fri 11/15/13		API Engineering,SVMH IT
40	40		SU 9.3.1 shipment/install to Live					API Engineering,SVMH IT
41	41		Set-up in preparation for testing (API on-site)	1 day	Mon 11/18/13	Mon 11/18/13		API,SVMH IT
42	42		SVMH Testing - Session 1 (API on-site)	2 days	Tue 11/19/13	Wed 11/20/13	36,41	API,SVMH
43	43		Correct any CII bugs, additional expressions as required	10 days	Wed 11/20/13	Thu 12/5/13	42SS+1 day	API Engineering
44	44		SU 9.3.2 shipment/install to test	1 day	Wed 12/4/13	Wed 12/4/13		API Engineering,SVMH IT
45	45		SU 9.3.2 shipment/install to Live					API,SVMH IT
46	46		SVMH Testing - Session 2	3 days	Wed 12/4/13	Fri 12/6/13		API,SVMH
47	47		API Regression Testing	4 days	Fri 12/6/13	Wed 12/11/13	43	API Engineering
48	48		Client sign-off of testing results	1 day	Thu 12/12/13	Thu 12/12/13	47	SVMH
49	49		**Phase 3 Testing Placeholder if needed (Remaining 4-6 dimensions)**	**6 days**	**Mon 12/9/13**	**Mon 12/16/13**		
50	50		API Testing	3 days	Mon 12/9/13	Wed 12/11/13		API Engineering
51	51		SVMH Testing	4 days	Tue 12/10/13	Fri 12/13/13		API,SVMH

Salina Valley CII Implementation Plan110513

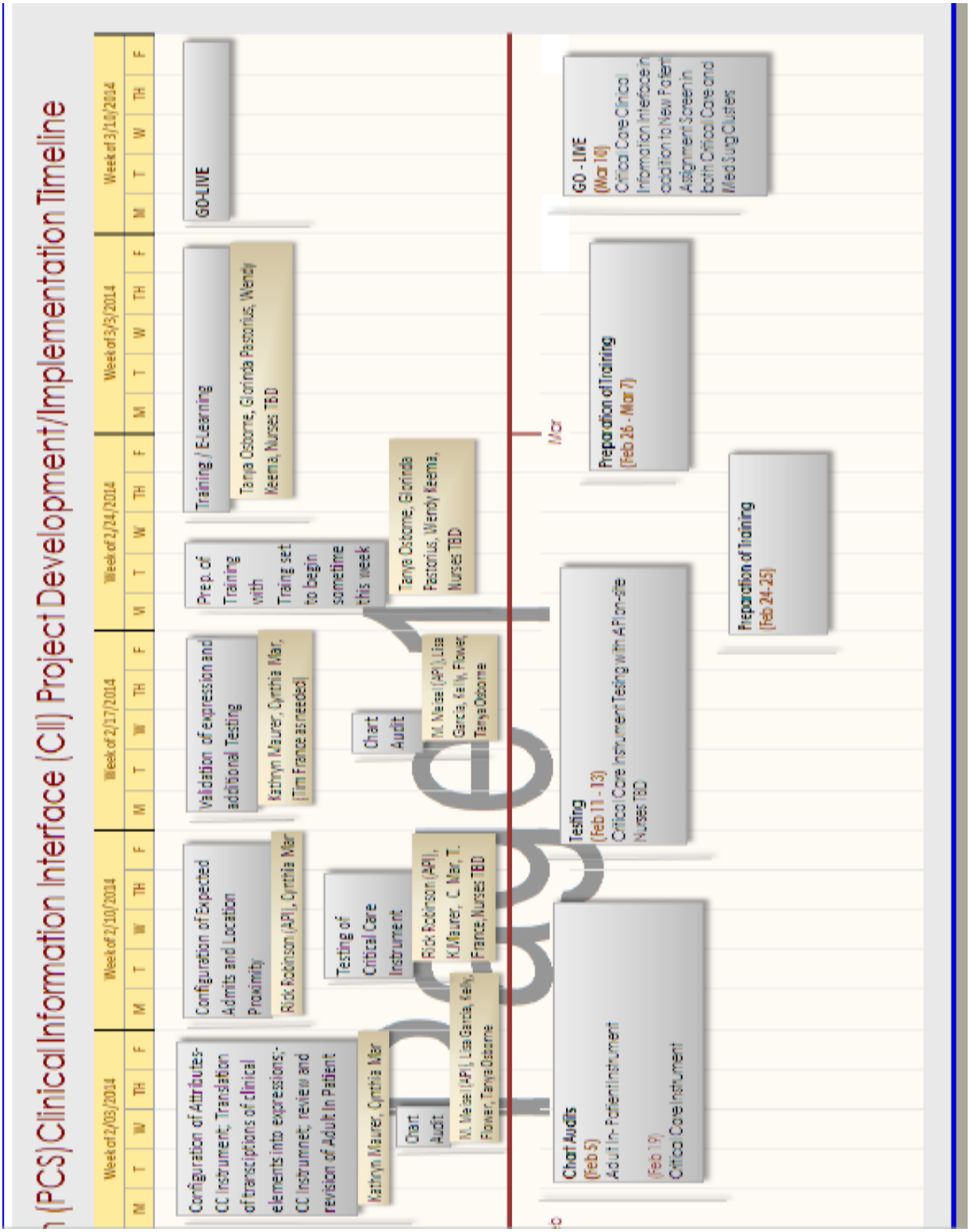
ID	ID	Task Mod	Task Name	Duration	Start	Finish	Predecesso	Resource Names
52	52		Correct any CII bugs, additional expressions as required	3 days	Tue 12/10/13	Thu 12/12/13		API Engineering
53	53		API Regression Testing	1 day	Fri 12/13/13	Fri 12/13/13	52	API Engineering
54	54		Client sign-off of testing results	1 day	Mon 12/16/13	Mon 12/16/13	53,51	SVMH
55	55		**Production Implementation**	**13 days**	**Mon 12/2/13**	**Wed 12/18/13**		
56	56		9.3.3 SU shipment/install to test	1 day	Fri 12/13/13	Fri 12/13/13		API Engineering,SVMH IT
57	57		9.3.3 SU shipment/install to live	1 day	Tue 12/17/13	Tue 12/17/13		API Engineering,SVMH IT
58	58		Develop product implementation checklist	3 days	Mon 12/2/13	Wed 12/4/13		Correen W
59	59		Production implementation checklist review	1 day	Thu 12/5/13	Thu 12/5/13	58	API,SVMH,SVMH IT
60	60		Develop support plan	3 days	Mon 12/9/13	Wed 12/11/13		Correen W
61	61		Support plan review	1 day	Thu 12/12/13	Thu 12/12/13	60	API,SVMH,SVMH IT
62	62		Production Readiness review and sign-off	1 day	Tue 12/17/13	Tue 12/17/13	54	API,SVMH
63	63		First Productive Use	1 day	Wed 12/18/13	Wed 12/18/13	62	Mike M,SVMH
64	64		**Post Project Review**	**65 days**	**Mon 1/13/14**	**Fri 4/11/14**		
65	65		Client feedback session (1x a week for 3 months after go-live)	65 days	Mon 1/13/14	Fri 4/11/14	62FS+14 days	API Engineering,SVMH,SVMH IT

