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Caution: Line-of-Sight in ICU Designs

Diane C. Bartos
University of San Francisco, dianebartos@gmail.com

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Diane Comeau Bartos

University of San Francisco

Committee Members:

Marjorie Barter, EdD, RN, CNL, CENP

Juli Maxworthy, DNP, MSN, MBA, RN, CNL, CPHQ, CPPS, CHSE

Leanne Hunstock, DNP

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Abstract

It has been estimated that by the end of 2015, the U.S. will spend approximately $200 billion in new healthcare facilities construction. Infection prevention, patient and family satisfaction, and technologies influence contemporary designs of critical care units. All of these impacts have created larger patient care units, with a majority of single patient rooms. These larger spaces have created challenges for the clinicians to maintain the line-of-sight. The line-of-sight is one tool clinicians often use to maintain patient safety.

Since the seminal publication by the Institute of Medicine in 1999, patient safety concerns have escalated after revealing numerous deaths in U.S. hospitals occur due to error. Nurses are in the forefront for patient safety, especially in the hospital setting, and are responsible for 24/7 assessments, monitoring, surveillance, and care. The one safety tool, the line-of-sight, if obstructed could have an impact on patient safety, and often, it is the environment that creates the obstructions.

In the design phase, before construction begins in any new critical care unit, the line-of-sight should be considered for optimal surveillance and safety. Coupling the line-of-sight with the field of human factors engineering may be the next major influence to subsequent generations of healthcare construction.

Keywords: line-of-sight, patient safety, critical care designs, human factors

Section II. Introduction

Background Knowledge

For more than a century, Saratoga Hospital has exemplified what is possible when an organization and the region it serves share a profound commitment to quality healthcare. This challenge for the community, city officials, and hospital leadership has long-term effects for the healthcare provided in the county. Currently, and counterintuitive to national trends with healthcare systems decreasing or shrinking hospital based services, Saratoga Hospital continues to grow.

The Saratoga region has had significance in the United States. Saratoga, originally occupied by the Mohican Indians, is the location of the Battle of Saratoga and is often cited as the turning point in the American Revolutionary War (Strange, 2015). Saratoga is also home to the oldest thoroughbred racetrack in the U.S. For six weeks during the summer, the population of Saratoga County explodes with visitors from all over the world. Throughout history, Saratoga has hosted many well-known families, such as the Mellons, Vanderbilts, and Whitneys. Many of these families have been benefactors of the hospital.

During the 1970's, most major cities in New York State (NYS) experienced significant decreases in populations as a direct result from the loss of manufacturing jobs, shifts toward global manufacturing, technology-based trends, and a shift towards suburban lifestyles (New York State Office of the Comptroller, 2004). For suburban Saratoga County, the 1970s recognized significant population growth when the remaining segment of the Adirondack Northway Interstate Highway System connected New York City to Montreal. Locally, this highway infrastructure connected Saratoga to Albany County by twin bridges over the Mohawk

River, allowing for the population to spread into rural Saratoga County. This interstate highway also connected Saratoga to the Albany International Airport, giving direct and convenient access for travel. Currently, Saratoga County is one of the few counties in NYS that has still experienced consistent population growth for the past four decades. By the early 2000s, the City of Saratoga Springs had the largest percentage of growth (31.5%) and remains the fastest growing city in (New York State Office of the Comptroller, 2004).

Currently the population of Saratoga County has maintained a steady growth between 3% and 5% each year (U.S. Census Bureau, 2014) (see Appendix A: Population Saratoga County). New industries with additional workforces have moved into the county. The most recent industry attracted to Saratoga County is Global Foundries, a divestiture of Advance Micro Devices (AMD) and IBM Microelectronics. This large semiconductor plant has prompted other complementary industries to move into the county.

