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Business Intelligence Competencies: Making Healthcare Data Come Alive

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University of San Francisco

DNP Comprehensive Project

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July 2017

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"Knowing is not enough; we must apply.
Willing is not enough; we must do." —Goethe

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Abstract

While a wealth of healthcare related data exists, nurse leaders (NL) have yet to understand its implications and adopt analytical skills to lead in the transformation of care delivery. Information science is at a new frontier for nursing to embrace. It is critical for nursing leadership to advance and support business intelligence (BI) and interactive data visualization (IDV) skills across the organization, and advocate for greater engagement of nurses in health system decision making. With these new tools and competencies, nursing and other health professions can innovate best practices, providing enhanced quality, safety, and value in healthcare. The aim of this Doctor of Nursing evidence-based project was to engage NL's to improve and extend competencies in BI and IDV. A survey was administered to NL's to assess their knowledge and use of these analytic tools and then guide a process for skill development via two workshops presenting an overview of BI and IDV to NL's. The use of BI is still in its' infancy, dashboards tools are beginning to be deployed across healthcare organization, however, data in real time is not readily available, nor is the ability to interact and conduct data discovery. The effectiveness of the education program was evaluated by the attendees' willingness to participate in workshops covering the basic uses of BI and IDV and understanding of the opportunities to incorporate them into their current leadership role.

Keywords: *business intelligence, competencies, data analytics, data visualization, healthcare data, healthcare informatics, leadership, nursing, and social determinant of health*

Section II. Introduction

Background

While a wealth of healthcare-related data exists, nurse leaders (NLs) have yet to understand its implications and adopt analytical skills to lead in the transformation of care delivery. Information science is a new frontier for nursing to embrace, and it is critical for nursing leadership to advance and support business intelligence (BI) and interactive data visualization (IDV) skills across the organization, and to advocate for greater engagement of nurses in decision making in the larger health system. For this project, the definition BI and IDV comprise an integrated array of IT tools that allow users to transform data into visual models to inform actions (Ferranti, Langman, Tanaka, McCall, & Ahmad, 2010). With these new tools and competencies, nursing and other health professions can innovate best practices, providing enhanced quality, safety, and value in healthcare. Below is an example of how BI is used to create a data dashboard of key performance indicators (KPI) for chronic heart failure by Health Catalyst.

CHF Readmission 2015 Health Catalyst

The speed and extent of change ushered in by the new technological advances are revolutionizing our traditional system of health care delivery (Risling, 2017). Other drivers fueling

transformation are the concerns of the cost and quality of care, increased competition, marketplace consolidation, and reimbursement moving from fee-for-service to a pay-for-performance model. In 2009, the American Recovery and Reconciliation Act (ARRA) legislation and later the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2010 set in motion a framework to reshape the U.S. healthcare system to provide timely, accessible, and high-value care, coordinated across different settings, and focused on improving the health of entire populations and not merely the treatment of disease (HHS.gov., n.d.). ARRA also established the Hospital Value Based Purchasing (VBP) program begun in 2011, a key regulatory catalyst that radically transformed healthcare reimbursement that paid for performance, and not simply volume of services provided. It incentivized the delivery of higher quality of care, and enhanced the hospital care experience for patients. It also instituted penalties for those that did not demonstrate improvements (Burwell, 2105; Burstein, Leatherman, & Goldman, 2016).

Provider reimbursement depends on enhancing efficiencies across all programs of care and improving patient quality outcomes to meet the requirements of VBP, lending support to extend BI across the organization (Krumholz, 2014; Vondrak, 2012; Willis, 2014). Progress to improve the quality of patient care has been slow. Despite significant efforts over the past 16 years, preventable medical errors are the third leading cause of deaths in the United States (Makay & Daniel, 2016) and are affecting the financial performance of hospitals.

A Fragmented System

Despite concerted efforts exerted in the past two decades, there is still not an efficient system of care in the United States, but rather a set of poorly coordinated and fragmented services that is challenged to demonstrate value for the care provided. There are many problems, including the burden of an aging population presenting multiple chronic conditions, decreasing reimbursement, rising costs to provide care, and a scarcity of trained healthcare professionals.

The health industry in response to the technological advances and marketplace pressures is dramatically shifting its business processes. Page and Simpson (2016) write: "it is the ever-exponential spinning rate of change. Balancing the business focus and technology innovations demand new competencies in leadership (p.272)." These changes expose the need of healthcare leaders to acquire new competencies to meet these challenges. However, most are besieged with an overabundance of information from within the organization, necessitating acquiring the skill to discriminate and distil down what information is actionable. At the same time, there is also a need to scan the greater environment to discern which factors have the potential to impact both the clinical and operational areas.

How BI Enables Discovery of New Healthcare Decision-making Insights

BI applications gather and structure data from different systems and assimilate it into customized visual reports to facilitate timely informed decisions tailored to specific customers or market segments. This technology enables the discovery of new insights from multiple data sources to strategically align scarce resources to improve quality outcomes, enhance efficiencies, improve patient satisfaction, and ensure financial viability (Ferranti et. al., 2010). Notable information technology (IT) businesses (e.g. Google, Apple) efficiently leverage BI to quickly capture and translate disparate consumer data into meaningful strategies to grow the business. Consumer product companies (e.g., NetFlix and Amazon) not only fulfill customer orders but also create demand by suggesting new selections to purchase based on past customer activity (Bates, Saria, Ohno-Machado, Shah, & Escobar, 2014).

Given healthcare's focus on cost containment, quality improvement, and marketplace competition it is critical to have a robust and credible data-empowered decision support system (Fralic, 2000). Regulatory changes are affecting hospital reimbursement and reinforce that decisions must not be based on intuition but objective and derived from data. Regrettably, healthcare is slow to adopt new health information technologies needed to transform itself. (Herzlinger, 2006). Across all organizations, leaders are demanding faster access to data to engage in data discovery to gain needed insights for real

time and strategic decisions (Page & Simpson, 2016).

Lack of BI Systems in Healthcare

A recent survey of 250 healthcare professionals revealed less than half had implemented a BI system. The respondents included senior-level health IT executives and medical staff such as chief information officers', directors of information systems and clinical informatics, physicians, and chief nursing officers across different health provider organizations from acute care hospitals to ambulatory care clinics were conducted before the HIMSS 2014 conference. The main deterrents cited were the complexity of health data and lack of skills (Foerster, 2014).

The knowledge and tools to harvest and display data typically reside within the data analytics departments. Clinical data must be "cleaned," a process to correct errors, eliminate redundancies, then structured and harmonized into a usable state capable of being incorporated into reports. BI enables organizations to create visual reports or dashboards of strategic goals or key performance indicators in a readily understood manner (Harper & Parkerson, 2015). Typically, lagging indicators (historical data) are used (e.g., falls or average length of stay of a time). Some organizations use smart dashboards to display a near real time view of the status of key indicators (e.g., numbers of patients waiting to be admitted in the emergency department, number of patients who left without being seen).

To improve and enhance patient care and operational outcomes, leading indicators or predictive analytics are needed to predict potential future states. Predictive analytics queries the data to provide possible outcomes by asking: What could happen next? What if the trends continue? Alternately, what happens next? (e.g., high temperature warnings announced for the organization anticipates more elderly and patients with respiratory problems coming to the emergency department (ED), (HFMA, 2016).

The specialized skills required to work with data analytic programs often dissuade those in healthcare from acquiring and maintain them. Fortunately, recent advances in BI technologies are providing data in enterprise wide data warehouses enabling non-IT employees to select data and

visualize it revealing insights previously hidden in traditional reports. An example of an enabled healthcare system is at Children's Hospital in Washington, D.C. Their providers are alerted when signing into a patient's electronic health record (EHR) of a high-risk score alerting the clinician to screen for potential risk from environmental exposures (lead, mold, etc.) determined by the patient's address (Beck, Sandel, Ryan, & Kahn, 2012). As the ease of use and accessibility of technologies improve, the more readily these can be integrated into the existing workflow of NLs and others to achieve better outcomes and realize operational efficiencies.

Local Problem

For purposes of this project, nurse leaders (NLs) include those in upper management, director and executive level positions. Nursing is now an information-intensive profession. In today's digital world NLs at all levels must be prepared to make swift operational and strategic decisions and skillfully navigate to ensure they are fully executed. Data analytic tools can harvest information needed from newly available data sources and provide needed insights that guide the NL (Hussey & Kennedy, 2016; Vondrak, 2012). However, are NLs prepared to successfully engage in this technology to successfully harvest from data the needed insights for decisions? Simpson (2013) and others found senior NLs often lacked the basic IT competencies. They and others also found NLs did not possess the expertise in BI tools and IDV to manage the overwhelming flow of information daily (Keerfoot, 2015; Kennedy & Moen, 2017; Sharts-Hopko, 2014; Simpson, 2013; Welton, 2016).

The American Association of Colleges of Nursing (AACN, 2015), *The Futures Task Force Final Report to the AACN Board of Directors, July 2015,* recommended adding competencies in nonclinical areas, including leadership, change management, and data analytics for nurses and other healthcare providers (AACN, 2015). In the 2014 Horizon Report, both healthcare and education leaders recognized data analytics as a critical component of using data to facilitate decision-making and guiding the development of new learning pathways (Skiba, 2014). These reports underscored the importance of

nurse executives and NL's becoming literate in analytics, to empower the needed clinical and operational transformation to enhance patient safety, improve quality outcomes, and ensure reimbursement (Krumholz, 2014; Vondrak, 2012; Willis, 2014).

Healthcare has trailed behind business in implementing BI and IDV to derive needed insights from data intense environments. The adoption and use of BI and IDV tools are more pervasive in non-healthcare areas; 57% of business and IT executives reported using BI compared with only 42% in healthcare (Foerster, 2014). Nursing has been even slower to incorporate new data technologies and lack systematic reviews and evidenced-based resources reflecting this trend.

The Data Dilemma: Data Quality and Discoverability

The problem confronting nursing as a profession is that information on nursing has remained hidden in the medical record; the ability to track nurses' impact on patient care outcomes has been largely non-quantifiable. Benner (2010) alluded to this when she wrote that nurses practice "deliberately in the in-between social space of medical diagnosis and treatment and the patients lived experience of illness, or prevention of illness in their particular life, family and community" (Benner et al., 2010, p. 31). To grow nursing knowledge and wisdom, data is the foundation. However, current systems that capture nursing documentation cannot be retrieved to provide current or near time data hindering clinical and operational decision-making (McEvoy, 2014; Swensen, Pugh, McMullan, & Kabcenell, 2013).

The inability of nursing to establish its contribution to patient outcomes is a serious concern. As more scrutiny is placed on the costs of nursing care and care outcomes, it is critical to quantify the added value that nursing contributes (Sousa, Weiss, Welton, Reeder, & Ozkaynak, 2015). In the new value based models of healthcare, each segment of care is scrutinized to determine if it contributes to positive patient outcomes or not. Historically, nursing data remained hidden, indistinguishable in its non-discrete form. The absence of data in most organizations is of great concern, and if it exists, is not readily available in near or real time, without which decisions regarding nursing care, its' impact, and

effectiveness are significantly challenged (Sousa, Reeder, Bondy, Ozkaynak, & Weiss, 2017). BI and newly developed nursing analytic models are revealing the impact that nursing care left undone have on patient outcomes (Ausserhofer et al., 2014), and to quantify the contribution of nursing care to patient outcomes, and determine the nursing cost by specific diagnosis (Welton, 2014).

NLs need to be visionaries, acquire new competencies to anticipate changes, and strategically transform how and where care is delivered for patients, families, and their communities. No longer can Chief Nurse Executives (CNEs) rely only on financial acumen and intuition to succeed; they must wield data analytic tools to realize the needed improvements and patient and organizational outcomes to assure financial outcomes (Kerfoot et al., 2010; Simpson, 2013). "Nursing leaders, as key end users, will be pushed beyond limits to do more with data through self-directed business intelligence (BI), analytics, and data discovery while safeguarding sensitive data and need skills to access, transform, and visualize data" (Page & Simpson, 2016, p. 234). Recognizing the rapidly changing healthcare environment, the American Organization of Nurse Executives (AONE) updated the Nurse Executive competencies, and extended the informatics competencies in 2015. These competencies spelled out seven new proficiency areas for NLs to function effectively in their roles as visionary leaders (AONE, 2015; Kennedy & Moen, 2017) (Appendix A).

Moving Closer to a Learning Health System

Nursing must exercise discipline and insist upon a common data framework to enable retrieval of nursing data. Without the ability to leverage data, NLs will continue to be data rich but information poor (DRIP). A Big Data Checklist for Nurse Executives outlines a strategy for NLs to work to establish a digital culture that creates systems to integrate the organization's data to inform operational and clinical decision-making (Englebright & Caspers, 2014). The checklist guides the Chief Nurse Executive (CNE) in making strategic decisions to move the organization closer to a learning healthcare system. For this project, the definition of a learning health system is a learning healthcare system is (IoM)), as a system

in which, "science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience" (Institute of Medicine, 2012). It complements AONE Nurse Executive competencies, extending and providing clearly defined actions to advance ever closer to becoming a learning health organization; where insights derived from real or near real time data supports NL decision making.

Intended Improvement

This project addressed NLs gaining awareness and understanding of the capabilities provided by BI and IDV to enhance their evidenced-based decision-making. This project incorporated social determinants of health (SDH) to understand their impact on patient outcomes. The goal of this project was for NL to:

- Develop an appreciation for the role of BI and IDV
- Combat data overload and exploit the visual centers of the brain to effortlessly recognize patterns and trends
- Rapidly respond with data derived decisions to changes in the environment
- Integrate SDH to reveal their influence on populations at high risk
- Leverage IDV for collaboration across the departments and professions

Application of both BI and IDV application can prove useful to aid in problem identification, evaluate outliers, assess what can be ignored or should be leveraged. The ability to visualize data enhances collaboration from others outside of one's area, discipline, or role and increases opportunities to brainstorm potential strategies using predictive or prescriptive analytics. Business has implemented these technologies yielding key insights into their marketplace and enabled more effective strategic planning, companies such as Google, Amazon, and NetFlix to name a few know more about certain

populations than the healthcare system which provides them healthcare. It is imperative that NLs learn and apply these new tools to enhance and extend their effectiveness as visionary leaders.

Review of the Evidence

The purpose of this evidence based project was to discover the current state of nurse leaders' competencies in BI and IDV. The following was the research question formulated using the population, intervention, comparison, outcome, time (PICOT) methodology. **(P)** – Population- NLs in California; **(I)–** Intervention- Presentation of business intelligence (BI) and individual data visualization (IDV); **(C)** – Compare-Willingness to participate in workshop on the basics of BI and IDV for NLs after presentation; **(O)** – Outcome– ACNL attendees' willingness to participate in workshops to develop a basic understanding of the application for BI and IDV and in their current roles was assessed.

For this paper, nine research and three expert opinion articles met the inclusion criteria addressing the PICOT question. The review provided expert opinions advocating that NLs need informatics competencies though none specifically addressed BI and data visualization (DV). Keyword and search terms utilized in the search were: *nursing, leadership, informatics, data analytics, healthcare, healthcare data, competencies, SDH, DV, and BI*. Using the search terms n*ursing leadership, informatics, and competencies* provided three research articles; the terms *data analytics, BI, IDV and DV* provided two more articles. Using the terms SDH with BI and DV, three additional research articles were found relating to drivers of *readmissions, increased the length of stay, and hospital acquired conditions.*

Databases selected were: Joanna Briggs Institute of EBP (JBI), Business Source Complete, Cumulative Index of Nursing, Allied Health Literature (CINAHL), Cochrane, PubMed, Scopus, and Fusion. The search filters used included peer reviewed journals, English-language only, and limited from 2010 through 2017. The search produced over 500 articles, which were narrowed down to those relevant to this project. An evaluation table was constructed using the Johns Hopkins Nursing Evidence

Based Practice Research Appraisal tool as a guide (Appendix B). To evaluate the literature, the John Hopkins Nursing Evidence-Based Practice (JHNEBP) Research and Non-Research Appraisal Tools (Newhouse, Dearholt, Poe, Pugh, & White, 2007) were used and entered in the evidence table (Appendix B).

The searches of both JBI and Cochrane databases using key words did not uncover current research. The CINAHL and Pub Med were more robust sources for applicable studies and expert opinion pieces. Of the 65 articles found, there were three expert opinion pieces, one on NL competencies; two others were on SDH impact on health outcomes, two literature reviews, and 12 research studies. The research studies looked at NLs' informatics competencies, use of data visualization of EHR data, and big data in nursing. Four 15 articles included were from medicine, due to the notable lack of research article from nursing SDH research. Employing the business database, Business Source Complete, three articles were selected from the 37 articles. The Fusion database search provided two additional articles.

Evidence Supporting Use of AONE Nurse Executive Competencies

Without a vision, a person perishes (Psalms 29:18 KJV). Professional competencies provide a vision of the characteristics and competencies to function and thrive in the role. Westra and Delaney (2008) identified the informatics competencies for nursing leaders using the AONE Nursing Executive Competencies and a review of the literature. A Delphi approach was used to identify 93 competencies which impact the NL's computer skills, informatics knowledge, and informatics skills. Simpson's research extended Delaney and Westra' earlier work on CNE competencies around health information technology (HIT)-related decision-making competencies and compared them to those outlined by AONE. The research identified a gap in CNEs' overall awareness of trends in the greater society, technology, and their potential impact on nursing. Simpson calls for CNEs to develop expertise needed "to exploit the power of computing to demonstrate the quality and financial-related advantages that

nursing brings to patient care… moreover lead or influence executive level decisions related to HIT investments and deployment" (p. 279). To advocate for nursing HIT investments, the currency of CNEs' knowledge of trends and advances in the greater healthcare environment is crucial to respond skillfully to new challenges in operational and clinical arenas (Sharts-Hopko, 2014). Further, NL competencies enable nursing to advocate as an equal partner at the table with medicine when making major decisions on capital and IT investments (Clancy & Reed, 2016; Simpson, 2013).

NLs are challenged to keep up with ever-increasing governmental, fiscal, and technological changes that necessitate a larger repertoire of knowledge and abilities (Leach & McFarland, 2014). In determining the professional development needs of experienced nurse executive leaders, these areas were identified: innovation/leading change, translation of evidence, reimbursement, advancing health, the future of nursing, healthy work environments, and nurse retention. To succeed, NLs must be lifelong learners to keep up with the changes. The absence of informatics, advances in technology, or other data topics underscores the need to raise awareness of this area across broader venues in nursing.

Leadership excellence and competency are the most important influencers of organizational culture, care delivery, and work environment. The Nursing Informatics Competency Assessment for the Nurse Leader (NICA-NL) extended and furthered the earlier work of Westra and Delaney (2008). Two articles were from the same research team with different lead authors. The first described the initial Delphi study to identify NL competencies in informatics (Collins, Po-Yin, Phillips, & Kennedy, 2017). The second research paper refined and validated the earlier identified key informatics competencies needed for NLs and CNEs (Yen P-Y, Phillips, Kennedy, & Collins, 2017). The identified competencies of strategic management, and executive planning reinforce the need for BI and IDV for NLs'.

The Role of Big Data

Brennan and Bakkens' (2015) expert opinion piece explores contemporary topics including Big Data, e-health, genomics, and the 'internet of Things' while discussing their dramatic impact on healthcare and nursing. For this project, big data is defined as high-volume, high-velocity or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation (Gartner, 2017).

The author's highlight opportunities created in the federal initiatives around big data, data science advances for nursing science, and practice to be integrated into the big data initiatives. Data science needs nursing's unique understanding of the patient experience to help inform new HIT systems which will "complement the reductionist approach taken by many data scientists" (Brennan & Bakken, 2015, p. 482). The authors summarize big data, exploring the world of data science, using Knowledge Discovery in Databases (KDD), data visualization, and exploration to gain insight. Data is stored in an ever-expanding data warehouse, where new relationships may be discovered. The older research models are based on prediction, seeking to determine cause and effect, and data sets (Brennan & Bakken, 2015). The authors' expert opinions inform and inspire those in nursing practice and academia, both to engage and to explore these new opportunities in data science.

Evidence Supporting Nursing's Use of Data Visualization

Past nursing leader, Florence Nightingale, successfully employed the power of data visualization to visually portray the death toll data in the Crimean War in 1858. Nightingale challenged previously held beliefs about of the causes of wartime fatalities, promoted adoption of her theories, and successfully transformed the British military hospital system (McDonald, 2001). More recently, a nursing study reevaluated an existing birth outcomes data set using data visualization analysis. The researcher reported this technique revealed previously hidden patterns and trends not discerned on the spreadsheet data (Vincent, Hastings-Tolsma, & Effken, 2010). A more sophisticated study researched

the effectiveness of visually displaying the multidimensional data sets to aid in decision making (Docherty, Vorderstrasse, Brandon, & Johnson; 2017). There was the ability to manipulate different data sets to explore relationships and uncover previously hidden relationships, associations, patterns, and trends in cost, data quality, and validated insights of prior analysis.