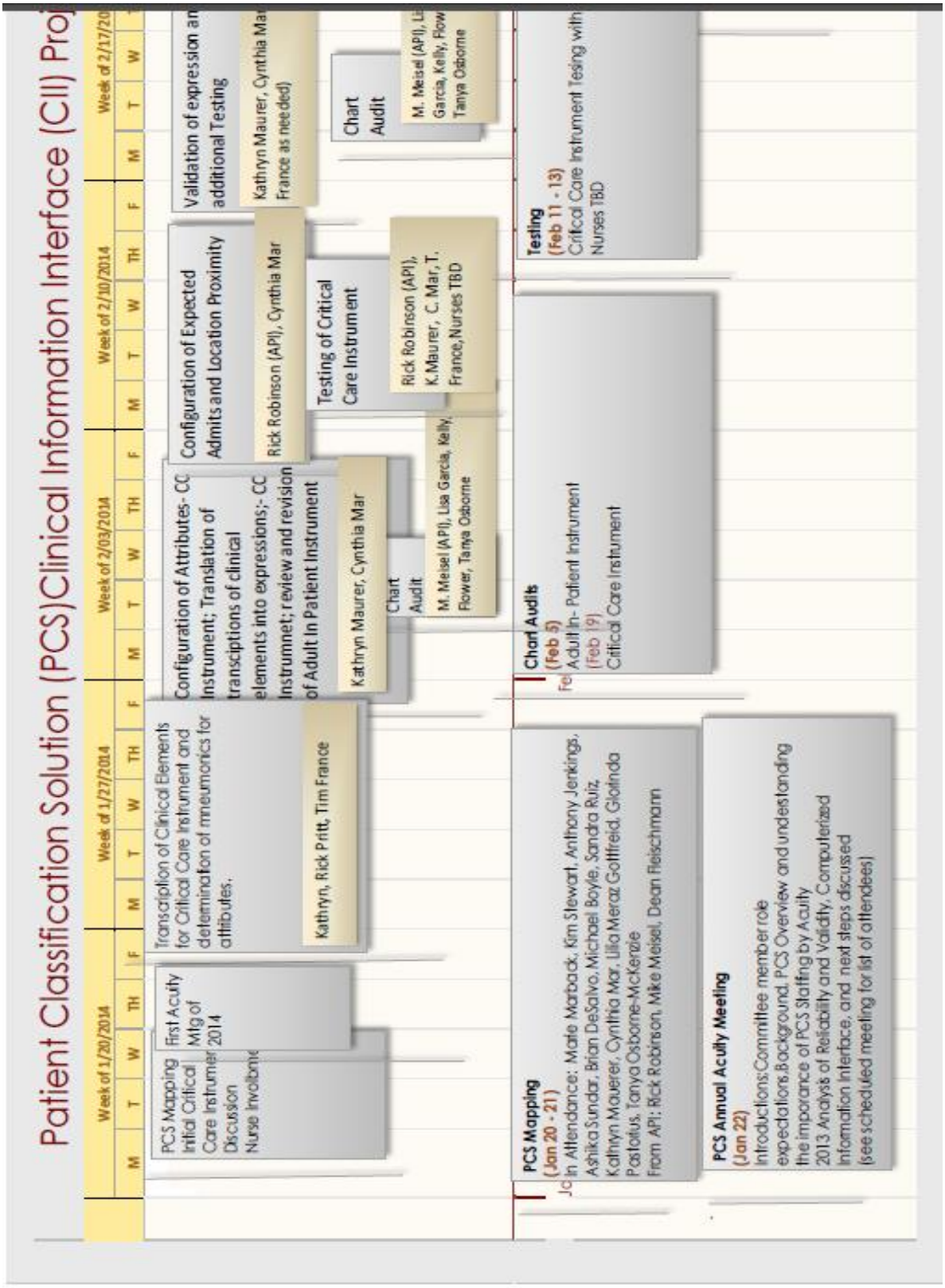
Salina Valley CII Implementation Plan110513