This consistent population growth has become a critical focus for hospital leadership, who are attempting to meet the healthcare demands of the growing county. Consequently, since the 1980s, Saratoga Hospital and the community it services have transformed the fledgling hospital into a thriving institution that anchors a growing network of healthcare services, including primary care, urgent care, imaging, occupational health, ambulatory surgery, rehabilitation, oncology, and a new community health center. The most recent endeavor to meet the community healthcare needs involves a multimillion-dollar project consisting of a new 19-bed intensive care unit (ICU) and a complete surgical service renovation with the addition of three operating rooms (OR).

Sarasota Hospital, the flagship organization, is a general not-for-profit community hospital serving Saratoga and bordering counties in upstate New York. This 171-bed hospital has a variety of acute care services, including an active emergency department (ED) and busy surgical services. Critical care is a vital service supporting these revenue-producing services. Strategically, the ICU, the only critical care unit at Sarasota Hospital, was physically surrounded by multiple surgical service support departments, such as OR, post anesthesia care, and same day surgery. The current physical footprint of the ICU was needed in order for surgical services to expand.

In 2009, a new building was erected adjacent to the main hospital structure that expanded the ED, information technology (IT), and the pharmacy areas. The IT and pharmacy were located on the subterranean ground floor, while the ED occupied the first floor for ease of entry to the outside for pedestrians and emergency vehicle traffic. At this time a decision was made to pre-construct the second floor by building the outside walls, placing windows, and establishing an elevator shaft. This unfinished 16,510 square feet of space had been serving as a giant storage area.

Senior leadership's long-term vision was to increase the OR capacity and move the ICU to the vacant space above the ED. The Board of Trustees was engaged to support the newest project, which consisted of construction and renovation of new surgical suites, pre- and post-operative areas, enhanced surgical support infrastructure, new ICU space, and family amenities as part of a $35 million expansion and renovation project.

The catalyst for the new critical care unit at Saratoga Hospital was the result of OR challenges and physical limitations in the ICU. The ICU environment had limited handwashing stations, dialysis capabilities, and private rooms for infection prevention practices and inadequate square footage to support current technologies. The operating rooms had tremendous space limitations trying to accommodate the 75% increase in surgical volume over the last decade.

Similar to the ICU and built during the same time era, the ORs had environmental challenges that resulted in regulatory deficiencies. To resolve the identified regulatory deficiencies, the project was accelerated for planning purposes. Since nursing support units for the OR physically engulfed the ICU, it was logical to build a new ICU and re-allocate this space for the expansion of surgical services. The only available space, which had previously been identified for the new ICU, was the pre-constructed space on the second floor of a building erected in 2009 adjacent to the main hospital structure. This available square footage on the second floor could accommodate a 19-bed ICU, with window and elevator placement already preselected.

Designing the new critical care unit necessitated foresight in work processes; patient, employee, and supply throughput; and environmental safety. The project was preceded by a risk assessment utilizing a strength, weakness, opportunities and threats analysis (SWOT) analysis for increased vulnerabilities concerning political, legal, and regulatory risks concerning the environment of care, state law requirements for certificate of need (CON), contractual issues concerning project management, and potential architectural design flaws (see Appendix B).

Saratoga Hospital is a three-time recipient of the prestigious Magnet status. The Magnet philosophy supports employee participation. Consequently, planning began with expected and willing participation from all employees interacting in the ICU space. The initial mutual overarching goal for the architects and clinicians was to design a preeminent critical care unit with a priority on safety and a healing environment focus. All end users who interfaced with the unit had multiple venues for recommended suggestions. During the design phase, along with all of the excitement, there were significant concerns raised by many clinicians about the ability to see and hear the patients or receive assistance when needed.

Local Problem

The current 14-bed ICU is a vital microsystem within the 171-bed Saratoga Hospital. All essential hospital services require a critical care sub-specialty at various times, with emergency and surgical departments utilizing these services the most frequently.