Data Visualization's Power

The need to review and scan vast amounts of data without becoming overwhelmed is critical for leaders flooded with reams of information on spreadsheets or reports. The brain's ability to process information has an upper limit. DV capitalizes on the human brain's ability to instantaneously interpret visual cues and alert if a danger is present. Brains are wired to perceive meaningful patterns, data relationships, and structures represented (Gentile, 2014; Potter, Wyble, Hagmann, & McCourt, (2014). In adopting the best practices of DV, information is provided in a manner that allows the reader to quickly and easily comprehended and discern its relevance without confusion (Brigham, 2014).

By providing a visual representation of the data assimilated from disparate sources, visual reports can enable prompt identification of issues, trends, or outliers. These processes foster data discovery and new insights from the data, then by collaborating, determine if a response is needed. If so, then determine the best course of action. The interactive features enable users to mimic how the human brain thinks with the ability to add or change data elements. BI users report making better decisions and are more confident in the decisions they make when data are provided to them visually and are easy to interpret and understand (Ward, Marsolo, & Forehle, 2014). Identifying outliers may hold the promise of changing deviant behaviors or helping patients thrive during adversity, providing the promise of strategies to be adopted across wider populations. The systematic review by West, Borland, and Hammond (2014) reviewed innovative techniques used to visualize clinical data to enable enhanced understanding of the underlying data e.g. Life Lines2, and Event Flow enables the visualization of multiple data sets to understand trends and impact on quality of care vis a vis their relationship. Their

work underscored data visualization's effectiveness in revealing previously hidden insights; cautions were added regarding the complexity of working with clinical data, however, which may be why the use of this technology is minimally compared to other fields.

Data visualization facilitates collaboration across multiple groups and across settings to engage outpatient clinicians to identify patterns of hospitalization use (Ferranti, et. al., 2010). IDV is a self-service and discovery decision-support tool that allows users to navigate, select, and display data via an easy to use interface to make sense of complex data. IDV enables users to explore data by dragging and dropping spreadsheets into the application and then immediately view the results. In collaborating across areas and disciplines, key questions can be discussed and decisions made about whether any further analysis is warranted, and what actions are needed to enable timely informed decisions (Kerfoot, 2014).

Evidence Supporting Use of Social Determinants of Health (SDH) in Population Health

There has been growing interest in studying the link between SDH and patient outcomes. Under new reimbursement models, providers and health plans are incentivized to be proactive, focused on strategies to keep patients out of the hospital, while improving their health outcomes. There is an increasing amount of research looking at high-risk for readmissions, increased the length of stay, and hospital acquired conditions. Recommendations made by both the Institute of Medicine (IOM) and the American Academy of Nursing (2015) called for including and addressing the social and behavioral determinants of health into the EHR (Helsing, 2015). A new emphasis on population health outcomes reinforces the importance of this research to enable improved outcomes; BI and IDV enable the identification of costly outliers, leveraging them, and providing meaningful interventions in averting hospital readmissions, hospital acquired conditions, and longer lengths of stay.

The use of geographic information science (GIS) discussed in an article by Clift, Scott, and Johnson (2014) demonstrated Kaiser Permanente's efforts as a health plan to understand the needs of the

communities they serve. To better understand the health needs of the population, GIS was used to identify the specific needs of identified high risk patient groups and map their access to services. Knowing the need and linking community resources was a key strategy highlighted by this study. The authors also highlight several successful use case exemplifying the successful adoption of BI technology in health planning. In Camden, New Jersey, Jeff Brenner collected and then mapped the high utilization of services from all hospitals in the city, revealing insight previously hidden high ED utilizers cutting their utilization rate by 40% (Gawande, 2011).

Collaboration is essential when working with under resourced communities. By working together, greater outcomes may result. The need for early identification of patients at risk, and in need of early intervention, is a common theme in the research for both adult and pediatric high-risk populations. According to Sills et al. (2017), pediatric readmissions correlated with where the children lived. A paper by Beck, Sandel, Ryan, and Kahn (2017) highlighted the opportunity for health systems to proactively inform clinicians about potential risk factors identified by geo markers from the patient's place of residence and work providing an opportunity to mitigate them.

Low Income and Poor Health Outcomes

A cross-sectional analysis of pediatric asthma patients correlated readmissions to groups with low income block groups (Auger et al., 2016). A retrospective cohort study by Kind et al. (2016) sampled 5% of the Medicare hospital discharges and applied a deprivation risk screen to correlate risk of readmission for CHF, pneumonia, and myocardial infarction. Here prescriptive analytics could evaluate with the patient and the family potential strategies to best support their longitudinal plan of care. Beck et al. (2017) additionally discussed inter-agency and cross-sector collaboration efforts to support at-risk families and communities using geo enabled data. In using neighborhood information, context provides an enhanced understanding of the development of risks – referred to as place-based risks. Once

identified more targeted interventions can intervene upstream to reduce ED utilization and manage conditions in an outpatient setting.

Research using both clinical data and zip codes to identify chronic heart failure patient rates of hospital readmissions linked patient residence with a six-month all-cause readmission rate even after adjusting for other patient-level factors, including individual SES (Agarwal, Menon, &Jaber, 2015; Bikdeli et al., 2014). Incorporation of SDH with clinical data shows promise to trigger screening and initiate implementation of needed upstream interventions averting the development of costly clinical conditions.

The understanding of the interplay of SDH and health outcomes is still very imprecise. A policy brief by McGovern, Miller, and Cromwick (2014) discussed ten key research studies on this subject. The apparent lack of agreement on which measures to use hampers research efforts in this needed study area. The adoption of BI can advance this effort, given its capacity to integrate disparate data sources, to understand the drivers of cost, and quality outcomes for population health.

NLs must advance the widespread use of data informed decision-making. It is critical to adopt a system thinking model to facilitate a successful transition from a volume to a value based reimbursement, from acute tertiary treatment to community-based primary prevention. It is imperative that NLs ask how they can best engage and empower patients, their families, and the community to shape and improve health outcomes. As more research substantiates the instrumental role of SDH in mediating health outcomes, their inclusion in both population and individual health assessment will gain greater acceptance. BI and IDV extend and deepen the NL ability to appreciate their impact on health. The IOM in 2014 and later the American Academy of Nursing's called for the capture and use of social and behavioral determinants of health in the electronic health record (EHR) to improve care and health-outcomes by (Sullivan, 2015). Currently, there is no agreed upon standard for defining and assessing SDH. The lack of consensus for a standard set of SDH impedes the 'sharable and comparable' data

needed to research and extend the understanding for their impact (Westra. et al., 2015).

NLs Must Gain BI and IDV Competencies

For most NLs, possessing HIT competencies has not been a prerequisite qualification for the CNO role (Hussey, 2015; Kerfoot, 2015). However, the evidence is clear that for NLs to meet the demands of an increasingly complex and chaotic digital environment, NLs must embrace analytics and integrate the insights gained to innovate new care strategies successfully. BI can reveal where the drivers of quality patient care exist. Predictive analytics enables users the ability to test out and then determine those with the greatest potential to impact operational and clinical care outcomes across the continuum of care, and then achieve operational goals (Bleich, 2015; Gentile, 2014; Linder & Barrett, 2015).

Conceptual and Theoretical Framework

The need for organizations to become learning health systems was presented in the work of Deming and advanced by Senge (1982). Together, the work of both men synergized a more coherent model, which was used for understanding and analyzing research for this paper. The work of Institute of Health Improvement (IHI), AONE, and the Institute of Medicine (IOM) evidence the influence of both Deming and Senge. Deming is best known for the plan–do-study-act (PDSA) cycle. *Out of the Crisis* (1982), articulated his philosophy and strategies not to just improve the quality and efficiencies of operations, but to transform their cultures (Taylor, McNicholas, & Nicola, 2013). Deming stressed the need to look out beyond the organization and bring back new information to then critically analyze the organization for application of this new outside information to improve operations. Organizations that support self-appraisal enable continuous growth, creativity, and innovation. The ideal state for an organization is when everyone in the organization is free to provide input, and understand their own critical and unique role and contribution to the functioning of the overall organization. The people, free of fear and competition within the system, can band together for optimization of the system. In a quality

system, everybody gains. “Deming was about working for the optimization of the whole system by nurturing the intellectual capabilities with-in the system to draw on people’s natural need to achieve their potential and find joy in work” (Berry, 2011, p. 4).

The call today is to step up and embrace data as our new language, and the tools by which care will be transformed, while we create a just culture of safety. Deming (1990) believed people were intrinsically motivated and naturally strove for dignity, pride, and joy in their work. The need to continually learn, grow, and adapt is critical in nature and in business. This is evident in the demise of natural species and of businesses. Since the early 1990s, several former industry giants have disappeared (Kodak), yet others have successfully reinvented themselves (International Business Machines (IBM)). In healthcare, the effect of new regulatory and reimbursement models has resulted in hospital closures or consolidation into larger health systems. A recent example is Providence Health System acquiring St. Josephs Health System in California in 2016, leveraging economies of scale and expanded geographic coverage to gain a stronger market presence in the west coast.

In his book, *The Fifth Discipline*, Senge (1990) expanded on Deming’s *System of Profound Knowledge* and explored how organizations can become learning systems by continually learning from mistakes and using data to improve performance. This enhanced awareness promotes greater productivity, and readiness to successfully respond to a new, uncertain future. Key tenets that Senge promoted are: systems thinking, personal mastery, mental models, building a shared vision, and team learning.

Both Deming’s (1982) and Senge’s (1990) philosophies are reflected in the later work of the IHI and the IOM continuously learning health system. The key tenets of continuous total quality improvement cycle are empowerment to experiment, and learn from mistakes without fear of reprisal enables data driven organizations to innovate and continually improve. Both men championed fostering of creativity and openness to feedback to refine further and develop one’s work (Senge, 1990). With the

creation of a shared organizational vision, systems thinking, and the realization of the many interdependencies across the entire system, all members understand that one part directly affects the other (Senge, 1999). Senge (1990) wrote,

> People in learning organizations react more quickly when their environment changes because they know how to anticipate when changes occur… and how to create the changes they want. Change and learning may not exactly be synonymous, but they are inextricably linked. (p. 11)

If adopted these tenets can empower NL's and their organizations, to be transformed into learning health systems.

Benefits of Learning Health Systems

The development of a learning health system requires leadership, extracting timely and meaningful insights from the business, and clinical data to continually advance in response to new data from multiple sources (Harper, 2014; Krumholz, 2014; Murphy, Scott, & Pawlak, 2013; Skiba, 2011). BI provides the foundation for the learning health system, enabling users to gather data from sources both within and outside the organization, helping them to understand variation, trends, and discover outliers which may be key indicators for deeper study. Thinking beyond the walls of the physical buildings and incorporating SDH data regarding readmissions, the length of stay, and even hospital acquired conditions can reveal valuable information that enables leaders to proactively engage upstream in ameliorating or preventing them (Scally, Petit & Arena, 2017).

Awareness of trends, events, and people or organizations in the external environment is essential for strategic planning. NL's needs to stay current, not just with events in healthcare, but in national and world events, policy debates, changing demographics, business developments, scientific breakthroughs, health trends, and popular culture as potential windows to query other new developments. Scanning of the rapidly changing environment prepares leaders for agile responses to new trends and their implications of future scenarios (Shats-Hopko, 2014).

The AONE nurse competencies for executives (AONE, 2015) reflects the work of both Deming and Senge (1982) (Appendix A). The need to use data to inform decision making, continually exploring new ideas and knowledge, promoting systems thinking as an expectation, recognizing mental models impact on behavior, and visionary thinking on issues that affect the healthcare organization, are all vital aspects of this model.

The challenge of VBP requirements provides support needed to extend BI across all programs to enhance patient safety, improve quality outcomes, and ensure reimbursement (Krumholz, 2014; Vondrak, 2012; Willis, 2014). Larger healthcare systems and insurers are successfully leveraging BI to understand patterns and trends over time to better manage high-cost patients at risk for readmission. An excellent example is the work Kaiser Permanente does with leveraging HealthConnect, their electronic medical record system, in cardiovascular disease management demonstrating savings of over $1 billion (Willis, 2014). Other health systems successes using BI include the Southeast Texas Medical Associates (STEMA), that reduced hospitalization readmissions by identifying causes then designed intervention strategies to address them, and the Duke University Health System, that utilized analytics to flag high-risk future events establishing evidence-based practices. Toronto's Hospital for Sick Children identified patterns of infection (Raghupathi, W. & Raghupathi, V., 2013), while numerous other entities are realizing the value of BI to help contain cost, improve the safety, and enhance the quality of care provided.

Section III. Methods

Institutional Review Boards

The DNP Statement of Non-Research Determination Form outlining the proposed project was submitted and reviewed by the Doctorate of Nursing Practice Department in the School of Nursing and Health Professions at the University of San Francisco. The prospectus outlined key elements of the project, was reviewed and it was determined that the proposed project not require Institutional Review

Board approval (Appendix D).

Ethical Issues

The data analytical tools of BI and IDV often incorporate protected health information (PHI) with other patient data to discover new relationships previously hidden and can "channel discoveries that lead to knowledge that is useful to the science of nursing (Page & Simpson, 2016, p. 273). The ANA's Code of Ethics for Nurses (Winland-Brown, Lachman, & Swanson, 2015) upholds the primary commitment to the patient, which requires that all PHI be handled to ensure its privacy and confidentiality. Breaches can occur, but be minimized with strict adherence to the organization's policies and procedures.

This project seeks to advance the profession of nursing's new ways of knowing by adding to the body of knowledge while promoting the greater good of patients, families, and the communities they reside. BI and IDV can enhance the ability to effectively and efficiently clarify problems and engage others in problem-solving using IDV resulting in improved clinical and organizational outcomes. These technologies can promote beneficence for both the community, patients, and the organizations serving them.

Data visualization depends on the quality of the data available to be visualized. The veracity of the data is a concern; much of nursing data is black data, or unable to be captured for use or reuse. Examining the veracity and completeness of a data set is important to ensure it is complete, accurate and not redundant to avoid producing inaccurate results. The 2010 American Nurses Association's (ANA, 2010) social policy statement challenged NLs to apply new technology and knowledge of health outcomes. This project exposes the current challenges facing nurse leadership: nursing data is all too often found to be deficient, its technology must be simplified, and nursing must take a stand for its data to be discoverable; its value must be quantified, and nursing knowledge extended.

Setting

At the 2017 Association of California Nurse Leaders (ACNL) annual meeting, a workshop on BI and IDV provided NLs with an overview of these tools to enhance their decision making and derive deeper insights from data. The discussion focused on the power of IDV and cautions needed to convey accurate display of data sets. Examples of best practices provided examples of the uses of these and how they enhance decision making.

Planning the Intervention

The business world is replete with examples of how BI and IDV has advanced the transformation of companies to compete in the digital economy. The ability to understand the broader markets makes possible the evaluation of new niche markets for specific product lines. In healthcare, innovation and adoption of new business technology are significantly slower than in the business world (Herzlinger, 2006). For this project, subject experts (SME)s were consulted to gain an understanding of the extent and use of BI and IDV in healthcare, specifically by NLs (Appendix F). One senior NL interviewed and whose organizations have BI and DV commented that she knew of the tools, but due to time constraints of schedules and time needed to learn the software, she had not used such tools.

The major challenge for NLs is twofold: first is the time, and second, having the ability to sift through all the information flooding them that demands immediate attention. In the past, these technologies were very labor intensive to use, and data from outside sources was only available at a considerable expense, providing little support for local problem-solving. Recently, government sources have released new data sets at a much more granular size, providing data on SDH at a block group level. The SDH data offers significant opportunities for a better understanding of high risk/high cost populations. BI and IDV tools make discovery of unique patterns and population characteristics readily available to users, providing opportunities for better prevention strategies. Newer and more user-friendly releases of BI are available (e.g., Tableau, Qlikview, and PowerBI) and these companies are interested in demonstrating their value in the healthcare arena. Over the past year, this scholar has engaged in

discussions to showcase different BI tools in a workshop for NLs. One company has provided a mock set of data for the workshop. Permission to use software for this workshop is through academic licenses.

To prompt healthcare leaders to change, it is important to provide a strong business case for adopting a new technology that enhances and supports NLs in realizing a future goal through its adoption and use (Crow, 2006). Developing an understanding and appreciation for how new BI technologies work is the first step to evoking an interest in adopting these technologies into their work flow. The second half of the project provides several current uses cases. A proof of concept (POC) presented provides a strong business case for adopting change but requires the commitment by executive leaders to support a demonstration project to showcase the effectiveness of an integrated SDH-clinical screening tools for early identification of high-risk patient population and provide intensive nursing care coordination and case management.

Proof of Concept Opportunity

BI tools can identify patients at highest risk for readmission and emergency department (ED) visits. To minimize potential readmissions and ED visits, targeted enhanced case management are provided for high risk patients. Patients identified using an integrated clinical and SDH score at the time they seek health services at the ED or outpatient services. A high predictive risk score alerts clinicians on the patients' electronic health record (EHR). The risk score is computed from clinical risk screen combined with SDH risks. This project adopts best practices of several leading health systems that have demonstrated an enhanced ability to reduce LOS and readmission, prevent adverse outcomes and increase Hospital Consumer Assessment of Healthcare Providers and System (HCAPHS) via the enhanced case management.

Evidence. The fiscal impact of Medicare's new value based reimbursement is affecting the hospitals' bottom lines. At concern are penalties for an increase in the 30-day readmission rate (10%) and increased the length of stay. For purposes of this project, the congestive heart failure (CHF) patient

population was selected. As the percentage of Medicare patients served increases, these will also increase (Infographic C). The estimate of 2012 CHF annual costs is $22,280 per person. (Voigt et. al., 2014). (Infographic B)

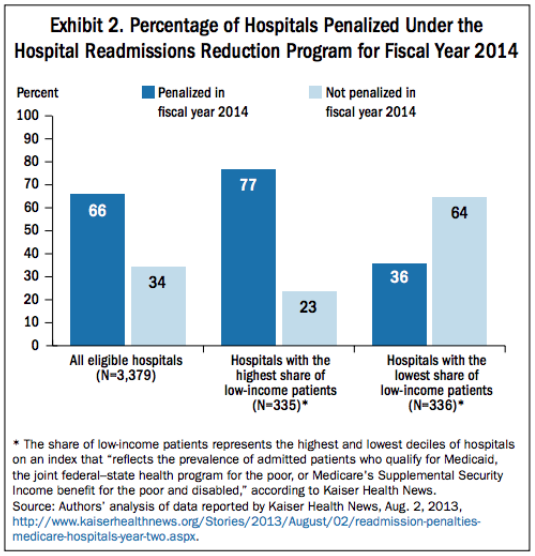
Proposed solution. To address the CHF population was selected to demonstrate the POC combined SDH and clinical risk screen tool with the vision of reducing hospital readmissions. Presenting a compelling business case is often needed for leaders to be induced to adopt new technology (Pearl, 2016). The Cardiovascular Service (CVS) has incentives to adopt new BI technology: tools and training to enhance their tactical and strategic decision-making skills. The second half of the project is to incorporate a SDH risk screening tool with the existing clinical screen to a targeted high-risk population to demonstrate improved outcomes for that population, enabling a significant return on investment (ROI) with costs averted for decreased readmissions, shorter length of stay, and decreased ER visits. After the initial training session, there will be an opportunity to be selected as a pilot site for this project for at least one of the organizations. The CVS chronic heart failure (CHF) program has a significant opportunity to demonstrate a significant ROI by SDH risk factor screening to their current clinical risk screen (Infographic A).

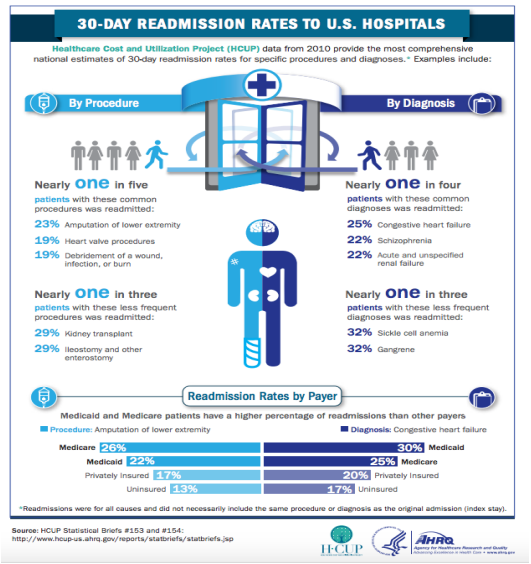
As a demonstration, the initial pilot uses as an example the CVS CHF program. Recent Medicare data identify heart failure (HF) at high risk for readmission: 60% of HF have one or more admissions, while 31% have two or more admissions (Kroch E, Duan, Martin & Bankowitz, 2016). The all-cause readmission rate is 28% in the HF population versus 16% in the non-HF population (Pelizzari & Pyenson, 2015).