ID	ID	Task Mod	Task Name	Duration	Start	Finish	Predecesso	Resource Names
18	18		Phase 1 test data send to API (nursing doc and medication data only)	4 days	Tue 11/5/13	Fri 11/8/13		Katherine,Tim
19	19		**Test CII with actual SVMH nursing documentation data**	**29 days**	**Thu 10/3/13**	**Tue 11/12/13**		**Rick R,API Engineering**
20	20		Develop a set PID segments for 25 pts in Engineering test data base for Tim	4 days	Thu 10/3/13	Tue 10/8/13		Engineering
21	21		API Testing (without order data)	3 days	Thu 11/7/13	Mon 11/11/13	15	
22	22		API Regression Testing	1 day	Tue 11/12/13	Tue 11/12/13	21	API Engineering,Rick R,Mike M
23	23		Release 9.3 SVMH shipment/install to Test	11 days	Wed 10/30/13	Wed 11/13/13		SVMH,API Engineering
24	24		Release 9.3 SVMH shipment/install to Live					SVMH,API Engineering
25	25		**Phase 2 (Remainder of Adult In-Patient)**	**32 days**	**Mon 10/21/13**	**Thu 12/5/13**		
26	26		Complete Mapping	5 days	Mon 10/21/13	Fri 10/25/13		Rick R,Mike M,SVMH
27	27		Build expressions for identified data mappings	5 days	Mon 10/21/13	Fri 10/25/13		SVMH,Rick R,Mike M
28	28		Identify nursing documentation tables required for CII	4 days	Tue 11/12/13	Fri 11/15/13	17SS	Katherine,Tim
29	29		Develop database view of the required data elements	4 days	Tue 11/12/13	Fri 11/15/13	28SS	Katherine,Tim
30	30		Deliver order examples to API	1 day	Tue 11/12/13	Tue 11/12/13		Katherine,Tim
31	31		Expand database to capture additional fields for 4 dimensions (Chemo, IV Continuous, Specimen Collection, Continuous Bladder Irrigation)	19 days	Thu 11/7/13	Thu 12/5/13		API Engineering

Appendix I

Gantt Chart


(PCS)Clinical Information Interface (CII) Project Development/Implementation Timeline
Week of 2/03/2014
Week of 2/10/2014
Week of 2/17/2014
Week of 2/24/2014
Week of 3/3/2014
Week of 3/10/2014
M T W TH F
Configuration of Attributes-CC Instrument; Translation of transcriptions of clinical elements into expressions;- CC Instrumnet; review and revision of Adult In Patient
Kathryn Maurer, Cynthia Mar
Chart Audit
M. Nassal (API), Lisa Garcia, Kelly Flower, Tanya Osborne
Configuration of Expected Admits and Location Proximity
Rick Robinson (API), Cynthia Mar
Testing of Critical Care Instrument
Rick Robinson (API), K.Maurer, C. Mar, T. France, Nurses TBD
Validation of expression and additional Testing
Kathryn Maurer, Cynthia Mar, (Tim France as needed)
Chart Audit
M. Nassal (API), Lisa Garcia, Kelly Flower, Tanya Osborne
Prep. of Training with Traing set to begin sometime this week
Tanya Osborne, Glorinda Pastorius, Wendy Keema, Nurses TBD
Training / E-learning
Tanya Osborne, Glorinda Pastorius, Wendy Keema, Nurses TBD
GO-LIVE
Mar
Chart Audits
(Feb 5)
Adult In-Patient Instrument
(Feb 19)
Critical Care Instrument
Testing
(Feb 11 - 13)
Critical Care Instrument Testing with API on-site Nurses TBD
Preparation of Training
[Feb 24-25]
Preparation of Training
[Feb 26 - Mar 7]
GO - LIVE
(Mar 10)
Critical Care Clinical Information Interface in addition to New Patient Assignment Screen in both Critical Care and Med Surg Clusters


Patient Classification Solution (PCS)Clinical Information Interface (CII) Proj
Week of 1/20/2014
Week of 1/27/2014
Week of 2/03/2014
Week of 2/10/2014
Week of 2/17/20
M T W TH F M T W TH F M T W TH F M T W
PCS Mapping Initial Critical Care Instrumer
First Acuity Mtg of 2014
Discussion
Nurse Involvme
Transcription of Clinical Elements for Critical Care Instrument and determination of mneumonics for attributes.
Kathryn, Rick Pritt, Tim France
Configuration of Attributes- CC Instrument; Translation of transciptions of clinical elements into expressions;- CC Instrumnet; review and revision of Adult In Patient Instrument
Kathryn Maurer, Cynthia Mar
Chart Audit
M. Meisel (API), Lisa Garcia, Kelly, Flower, Tanya Osborne
Configuration of Expected Admits and Location Proximity
Rick Robinson (API), Cynthia Mar
Testing of Critical Care Instrument
Rick Robinson (API), K.Maurer, C. Mar, T. France, Nurses TBD
Validation of expression an additional Testing
Kathryn Maurer, Cynthia Mar France as needed)
Chart Audit
M. Meisel (API), Li Garcia, Kelly, Flow Tanya Osborne
PCS Mapping
(Jan 20 - 21)
In Attendance: Marie Marback, Kim Stewart, Anthony Jenkings, Ashika Sundar, Brian DeSalvo, Michael Boyle, Sandra Ruiz, Kathryn Maurer, Cynthia Mar, Lilia Meraz Gottfreid, Glolinda Pastolius, Tanya Osborne-McKenzie
From API: Rick Robinson, Mike Meisel, Dean Fleischmann
Chart Audits
(Feb 5)
Adult In- Patient Instrument
(Feb 19)
Critical Care Instrument
Testing
(Feb 11 - 13)
Critical Care Instrument Tesing with Nurses TBD
PCS Annual Acuity Meeting
(Jan 22)
Introductions;Committee member role expectations.Background. PCS Overview and understanding the imporiance of PCS Staffing by Acuity
2013 Analysis of Reliability and Validity. Computerized Information Interface, and next steps discussed
(see scheduled meeting for list of attendees)

Appendix J

Boot-camp Agenda

Patient Classification Solution – Nursing Leadership Training

(1/2 day session)

CLIENT NAME
CITY, STATE

PREPARATION

Dates: 01/01/01

Time: Start time to end time (four hours)

GOALS

Assist nursing leadership in preparing for the monitoring process of Patient Classification

Assist nursing leadership in understanding the importance of monitoring Patient Classification data.

OBJECTIVES

By the end of this session the attendees will be able to

Discuss the Patient Classification process specific to their organization.