The majority of Saratoga Hospital has an architectural footprint from the early 1970s; the critical care area was no different. The antiquated ICU design still had open bay rooms separated by cubicle curtains. Patients, families, and clinical staff had voiced multiple challenges concerning the physical environment of the ICU. Despite the overall positive patient survey results, hand written comments revealed complaints about noise, lack of bathroom facilities, and a very small visitors' lounge. Complicating the patients' and families' experiences are the clinicians' challenges while working within the confines of this environment. The clinicians identified multiple deficiencies, including a lack of handwashing sinks, one communal hopper area to dispose of bodily fluids, difficulties maintaining privacy requirements, and inadequate infection control practices. Patients were perpetually moved, wasting time and efforts to accommodate for the needs of either isolation or dialysis. Many times, even though the patient required a private room, it was impossible to achieve due to the physiological instability of the patient, potentially exposing the entire ICU patient population to certain infections. Additionally, the lack of square footage in all the rooms made it difficult to adapt today's technologies required at the bedside. Many times, procedures commonly performed in an ICU setting, which is safer for unstable patients, were accommodated in other areas, such as the endoscopy suite, to avoid the space restrictions of the ICU rooms.

Another critical impetus for the ICU move was created by identified deficiencies in the physical plant of the current OR. Since the previous ICU occupied the space adjacent to the OR, it had been coveted for some time. Due to the aged ORs, the need to increase the number of operating rooms to respond to volume demands and multiple safety and regulatory challenges, time was of essence to rectify all of these identified issues.

Options Explored

Prior to presenting a proposal to the Board of Trustees for approval, all possible options were explored for this substantial construction project. Three viable options were reviewed:

1. To expand surgical services to the unoccupied space in the pre-constructed second floor, leaving the ICU in the current location.

The reason this option was not optimal is because the operating rooms did not require all of the square footage available on the pre-constructed second floor, leaving valuable square footage space vacant. The remaining space could not accommodate the remaining surgical support services (i.e. post anesthetic care unit), thus breaking up surgical patient flow support services. This option did not address concerns identified in the current ICU.

2. To expand surgical services to the unoccupied space on the second floor, adding a third floor for the ICU.

This option was seriously explored, but the cost of adding a third floor was prohibitive with the current financial status. The operating room did not require the available pre-constructed square footage available on the second floor, as explained in number 1. There were no identified advantages to the floor plan on the third floor over the second floor plan; it would have had the same basic layout and design flaws.

3. To move the ICU to the unoccupied space on the second floor; to redesign the surgical services flow with the addition of the vacated ICU floor space.

Additional space was provided on the first floor for pre-admission testing and surgical home services. This option was approved, with some functional concerns, for a critical care unit due to floor layout in the pre-constructed space.

Once the decision was made to move the ICU into the pre-constructed space above the ED, the design and planning phases began. The concepts of evidence-based design were introduced, and an open intranet file was developed to house a library of articles for all to read. The definition of evidence-based design was adopted from renowned architect D. Kirk Hamilton's definition: "Evidence-based design is the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions together with an informed client about the design of each individual and unique project" (Hamilton, 2013, p. 98).

All multi-professional staff were invited to critique the new space and /or floor plans during all phases and decision points in the room design. All feedback was considered and design plans changed as recommended. The one design plan that was identified and could not be changed was the limitations created by the pre-existing space with window and elevator placement. The spatial layout of the floor and the pre-selected window placement dictated the basic design by creating two adjacent hallways, with significant space between rooms. The current building codes require patient rooms to have visibility from windows. Consequently, due to the previously placed windows, the patient rooms would be on the perimeter of this square shaped unit. The highest end users of the new unit – nurses, technicians, and respiratory therapists – voiced concerns about the size of the unit with a decrease in the line-of-sight. The line-of-sight provides a mechanism for continual observation of the patient to enhance patient safety. The line-of-sight includes visibility and, as verbalized by the clinicians, is contextual to the movement of the clinician and where and how they position themselves. A summation of the clinicians' concerns follows in three identified main functions:

1. A visual field function: The ability of the clinicians to perform a quick assessment of the patient, particularly of the head and chest and pieces of life-supporting equipment, without obstruction. This is usually accomplished by intentionally walking by the patient while on the way to perform another task.
2. An auditory field function: The ability of the clinicians to hear alarms and patient and other clinicians' communications within the specific work environment. Nurses also need to differentiate between types and volume of alarms and the pitch in clinicians' voices to identify the need to respond to an escalated alarm or situation for patient safety.
3. Teamwork function: The ability to obtain physical and consultative help when needed. Obtaining help can be time sensitive, especially in emergency situations. The teamwork function also requires peer-to-peer consultative assistance. Nurses can often be overheard asking another nurse to "come look at my patient and let me know if I am missing something."

All three of these functions are vital for detecting risk and promoting patient safety, especially in the critical care environment. As plans developed over time, the concerns about the line-of-sight escalated. These needs were never identified as an issue in the previously occupied unit simply due to the small square footage and close proximity.

Essentially, the pre-constructed space was designated for the new ICU. The pre-constructed area, with existing window and elevator placement, was not built for maximal function of a critical care unit nor was it optimal for the clinical functions of the line-of-sight.

The old ICU unit had significant safety challenges; by design, the new unit created new and different challenges and safety issues. Consequently, to respond appropriately, the existing goal quickly changed to design a pre-eminent ICU by mitigating risk due to a decrease in the line-of-sight and the three functions – seeing, hearing, and teamwork. Technology was assessed to determine what could be implemented to overcome the voiced trepidation by the clinicians caused by the decrease of the line-of-sight.

Intended Improvement / Purpose of Change

After the Board of Trustees approval for the entire project, which included both ICU and surgical services, the ICU design began with utilizing the pre-constructed space on the second floor of the newest building. The overall guiding principles established by the multi-professional construction team became threefold:

1. Create a safe and healing environment conducive for all interacting within the unit, especially patients, families, and clinicians.
2. Utilize research/evidence-based design and expert knowledge to guide decisions for a new critical care design in the pre-constructed space for patients, families, and clinicians.
3. Utilize technologies to mitigate design challenges created by the pre-constructed design plans, thereby alleviating the identified trepidation of all clinicians created by a decrease in the line-of-sight.

AIM Statement: To design, construct, and occupy a new critical care unit by March 2015. This was achieved by:

1. Maximizing multi-professional clinician input into the design process.
2. Attending various site visits to assess design, function, technologies, and equipment.

3. Collaborating with architects and construction teams to achieve the construction time schedule.
4. Remaining within +/- 10% of budget dollars.
5. Developing and implementing a new staffing plan.
6. Developing and implementing a migration plan for the move and occupancy of the new unit. This included upgrading and standardizing the facility-wide monitoring system.
7. Mitigating risk by implementing new technologies for teamwork and communication.
8. Evaluating progress throughout the project by agreed upon metrics.

The original goal had the overarching purpose of designing a preeminent unit utilizing the process of evidence-based design to guide decision-making. To achieve this goal, multiple site visits were arranged to look at other critical care areas and the function of equipment in the rooms. Multiple design elements were adopted utilizing the highest rated concepts from the various site visits. Decision-making occurred by either consensus or voting processes from numerous multi-professional staff that interacted in the environment. All choices regarding plans and renditions were displayed on a large poster board in a very public area. A banner placed above both design plans requested a staff signature be placed on the sheet of the corresponding design of choice. Options from the general public were solicited from the ICU visitor population by encouraging them to sign up for the preferred design. Ample time was given to the displayed plans, while adhering to the timeline to keep the project on schedule.

Further along in the process, a mock room was temporarily constructed in the new area to replicate the room design plan. Using several of the same processes, multi-professional opinions were obtained during many visits to the mock room. Self-adhering paper was used to allow clinicians to move the placement of required items, such as oxygen outlet placement and used syringe receptacles. A large blank poster paper was also hung to solicit ideas and comments. All of the suggestions were incorporated into the design plan, if appropriate. Weekly staff meetings were conducted focusing on discussion about various differences of opinions in options until a final consensus was reached.