Forecasting the financial benefits of utilizing BI and IDV in this patient population is linked to the 30-day readmission rate, the length of stay and number of ED visits. The ROI for this business case as proposed in the future can will be demonstrated from the financial savings in reducing the readmissions and length of stay of the CHF services for the first quarter and at least four up to eight days

per quarter fewer than the same quarter in the prior year. The average cost of readmission for CHF patient is $7,200 (CMS 2014, Voigt et al. 2014) (Appendix H: Cost Avoidance / Return on Investment analysis).

Support from leadership is a critical success factor as seen in the project's communication plan; key stakeholders are defined along with specifically tailored messaging. The budget estimated for this project was based on administrative and evaluation personnel to support the project, travel to conferences, meals, lodging, and incidentals, conference fees for participants, software for evaluation for student licenses not available, administrative supplies, and miscellaneous expenses (Appendix G). Below are examples of an Infographic Data Visualization for CHF and Hospital readmissions





http://hin.com/blog/2013/07/17/infographic-30-day-readmission-rates-to-u-s-hospitals/

Cost Benefit Analysis/Return of Investment

The project's estimated cost and return on investment (ROI) is discussed here. The projects' goal is to enhance the NL's ability to make swift decisions based on a visual representation of data from multiple sources that has been integrated and harmonized to reveal insights hidden in traditional reports. These tools enable inter-professional collaboration, invite inquiry from others, and enhance the quality of their work while saving time. The investment required is time. Initially the NLs attend a four-hour

workshop, then take an additional two to four hours weekly to develop a working knowledge of the tools as they apply them to projects in their current roles. The support needed from the data analytics department will vary by organization, depending upon the current availability of data in the enterprise data warehouse for data visualization tools. After investment of training, overall time savings is estimated to be up to 20 hours for year one, increasing in subsequent years. The ROI is based on implementation at one hospital for a team of executives, directors, and managers.

The AONE Nursing Salary and Compensation Survey (AONE, 2016) provided salary information for different nursing roles based on years of experience and region. An average was taken for the salaries of NLs in executive, director, and manager positions. Estimates were made to project a cost avoidance based on time savings for the Nurse Executive, three Directors, and five managers of total of $700 for year, and $11,200 for year two. Similar savings would be realized in other departments as leaders develop skill and proficiency with these tools and they become normalized within the operations of the hospital.

Implementation of the Project

The project was not selected by the program committees of the state (ACNL) or national level (AONE) Nurse Leaders conferences for inclusion in the 2017 annual meetings; however, the California meeting provided an opportunity to obtain survey information from attendees. This meeting was chosen as the attendees identify themselves as NLs. The AONE Nurse Executive competencies provided the framework for developing the questions used in the survey. The tool was reviewed by several SME's and their recommendations were incorporated into the tool. The survey asked five demographic and ten specific questions reflecting the NL engagement with IT and BI.

A voluntary survey of NLs attending the 2017 ACNL meeting February 7-8, 2017, in Anaheim, California, was first conducted to ascertain their knowledge and use of new analytic tools of BI and IDV. These results informed the development of two workshops to provide NLs an overview of BI and

IDV at the Inland Empire Chapter of the Association of California Nurse Leaders (ACNL) March 17, 2017, in Redlands, California, and at Eisenhower Medical Center's Nurse Leadership Council in Palm Desert, California, on May 17, 2017. The program reviewed the latest AONE Nurse Executive competencies, the need for timely data driven decisions for operational and clinical areas, and examples of how BI and IDV enable this. The effectiveness of the program was evaluated by the attendee's willingness to participate in a workshop covering basic uses of BI and IDV.

Seventy-seven surveys were obtained from NLs attending the ACNL annual meeting in Anaheim, California, in February 2017. Nine surveys were eliminated due to participant roles outside of health system operations or surveys being incomplete. The information obtained from the resulting 68 surveys informed the development for the education program content. The education content was reviewed for appropriateness of the content for the audience, clarity, and applicability by two executive NLs and 10 senior students in the ELDNP program at the University of San Francisco (USF). All feedback from the reviewers was incorporated into the final presentations.

Two workshops covering business intelligence and data visualization were then provided to nurse leaders at the Inland Empire Chapter of the Association of California Nurse Leaders (ACNL IE) on March 17, 2017, in Redlands, California, and at Eisenhower Medical Center's (EMC) Nurse Leadership Council in Palm Desert, California, on May 17, 2017. An overview of Business Intelligence (BI) and Interactive Data Visualization (IDV) to enable leaders to make timely data driven decisions applying these tools for operational and clinical areas was presented at these workshops. The program's effectiveness was evaluated by attendees' willingness to participate in workshop covering basic uses of BI and IDV, in their current leadership role.

Planning the Study of the Intervention

The project entailed multiple steps and utilized a Gantt chart to track progress and updating the project as needed (Appendix I) and a Work Breakdown Structure Chart (Appendix J). Needed

refinements to the project were achieved with the selected conceptual framework, and the PDCA (plan, do, check, act) tool was used to refine the content and ensure its relevance for the audience (Appendix K).

A strengths, weaknesses, opportunities and threats (SWOT) analysis was completed to provide a foundation for this project (Appendix L). Strengths identified were: it is a data integrator tool, it is a key need that has been identified, it is available in many health setting, the licenses are free to students, it creates a community of learning of those using selected software, and provides insights across discrepant data sources. Weaknesses identified: assumes an interest in BI, assumes a comfort with using data, assumes evaluation tool is available, requires time to learn and develop a comfort applying it into current workflow, requires ongoing education to keep current.

Opportunities identified: a new useful skill for NL, follow-up classes are provided, increases skill using data for visualization of reports and brainstorming, enables interprofessional collaboration and across the continuum of care. Threats identified: it may not be viewed as a priority due to time constraints, or viewed as not central to current role, volunteer unavailable for conducting a pre-test, an insufficient number of registrants for the workshop and it being cancelled, ACNL annual meeting program committee does not select this project to include in this year's program, and no Wi-Fi at the venue.

Change for change sake does not happen, especially for overly busy nurse executives. To induce NLs to adopt new technology, provide a POC demonstrating a compelling business case of how it will support the NL in realizing a future goal through its adoption and use (Crow, 2006). Presenting a POC to showcase how these technologies can enhance their ability to meet key metrics with a new and better process increases likelihood of acceptance of a new project. One potential high risk target population are those patients with chronic heart failure (CHF) for whom Medicare readmission penalties are at an

all-time high. Another population with significant readmissions are Asthma patients; readmission rates within 30 days have stubbornly remained at 5% (Obaidat, Alkhatib, Garcia, & Tabba, 2016).

To understand and strategize how best to elicit support for NLs to make a change, various resources were incorporated into a model for this project (Appendix W). Pearl (2016) recommends the following steps to promote leadership to change by taking the following steps and using an alphabetic mnemonic, A to E:

- Create an **a**spirational vision.
- Clearly define the needed **b**ehaviors.
- Explain the **c**ontext for the changes required.
- Provide timely, actionable **d**ata.
- **E**ngage personally, and genuinely

Analysis

The attendees of the ACNL annual meeting were provided the opportunity to complete a survey composed of basic demographic information and questions based on the AONE NL informatics competencies (Appendix A). Upon completion of the initial survey, this researcher reviewed the goals and objectives of the project with SMEs to provide clarity and purpose for this session. A self-survey was developed and distributed electronically and via paper copy to attendees (Appendix O). Data was cleaned and screened for missing variables and then analyzed in SPSS 22 to ascertain the adoption and use of business intelligence and interactive data visualization tools.

IV. Results

Program Evaluation/Outcomes

This project demonstrated that NLs were interested in engaging in new technology and discovering how to apply it into their existing workflows demonstrated by their interest to attend further

workshop on BI and IDV. A review of the post-conference survey responses as well as verbatim comments reflected significant satisfaction with the content provided as valuable. NLs reported the information would advance them in their leadership roles, afford them an opportunity to learn how potential or newer innovative technologies could be integrated into current workflows to enhance decision making as leaders, increase inter-professional collaboration, and make their workplaces more productive (Appendix P).

Leadership Self-Assessment Survey

Responses from the NL needs-assessment survey conducted at the 2017 ANCL conference were collected and saved onto an Excel spreadsheet. The first section asked basic demographic questions, including age, level of education, role in the organization, and type of organization employed in. Most respondents were older 40+ (*n*=62, 80%). The majority had a masters' a degree (*n*=42, 67%) or higher, were working in an acute not-for-profit hospital (*n*=59, 76%), and one third (*n*=22, 29%) were clinical leaders or managers, and another third (*n*=23, 30%) were directors in clinical or administrative roles.

The questions in the second section reflected involvement of the NL in organizational decisions for IT investments, and the selection of key performance indicators (KPI)s (e.g. average length of stay, hospital acquired conditions) for data dashboards. Additional questions asked about the recency of data available, ability to drill down into the data supporting the dashboards, if additional indicators could be added to the dashboards for self-service data visualization, and whether their organization used analytic tools to predict risk for readmission (Appendix R).

Results revealed that nursing leadership is being involved in IT investments, the selection of KP's, and that most receive KPI reports on a data dashboard (*n*=60, 78%). Most reported that the information provided on the visualized report (data dashboard) was readily understood (*n*=50, 65%) and was actionable (*n*=55, 73%).

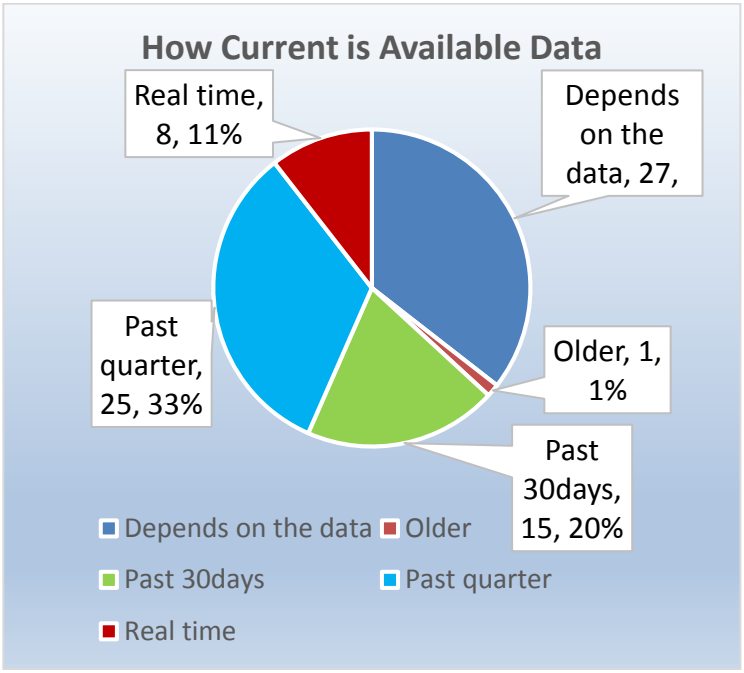
Deployment of BI and IDV

To ascertain the extent of BI and IDV within their organizations, NLs were asked if the dashboard reports provided hot links that connect to the data source supporting the figures displayed. 42% of participants (*n*=32) reported that they did not have data behind the dashboards to support the figures reported. Another question asked if the NL could add variables to the dashboards to extend querying the data and to delve down and discern more about the observed condition. Most participants could not add variables to the dashboards, with 64% (*n*=49) revealing these organizations had static dashboards.

Recency of data

Recency of data was another issue uncovered in the survey results. Respondents were asked about how current the data was in their organization. Most organizations were not providing real time data, and most data provided was lagging data, giving a look back in time hampering the NL's ability to make swift decisions based on near real time data (Table 1).

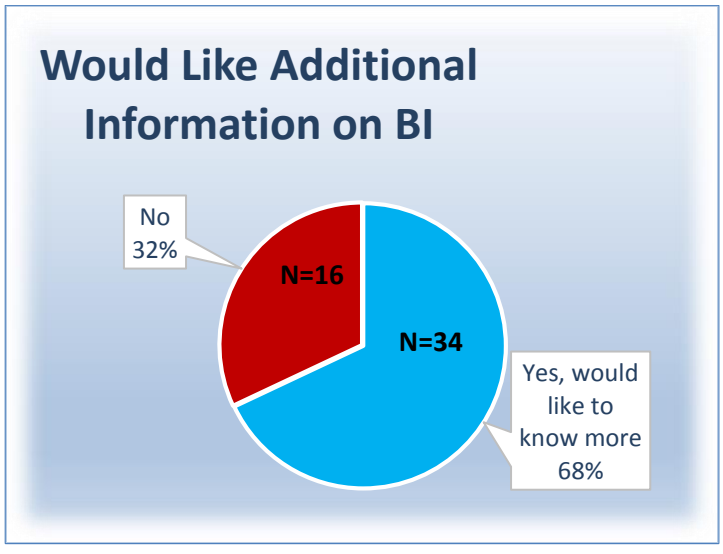
Recency of Data	N	%
Real time	8	10.5
Past 30 days	15	19.7
Past quarter	25	32.9
Depends on data	36	27



Results from Regional NL Workshop

The regional NL Education program was deemed a success as demonstrated by results from the post-conference survey. Two thirds (*n=34)* of the respondents showed interest in a desire to expand their knowledge of BI and IDV. Additionally, all the respondents (100%, of *n*=50) responded that this program provided them with information that they could apply in their current professional role.

Figure 1



These scores, plus verbatim comments, reflected significant satisfaction with the content provided, and that it was of value to support and enhance them in their leadership roles.

A positive unintended result occurred, after presenting to the Inland Empire ACNL chapter in mid-February, several of the NLs from Eisenhower Medical Center requested the 'Intelligent data: enhancing capabilities to empower change' presentation provided to their Nursing Leadership Council.

V. Discussion

Summary

The project provided an impetus for NLs to develop and extend their current competencies and skills in BI and IDV as demonstrated by the robust interest in attending a further workshop or receiving additional information to develop basic skills and deeper understanding of these capabilities. The initial survey provided an understanding of the NL perception of BI and DV and the current challenges faced in implementing these technologies in their organizations. The lack of near real-time data, the restrictions of education, and diffusion of innovation in healthcare is behind other business sectors. The results of this project expose the need for NLs to understand and to develop a fluency and skill in digital competencies of BI and IDV. The results revealed that across the different healthcare settings, there has been only minimal use of BI and IDV into the NL workflow.

The education programs provided an opportunity to present a strong business case for adoption of BI and IDV and how its' application fosters successful achievement of a strategic goal for the NL. The project revealed issues with access to near real-time data, and the ability to pull that data into a data dashboard to better understand the problems and developing data derived decisions to intervene in them was also noted. There was little difference between the responses of executive, administrative, and clinical leadership roles within the organization. There was NL involvement in IT investments, and decisions regarding selection of KPIs to include in dashboards whose content is easily understood and mostly actionable.

The healthcare industry's slower adoption of BI tools is reflected in these results, where data visualization is being used for reporting but providing services at a basic level. There were only 11% of the organizations that reported near real time data (*N*=8) while 64% (*N*=28) could add variables into the dash boards, suggesting a more advanced deployment of BI.

The challenge with nursing having access to near or real-time data is the age-old problem of nursing information has remaining hidden in the medical record. However, a team of nurse researchers is tackling this conundrum and this year their hope is to publish preliminary results on nurses' impact on patient care outcomes and assert its value, and the language for expressing value is data (Welton & Harper, 2016). To best leverage data value is to enable the reuse of high quality nursing data by expert nurse researchers to give a clear and loud voice to nursing's unique contribution to producing health (Sousa, Weiss, Welton, Reeder, & Ozkaynak, 2015). Although this author did not survey it would be further explore this in the future.

Relation to Other Evidence

User dissatisfaction with current EHR system is well documented. To deal with the non-intuitive and cumbersome workflows, staff have innovated creative work arounds. One study found 67% of respondents were taught workarounds (Nelson, 2016), resulting in more unusable data. The electronic record systems were not designed for capture of clinical information and retrieval, but to meet the needs of financial and legal goals. "Every system is perfectly designed to get the results it gets." (attributed to Deming).

The evidence is in, there was no plan at the initial development of electronic health records that data deposited in there we would be able to learn from or any requirement to we leverage it to enhance the processes to improve the care provided (D'Avolio, 2016).

An implicit goal of this project is, as nursing and other leaders use BI and IDV with data, there will be a deeper appreciation for its ability to create the richer understanding needed for decision making

and create a demand for having more data available. The work to map and link data elements to enable retrieval is significant; and, one dedicated group led by Welton and Harper is making the investment and is determined to demonstrate value from nursing data. In 2018, the first reports from Nursing Value Data Model will be shared. This project captures and measures nursing care at the nurse – patient level, enabling real time information about nursing quality performance, effectiveness, and outcomes of care (Welton & Harper, 2016). At the recent Nursing Big Data Nursing Knowledge conference, a presenter shared this comment from a Chief Information Officer: "Where are we depositing our clinical data? Are we depositing in an investment account or in a toilet where it will be lost?" (Personal account, Susan Matney, June May 7, 2017).

Barriers to Implementation

The ACNL and AONE annual meetings meet the learning needs of nurse leaders to stay abreast of current issues and develop needed skills and competencies. An abstract of the proposed workshops and lightening session were submitted for inclusion for the annual meeting in February 6-8, 2017, in Anaheim, California, and March 29-31, 2017 in Baltimore, Maryland (see Appendix J and I). The project was submitted to both the ACNL and the AONE to present at their annual meetings. The aim of this educational work was to spark NL interest in BI and IDV, and demonstrate interest in attending a follow up education session or receive information on BI and IDV. The project was not selected for inclusion at the ACNL or AONE annual programs and an alternate plan was initiated. A voluntary survey was offered to attendees at the ACNL meeting; the data obtained from the survey assisted in shaping the subsequent project presentation at the Inland Empire ACNL and Eisenhower Medical Centers (Appendix Q).

It is challenging to gauge what will interest the selection committees. This scholar has worked in healthcare association in the role of a regional vice president, supporting members by advancing new innovative strategies to meet the voiced needs of NLs, hospitals, and communities (e.g., Telemedicine

program contracted for hospitals struggling for neurology, psychiatric physician coverage after hours, development of a regional health information exchange). A lesson learned is how influence and credibility is tied to being part of an organization and the position held.

The challenge faced by data analytic departments is establishing priorities from the multiple competing requests; nursing is often viewed as a lessor priority to the requests of medicine, finance, or board of directors (Engelbright, 2017, CNO Hospital Corporation of America, Personal communication). Once nursing demonstrates its's value by tangibly contributing to operational and strategic goals there is a greater likelihood of nursing projects getting greater priority. NL use of BI will enable the discovery of key insights to impact both the process and practice of nursing care delivery to achieve desired outcomes thus further support for their initiatives.

The project selected by this scholar was to initiate change on a mesosystem level which requires ascertaining the current level of support and readiness for change. The ability to effect change takes significantly longer especially serving as on relative outsider to these professional organizations (ACNL, AONE) and working in academia. When HIT is brought up it is often coupled with the emotions of frustration and anger because of its lack of usability, and significant additional time needed to document something that used to take a just a few minutes in a paper chart. Providers complain that they are spending more time documenting than with the patient (Serota, 2017).

Interpretation

The environment in which NLs are functioning is changing rapidly in all areas, necessitating responding with skill and agility to lead strategic changes: clinical advances, HIT, and compliance mandates. New knowledge and competencies are demanded to meet these, 2015). Increasingly, there is a greater availability of BI and IDV tools in large health systems (KP, HCA, Providence), although access and ability to incorporate them into daily work flow is minimal (personal communication St. Josephs, KP). Most CNEs have not had informatics or analytics content in graduate school. Some

subsequently may have acquired it through continuing education or in the workplace (Kerfoot, 2015). Inhibiting uptake of these tools is the lack of access to data, the lower priority given to nursing projects over other C-suite members, competing demands to address critical, and impending crises. The need for NLs to acquire the knowledge of and a vision for how new technologies can help drive needed change. It is critical they be prepared with data derived recommendations when at the table to be viewed as an equal partner with other C-suite leaders to effectively advocate from an informed position for nursing, especially in decisions with impact on patient care delivery.