Run reports from the Patient Classification Solution.

Understand the importance of Patient Classification surveillance.

PREREQUISITES

Understanding of the Patient Classification Solution.

Knowledge of unit staffing requirements as mandated by staffing practices/legislation.

EQUIPMENT

Projection unit able to support Super VGA

All connecting cables and power supplies

Projection screen

1 PC for each attendee that meets the requirements listed in your hardware requirements document and has access to Patient Classification.

MATERIALS

Item	Responsibility
Nursing Leadership Training ppt.	API Healthcare
Report Catalog	API Healthcare
Session Follow-up Summary	Client and API Healthcare

PERSONNEL

Day	Recommended Participants
1/2	Project Manager Functional System Administrator(s) (FSA) CNO Unit Nursing Management (required) Off shift Nursing Leadership (preferred) Staffing Office Leadership API Healthcare Nurse Implementation Consultant

Appendix K

Accountability Table

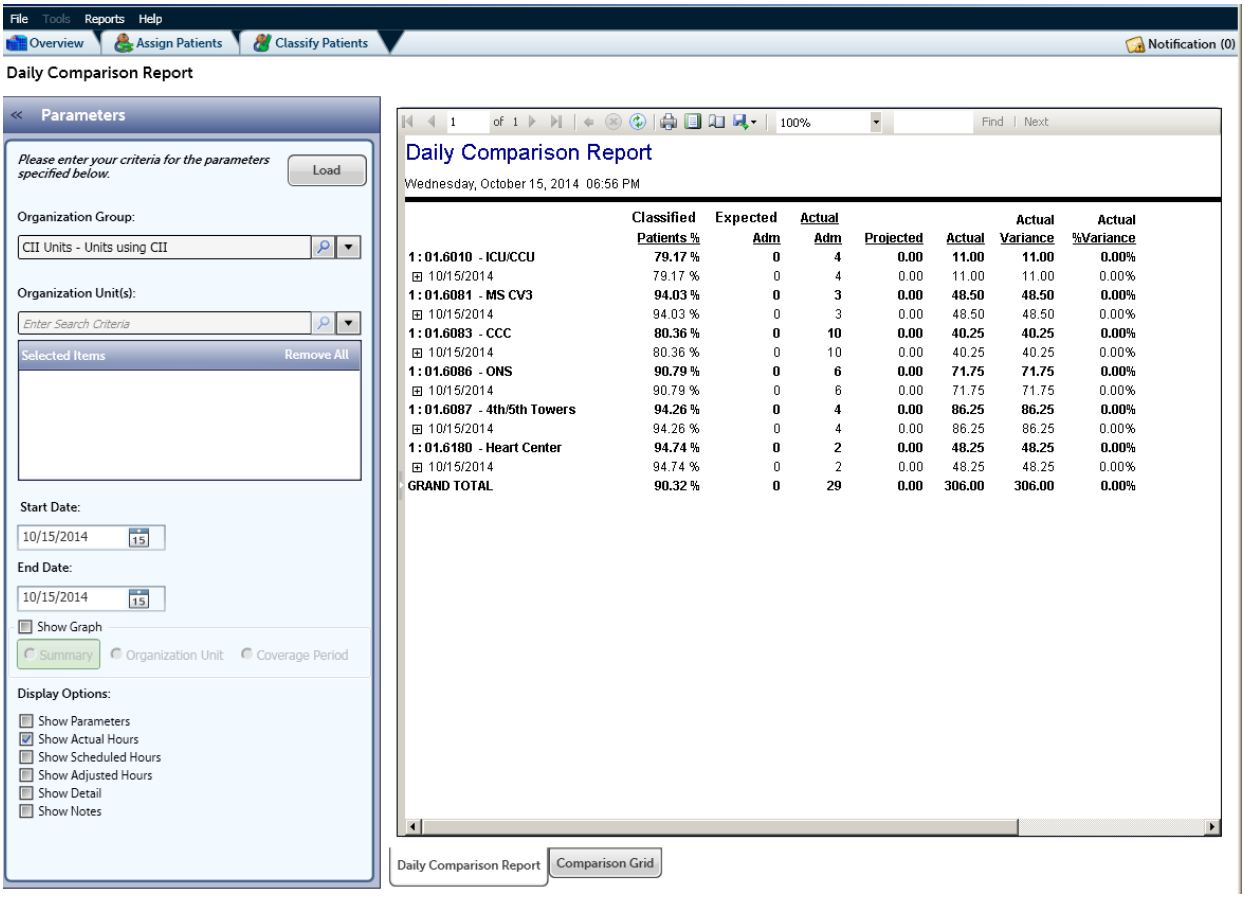
Salinas Valley CII Implementation Checklist			
Item	Date	Owner	Comments
Pre-Implementation			
Communication to SVMH RN staff	Thurs 12/12, Fri 12/13	SVMH	Timeline for the install, what to expect, how to submit questions and report issues, Info on the validation phases after install: data validation, chart checking, workload validation
Create a process for documenting CII classifications that may be overwritten by the Charge Nurses	Monday, 12/16	SVMH	Communicate to Charge RNs
Stage 9.3.3 for SVMH	Thurs, 12/12	API Engineering	
Install 9.3.3 to test	Thurs, 12/12	Cynthia/Aaron	
Test expressions in Test	Thurs 12/12, Fri 12/13	SVMH	
Install 9.3.3 to live	Mon 12/16	Cynthia/Aaron	
Import expressions from Test to Live	Mon 12/16	Cynthia/Aaron	
Turn on CII live feed after install	Mon 12/16	Cynthia/Aaron	
Set permission to allow RN Charge Nurse the ability to override CII classifications	Mon 12/16	Cynthia	
Validation of CII feed	Mon 12/16, Tues 12/17	API Engineering	Validate clinical elements and documentation is being written to the database via the HL7 feed
Communication to RN staff of successful install	Tuesday 12/17	SVMH	