Despite all of the input into the design, apprehension remained from the clinicians concerning the void in the line-of-sight and the three functions of seeing, hearing, and teamwork. To accommodate for the decrease in the line-of-sight and to enhance patient safety technologies, a different staffing plan was explored.

Various measurement tools were evaluated to measure the design concerns regarding the decrease in the line-of-sight in conjunction with the impact of implementing new technologies and staffing plans. Since there is not one tool that specifically addresses the line-of-sight phenomena and patient safety, the Healthcare Team Vitality Index (HTVI) was selected due to its validity with multi-professional teams in the areas of communication and teamwork (Upenieks, Lee, Flanagan, & Doebbeling, 2009) (see Appendix D: Healthcare Team Vitality Index).

Both teamwork and communication are vital functions, as previously identified in the line-of-sight definition. Since the multi-professional team members significantly influenced the ICU design, the HTVI tool was deemed appropriate due to its inclusiveness. A pre-move and post-occupancy data collection process was planned. The post move collection was postponed for three months after the move, allowing for adjustments to the new environment. The premise for the survey process was that the environment changed, but clinicians in the work environment were stable with no turnover. The anticipated results would measure the difference in teamwork and communication from the previously occupied ICU to the current ICU. Enhanced technologies and implementation of a new staffing plan would compensate for the decrease or absence in the line-of-sight. If the results were neutral or positive, it would indicate no decrease in teamwork and communications measurements, therefore measuring a positive impact from implementing technologies and a new staffing plan to compensate for the decrease in the line-of-sight. If the results were a negative deflection, it would suggest that the technologies did not improve communications and teamwork.

Review of the Evidence

Architectural codes apply to the entire hospital, so critical care design must utilize all of the general hospital guidelines, along with the additional guidelines specific to critical care. The golden book for healthcare design is the *Guidelines for Design and Construction of Hospitals and Outpatient Clinics* (Facility Guidelines Institute [FGI], 2014). The specialty of critical care design has begun to flourish within the last decade (Bartley, Olmsted, & Haas, 2010; Bartley & Streifel, 2010; Hua, Becker, Wurnser, Bliss-Holtz, & Hedges, 2012; Joseph & Rashid, 2007; Lu & Zimring, 2012; Pati, Harvey, & Cason, 2008; Rashid, 2014; Sadler et al., 2011; Sydnor & Perl, 2011; Thompson et al., 2012; Ulrich et al., 2008; Zborowsky & Bunker-Hellmich, 2010). Some of the professional societies have developed their own set of guidelines, an example being the Society of Critical Care Medicine's *Guidelines for Intensive Care Unit Design*, to assist critical care design (Thompson et al., 2012).

Patients in critical care are unique and have a wide spectrum of disease processes. Some patients may be in critical care for observation, while the more critically ill require full support for multi-organ failure. This wide variability in patient needs demands different functions with a room design for different times in the recovery period. Most clinicians in the critical care environment recognize the unique needs of each patient and incorporate these needs into the practice of intentional surveillance, while promoting patient safety. Surveillance is impacted by the design of the unit. An example of this surveillance is the clinical nurse intentionally walking around a support structure to look at critical intravenous solutions before meeting the needs of another patient. Most clinicians depend on the line-of-sight and will modify how they work when it is unavailable. Studies on the impact of visibility in critical care environments are scarce, but some have just recently begun to be published (Hua et al., 2012; Leaf, Homel, & Factor, 2010; Lu & Zimring, 2010; Lu, Ossmann, Leaf, & Factor, 2014).

A comprehensive literature review was conducted using the identified key words as individual terms and in combination: line-of-sight, nursing and architecture. Publication dates were limited to the last five years. The search produced only seven articles from the CINAHL, Pub MED, and Google Scholar databases. To increase the number of articles produced for the search, patient safety and visibility were added as key words, and the timeframe was expanded to 10 years. The quality of evidence was ranked using the John Hopkins Nursing Evidence Based Practice Model. The articles were also graded by the strength of evidence using Melnyk's and Fineout-Overholt's hierarchy of evidence (2014, p.12). The appraisal scale follows as: A = high quality, B = good quality, and C= low quality (see Appendix E: Evidence-Based Table).