The leadership of the CNE in information technology is essential for the future of nursing and excellence in patient care. Unfortunately, extensive competency in health care information technology (HIT) is not universally seen as an entry into practice in the CNO role. This results in a wide variance across the country in the ability to make informed decisions about HIT, to advocate for technology support for nursing and nursing care, and to provide support for nonclinical smart solutions and clinical solutions (Keerfoot, 2015). These are all potential gaps for nurse leaders.

The need for innovation and improvement in health care outcomes could not be greater today. The per capita spending on health in the U.S. is twice that of other developed countries (OECD Health Statistics, 2015); regrettably dollars consumed has not translated into improved quality outcomes. Recent research published found that medical errors were the third leading cause of death in the United States, despite spending twice the average per capita on health as other developed nations (Makary & Daniel, 2016; OEDC Health Statistics, 2015). As NLs are empowered by leveraging BI and IDV, nursing can and will do better at coming ever closer to realizing the goal of a continuously learning healthcare organization.

Conclusion

Health care leaders, and specifically nursing, must address these significant discrepancies by harnessing new technology tools. Healthcare and nursing are late adopters of BI and analytics (Foerster,

2014; Groves, Kayyali, Knott, & VanKuiken, 2013; Herzlinger, 2006). Nursing is purported to more slowly adopt new data technologies than medicine or finance; however, in not having an equal place at the table when IT investments are decided, it is more challenging for nursing to advocate for HIT investments (Hamer & Cipriano, 2013). The lack of systematic reviews and evidence-based resources for the implementation of BI and analytics in nursing reflect this trend. More healthcare data is providing nursing an opportunity to better understand factors promoting health and demonstrating nursing's value. Our unique understanding of the patient experience can inform care delivery initiatives and HIT systems selection.

Nurses need to develop a greater understanding of HIT, as well as the applicability to interpret clinical data via algorithms for early warning alerts of clinical deterioration. Currently the profession is just beginning to appreciate the need to employ analytical skills in making strategic decisions (Murphy & Warshawsky, 2015). This project's primary focus was on NLs in practice; however, it is equally compelling to engage academia to include similar content in their nursing curriculum. There is an opportunity for future scholars to pursue this vital direction, particularly regarding the lack of serious review given to informatics by academic accrediting bodies (personal communication, June 7, 2017)

The use of DV is an area to be explored for NL to be aware of distortions due to lack of quality, and type of style selected to visualize the data. In our digital age, content is moving to visual representations and less on text. As we attempt to engage different stakeholders what considerations need to be taken to appropriately convey information to enable it being readily comprehended. Clear, concise, and compelling communication is needed to effect needed change; however, a new set of skills are needed to meet the new demands.

Section VI. Other Information

Funding

There was no source of additional outside funding to support this project. The costs to implement this project was absorbed by the scholar. The final budget and return on investment (ROI) is outlined in Appendix K.

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Appendix A: AONE Nurse Executive Competencies

5. Business Skills-Information Management and Technology

AONE Nurse Executive Competencies

#5. BUSINESS SKILLS

D. INFORMATION MANAGEMENT AND TECHNOLOGY

- Use technology to support improvement of clinical and financial performance
- Collaborate to prioritize for the establishment of information technology resources
- Participate in evaluation of enabling technology in practice settings
- Use data management systems for decision making
- Identify technological trends, issues, and new developments as they apply to a patient care
- Demonstrate skills in assessing data integrity and quality
- Provide leadership for the adoption and implementation of information systems American Organization of Nurse Executives. (2015). AONE Nurse Executive Competencies. Chicago, IL: Author. Accessed at: www.aone.org

Appendix B

Evidence-Based Rating Scale

Level I	Experimental study/randomized controlled trial (RCT) or meta-analysis of RCT
Level II	Quasi-experimental study
Level III	Non-experimental study, qualitative study, or meta-synthesis
Level IV	Opinion of nationally recognized experts based on research evidence or expert consensus panel (systematic review, clinical practice guidelines)
Level V	Opinion of individual expert based on non-research evidence. (Includes case studies; literature review; organizational experience e.g., quality improvement and financial data; clinical expertise, or personal experience)

A High	Research	Consistent results with sufficient sample size, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific evidence.
	Summative reviews	Well-defined, reproducible search strategies; consistent results with sufficient numbers of well-defined studies; criteria-based evaluation of overall scientific strength and quality of included studies; definitive conclusions.
	Organizational	Well-defined methods using a rigorous approach; consistent results with sufficient sample size; use of reliable and valid measures.
	Expert Opinion	Expertise has been clearly evident
B Good	Research	Reasonably consistent results, sufficient sample size, some control, with fairly definitive conclusion reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence.
	Summative reviews	Reasonably thorough and appropriate search; reasonably consistent results with sufficient numbers of well-defined studies; evaluation of strengths and limitations of included studies; fairly definitive conclusions.
	Organizational	Well-defined methods; reasonably consistent results with sufficient numbers; use of reliable and valid measures; reasonably consistent recommendations
	Expert Opinion	Expertise has been clearly evident
C Low quality or major flaws	Research	Little evidence with inconsistent results, insufficient sample size, conclusions cannot be drawn undefined, poorly defined, or limited search strategies; insufficient evidence with inconsistent results; conclusions cannot be drawn
	Summative reviews Organizational	Undefined, or poorly defined methods; insufficient sample size; inconsistent results; undefined, poorly defined or measures that lack adequate reliability or validity
	Expert Opinion	Expertise has not been discernable or has been dubious
Newhouse R, Dearholt S, Poe S, Pugh LC, White K. John Hopkins Evidence – Based Practice Appraisal. The Johns Hopkins Hospital.		

Appendix C: Table of Evidence

Appendix B:
Evaluation Table, template from Melnyk & Fineout-Overholt (p.552)

**"Appraisal of Worth to Practice Strength of the Evidence" based on John Hopkins Nursing EBP Research Evidence Appraisal Tool*

Citation: Author(s), Date of Publication & Title	**Design/ Method**	**Sample/ Setting**	**Variables Studied and their Definitions**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	***Appraisal: Worth to Practice**
Brennan & Bakken 2015 *Journal of Nursing Scholarship* Nursing needs **big data and big data needs nursing.**	Expert opinion	n/a	n/a	n/a	**n/a**	Impact of Big Data, e-health, genomics, and the 'internet of things, nursing science integrated into data science initiatives. Data science needs nursing's unique understanding of the patient experience to help inform new HIT systems to "complement the reductionist approach taken by many data scientist	Level: V Quality: A High Quality
Westra, B. & Delaney, C. **Informatics Competencies for Nursing and Healthcare Leaders** (2008) AMIA Symposium Proceedings	Survey with Delphi approach	n/a	Competencies from on Informatics compared with AONE competencies.	The first survey resulting from this process included a total of 119 items with 38 competencies addressing computer skills, 37 addressing informatics knowledge, and 44 addressing informatics skills.	Delphi process that included three rounds of surveys using an expert panel of experienced nursing leaders, informaticians, and researchers. And a content validity index calculated for each competency	Informatics competencies for nursing leaders were developed through a review of the literature and a Delphi process that included three rounds of surveys using an expert panel of experienced nursing leaders, informaticians, and researchers. Based on the results of round one, there were a total of 93 competencies: 24 competencies addressed computer skills, 36 addressed informatics knowledge, and 33 informatics skills.	Level: III Quality A High
Collins, S, Po-Yin, Phillips, & Kennedy. (2017) *Journal of Nursing Administration*, **Nursing Informatics Competency** Assessment for the Nurse Leader. The Delphi Study	Followed the 8-step scale developme nt process by DeVellis Environ-mental Scan & 3-round Delphi survey	Nurse leaders HIMSS region meetings Total N=101(34, 26 & 41) HIMSS Symposiums June-July 2013, Sept-Oct 2013, Dec-Jan 2014, &	108 competencies items for nurse leaders in HIT	Delphi method to rank order competencies	A 2-year, multimethod study to define, develop, and validate a nursing informatics competencies self- assessment instrument specific to the needs of nurse leaders to evaluate their levels of nursing informatics competencies and target learning and professional development opportunities Competencies were narrowed down each subsequent group, 108 to 92, to 74 retained competencies.	Identification of 74 Nurse leadership competencies for HIT. Currently most leaders gain knowledge on the job however there is need to fully partner with other c-suite leaders to have not just knowledge but demonstrable competencies in HIT.	Level: III Quality A High.

Yen P-Y, Phillips A, Kennedy M, Collins SA. (2017). **Nursing Informatics Competency Assessment for the Nurse Lead**er (NICA-NL): Instrument Refinement, Validation, and Psychometric Analysis.	Factor analysis of previously identified set of informatics competencies specific to the NL. Here, we report the factor analysis phase from step 5 to step 8	Nurse Leader Survey	Infor-matics competencies of Nurse Leaders	26 measures in a 6-factor solution to identify specific informatics and technology competencies for Nurse Leaders and CNO's	An exploratory factor analysis to validate, optimize, and explore the psychometric properties of the proposed NICA-NL	Study refined and validate a new instrument, Nursing Informatics Competency Assessment for the Nurse Leader (NL) 1) strategic implementation management, (2) advanced information management and education, (3) executive planning, (4) ethical and legal concepts, (5) information systems concepts, and (6) requirements and system selection. Cronbach's were .96, .91, .90, .83, .92, .81, respectively	Level III Quality A High
Simpson, (2013) *Nursing Economic$* **Chief nurse executives need contemporary informatics competencies**	Chief Nurse Executives	R. Simpson interviewed 7 system CNE's who were member of Health Management Institute (HMA)	AONE Essentials Informatics Competencies	Nurse Executive speaking to the AONE Nurse Leader Informatics	Qualitative-Ethnographic Interviews	Interviews validated the current CNE competencies in all except two areas: "ability to demonstrate awareness of societal and technological trends, issues and new developments as they relate to nursing'	Level: III Quality: B good
Leach &McFarland (2014) *JONA* Assessing the **professional development needs of experienced nurse executive leaders**	Descriptive study	Convenience sample study of ACNL Membership	Identification of professional development topics for senior nursing leader's future advancement or success	N/A	Initial sample sent to 400 CNE's then to 1200 with 155 respondents	Areas of interest/need identified were: Innovation/leading change, translation of evidence, reimbursement, advancing health: the future of nursing, healthy work environments, and nurse retention. Leadership excellence & competency is the most important influencer of org culture, care delivery& work environment for nurses.	Level: III Quality: B good
Vincent, D., Hastings-Tolsma, M., & Effken, J. (2010). Data **visualization and large nursing datasets.** *Online Journal of Nursing Informatics*).	Visualization of nursing dataset	Nurse Midwifery Clinical Data Set (NMCDS)		Birth outcomes	Secondary analysis to data set to uncover any relationship between perineal lacerations (tears), parity and BMI was examined using a standard graphics format Data Visualization	This study describes the process and outcomes of a secondary analysis of an existing large dataset using data visualization software. By using data visualization, we could identify patterns not appreciated on previous standard analysis. Constraints identified: cumbersome tools demand significant time to learn. Potential misrepresentation of data visually needs to be monitored.	Level III Quality B

West, V.L., Borland, d., & Hammond, W.E. (2014) **Innovative visualization of electronic health record data:** a systematic review Journal of American Medical Informatics Association	System-atic review	Electron-ic search between 1996-2013	191 articles selected from 891	Key words related to clinical EHR data visual-ization.	Data matrix was developed to determine selection	Focus on identifying articles on innovative visualization and interactive abilities found there are few methods to easily and effectively visualize EHR data due to its complexity both temporal and complexity and changing variables. The use of these techniques available in other domains has not been significantly been applied in healthcare.	Level 1V Quality B
Kind, A.J., Jencks, S., Brock, J., Yu, M., Barles, C., Ehenback, W., Greenberg, C., & Smith, M. (2016) Neighborhood Socioeconomic Disadvantage and 30-Day Re-hospitalization. Annals of Internal Medicine	Retrospect ive cohort study	Random 5% national sample of Medicare discharged patients	Congestive heart failure, pneumonia, myocardial infarction Area deprivation rate.	Re-hospitalization rates	Relationship between area deprivation index (ADI) rate and re-hospitalization using logistic regression, random effects logistic regression for within hospital ADI effects	Use of a risk screen such as the ADI is useful to alert clinicians of potential increased risk for development of conditions leading to re-hospitalization. It would support the targeting of transitional intensive care management resources, and prompt targeted development of community based services in those 15% highest ADI neighborhoods. It would be useful to adjust Medicare readmission measures.	Level III Quality B
Auger, K, Kahn, R.S., Simmons, J.M., Juang, B, Shah, A. N., Timmons, K., & Beck, A. F. (2016) Using address information to identify hardships reported by families of children hospitalized with asthma. Academic Pediatrics	Cross-sectional analysis	Pediatric asthma patients admitted to Cincinnati Children's Medical Center Admitted between Aug 2010 to October 2011 in 8 county service area	774 children seen for acute asthma or broncho-dialator – responsive wheezing	Household income, financial strain, primary care access within zip code, census track and block group		Risk scoring based on characteristics of block group and census track would help identify needs and better target resources to address the needs in those areas. This research adds to the limited work to date on how patient neighborhood characteristics correlate with patient and families. Of 60% of those eligible enrolled 57% were African American, 73% publicly insured, 60% annual income <$30,000 with suboptimal access to primary care.	Level III Quality B
Slayer, P. (2014) Integration of health information technology to improve patient safety. Journal of Nursing Education and Practice	Literature review	Articles from 2010-2013		Keywords technology drivers, advancements and effects in patient safety areas of patient records, patient falls, pressure ulcers, and medication errors.	N/A	40 articles were selected suggest there are newer technologies that can make a difference in reducing patient events but must not replace professional critical thinking and nursing oversight	Level V B

Clift, K., Scott, S., Johnson, M. &Gonzales. (204) Leveraging geographic information systems in an integrated healthcare delivery system	Apply GIS to data sets	KP health communities in the US in CA, FL,	Use of geographic information systems, (GIS) with spatial analytics and map-based visualizations, to data sourced from its electronic medical records and from publicly and commercially available datasets.	Community Needs Assessment to determine unmet needs incorporating SDH	Application of GIS as a spatial approach to identify SDH GIS data visualization	GIS is a powerful tool that enables integrations of various data sets to better understand the health needs KP members in the context of their communities. This understanding is part of a strategy to inform partnerships and interventions in and beyond traditional care delivery settings. Use would serve to be applied widely including the integration of social services, and other public databases.	Level III Quality B
Docherty, S. L., Vorderstrasse, A., Brandon, D., & Johnson, C. (2017). *Western journal of nursing research*, **Visualization of Multidimensional Data in Nursing Science.**	Descript-ive study	Demonstrate the utility of data visualization understanding		Demonstrate the power of visual scientific visualization in 2 studies. Multiple case study on decision making events from multiple perspectives using a range of data types.	Describe the analytic lines resulting from visual display examples Describe initial stages of evaluation& analytic tools to assess the merit, utility and ability to derive insight of visualization tools used. Utilizing scientific visualization in 2 studies to s.	Challenges exist for deriving meaning from multidimensional data sets by utilizing scientific visualizations Visualized date aids enhanced of associations, patterns and trends in multidimensional data base, cost, data quality and veracity of insights of findings generated.	Level III Quality: A
Sills, M. R., Hall, M., Cutler, G. J., Colvin, J. D., Gottlieb, L. M., Macy, M. L., ... & Auger, K. A. (2017). *The Journal of Pediatrics* Adding social determinant data changes children's hospitals' readmissions performance.	Retro-spective cohort	N= 458,686Pediatric All-condition readmissions (PACR) score from 47 hospitals in the Pediatric Health Info database Jan-Dec 2012	Added risk adjustment factors: chronic condition indicators, age and sex, race ethnicity payer. SDH	Impact on readmission rate of SDH data derived from zip code (families below poverty level, vacant housing units, adult's w/o HS diploma, sign parent households, Median Household income, unemployment rate.)	Bivariate comparisons Kuskal-Wallis of distribution of zip linked SDH Multivariate analyses 4 models of 30 day PACR outcome of	SDH risk adjustment has substantial impact at the hospital level, where readmission penalties are calculated, but only minor impact on readmission prediction model performance at discharge level. These results validate authors previous findings the SDH risk adjustment can impact penalties levied for readmissions. For pay for performance measures calculated at a hospital level, and for research on hospital level performance, findings support inclusion of SDH variables in risk adjustment,	Level II Quality B

Bikdeli, B., Wayda, B., Bao, H., Ross, J. S., Xu, X., Chaudhry, S. I., … Krumholz, H. M. (2014). Place of residence and outcomes of patients with heart failure: an analysis from the tele-health f trial.	Retrospect ive analysis and patient interviews data from participant s of the Telemonit or-ing to Improve Heart Failure Outcomes (Tele-HF) trial, recruited from 33 US internal medicine and cardiology practices	We included 1557 patients: 524, 516, and 517 from low, medium, and high SES neighborhoo ds, respectively (mean age, 61.1±15.2 years; 42.2% women). Overall, 745 patients (47.8%) had ≥1 readmission and 179 patients (11.5%) died.	HF readmission rates, all cause death at 6 mos, Death or re-admission All cause re-admission High, middle or low SES SDH	The effect of neighbor- hood SES on all-cause hospital readmissions among patients with heart failure,	Continuous variables as mean (SD) and compared them using 1-way ANOVA Logistic regression with generalized estimating equations (GEE) method to determine the association between neighborhood SES and outcomes Linear regression method was used for continuous variables	Findings were a higher rate of all-cause readmission and a composite of death or readmission at 6 months for patients with heart failure who lived in low-SES neighbor-hoods, neighborhood effect persisted after multivariable adjustment for demographics, clinical factors, and individual SES variables. This study demonstrated a causal role of neighborhood is supported by a randomized housing mobility experiment, in moving from a low-SES to a high-SES neighborhood leads to improvements in objective and subjective physical and mental health indices. Additional work is needed to identify the key elements of neighborhoods that mediate neighborhood-level disparities in disease incidence and outcomes.	Level III Quality A
Beck, A. F., Sandel, M. T., Ryan, P. H., & Kahn, R. S. (2017). Mapping Neighborhood Health Geomarkers To Clinical Care Decisions to Promote Equity In Child Health. *Health Affairs*	opinion	N/a	Child health equity, SDH, geo markers	Neighborhood Geo markers	Opinion piece	Knowledge of SDH or geomarkers can inform not just community health but individual patient care, an example used is asthma. Available granular data on SDH can trigger clinicians of need to screen and attempt to mitigate risk factors. Inter-agency collaboration can be fostered as the patient and family is kept at the core of cross-sector collaborations to promote health for both populations.	Level V Quality B
McGovern, L., Miller, G. & Huges-Cromwick, P. (2014) Relative contribution of multiple determinants to health outcomes. Health Affairs: Health Policy Brief	Policy brief citing recent research	N/a	Multiple determin-ants of health, multiple dimensions, causal pathways, and level of influence on health,	n/a	Research papers relative contribution to the understanding of non-clinical factors impact on health outcomes.	10 Major research studies discussed looking at health determinants impact on health outcomes. Different models used, varying theories of interplay of different community level factors on health outcomes. This paper highlights the need for more precise measures and comparability of studies on determinants of health outcomes to ascertain their relative impact on health. Timely data at a population level is needed on outcomes.	Level V Quality A

Appendix D:

DNP Statement of Non-Research Determination Form

Student Name: Christina Bivona-Tellez

Title of Project:

Business Intelligence: Making the Data Come Alive

Brief Description of Project:

In healthcare today we are drowning in data the question is how can one efficiently and effectively harness it to yield the knowledge needed in real time and for strategic planning? Tools used commonly in business are beginning to be embraced by healthcare. It is key for the nurse leader to become acquainted with and develop a working knowledge of Business Intelligence (BI) tools and their application in administration and clinical operations.
An introduction and overview of BI tools, their uses and application in Nursing Leadership will be provided with an opportunity for hands-on training for participants leveraging available tools for their institution.

A) Aim Statement: Nurse leaders will demonstrate a basic understanding of Business Intelligence tools and their application in clinical and operational settings by completion of training program.

B) Description of Intervention: Nurse leaders will be provided education on what is data analytics, business intelligence tools, and data visualization. Key concerns regarding how to best display data for which intended audience. Participants will be actively engaged initially by completing a pre-test of their current knowledge and skill with BI later in the course participants will have the opportunity to use the software in a 'hands on' workshop reviewing some basic BI tools and develop a dashboard applicable to their setting.

C) How will this intervention change practice? Nurse leaders will have a basic fluency in BI to converse and understand what they may want to request from data analyst providing reports under their purvey.

D) Outcome measurements:

Pre-and post-conference comparison will validate increased knowledge and fluency with BI.