Additional expression testing	Mon 12/16, Tues 12/17	SVMH	
Update Expression document	Mon 12/16, Tues 12/17	Cynthia, Rick	Rick on site Monday, Tuesday
Confirm API and SVMH support resources	Mon 12/16	API, SVMH	
Go/No-Go meeting	Tues 12/17	SVMH, API	
First Productive Use - start classifications with CII	Wed 12/18	Cynthia	Configure departments to utilize documentation driven CII
Post Implementation			
Staff and Charge RNs can start looking at classifications	Thursday 12/19	SVMH	Charge RNs use pre-defined process for documenting classifications that they override
Validation of CII classifications	Wed 12/18 - Wed 12/31	API Engineering	Review the system, look at classifications, verify the data for each, and review the CII diagnostic logs.
Update communication to SVMH RN staff on status of CII classification processing	Monday, 12/23		What did we find through the validation process, what feedback are we getting from the RN staff and Charge Nurses? Reminder what's planned for after the holidays, i.e.., data validation, chart checks
Data Validation	1/6/14 - 1/10/14		
Conduct chart checks against CII	1/6/14 - 1/10/14		
Update communication to SVMH RN staff on results of chart checks	1/13/2014		
Validate workload validation numbers	1/13/14 - 1/17/14		
API Team on site	1/20-24/14	API	
Mapping for Critical Care instrument	1/21,22 and 24/14	API SVMH	
Acuity Committee	1/23/2014	API, SVMHS	Includes staff from all areas (50% direct

meeting			care providers)
Manual chart audits of Adult In-pt tool	1/22/2014	SVMH	Lisa Garcia/Kelly Flower (MSN Prepared RNs)
Test expressions in Test	1/28/2014	SVMH	Cyndi Mar
Manual chart audits of CC tool	2/5/2014	SVMH	Lisa Garcia/Kelly Flower (MSN Prepared RNs)
Implement staff education	2/4/2014	SVMH	Wendy Keema/Vanessa Irwin (e-Learning charge RNs)
Training on the Smart Assignment Screen	2/28/2014		Live education of charge RNs(AHNs lead?)
Staffing by Acuity and Smart Assignment	2/28/2014		