Hua et al. (2012) produced the most robust research that mentions and supports the significance of the line-of-sight. This research incorporated a pre- and post-move research design involving four medical surgical units to determine the impact of a new multi-hub unit design on communication, patient and nurse satisfaction, distance walked, organizational outcomes, and patient safety. The multi-hub design situated a nursing station for every 12 beds within a 36-bed unit. The study identified multiple evidence-based design features, such as large private rooms with windows and a designated family area within each room. The overall intent of the design was to enhance the patient and family experience. Another identified outcome was to increase communication and teamwork and to support the quality and safety of care rendered. Four nursing units were studied. One unit, which did not move nor receive any renovations, was utilized as a control unit. Patient satisfaction scores for six quarters (three quarters before the move and three quarters after the move) demonstrated a significant improvement. Although patient satisfaction results showed a significant increase, there were no improvements noted in nursing satisfaction metrics for overall satisfaction, stress reduction, increase in teamwork, and collaboration. The researchers recognized some unintended outcomes for teamwork and communication and suggest further study (Hua et al., 2012).

Leaf et al. (2010) found that high acuity patients (n = 664) placed in intensive care unit rooms with low visibility from the nurses' station had a higher mortality rate. In this retrospective study, patients were randomly selected and identified as residing either in a high visibility room or a low visibility room. Low visibility rooms were identified by the inability to establish a direct line-of-sight from a clinician while at the nursing station. Acuity scores for each patient were standardized utilizing a reputable acuity tool. When compared, the subset of higher acuity patients when placed in a low visibility room had a significant increase of mortality (p=0.46) than their counterparts in high visibility rooms (Leaf et al., 2010). This influential study was the first suggesting a relationship between visibility and patient safety.

Lu, an architect, has conducted multiple studies concerning visibility in nursing environments, especially critical care. His seminal work gives credence to quantifying visibility through the development of targeted visibility index (TVI) (Lu, 2010). The TVI debuted in this study by measuring the visibility a person has for targets, especially patients in beds on a nursing unit, and through a series of measurements calculating a quantifiable number for visibility. Lu then calculated TVI measurements of the most frequent nursing unit designs – the radial, the double-corridor, and the single corridor design. The single corridor design scored less favorably, with a score of 0 on the TVI, where no patients in beds could be seen. The results of this study have implications for healthcare unit design concerning behavioral effects for nurses generated by environmental structures, such as unit design. The results also indicate consideration should be given to visibility as a key component to the functional and organization design of nursing units (Lu, 2010).

Lu et al. (2014) reanalyzed the data from the original Leaf et al. (2010) study in a conceptual replication study. Lu et al. assigned computer-aided quantitative metrics to the design plan for visibility in the previously studied unit. In this replication study, visibility accounted for a 33.5% variance in mortality (p=0.049). This study added to and strengthened the original study and the evidence for a relationship between visibility in the critical care patient environment and patient outcomes (Lu et al., 2014).

Lu and Zimring (2012) published visibility research with data from a 20-bed neurological ICU looking at the behaviors of physician and nurse in relation to the spatial visibility of the patients. The study used a standard visibility analysis. Observational data were collected via rounds occurring over a 2-week period on all shifts. Both nurse and physician were classified either as interacting or non-interacting. Nursing behavior showed that interacting nurses exhibited a significant difference ($r(10) = .894$, $p < .001$) for adapting to patient visibility or were situated in locations closer to patient beds over the non-interacting nurses ($r(10) = .359$, $p = .309$). The results for physicians show their locations were associated with larger spaces. This study adds to the knowledge that the behaviors of nurses are to keep the patients within their line-of-sight.