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) 45CFR46.101(b)(2)

X 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: **Business Intelligence: Making The Data Come Alive**	**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.	**?**	
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):
_____Christina Bivona-Tellez_____
Signature of Student:
_____DATE_____

SUPERVISING FACULTY MEMBER (CHAIR) NAME (Please print):
_____
Signature of Supervising Faculty Member (Chair):
_____DATE_____

Appendix E: Chief Nurse Executive Big Data Checklist

Table 1. The Chief Nurse Executive Big Data Checklist

Create a data culture	Incorporate data-driven decision making into clinical and operational processes at all levels of the organization. Create continuous, timely feedback loops from data to decision-maker within clinical and operational technologies and processes. Drive access to data to all levels of the organization. Define the nursing terms needed in the existing financial, human resources, operations, and clinical data systems. Adopt standard nursing taxonomies to structure and codify nursing terms in each of these data systems to enable internal analysis and external benchmarking. • Nursing Minimum Data Set (NMDS)[14] • Nursing Management Minimum Data Set (NMMDS)[9,10] • American Nurses Association (ANA) recognized clinical terminologies[15–19] Collaborate with health care information technology professionals to assemble nursing terms from the existing financial, human resources, operational, and clinical data systems into a common platform for analysis.
Develop data competencies	Secure access to critical informatics and data analytics skills, including statistical analysis, benchmarking, dash boarding, and data visualization to realize full benefit of investment in big data. Establish the data and informatics competencies required for each nursing role and create a path to achieving those competencies.
Create a data infrastructure	Establish a governance structure that includes direct care nurses and is charged with approving changes to the data sources and nursing terms, balancing the benefits and costs of expanding data collection activities. Align the nursing data agenda with the overall informatics strategy for the organization by integrating nursing and informatics professionals into the decision-making committees at all levels. Enforce use of big data, nursing business intelligence, and clinical data, and establish data security. Ensure that information is integrated across departments/silos, and that data are reliable and consistently used across the enterprise.

APPENDIX F: Subject Matter Expert Discussions

Subject Matter experts were interviewed to gain a deeper understanding of the use of BI and IDV within their Health Systems, identify any issues inhibiting their use, and What future goals there may be for BI and IDV.

- Katie Skelton, Chief Nurse Executive, St. Josephs' Orange Medical Center: Use of BI & IDV elsewhere in organization but not regularly in Nursing. Technology is there to use but time constraints dissuade NL from learning and using.
- Anne O'Brien, Senior Director and Chief Nursing Officer Kaiser Permanente: No wide spread use of BI and IDV by NL yet, however currently evaluating creating dashboards available for NL's using Tableau and Qlikview.
- Amy Garcia, Director and Chief Nursing Officer for workforce capacity, Cerner Corp: Challenge for NL is available nursing data, limited Data Analytics resources makes it highly competitive for them to work on a specific nursing project.
- Patricia Radovitch, Director of Nursing Research, Loma Linda University Health Care: Evaluated the ACNL NL Self Survey content and provided feedback which was incorporated into the survey.
- Fran Paschal, Senior Vice President, CNO, Riverside Community Hospital: HCA does use BI and IDV, time constraints deter NL from using them. Hers is highly data driven organization and very supportive of NL who would want to use the technology.
- Jane Engelbright, CNO, HCA: Jane echoed comments of others above –NL limited time and opportunity to learn new technology and access to nursing data and the limited business analytics support challenge nursing from getting desired projects.

- Sharon Fabbri, NP Loma Linda University Chronic Heart Failure Program, discussed current clinical risk screens used and how including SDH could trigger clinicians to the need to screen further.

Appendix G: Budget

Item	Description	Amount
Personnel	MY time Evaluation Consultant	$60/hr. x 90hrs. = $54,000 $100/hr. x 19 hours = $1,900
Travel: **Meetings in San Francisco with DNP Committee** **Plane fare, hotel and meals**	Plane fare mileage ($ 0.54/mile) (GSA per diem $250/day) ACNL Local	Virtual Virtual x 425 mi = $230*
Software for Evaluation	Survey Software	Academic subscriptions
Conference Fees	ACNL, n/a AONE	$1,125*
Licenses and Fees	Tableau, Clik, Cognos	Academic subscriptions
Supplies - Administrative		$150*
TOTAL		$7,300

*** = expenses covered by APU**

Appendix H: Cost Avoidance/Return on Investment

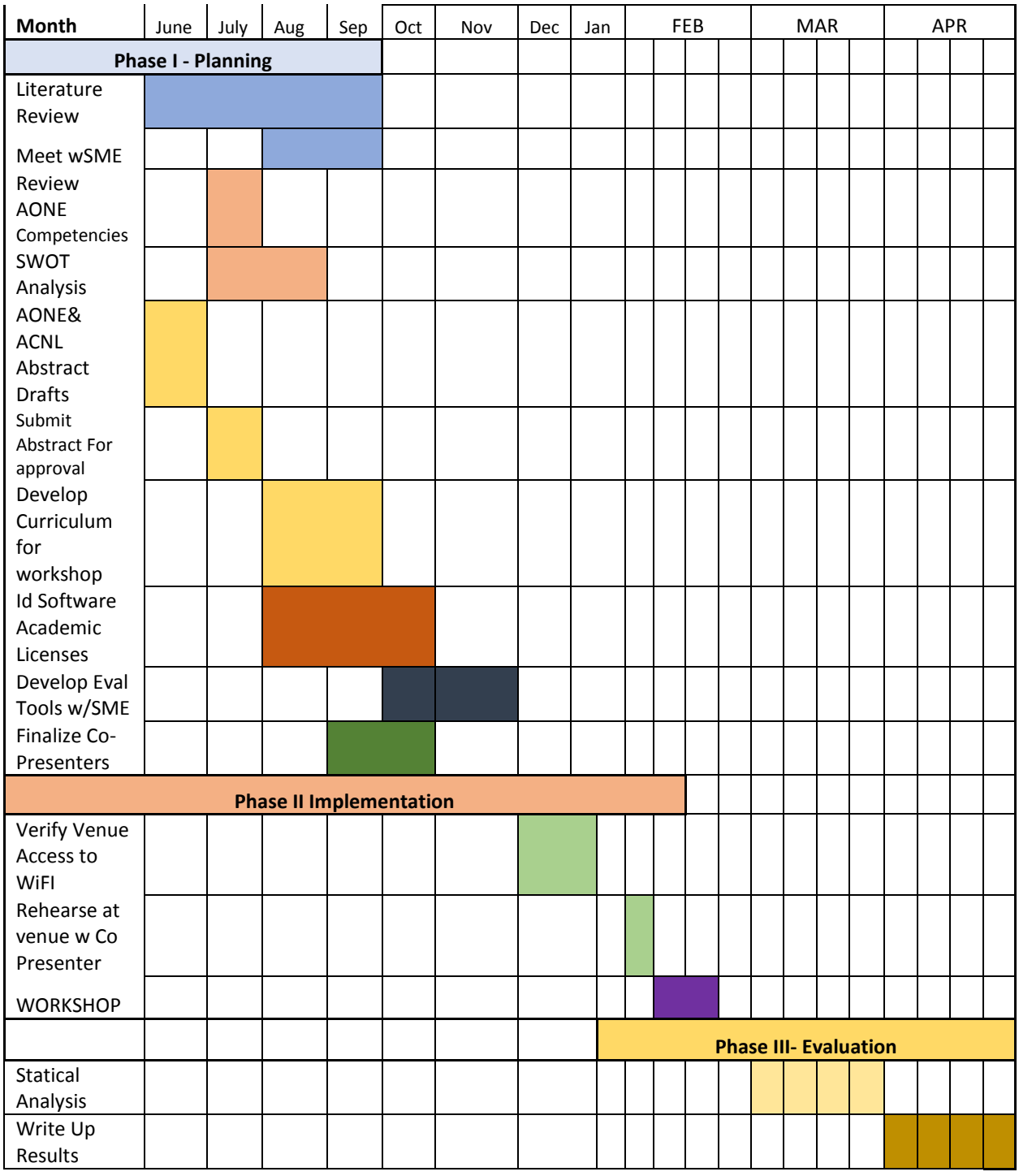
Role	Salary	Estimated Annual Hours Saved per FTE	Savings 1 FTE	Estimated Savings Year 1	Estimated Savings Year 2
Chief Nursing Officer Nurse Executive	$170k avg. hourly = $82	25	$2,050 (less $1640 training)	x1 $410	$2050
Director Administrative/Clinical (3 FTE's)	$120k avg. hourly =$58	25	$1,450 (-$1,160 training)	x 3 FTE's= $290	$4, 350
Administrative/ Clinical Manager (5 FTE's)	$100k avg. hourly =$48	20	$960 (-$960 training)	x 5 FTE's = $0	$4,800
Total Est. Savings		70		$700	$11,200

American Organization of Nurse Executives (2016). AONE Salary and Compensation Study |

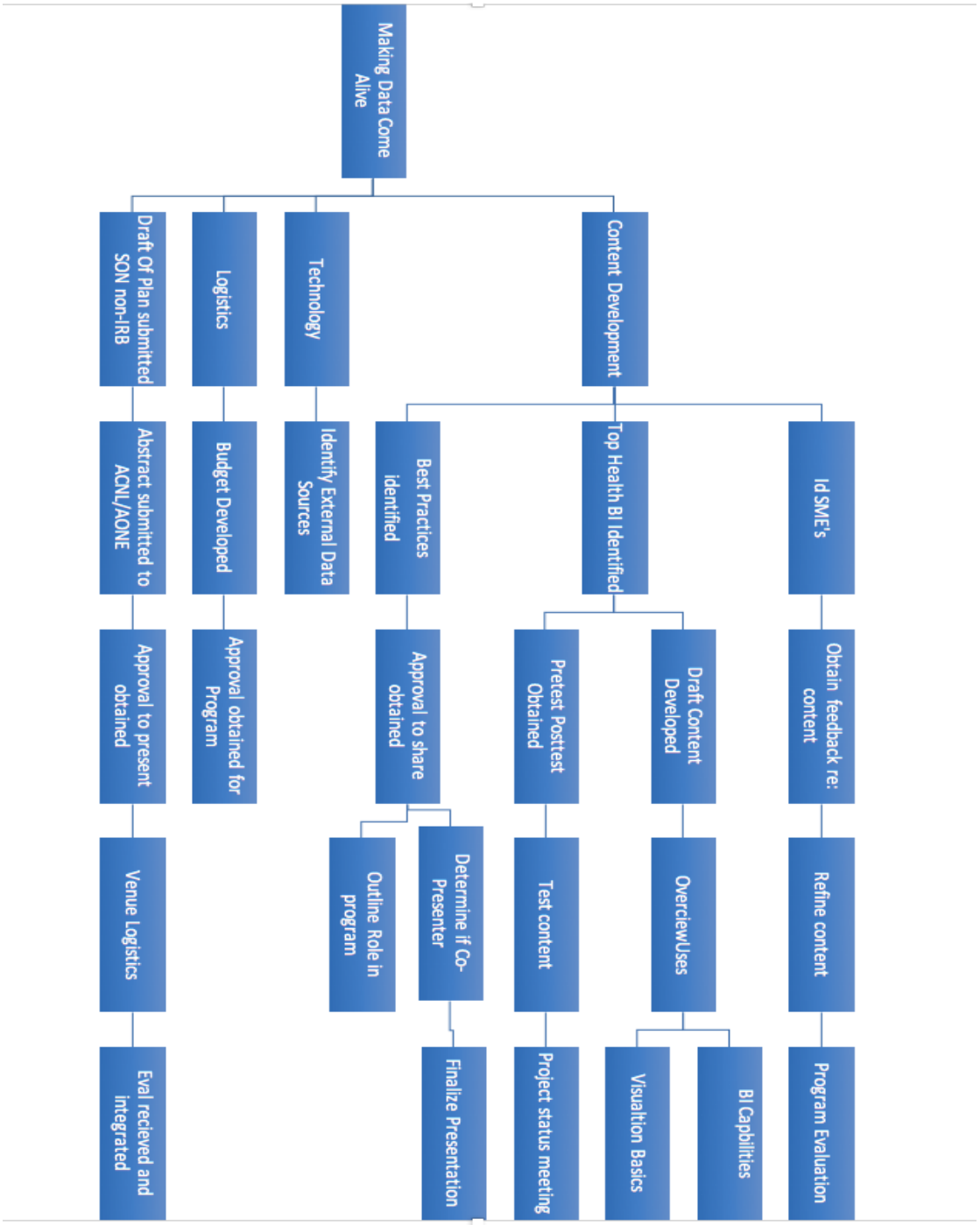
Initial investment = 20 hours average training
Assumptions:

- cost avoidance in time saved employing this new technology
- BI software is currently within the organization
- No additional cost by expanding the number of users of existing BI