Appendix L

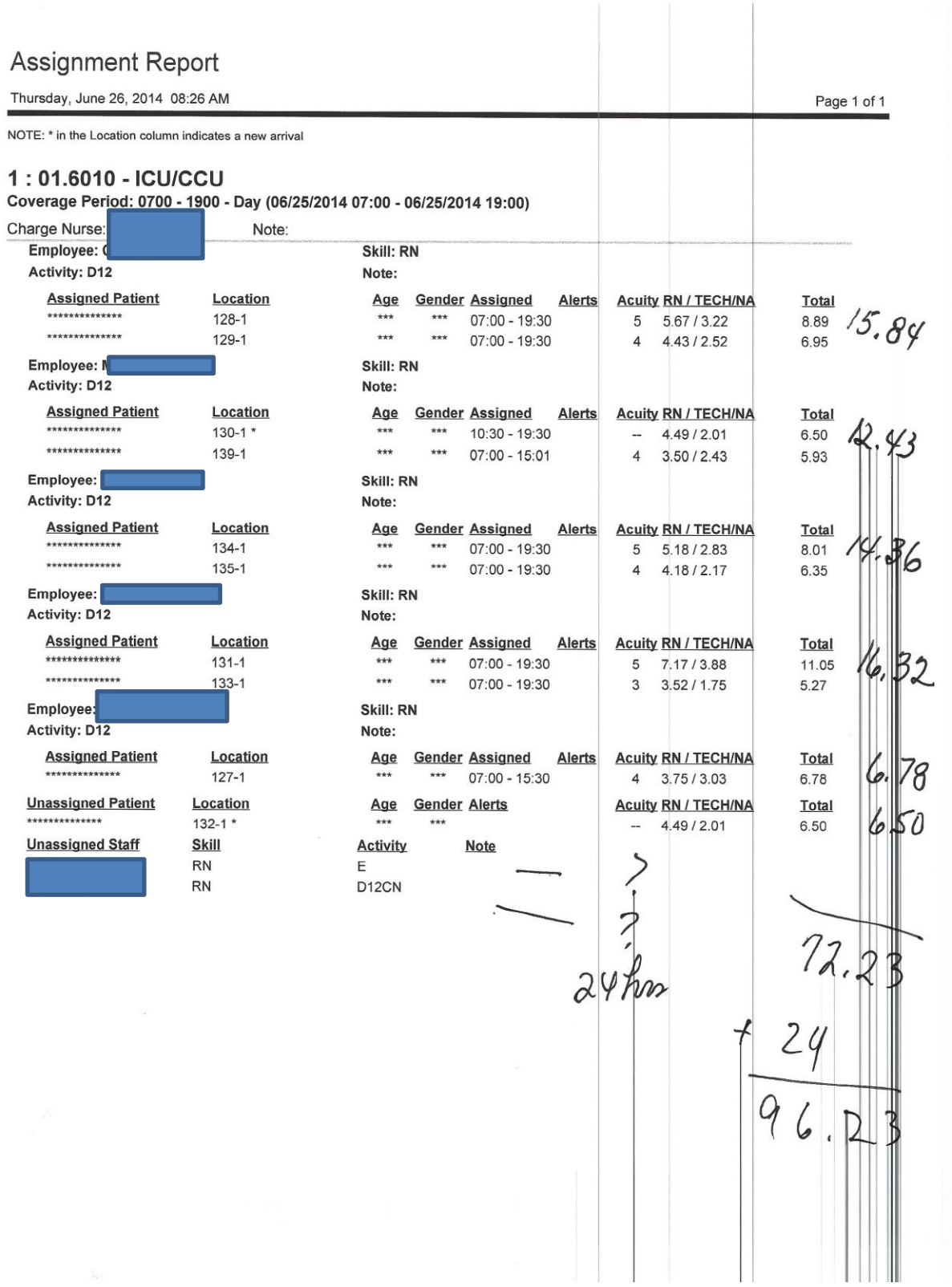
Comparison Report



	Classified Patients %	Expected Adm	Actual Adm	Projected	Actual	Actual Variance	Actual %Variance
1 : 01.6010 - ICU/CCU	**79.17 %**	**0**	**4**	**0.00**	**11.00**	**11.00**	**0.00%**
⊞ 10/15/2014	79.17 %	0	4	0.00	11.00	11.00	0.00%
1 : 01.6081 - MS CV3	**94.03 %**	**0**	**3**	**0.00**	**48.50**	**48.50**	**0.00%**
⊞ 10/15/2014	94.03 %	0	3	0.00	48.50	48.50	0.00%
1 : 01.6083 - CCC	**80.36 %**	**0**	**10**	**0.00**	**40.25**	**40.25**	**0.00%**
⊞ 10/15/2014	80.36 %	0	10	0.00	40.25	40.25	0.00%
1 : 01.6086 - ONS	**90.79 %**	**0**	**6**	**0.00**	**71.75**	**71.75**	**0.00%**
⊞ 10/15/2014	90.79 %	0	6	0.00	71.75	71.75	0.00%
1 : 01.6087 - 4th/5th Towers	**94.26 %**	**0**	**4**	**0.00**	**86.25**	**86.25**	**0.00%**
⊞ 10/15/2014	94.26 %	0	4	0.00	86.25	86.25	0.00%
1 : 01.6180 - Heart Center	**94.74 %**	**0**	**2**	**0.00**	**48.25**	**48.25**	**0.00%**
⊞ 10/15/2014	94.74 %	0	2	0.00	48.25	48.25	0.00%
GRAND TOTAL	**90.32 %**	**0**	**29**	**0.00**	**306.00**	**306.00**	**0.00%**

Appendix M

Assignment Report



Assignment Report

Thursday, June 26, 2014 08:26 AM — Page 1 of 1

NOTE: * in the Location column indicates a new arrival

1 : 01.6010 - ICU/CCU

Coverage Period: 0700 - 1900 - Day (06/25/2014 07:00 - 06/25/2014 19:00)

Charge Nurse: [redacted] Note:

Employee: [redacted] **Skill: RN**
Activity: D12 **Note:**

Assigned Patient	Location	Age	Gender	Assigned	Alerts	Acuity	RN / TECH/NA	Total
**********	128-1	***	***	07:00 - 19:30		5	5.67 / 3.22	8.89
**********	129-1	***	***	07:00 - 19:30		4	4.43 / 2.52	6.95

Employee: [redacted] **Skill: RN**
Activity: D12 **Note:**

Assigned Patient	Location	Age	Gender	Assigned	Alerts	Acuity	RN / TECH/NA	Total
**********	130-1 *	***	***	10:30 - 19:30		--	4.49 / 2.01	6.50
**********	139-1	***	***	07:00 - 15:01		4	3.50 / 2.43	5.93

Employee: [redacted] **Skill: RN**
Activity: D12 **Note:**

Assigned Patient	Location	Age	Gender	Assigned	Alerts	Acuity	RN / TECH/NA	Total
**********	134-1	***	***	07:00 - 19:30		5	5.18 / 2.83	8.01
**********	135-1	***	***	07:00 - 19:30		4	4.18 / 2.17	6.35

Employee: [redacted] **Skill: RN**
Activity: D12 **Note:**

Assigned Patient	Location	Age	Gender	Assigned	Alerts	Acuity	RN / TECH/NA	Total
**********	131-1	***	***	07:00 - 19:30		5	7.17 / 3.88	11.05
**********	133-1	***	***	07:00 - 19:30		3	3.52 / 1.75	5.27

Employee: [redacted] **Skill: RN**
Activity: D12 **Note:**

Assigned Patient	Location	Age	Gender	Assigned	Alerts	Acuity	RN / TECH/NA	Total
**********	127-1	***	***	07:00 - 15:30		4	3.75 / 3.03	6.78

Unassigned Patient	Location	Age	Gender	Alerts	Acuity	RN / TECH/NA	Total
**********	132-1 *	***	***		--	4.49 / 2.01	6.50

Unassigned Staff	Skill	Activity	Note
[redacted]	RN	E	
	RN	D12CN	

15.84
12.43
14.36
16.32
6.78
6.50
72.23
+ 24
96.23
24hrs

Appendix N

Workload Summary

Workload Summary Report

Friday, May 9, 2014 09:30 AM

Parameters

Organization Unit(s) 1 : 01.6081 - MS CV3, 1 : 01.6083 - CCC, 1 : 01.6086 - ONS

Date Range 5/8/2014

	Census		No.	Exp	Admit	No.		Average Unit	Patients				Total Acuity	Actual		
									Classified		Assigned				Variance	
	Begin	End	Adm	Adm	Factor	Dis	Encntrs	Acuity	Number	Percent	Number	Percent	Hours	Hours	Hours	Percent
Totals																
1 : 01.6081 - MS CV3																
05/08/2014	**55**	**51**	**2**	**0**	**3.6%**	**6**	**57**	**4.1**	**55**	**96.5%**	**19**	**33.3%**	**169.5**	**176.0**	**6.5**	**3.9%**
0700-1500	19	20	1	0	5.3%	0	20	4.1	19	95.0%	18	90.0%	62.4	63.0	0.6	1.0%
1500 - 2300	20	16	1	0	5.0%	5	21	4.1	20	95.2%	0	0.0%	59.9	65.2	5.3	8.9%
2300 - 0700	16	15	0	0	0.0%	1	16	4.0	16	100.0%	1	6.3%	47.2	47.8	0.6	1.3%
1 : 01.6083 - CCC																
05/08/2014	**53**	**52**	**19**	**0**	**35.8%**	**20**	**72**	**3.6**	**52**	**72.2%**	**3**	**4.2%**	**152.2**	**175.5**	**23.3**	**15.3%**
0700-1500	19	17	11	0	57.9%	13	30	3.9	19	63.3%	0	0.0%	55.2	66.8	11.6	21.0%
1500 - 2300	17	17	7	0	41.2%	7	24	3.1	16	66.7%	0	0.0%	48.4	56.0	7.6	15.7%
2300 - 0700	17	18	1	0	5.9%	0	18	3.6	17	94.4%	3	16.7%	48.7	52.8	4.1	8.4%
1 : 01.6086 - ONS																
05/08/2014	**63**	**65**	**6**	**0**	**9.5%**	**4**	**69**	**3.9**	**63**	**91.3%**	**2**	**2.9%**	**192.3**	**217.5**	**25.2**	**13.1%**
0700-1500	19	22	5	0	26.3%	2	24	3.9	19	79.2%	0	0.0%	55.6	77.1	21.5	38.8%
1500 - 2300	22	22	1	0	4.5%	1	23	4.0	22	95.7%	1	4.3%	73.7	73.4	-0.3	-0.4%
2300 - 0700	22	21	0	0	0.0%	1	22	3.7	22	100.0%	1	4.5%	63.1	67.0	3.9	6.2%