Although not a research study, the opinion of three critical care nursing experts, Henneman, Gawlinski, and Giuliano (2012), express the role of surveillance in the critical care environments. Surveillance is defined differently from monitoring, yet monitoring contributes to surveillance. Monitoring is describe as the process of “observing, measuring and recording patient data”; while “Surveillance is the purposeful and ongoing acquisition, interpretation, and synthesis of patients’ data for clinical decision making” (Henneman et al., 2012, p. e10). Nurses that utilize surveillance are proactive in preventing errors and avoiding adverse events. Henneman et al. state that “surveillance demands that the critical care nurse selectively attend to both patient and environmental factors, in an appropriate sequence, and at the correct time” (p. e13). The authors stated that nurses should play a critical role in redesigning the work environment. More research is needed combining the fields of environmental design and human factors in conjunction with the concept of surveillance in nursing practice.

Pati et al. (2008) conducted qualitative research with multi-professionals at six different hospitals spanning the U.S. From multi-professionals in these adult medical surgical units, nine different flexibility needs were identified. The nine flexibility needs included peer line-of-sight; patient visibility; multiple division and zoning options; proximity of support; resilience to move, relocate, and interchange units; ease of movement between units and departments; multiple administrative control; service expansion options; and single patient and universal rooms. Pati et al. found that nurses and other multi-professionals work in teams for many reasons, some of which include optimizing care, educational and mentoring opportunities, and socialization. The lines-of-sight are crucial for multi-professional collaboration and security; without it, the levels of stress increase. The authors further define the current design of inpatient units is to have all required equipment and supplies close to the patient to decrease travel distances. Accordingly, these designs increase time with patients, but may also decrease the line-of-sight, further complicating the stress levels perceived by the caregivers (Pati et al., 2008).

Conceptual/Theoretical Framework

The perils in the United States healthcare system were highlighted in the 2000 IOM report, *To Err is Human,* which identified healthcare errors as the 8th leading cause of death (Kohn, Corrigan, & Donaldson, 2000). Safety research has been flourishing in the literature since this publication has circulated. Extrapolating patient safety data into a critical care environment, Rothchild et al. (2005) concluded that approximately 148,000 deaths occur annually in critical care units.

Due to the highly complex environment in critical care, a combination of conceptual and theoretical frameworks focused on patient safety will be explored. Each of these frameworks, singularly and combined, have significant implications for patient safety in the critical care arena. Patient safety has long been a hallmark of nursing care and is imperative in the critical care environment. The exploration and discussion of the following patient safety frameworks is respectfully superficial. There remains a significant need for quality strategies and research to explore the dynamic interconnection between patient safety, nursing interventions, human factors, and the environment.

Critical care units are complex environments with innate risks. Some of the risk is associated with the physical structure of the environment. Various noises generated by the activities from visitors, staff, alarms on multiple pieces of equipment, and emergencies all compound the noise volume and distractions in the environment. Clinicians working in this environment learn how to incorporate distinct nursing interventions to overcome the limitations of the environment. Clinical nurses intentionally accommodate for the environment by walking by a patient to perform a quick assessment, which is often referred to as the line-of-sight. One might also find the volume turned up on one set of monitors if the clinician plans on being in another room for an extended period of time.

Patient risk detection theory incorporates concepts of signal detection theory with high reliability theory (Despins, Scott-Cawiezell, & Rounder, 2009). This theory applies reasoning to how clinicians work in complex environments while remaining vigilant about patient safety. The overarching concepts from high reliability theory are incorporated within patient risk detection theory by supporting an organizational culture for patient safety. A clinical nurse in a highly reliable organization is more likely to have a proactive mindset for detection, reporting, and avoidance of risk related to patient harm. Highly reliable organizations have created a culture of safety to support nursing practice (Vogus, Sutcliffe, & Weick, 2010).