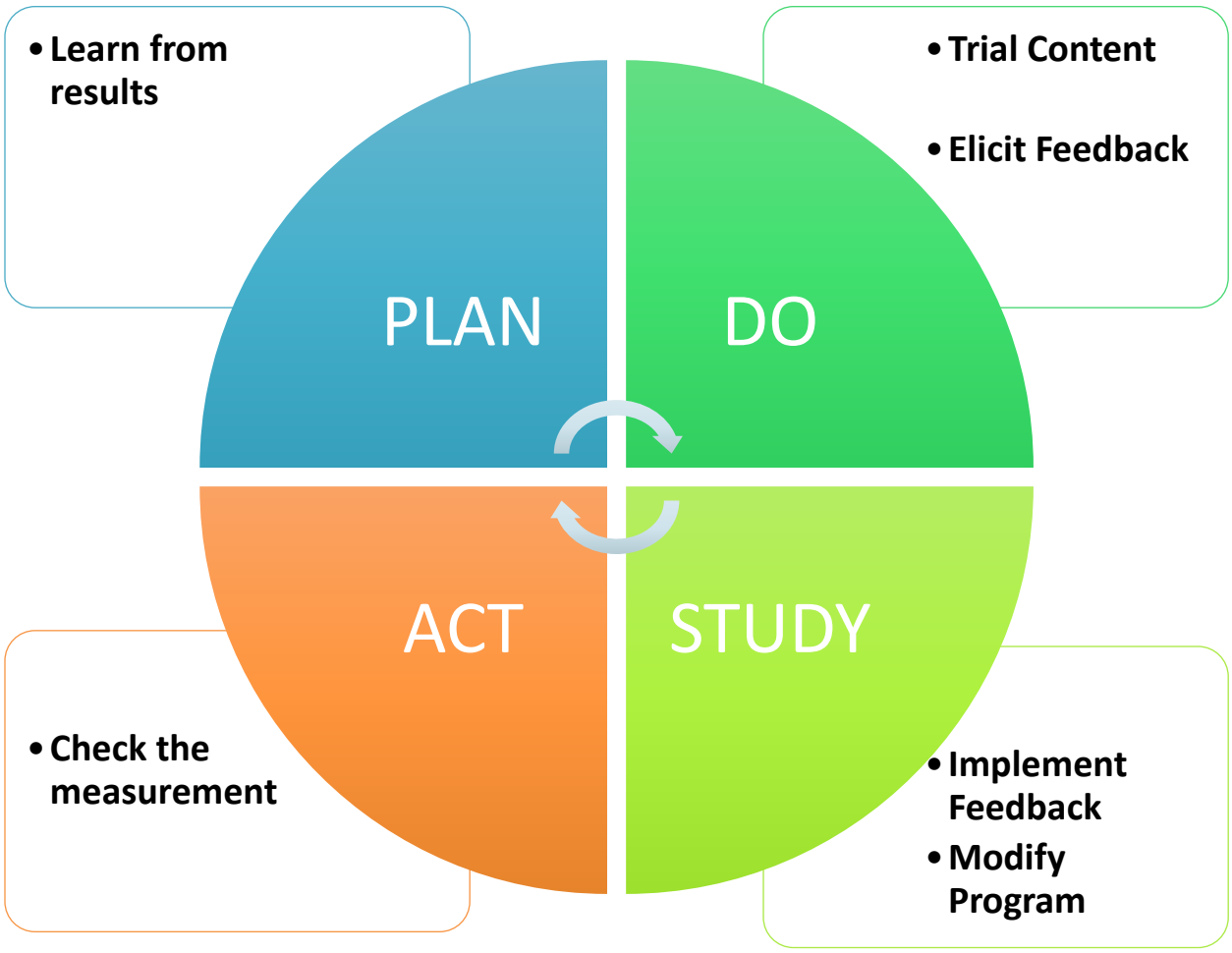
Appendix I: Gantt



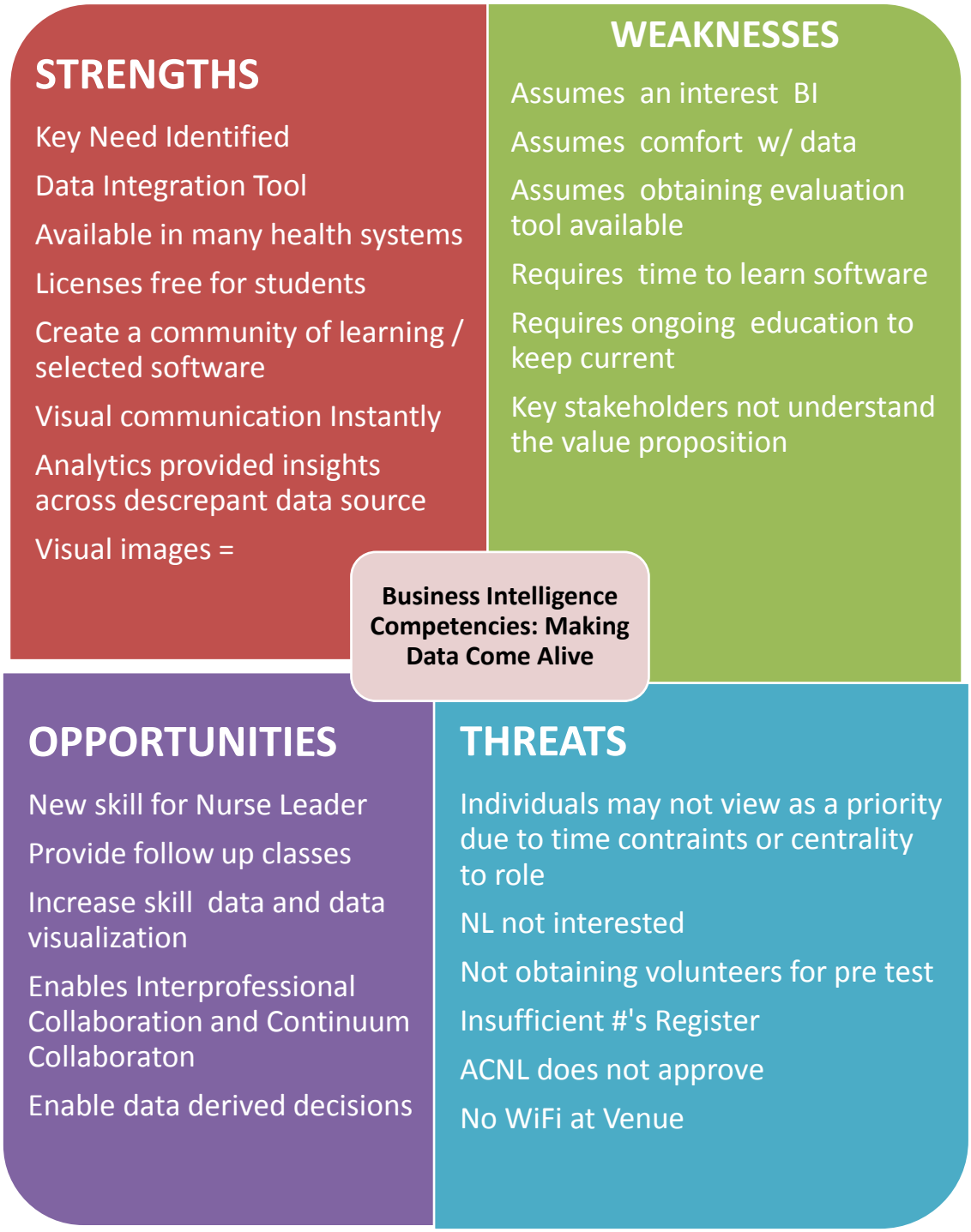
Appendix J: Work Break down Structure



Appendix K: PDSA

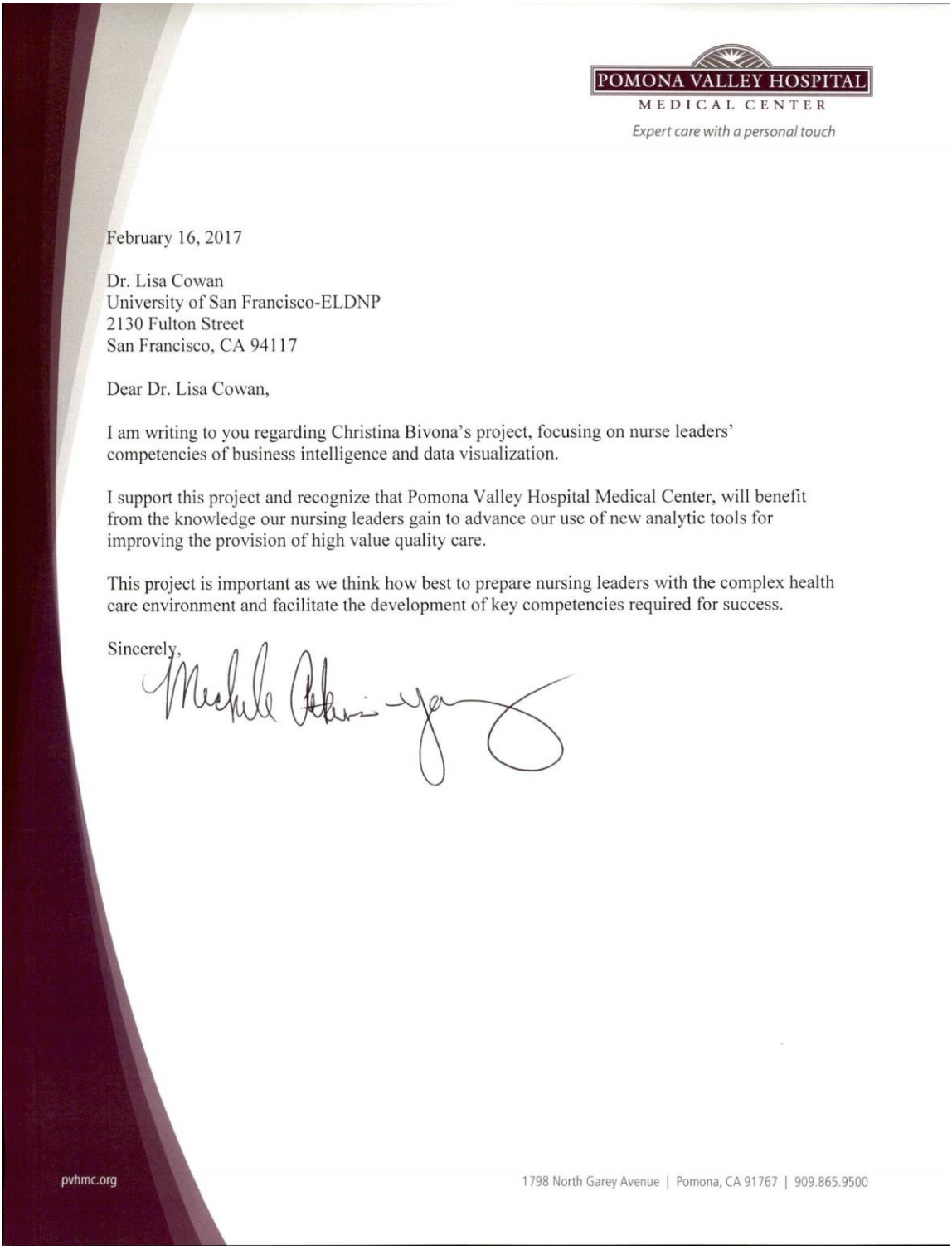


Appendix L. SWOT



Appendix M: Letters of Support

Inland Empire ACNL



POMONA VALLEY HOSPITAL
MEDICAL CENTER
Expert care with a personal touch

February 16, 2017

Dr. Lisa Cowan
University of San Francisco-ELDNP
2130 Fulton Street
San Francisco, CA 94117

Dear Dr. Lisa Cowan,

I am writing to you regarding Christina Bivona's project, focusing on nurse leaders' competencies of business intelligence and data visualization.

I support this project and recognize that Pomona Valley Hospital Medical Center, will benefit from the knowledge our nursing leaders gain to advance our use of new analytic tools for improving the provision of high value quality care.

This project is important as we think how best to prepare nursing leaders with the complex health care environment and facilitate the development of key competencies required for success.

Sincerely,

pvhmc.org

1798 North Garey Avenue | Pomona, CA 91767 | 909.865.9500

Appendix N: Eisenhower Medical Center

EISENHOWER MEDICAL CENTER

June 19, 2017

Dr. Lisa Cowan
University of San Francisco-ELDNP
2130 Fulton Street
San Francisco, CA 94117

Dear Dr. Lisa Cowan,

I am writing to you regarding Christina Bivona's project, focusing on nurse leaders' competencies of business intelligence and data visualization.

I support this project and recognize that Eisenhower Medical Center, will benefit from the knowledge our nursing leaders gain to advance our use of new analytic tools for improving the provision of high value quality care.

This project is important as we think how best to prepare nursing leaders with the complex health care environment and facilitate the development of key competencies required for success.

Sincerely,

Ann Mostofi

Ann Mostofi, MSN, RN, NEA-BC
Vice President Patient Care Services & CNO
Eisenhower Medical Center
39000 Bob Hope Drive
Rancho Mirage, CA 92270

Appendix O: ACNL Leadership Self - Assessment

Nursing Leaders Engagement with Informatics and Data Reporting

Thank you for taking time to answer this brief survey covering the Nursing Leaders use of newer analytical tools (business intelligence and interactive data visualization *). No individual information will be reported, and only summary data collected as an academic project and possible professional publication.

** Business intelligence refers to technology-driven process for analyzing data and presenting actionable information to help users make more informed decisions. BI encompasses a wide variety of tools, applications and methodologies that enable organizations to collect data from internal systems and external sources, prepare it for analysis, develop and run queries against the data, and create reports, dashboards and data visualizations to make the analytical results available to corporate decision makers as well as operational workers. BI programs can also incorporate forms of advanced analytics, such as data mining, predictive analytics, text mining, statistical analysis and big data analytics. There are a variety of different products on the market today, some with a narrow focus others offering a wide range of services. Here a link to the top business intelligence software in 2016 by PC magazine: http://www.pcmag.com/business/directory/business-intelligence*
Gartner magic quadrant of top business intelligence software: https://www.gartner.com/doc/2989518/magic-quadrant-business-intelligence-analytics

I. DEMOGRAPHICS

1. Age
   a. □< 25 □26-40 □41 – 55 □56-70 □71 +

2. Where do you work?
   □Community Based Care Primary Care Clinic, Community/Public Health, Population Health Program, etc.)
   □Acute Care –(For-Profit) □Acute care (Not for Profit) □ Tertiary Teaching Hospital
   □Industry (Vendor, Pharma, etc.) □Consultant
   □Hospital is part of a Healthcare System □ Skilled Nursing/Extended Care □Academia
   □Other

3. What is your current role in Leadership:
   a. □Executive Director □Chief Nursing Officer □Administrative Director □Clinical Director □Manager □Clinical Leader □ Student □ Faculty □ Research □other
4. Education highest level:
   □Bachelors of science (nursing) □Masters of Nursing □ DNP
   □Bachelors (non-science) □Masters non-Nursing □ PhD(nursing)

□Bachelors of science (non-nursing) □ EDD □ PhD(non-nursing)

II. ENGAGEMENT WITH INFORMATICS AND DATA REPORTING

1. Does nursing leadership in your organization provide input regarding decisions on information technology? (purchases, implementation strategies, etc.)
   □Yes □No
2. Do nurse leaders in your organization help determine which Quality Indicators/Key Performance Indicators (KPI's) are selected for your organization wide reports?
   □Yes □No
3. If No, who selects the Quality Indicators/ KPI's for the organization?
   □administration □EHR Vendor □Mandated by payers □other
4. Do you currently receive reports of KPI's in a
   □ visual 'dashboard' □written report □oral report in a meeting □ Oral report individually
   □ spread sheet □ email
5. If visual dashboard, are they developed in a way so the information is readily understandable?
   □Yes □No □sometimes
6. Is the information portrayed in the visualized report actionable?
   (Do you know what the issue is and what to do in response to it?)
   □Yes □No
7. Does your organization have additional data available behind the dashboard (hyperlinks) that is readily available for you to pull up and view the detail data supporting the dashboard?
   □Yes □No
8. Do you have the ability and authority to add other variables to the visual data dashboard to discover new relationships across the various data?
   □Yes □No
9. Within your organization how current is the available data?
   □ Real time □ Past 30days □ Past quarter □ Older
10. Does your organization use analytic tools to predict risk for readmissions?
    □Yes □No
11. Do you use data visualization tools such as data visualization to share information with your team and leadership?
    □Yes □No
12. Do you have a multidisciplinary/ interprofessional team that is invited to provide input for your visualized reports?

□Yes □No

Appendix P: ACNL Survey Results

Tables 1-8

Table 1

Age of Participants

	Frequency	Percent
Under 25	1	1.3
26 to 40	13	16.9
41 to 55	26	33.8
56- 70	36	46.8
70 +	1	1.3
Total	77	100.0

Table 2

Education Level of Participants

	Frequency	Percent
AA	2	2.6
BS Nursing	8	10.3
Masters student	1	1.3
DNP	9	11.5
Masters (non-nursing)	12	15.4
Masters of Nursing	39	50.0
PhD	4	5.1
Missing	3	3.8
Total	78	100.0

Most those who completed surveys (19.5%) were clinical directors of their facilities (Table 3).

Current Role in Leadership

	Frequency	Percent
Senior Leadership (CNO, Executive Director)	16	20%
Administrative Managers	24	31%
Clinical Managers	23	30%
Other	17	22%
Total	77	100.0

Table 3

Current Role in Leadership

	Frequency	Percent
Director Clinical	15	19.5
Manager	14	18.2
Other	12	15.6
Chief Nursing Officer	11	14.3
Director Administrative	10	13.0
Clinical Leader	8	10.4
Executive Director	5	6.5
Faculty, Research	1	1.3
Research	1	1.3
Total	77	100.0

Table 4

Where They Worked

	Frequency	Percent
Academia	3	3.9
Acute (For-profit) Hospital	5	6.5
Acute (not for profit) Hospital	59	76%
Community based care setting	1	1.3
Consultant	5	6.5
Other	3	3.9
Tertiary teaching hospital	1	1.3
Total	77	100.0

Where They Worked

	Frequency	Percent
Academia	3	3.9
Acute (For-profit) Hospital	5	6.5
Acute (not for profit) Hospital	45	58.4
Community based care setting	1	1.3
Consultant	5	6.5
Hospital part of healthcare system (Kaiser, etc.)	14	18.2
Other	3	3.9
Tertiary teaching hospital	1	1.3
Total	77	100.0

Participants were grouped into three nurse leader categories for analyses: Senior Executive (Included Chief Nurse Executive and Executive Directors, *n*=16), Clinical Leaders (Clinical Directors and Clinical Leaders, *n*=23), and Administrative Leaders (Administrative Directors and Manager Directors, *n*=24). Those outside these categories were not included in this analysis (Table 5).

Table 5

*Leadership Role * Input*

		Input			
		No	Yes	Total	Percent
Leadership Role					
	Senior Executive	0	16	16	25%
	Clinical Leader	4	19	23	37%
	Admin Leader	1	23	24	38%
Total		5	58	63	100.0

NLs reported working at a variety of facility types, though the majority worked at acute care not-for-profit hospitals (see Table 6).

Table 6

*Facility Type * Input*

		Input		Total
		No	Yes	
Facility Type				
	Academia	1	2	3
	Acute (For-profit) Hospital	2	3	5
	Acute (not for profit) Hospital	4	46	50
	Community based care setting	0	1	1
	Consultant	1	4	5
	Hospital part of healthcare system (Kaiser, etc.)	1	8	9
	Other	0	3	3

	Tertiary teaching hospital	0	1	1
Total		9	68	77

Sixty-three nurse leaders answered the question of whether they had the ability and authority to add variables to existing data when necessary. Of those, the majority (*n*=38) they did not have such access or authority and worked for not-for-profit hospitals, while 25 reported having some access. Of these, 56% (*n*=14) worked for not-for-profit hospitals (Table 7).

Table 7

*Facility Type * Leadership Role Cross tabulation*

Add Variables			Leadership Role			Total
			Senior Executive	Clinical Leader	Admin Leader	
No	Facility Type	Academia	0	0	2	2
		Acute (For-profit) Hospital	0	1	1	2
		Acute (not for profit) Hospital	6	14	10	30
		Consultant	1	0	1	2
		Hospital part of healthcare system (Kaiser, etc.)	0	0	2	2
	Total		7	15	16	38
Yes	Facility Type	Acute (For-profit) Hospital	1	0	2	3
		Acute (not for profit) Hospital	4	6	4	14
		Community based care setting	0	0	1	1
		Consultant	0	1	0	1

	Hospital part of healthcare system (Kaiser, etc.)	3	0	1	4
	Other	0	1	0	1
	Tertiary teaching hospital	1	0	0	1
Total		9	8	8	25

There were 74 participants who responded to question #8 regarding hyperlinks. Of those, 42 responded yes, while 32 responded no. Yes/No responses were similar in not-for-profit hospitals

Table 8

*Facility Type * Hyperlinks Cross tabulation*

		Hyperlinks		Total
		No	Yes	
Facility Type	Academia	0	3	3
	Acute (For-profit) Hospital	2	3	5
	Acute (not for profit) Hospital	24	25	49
	Community based care setting	0	1	1
	Consultant	2	3	5
	Hospital part of healthcare system (Kaiser, etc.)	2	7	9
	Other	1	2	3
	Tertiary teaching hospital	1	0	1
Total		32	44	76

Appendix Q: Inland Empire Nurse Leader Evaluation

Post Conference Survey: Intelligent Data
ACNL IE March and May 17, 2017

1. Do you use data dashboards KPI to share with staff?
   Yes ☐ NO

2. If NO, how likely are you to begin to use a data dashboard for reports with your staff?

1 ○	2 ○	3 ○	4 ○	5 ○
Not likely				YES, I am going to begin right away.

3. If YES, how likely are you to begin to add in additional variables to further query my data?

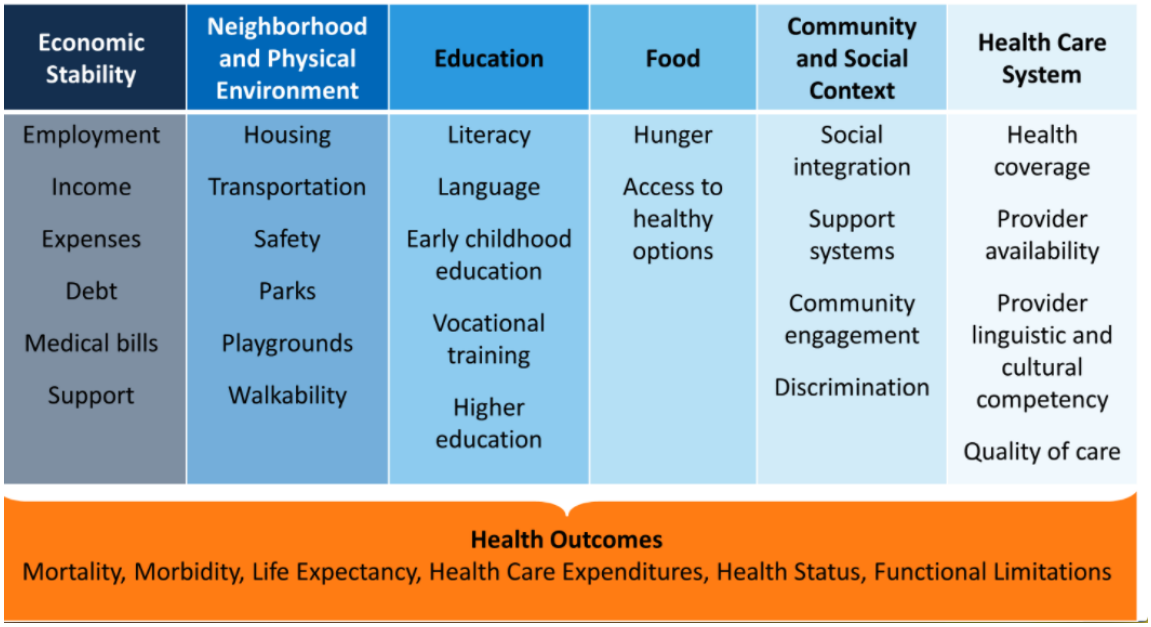
1 ○	2 ○	3 ○	4 ○	5 ○
Not likely				YES, I am going to begin right away.

4. How likely is it to have your own data visualized for reports?

1 ○	2 ○	3 ○	4 ○	5 ○
I do not plan to data visualization for my reports in the future	I plan to by the end of the year	I plan to in the next six months	I plan to in the next quarter	I currently use data visualization for my reports.

○ Not Applicable, I do not have data I report on

Use of Social Determinants of Health (SDOH). Please refer to the chart below for the following questions Kaiser Family Foundation November 2015



5. Does your organization currently incorporate any of the SDOH into your risk screens (i.e. readmission, sepsis, additional screening for lead etc.).

   YES ○ **NO** ○

6. How likely will your organization be to incorporate any of the SDOH into your risk screens in the next 6-12months?

1 ○	2 ○	3 ○	4 ○	5 ○
Not likely	Within the year	Within the next 6mos	Within in the next qtr.	YES, they use them now

7. If your organization incorporates SDOH into your risk screens, which ones do they use? (check all that are used)

○	○	○	○	○
Economic Stability	Neighborhood and Physical	Education	Food	Community and Social

	Environment			Context

8. Would you like to have additional information on Data Analytics/Business Intelligence software currently used today?

○ YES, I would like to hear a presentation on available software	○ YES, but just send me the information	○ NO

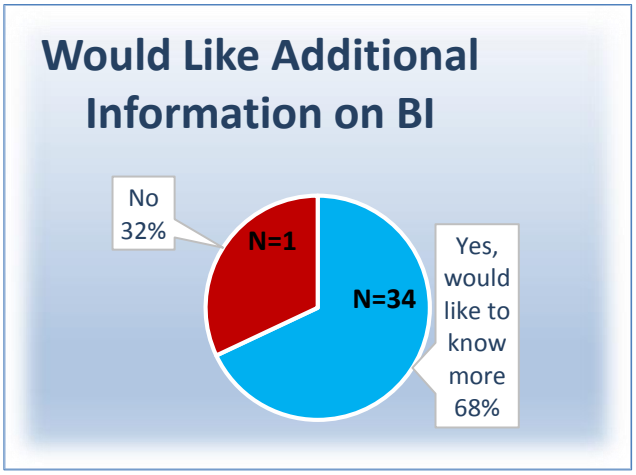
9. Would you like to have additional information on Data Visualization currently used today?

○ YES, I would like to hear a presentation on available software	○ YES, but just send me the information	○ NO

10. This program provided information that I can apply in my current professional role.

YES ○ **NO** ○

Appendix R: Inland Empire ACNL Evaluation



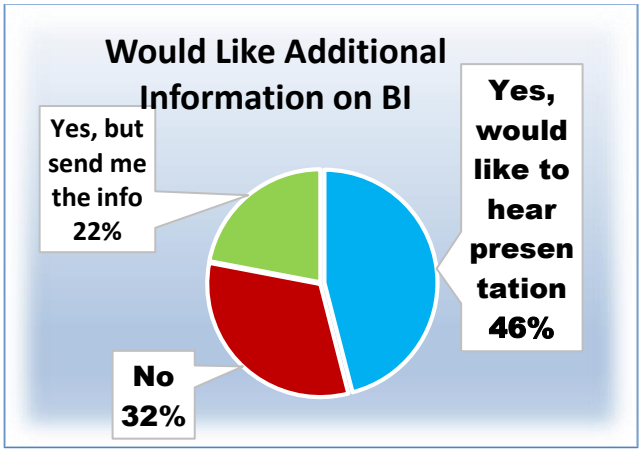


Figure 1 and 2. ACNL IE and EMC Workshops survey responses to question: *Would you like to have additional information on data analytics/business intelligence software currently used and available today?*

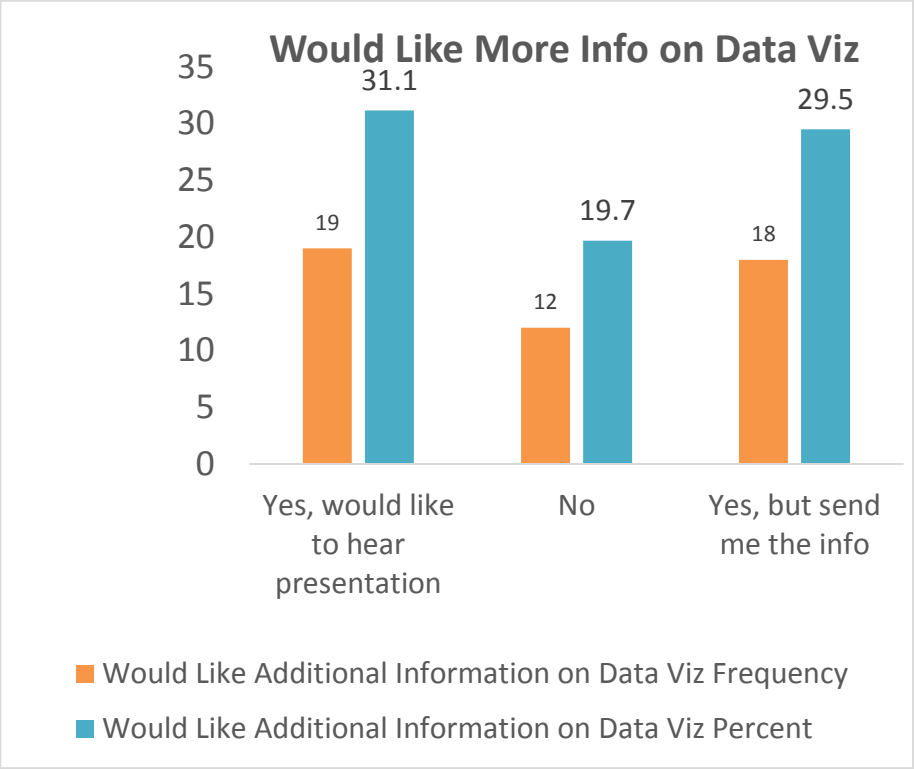


Figure 3. ACNL IE and EMC Workshops survey responses to question:
Would you like additional information on data visualization currently used today?