Appendix O

Face Validity Audit

PCS FACE VALIDITY SURVEY

Date/Unit: _____ Number of RNs: _____

CN: _____ Time: _____ Number of C.N.A.: _____

RN Initials/# of patients	Time Per Assignment Report/ % capacity	Individual Assessment	CN Assessment	Direct Care Provider Assessment

PCS FACE VALIDITY SURVEY: Instructions

1. Review Assignment Report:
    a. Add amount of time assigned to each RN
    b. Note number of patients assigned to each RN
2. Scan the unit. Using your critical thinking as a charge RN and staff RN:
    a. Does the amount of time indicated on the Assignment Report match reflect what you see?
    b. Enter, under Individual Assessment, if you believe the assignment is Light, Average or Heavy (L, A, H).
    c. If the assignment is ranked differently than your assessment, provide rationale for your ranking.
3. Speak with CN:
    a. Enter under CN Assessment, charge nurse's ranking of assignment (L,A, H).
    b. If the assignment is ranked differently than the CN assessment, provide rationale for CN ranking.
4. Speak with RN:
    a. Enter under Direct Care Provider Assessment, DCP's ranking of assignment (L, A, H).
    b. If the assignment is ranked differently than the DCP's assessment, provide rationale for DPC's ranking.

Appendix P

Cross-Compare

Issues in Yellow. Others correct

Pt Ed- Documented as Needs Reinforcement - correct
ADL – standby assist, min assist, 1 person assist. I don't see where the rest of the necessary documentation was done- need to review this mc
Fall Risk >35 should not have- need to review this more
Cardiac Assist Device- There is a Pacemaker active orders - correct
Cardiac Monitoring- Paced- correct
Wound Management- need to review this more. It is counting three wounds when there is one

X Substantial Intervention	Wound Care AND Dressing Change:PASS Count WOUND.TYPE or INT.LTYP:PASS [10/08/2014 18:54 WOUND.TYPE2 value: Incision] [10/09/2014 00:00 WOUND.TYPE2 value: Incision] [10/09/2014 07:30 WOUND.TYPE2 value: Incision] APS.ISO or APS.BEDT or WOUND.DSG4 or VAC Order:PASS [10/08/2014 18:15 APS.ISO value: N]

1 of 1 100% Find | Next

Patient: [redacted]	System 10/09/2014 06:50 TECH/NA - 0.21 RN - 2.6	[redacted] 10/09/2014 09:53 TECH/NA - 0.26 RN - 0.84
Cognitive		
X Safety Judgment		Minimal Safety Needs
Coord/Ed/Document		
X Patient Education	Moderate Intervention	Minimal Intervention
Family		
X Family Cooperation/Demands/Expectations	Moderate Demands	Minimal Demands
Pain/Comfort		
Pain/Comfort	Minimal Pain	Minimal Pain

Appendix Q

Revised Cost Savings of CII

Unit	CCC			
One shift right sizing				
role	shift length	shifts/ year	rate	Total
C.N.A.	8	365	$ 22.00	$ 64,240.00
RN	8	365	$ 65.00	$ 189,800.00
Unit	CV3			
One shift right sizing				
role	shift length	shifts/ year	rate	Total
C.N.A.	8	365	$ 22.00	$ 64,240.00
RN	8	365	$ 65.00	$ 189,800.00
Unit	ONS			
C.N.A.	8	365	$ 22.00	$ 64,240.00
RN	8	365	$ 65.00	$ 189,800.00
One shift right sizing				
Unit	Heart Center			
C.N.A.	8	365	$ 22.00	$ 64,240.00
RN	8	365	$ 65.00	$ 189,800.00
One shift right sizing				
Unit	4th / 5th Towers			
C.N.A.	8	365	$ 22.00	$ 64,240.00
RN	8	365	$ 65.00	$ 189,800.00
One shift right sizing				

Unit	ICU			
RN	12	365	$ 65.00	$ 284,700.00
One shift right sizing				
				$ 1,554,900.00

Appendix R

Skills Checklist

Patient Classification System

Skill Checklist

Charge Nurse Unit:_____

Performance Criteria: The (Charge Nurse) is able assign patients to staff and classify patients.

Directions: Trainee initials the "initial" column when independently able to perform, under the supervision of a trainer, the following:	**Initial when completed**
○ Access Virtual Desktop	
○ Access API PCS LIVE (TRAIN)	
○ Patient Classification Screen Overview (Filter, Tools, Alerts, Patient List, Coverage Period, Organization Unit, Staff List, Summary Column)	
○ **Assign Patients** ➢ **Patient List** ✓ **Assignment Details Pane** ✓ **Edit Assignment Pane** ➢ **Staff List** ✓ **Selections from Employee Tiles** ✓ **Employee Detail Pane** ✓ **Break Relief Assignment** ✓ **Reassignment of Patient Coverage**	
○ Classify Patients ➢ Patient Information Area ✓ View Patients ➢ Dimensions Care Categories ✓ Classify Patient ➢ Self-Assign Patients (New Admissions Only)	

○ Reports ➢ Assignment Report ➢ Employee Classification Compliance Report ➢ Unit Classification History Report	

Trainee (Print): _____ Trainee Initials:_____

Trainee (Signature):_____ Date: _____

** Note: My Signature verifies I have completed this checklist and understand the content.

Appendix S

Frequently Asked Questions

FAQs

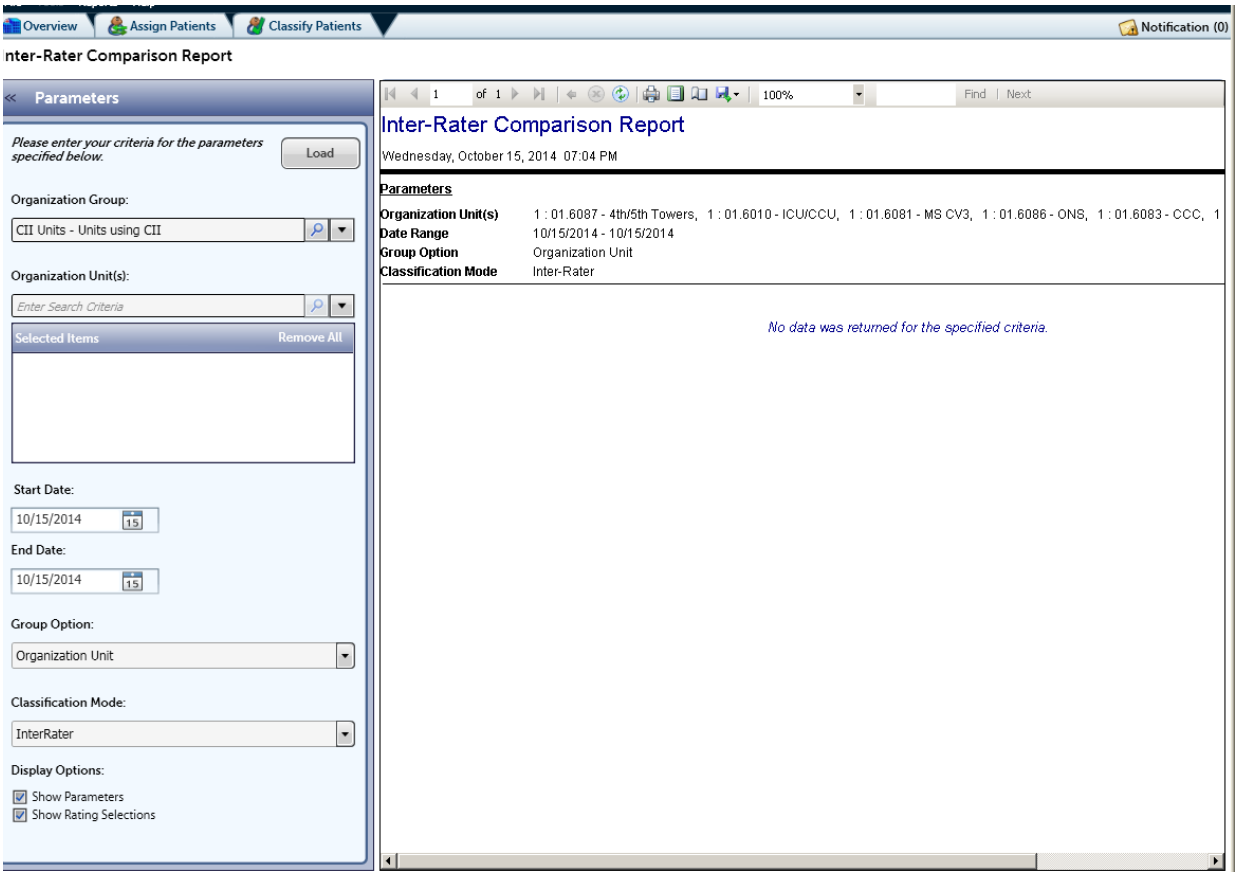
1. **How come I didn't get my same assignment back?**
    - **a.** The goal is to have balanced assignments.
    - **b.** Assignments are made based on patient acuity.
    - **c.** Patient acuity continually changes.
2. **What about continuity of care?**
    - **a.** Patient care is driven by the plan of care.
    - **b.** All care providers follow the same plan of care for an individual patient.
    - **c.** The continuity comes from the plan of care, not the assignment of the RN.
    - **d.** Dependent upon a clear and complete handover process
3. **How are new admissions assigned?**
    - **a.** They are based on acuity.
4. **What if the staffing assignment for the oncoming shift is not available in PCS?**
    - **a.** Call the Staffing Office and request it be entered.
5. **What if a patient isn't listed on the assignment screen?**
    - **a.** Call the Staffing Office and request it be entered.

Appendix T

Assignment Screen

Appendix U

Inter-rater Reliability



Appendix V

Revised Cost/Benefit of CII Implementation

	2013	2014	2015	2016
ANTICIPATED SAVINGS				
Overstaffing	0	16,224	1,554,900	1,558,010
Incremental Overtime	0	121,680	124,722	127,840
Nurse Manager Time	0	23,400	23,985	24,585
CDPH Survey	0	1,218	0	0
Total Savings	0	$162,522	$1,703,607	$1,710,435
OPERATING EXPENSES				
Direct Care RNs	26, 000	15,600	4,264	4,371

Auditing RNs	0	4,480	2132	2185
Informaticists	5,600	5,600	0	0
Director, Informatics	3,600	3,600	0	0
Misc. IT	1,300	1,300	0	0
Clinical RN Manager	3,600	3,600	1474	1511
Total Expenses	$40,100	30,580	7,870	$8,067
NET SAVINGS	($40,100)	131,942	$1,696,737	$1,702,368