Appendix S: *Annual Meeting Abstracts*

ACNL Annual Meeting Abstract

Podium Presentation Brief Description:

Understand how newer analytics tools can empower nurse leader's decision making. An overview of business intelligence/data visualization applications used healthcare today will be presented. Attendees will develop an understanding of how data available data from disparate sources, both internal and external to the organization, can be analyzed and synthesized using BI and IDV to make timely informed decisions to improve care outcomes. The options available today are vast leading BI tools will be compared with best practices presented.

Presentation Abstract (limit 500 words).

Healthcare's environment is rapidly changing necessitating the nurse leader stay informed of advances impacting clinical practice and operational areas: technology, evidence-based practice, compliance, and operations. The Futures Task Force Final Report to the American Association of Colleges of Nursing (AACN) Board of Directors in July 2015 and the 2014 Horizon Report, anticipate to fully participate in the digital revolution, nursing leaders in clinical, administrative, and academic roles need to have a working knowledge of informatics to support health information technology (HIT), nursing informatics (NI), and (BI). Likewise, leaders in academia need to adopt and integrate HIT and BI into curriculum to ensure future healthcare leaders are adequately prepared (AACN, 2015; Keerfoot, 2015; Remus, 2012; Skiba, 2014). Currently the education of many nurse leaders did not prepare them with the necessary competencies to manage the volume of data they receive on-going, nor do they have expertise in business intelligence (BI)tools and IDV.

AONE 2017 Annual Meeting Abstract

Today nursing leaders are besieged by an ever-greater reams of information flooding in from everywhere, smart phone, computer, paper reports, and publications. The challenge is to wade through the information to discern what is timely, pertinent and actionable and keep informed of key advances in clinical and operational areas. Given these conditions what are the best strategies to disseminate critical information for recipients' to immediately determine what is crucial; then intelligently respond.
By developing a greater understanding of business intelligence(BI) and its applications in healthcare, nurse leaders acquire wisdom needed to make informed decisions.

Thought leaders in nursing (Simpson, Kerfoot,) acknowledge the nurse leaders need to add BI and informatics competencies. The Futures Task Force Final Report to the AACN Board of Directors in July 2015 and the 2014 Horizon Report, anticipate nursing and other healthcare professions acquiring competencies of in data analytics, change management, and leadership.

The brains ability to process information has an upper limit, it behooves leaders to understand and adopt best practices of data representation so readers can readily comprehend its meaning and relevance quickly without confusion. Data visualization capitalizes on the human brain ability to instantaneously interpret visual cues and alert if a danger is present. Brains are wired to perceive meaningful patterns, data relationships, and structures represented. By providing visual representation of the data assimilated from disparate sources, visual reports enable prompt identification of issues, trends or outliers. These reports enable data sharing, collecting insights regarding the data; collaboratively determine if additional analysis may be needed, and if a response is needed, determine the best course of action. BI users report making better decisions or are more confident in the decisions they make when data are provided to them visually and are easy to interpret and understand.
Determine how best to disseminate critical information in a manner for users to determine what is crucial; then determine various courses of action and then intelligently respond.

Determine how to extract available data from data warehouse and combine it with other available data sets (i.e. community health indicators, census, etc.) to
Develop an understanding of specific patient population group identified patient from a population health perspective,
Ascertain the impact of social determinants of health on the identified problem to determine the most effective interventions

Business intelligence (BI) systems traditionally have resided in finance. Key indicators are captured in the BI systems assimilated preparing performance reports of key performance indicator (KPIs') displayed as dashboards. BI can go beyond static dashboards to enable interactive data visualization (IDV) by allowing users to navigate, select, and display data visually via easy to use interface.
There are three levels of data analytics all of which are important for the CNE:

- Descriptive analytics describes what the events are and how many occur? How often do they occur? And when are actions needed (e.g. falls in a hospital, occur every 4.5 hours, and fall precautions implemented for at-risk patients)?
- Predictive analytics describes what could happen? What if the trends continue? And what happens next? (e.g. Heat warnings announced if they continue to anticipate more elderly and patients with respiratory problems coming to the ED).
- Prescriptive analytics seeks to ask how do we best achieve the best outcomes? (e.g. asthma patient's intervention with self-management tools and iPhone app.)

A workshop will expose attendees to various business intelligence systems in the health marketplace today. Discuss their uses and challenges, comparing and contrasting systems features. Examples of best practices in healthcare settings will be shared and discussed.
As healthcare moves from a volume based to a value based plan reimbursement, it requires nurse leaders to understand how best to provide high-value patient care. Drivers of high value patient care need to be Identified and understood within each service line, community and region to enable care interventions are integrated into coherent systems of care to effect high quality outcomes.

The opportunity exists to leverage business intelligence (BI) to provide needed wisdom to make informed leadership decisions across the enterprise.

Appendix T: Outcomes Matrix

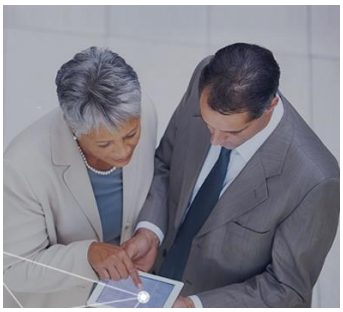
Outcomes Hierarchy	MEASURES Evaluation Questions	Indicators Information Sources	Sources	Standard/ Judgement method	Evaluation of Output Use
Ultimate Outcomes	How has the patient high SDH risk Score been integrated into your workflow?	Use of High SDH Risk Score to trigger Enriched Case Management	EHR, &CVS reports	SDH Risk accurately rated patient for High SDH Risk for Re-admission in 30 days, risk for longer LOS, &adverse outcome.	30-day readmission rate to BCH or other hospital CVS LOS decreased Adverse event rate decreased
Intermediate Outcomes	SDH high risk score visualized on patients EHR. CVS service reports volume of High risk patients at BCH &ED	# of patient charts with SDH scores into BI/IDV format	Case Mgt., CQI &Manager reports	Evaluation of reports by project team for accuracy of scores monthly, quarterly /annual.	Data from clinical staff on SDH risk scoring alert. Likert scale to evaluate pre & post: 1. Ease of use? 2. Ability to take?
Activities	What are the potential criteria for risk 30-day readmission, increase LOS &Adverse event? How valid were these criteria to be responsive to patient clinical changes? *How accurate are SDH scores to identify patients at risk? * How could you use IDV communicate key reports?	*Identify current indicators. *Evaluate their focus (current or past state). *Identify opportunities to use BI/IDV	Reports, blogs & present-ations. *Present-ations by SME's at leadership forums *key early adopters identified to present at hospital &regional meetings	*Focus group feedback. *Survey *Meeting attendance	Reports compared application of SDH utilizing current then predictive analytics w/ same indicators demonstrate use of 'leading' indicators. Reports modeled with data visualization with options to interact with different data sources incorporated.
Needs	*What do our current indicators monitor &is it effective to improve quality outcomes for Key CMS indicators?	Focus group of key stakeholders	Focus Group Feedback. Organizational Sponsor	Current licenses for BI/IDV.	As above with evaluation of opportunities to act on high risk scores for

	*Do we know the potential uses for incorporating predictive indicators for high risk patients provided by BI/IDV? *How well comprehended are your current reports to your reports/leadership? *What staff have knowledge/exposure to BI/IDV? needs do you need to quickly communicate for your team to act on?	Collection of regular reports from Pilot Department. Key information reported out that is critical, time sensitive &needing input across departments &disciplines.	feedback on their vision for project needs, uses, potential constraints &resources Subject matter expert input for best practices available in the industry &academia for predictors of high risk patients.	Number of downloads of best practices. Input from survey of staff.	patients residing in low resource areas identified by block group. Service evaluate historic data for high risk score mapped to block group visualized versus in report form compared.

Appendix U: Lewins Theory of Forces Impacting Adoption of Innovation

Analysis of Forces Impacting Adoption of New Program	
Potential risks	**Rebuttal to Risks Raised**
Increased stress having to deal with more change	'Early Adopters' program to mentor others to use of SDH risk score use, and mapping to block group showcase how their enhanced skill set provides critical edge over peers without. Demonstrate ease of use after initial training.
Greater expectations, already overwhelmed with current volume of projects	Enables opportunities to be creative in the workplace and expand opportunities for professional growth.
Fear of exposure of poor data =/or poor outcomes	Opportunity is in exposing the poor quality of data to align others to help remedy it.
Concern of added expense of labor and capital expense w/o ROI	Other use cases demonstrate positive ROI. Incorporate social determinants of health data to identify high risk for longer LOS, readmission, and complications.
Time constraints	Initial investment yields significant returns later with use of predictive analytics
Clinically focused not technology savvy	Tools are intuitive, education is self-paced
Competing project(s)	Leadership sponsorship is critical to ensure ongoing support
Threats to established power structure	Help to clarify underlying concerns and identify ways to support their success via this project.

Appendix V: Evaluation Plan for Proof of Concept

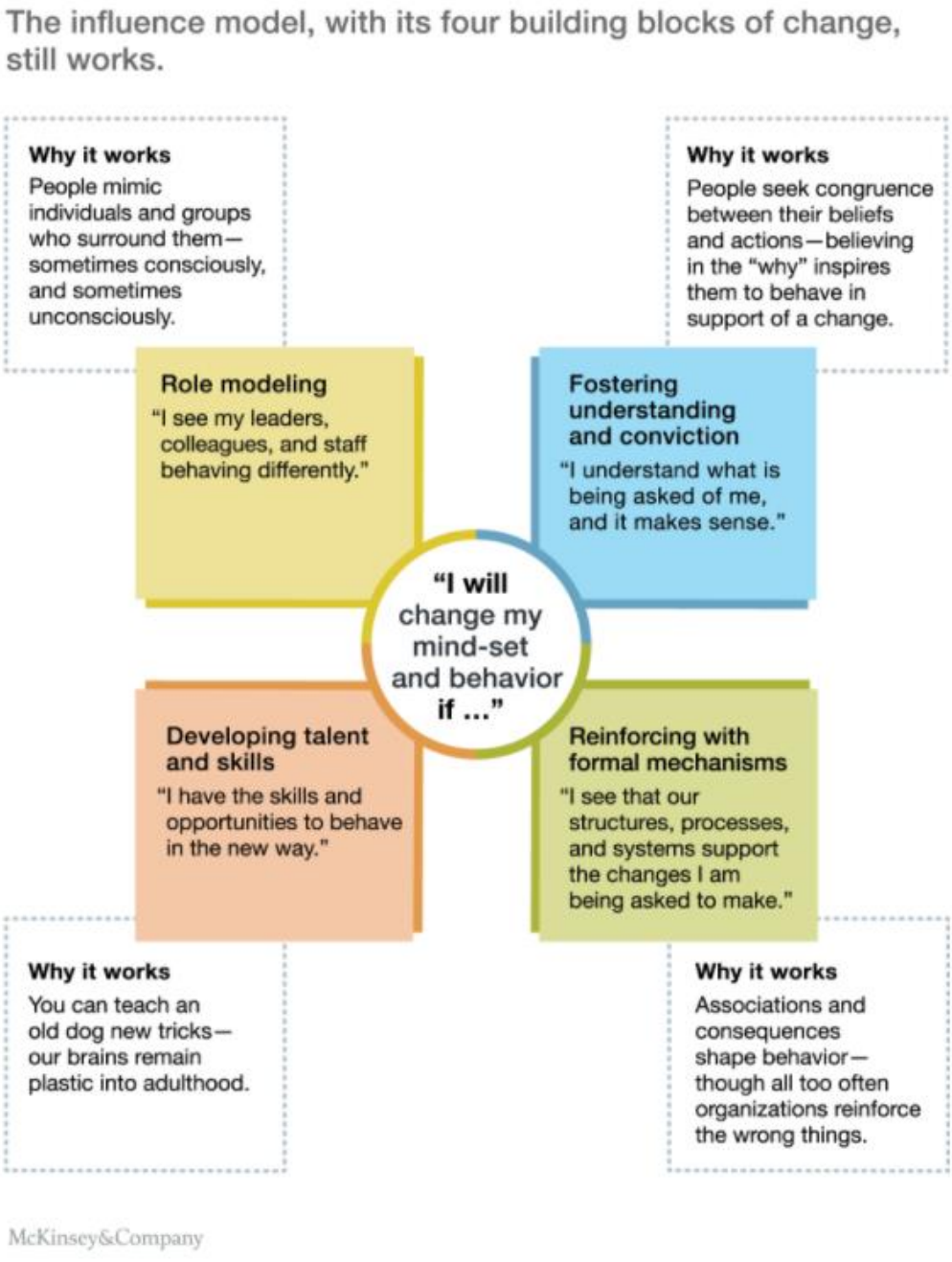
BACKGROUND	**STAKE HOLDER GROUPS**		
Goal: The board of Trustees directors prompted leadership's deeper adoption of Business Intelligence(BI) & Interactive Data Visualization (IDV) to enhance responsiveness to current and potential changes. Several board members from large retail business urged, the adoption of analytics citing examples from their own industry and other larger healthcare systems. The CVS SDH Project was adopted as a pilot for a one year trial. **Evaluate:** Within One Year to discern widespread adoption or not.	**CNO & CIO**  Leadership sponsors obtained board support and funding for a one year pilot with option to extend three years. Both CNO and CIO have co-chaired the RFP for BI vendors. **Need:** **I**mproving the 30-day readmission rate, decrease rate of adverse events and increase HCAPHS scores. A ROI exists especially for cardiovascular services (CVS) program patients at risk for complications, increase LOS and/or readmission employing predictive tools and Visualization as key Communication Tool.	**Quality Improvement & Nurse Informatics Team (QINI)** Key influencers identified to promote and impact project are technology extreme users, innovators or early adopters. Most of their day to day roles involve use of data analytics and BI tools (dashboards). The QI team understands the need for decisions to be data driven. Eager for clinical and administrative teams to understand the need for greater adoption across the organization to utilize these tools to catalyze needed changes employing 'leading' indicators (predictive analytics) for planning. **Need:** Resource time for project team work, access to best practices subject matter experts, IT, and evaluation consultant.	**Clinical Leaders Nursing and others** Common challenges and concerns unit the clinical leaders across programs and disciplines. The rapidity of changes across the organization and professionally are concerning them. Adoption of a new process is met with diverse reactions. **(see Appendix A)** **Need:** Ease of use of tool and minimal time commitment to serve on evaluation team.

Forces Impacting Program Success	Concern of added expense of labor and capital expense w/o ROI Threats to established power structure	Fear of exposure of poor data =/or poor outcomes Time constraints Competing project(s)	Greater expectations, already overwhelmed with current volume of projects Clinically focused not technology savvy Increased stress having to deal with more change
Evaluation Questions **Clinical indicators collected by QI program.** **Administrative data collected by business & finance.**	1. Collect the current clinical indicators monitored for the CVS program by the QI, case management, clinical, and services? a. Evaluate clinical indicators: Did they identify negative trends? Positive trends? Future clinical needs? b. Evaluate administrative indicators: Did they identify negative trends? Positive trends? Future clinical needs? c. What does that literature indicate as potential predictive criteria for 30-day re-admissions? d. Adverse events? e. Increase LOS? 2. Evaluate current reports to determine if results reported were actionable? 3. **HOW?** Retrospective review to identify if negative trends reported any action was implemented to address it? And new evaluation tool adopted to report its impact. 4. Evaluate existing knowledge and/or experience using BI/IDV across the organization? Within CVS? 5. Determine the percentage currently using (or in the past use)? Of BI/IDV in the organization?		
Evaluation Procedures	1.Conduct focus groups of key stakeholders from clinical and administrative positions in the CVS program and leadership teams across the organization. 2.Collect and evaluate of regular reports across organization (QI, Leadership Quarterly Outcomes, Clinical Outcomes by Program/ Department ***HOW?*** *Retrospective record review of past 24 months* 3. Identify opportunities for improvement within and across departments to improve outcomes and meet targeted goals (identify patients at risk for 30-day readmissions, adverse events, and increased LOS)		
Project Evaluator	1. Qualitative analysis to be applied for Focus Group Feedback utilizing. a. coding of key terms and themes used to identify key subjects b. traditional categorization and coding techniques, looking for patterns and themes both within and across the program sites. (WWKellogg handbook)		

Data Analysis **Data storage & security:** **CVS SDH Data Management Plan** ********** *If project is adopted enterprise wide:*	2. In-depth interviews and participant observation regarding the vision for project needs, uses, potential constraints and resources. 3. Subject matter expert input for best practices available in the industry and academia of key predictors for 'at-risk' patients. 4. How effective were 'at-risk' predictive scores to identify actual 'at-risk' patients: **<u>At MY HOSPITAL</u>** a. Upon admission to MY HOSPITAL inpatient? b. MY HOSPITAL Emergency department visit? c. Adverse event while an inpatient at My Hospital? d. Increased LOS while inpatient at My Hospital? **<u>Non-MY HOSPITAL</u>** e. Upon admission to other hospital inpatient unit? f. Emergency department visit at other hospital? g. Adverse event while an inpatient at other hospital inpatient unit? ********** *5. # of reports now consumed and distributed using BI/IDV* *6. Regular communiques utilize IDV and BI What type of communiques- is a personal email sufficient to qualify?* *7. Quality of reports unbiased and without distortion how do you identify these*
Findings	1. To determine effectiveness of the project and adoption across the enterprise. 2. Evidence that BI/IDV tools were used in strategic planning utilizing predictive analytics? 3. ROI after end of year one
Conclusions/ Recommendations	Project updates provided monthly to will continue with minor modifications made to report modeler. Train the trainer workshops will continue along with weekly best practices highlights. Web site with blogs promoting stories of users' best practices and lesson learned. Conference presentations are being solicited for national programs across key leadership and clinical organizations.

Appendix W: Influence Model of Change

Basford & Schaninger (2016)



Appendix X: Strategic Messaging Plan

Appendix X: Proof of Concept
Reflecting Data Derived Insights

Core Message:

Data is the new currency, successfully harnessed, transformed and visualized; it instantly reveals patterns, enables new insights and concisely communicates key messages BI & IDV.

Current Symptom:

Information overload, drowning in a deluge of data. Nurse leaders are challenged to discern 'what is the real problem?' How to efficiently 'try on' future scenario without incurring the cost of implementing an intervention. With so much information flooding in how we concisely convey key messages? Leaders are challenged of knowing where to invest resources to improve clinical outcomes for population health? If I start up a new service line what is the implication on other existing segments? Do I manage or leverage these outliers?

Proposed Solution:

BI & IDV: Reflecting Data Derived Insights. It enables integration of discrepant data sources to enable the discovery of relationships. Visual display of data enables rapid decision making and prediction of future states. Bias is minimized with visual versus text to explain a scenario. can navigate, select, and display data via an easy to use interface to make sense of complex data and collaborate across areas and disciplines, and enable timely informed decisions (Kerfoot, 2014)

MISSION	***VISION***	***VALUES:***
Educate healthcare leaders of tomorrow with cutting edge competencies and character.	Spark the 'Spirit of Inquiry' for thoughtful solutions in nurse leaders equipped with analytical competencies for health creation in our communities	• Integrity • Creativity • Innovation • Trust • Respect

The three key stakeholder groups are:

Group 1: Quality Improvement, Nurse Informatics (QINI)

Group 2: Sponsoring CNO & CIO's & Professional Organizations in Health Systems

Group 3: New and seasoned nurses in management and executive positions.

The current organizational culture regarding informatics and other newer technologies is reflected in these comments below:

- ⇒ Nurse administrators have some awareness of informatics do not regularly delved into KPI Dashboards to understand the 'WHY' of their indicators.
- ⇒ Nurses coming into leadership with primarily a clinical background just becoming facile with finance but challenged with being overwhelmed with any data discussions.
- ⇒ There is clear agreement that key information needs to get promptly and accurately communicated ideally in a concise, clear information that is readily comprehensible.
- ⇒ These issues are consistent with other clinical leaders in healthcare who confront these same dilemmas.

MESSAGE MAP: SEGMENTATION OF AUDIENCE			
	QI & NI	**CNO & CIO Sponsors**	**Curious Others & Clinical Leaders**
Primary Message	Enhanced outcomes derived from data driven decisions with repeatable reliable data	Sparks the spirit of inquiry with visual display of the data	Sparks the spirit of inquiry with visual display of the data
Secondary Message	Integrates and analyzes disparate sources of data	Concisely conveys messages visually with decreased risk of bias	Encourages boundary spanning across disciplines, departments, settings, etc.
Third Wave Message	Discover previously hidden relationships and patterns	Visual display of the data enables rapid decision making	Discover previously hidden relationships
Additional Message	Evaluate outliers to determine to manage or leverage them	Invites inquiry as a natural presentation of information	Predict future states and derive wider inferences

Below are key messages for new nurse leaders:

1. What do you want them to know?
   "BI is easily accessible & efficient tool to use."
2. What do you want them to think?
   "I can do this. I have time for this. This will save me time in the long run. New insights gained will provided key insights needed to improve clinical outcomes and realize better efficiencies. "

3. What do you want them to do?
   "Dive into their data and discover new relationships and patterns to open new insights for meeting their current challenges. "

4. Why should I care? How does it affect me? What's in it for me? (WIIFM)
   BI can more efficiently handle large data sets, enables understanding Social Determinants of health impacts on the population served.

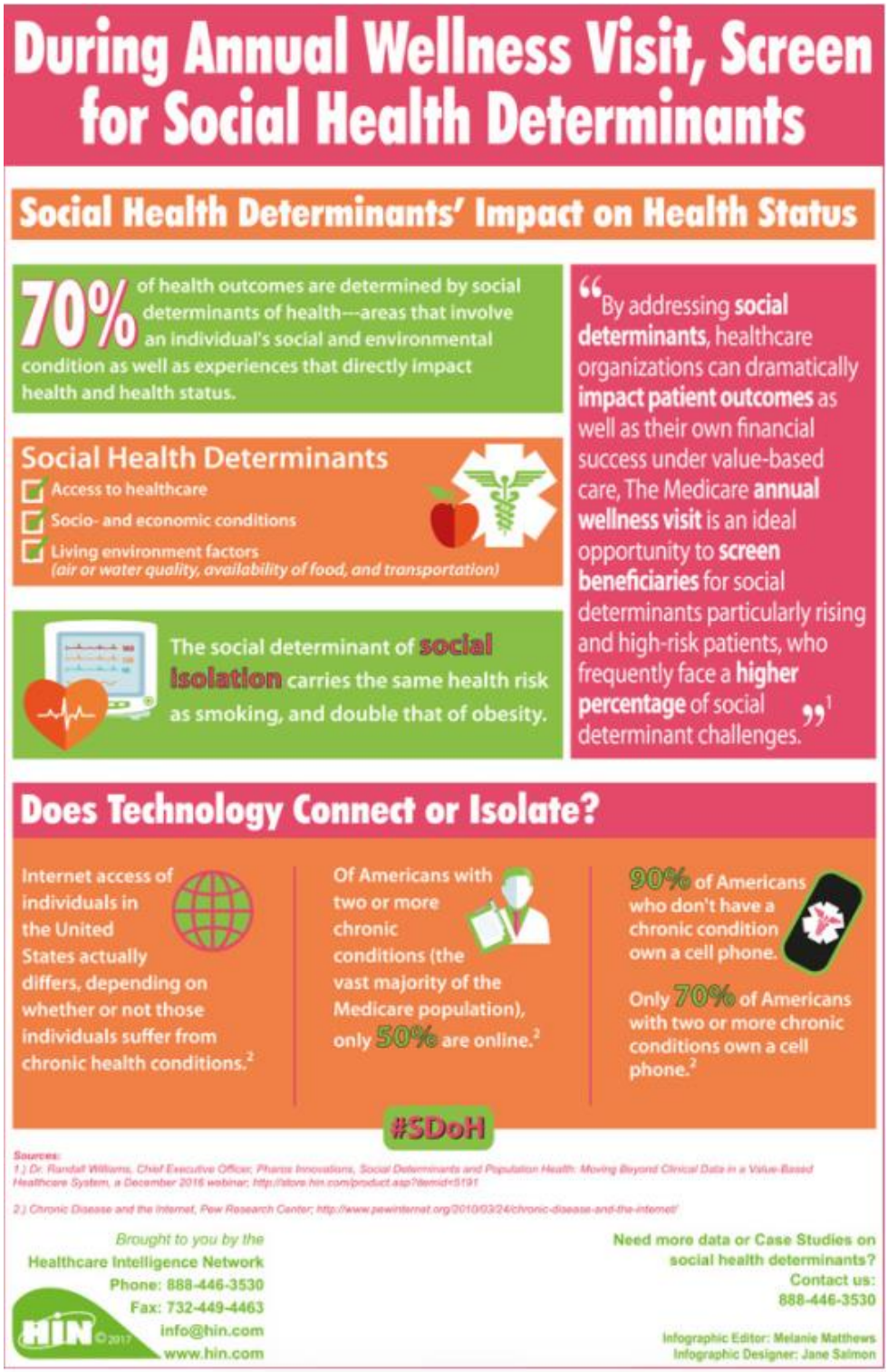
5. Statistics and case studies, best practices obtained from other nurses in leadership positions for use in blogs and other marketing materials.

Communication Plan Timeline			
	Month 1	Month 3	Month 8
Lobbying Personal Contacts	Ask leadership for support for pilot to try out messaging and program. Secure sponsors from ACNL, Local ACNL Chapter, CANP, ANA-C	Attend key local, regional, state and national professional association meetings	Engage with leadership to hear direct response to project report hear concerns of encouragement
Media	Identify key messages & test effectiveness. Identify spokespeople in Quality, Nursing Informatics, and Health Administration	Propose an interview with marketing to prepare release	Post blogs regarding the project initial wins
Publications	Design invitation and display boards	Print the materials	Distribute the materials at the event
Marketing: Web Site	Obtain domain name Link other social media sites Identify 'Boundary Spanners' and Thought Leaders for interviews for Blogs	Post monthly blogs on best practices to host on site	Track traffic to site

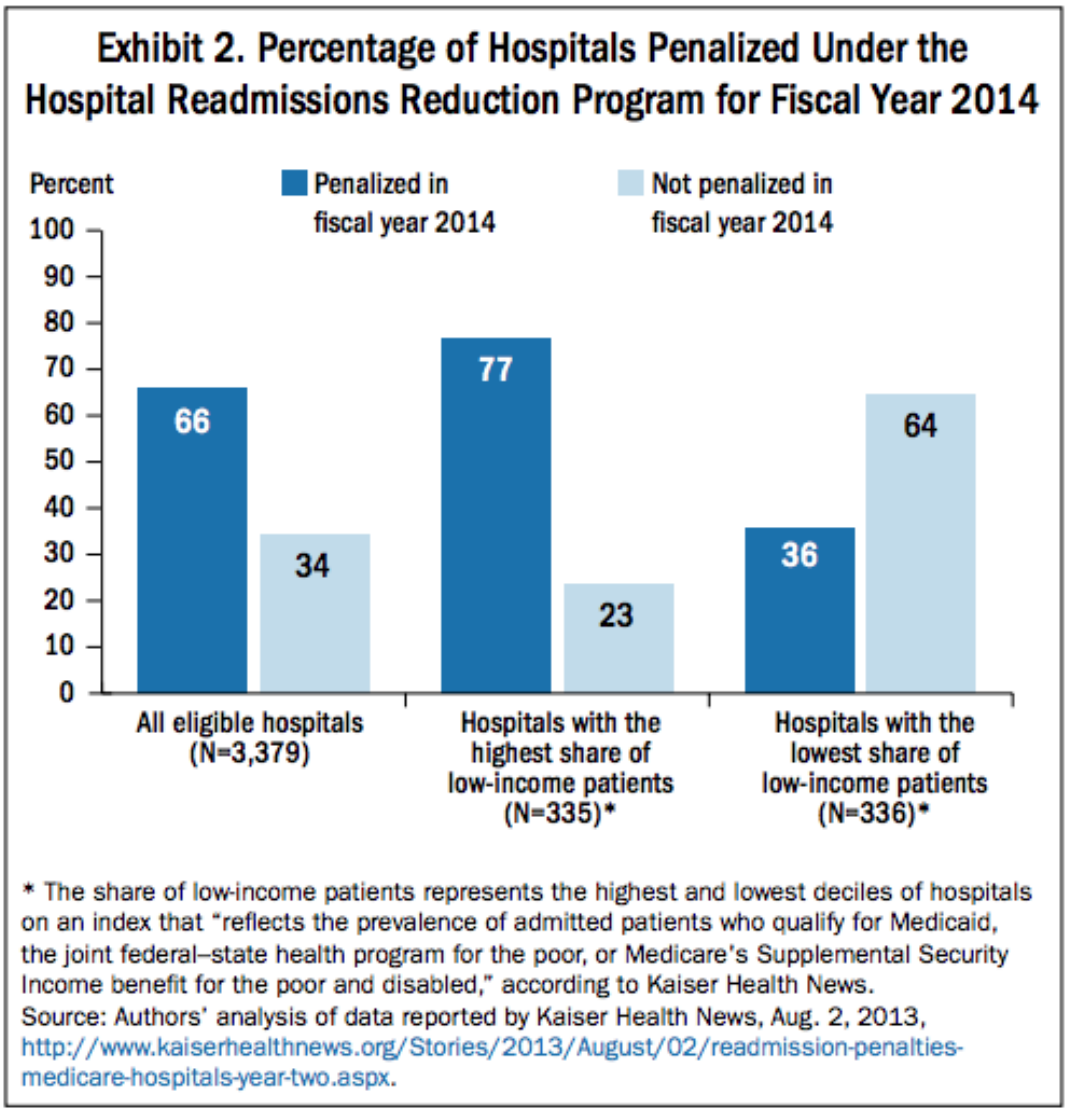
Potential risks	Rebuttal to Risks Raised

Increased stress having to deal with more change	Voluntary program only for those who are interested and excited about developing enhanced skill set
Greater expectations	Enables opportunities to be creative in the workplace and expand opportunities for professional growth.
Fear of exposure of poor data	Opportunity is in exposing the poor quality of data to align others to help remedy it.
Concern of added expense w/o ROI	Other use cases demonstrate positive ROI
Time constraints	Initial investment yields significant returns later
Competing project(s)	Leadership sponsorship is critical to ensure ongoing support
Threats to established power structure	Help to clarify underlying concerns and identify ways to support their success via this project.

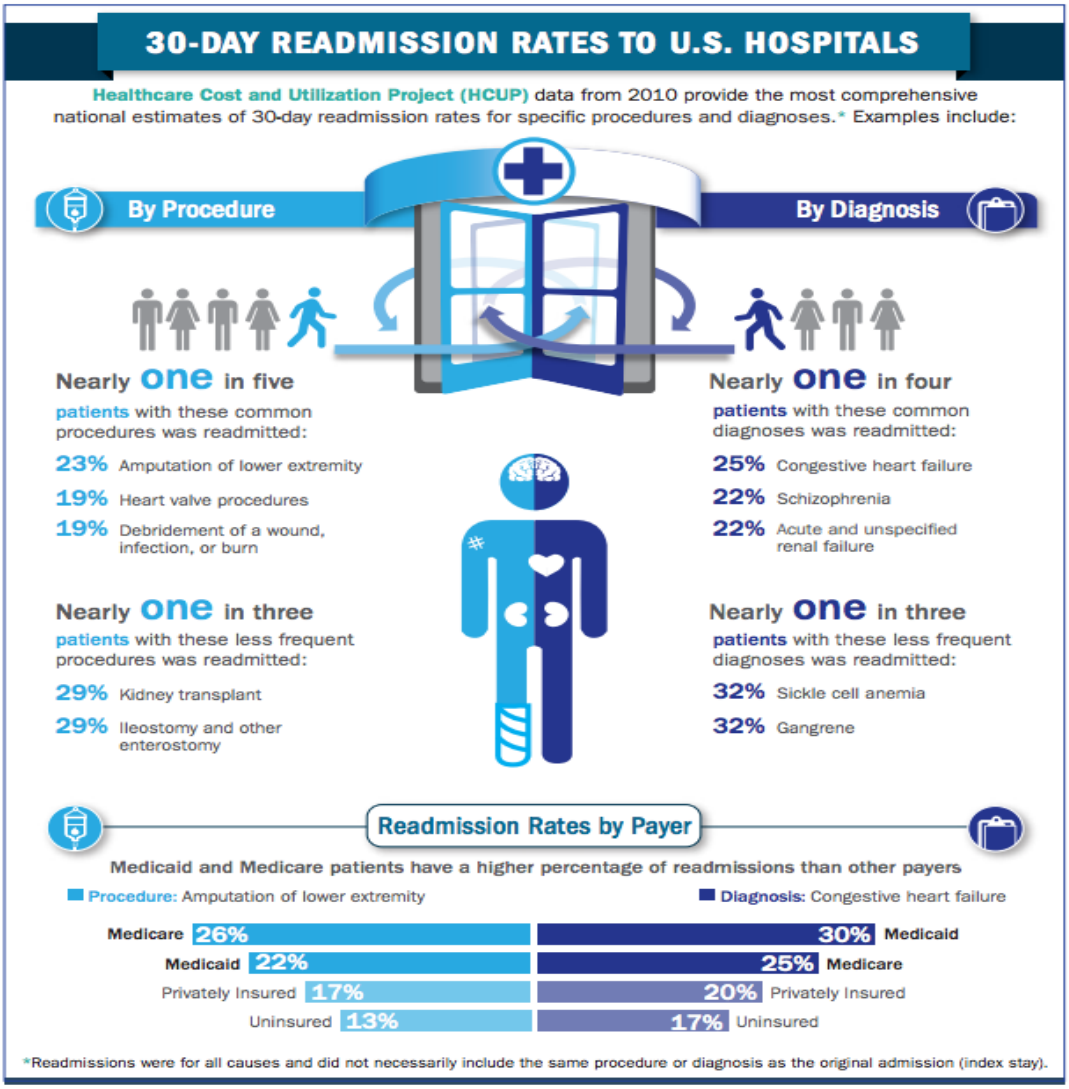
Infographic A: Social Determinant of Health Infographic



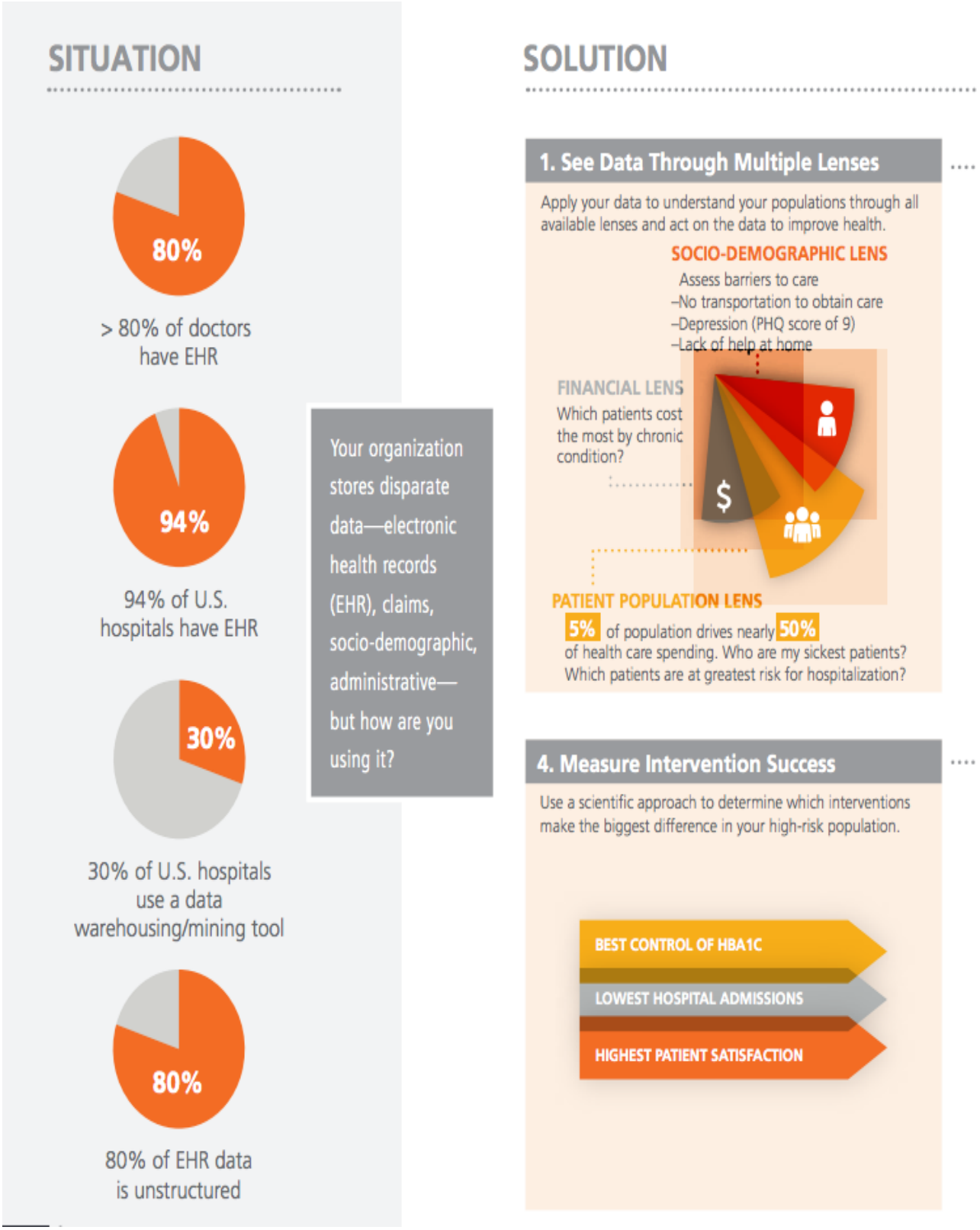
Infographic B: Hospital Readmission Penalties



Infographic C: Readmission Rates



Infographic D: SDH Optum Health High Risk Patient Screening Pilot Part 1
Identifying High Risk Patients: Socio-Demographic Multiple Lens

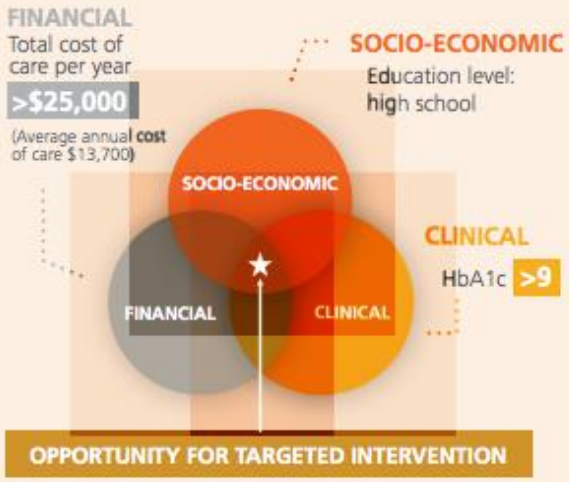


Infographic D: SDH Optum Health High Risk Patient Screening Pilot Part 2

Identifying High Risk Patients: Socio-Demographic Multiple Lens

2. Find Opportunities for Intervention

Utilizing advanced analytics, find the populations that are not only the highest-risk but also the most likely to be helped through clinical intervention. For example, take a look at your patients with diabetes.



3. Plan Your Interventions

Create a plan for targeted outreach and care coordination for high-risk patients with the highest likelihood for improving.

5. Data Rich, Insight Rich

Now that you have gained insights from your data, use those insights to continuously improve.

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