The second concept woven into patient risk detection theory is signal detection theory. Synthesizing signal detection theory into the critical care work environment explains how clinical nurses detect all types of stimuli from various alarms. Using the cardiac monitor alarms as an example of a means of measurement for patient safety, the clinical nurse can choose to react to the alarm as an indication of patient compromise, recognize it as a false alarm, or reset the alarm to adjust for patient variability. The attentiveness of the clinical nurse to detect, scan, and filter alarms is affected by past experiences, fatigue, level of training, and sensitivity to the alarms (Wickens, 2002).

Patient risk detection theory combines the individual’s ability to detect and mitigate risk with support from the organization to promote high reliability theory. Patient risk detection theory has not yet been widely studied, but it does provide a reliable framework for patient safety, especially in the critical care environment. However, not all of the challenges created by the physical environment in critical care are addressed with this theory. Signal detection theory is generally applicable to noise, which is the majority of safety concerns in critical care. However, what does a clinician do when they cannot detect the noise? Often clinicians will adjust their work to incorporate another component of constantly scanning the patient. This scanning takes foresight and dictates how the clinicians adapt their work to adjust for a quick visual assessment to accommodate for visual and auditory cues from the patient and/or any alarmed devices attached to the patient. It is important that walls or other opaque barriers produced by construction do not impede the line-of-sight assessment. This scan is vital for patient safety and early warning to prevent harm. The nurse who detects any signals can intervene and minimize or mitigate any future problems. More research is needed to enhance the knowledge base of the precarious relationships between the environment, patient safety, clinical thinking/judgment, and human factors.

Another concept related to nursing is the intervention of surveillance, which has been identified and utilized as a patient safety mechanism (Henneman et al., 2012). Surveillance in the critical care environment is multifactorial and essential to patient safety, requiring the critical care nurse to “selectively attend to both patient and environmental factors, in an appropriate sequence, and at the correct time” (Henneman et al., 2012, p. e13). With deployment of surveillance techniques, the critical care nurse will detect early changes in a patient’s condition. The line-of-sight is one mechanism for achieving this surveillance.

Contextual cueing theory from the discipline of psychology can also be applied to the safety attributes of the nursing practice (Chun & Jiang, 1998). Contextual cueing theory can identify the ways in which a nurse learns to incorporate the physical environment to guide further visual behaviors. This theory encompasses the contextual nature of the environment relative to the spatial layout and the location of patient and equipment within the line-of-sight among blatant and subtle changes to the environment as they occur over time. As explained by contextual cueing theory, nurses will be conscious of regularities and irregularities in the environment, while adjusting their practice over time to maintain safety and mitigate harm. Obvious impairments to contextual cueing include the physical structure and barriers created by the design and construction of the environment. For example, the cubicle curtain becomes a visual obstacle, often obscuring visualization of the patient's face and chest. The cubicle curtain has much less impact on the visual, auditory, and teamwork functions of the line-of-sight compared to the challenges created by walls and columns, which greatly affect all three functions in the line-of-sight. Both of these examples necessitate the nurse accommodating and integrating various actions to overcome these obstacles. Additionally, other pieces of equipment and visual distractions further complicate the situation.

All of the previously described safety theories have significance for critical care design. The decisions made during the design phase of a new critical care unit will have a long lasting and significant impact on future safety, quality, efficiencies, risk mitigation, and operations.

Section III. Methods

Ethical Issues

The concept of the line-of-sight can be loosely traced back to Jeremy Bentham from England. Bentham, a philosopher, is widely renowned as the founding father of utilitarian ethics. Utilitarianism supports "the moral worth of an action is determined solely by its contribution to overall usefulness" (Pozgar, 2016, p. 10). Betham's philosophic views influenced the development of his panopticon design for construction. A panopticon design was envisioned for use in the construction of buildings, mainly prisons, but the occupants could also be patients, students, or the mentally ill. A panopticon structure is circular in design, allowing the position of a central observation tower maximizing a view of all prison cells/rooms. Some coined this "the gaze" for it was often unilateral, where the guard was able to view prisoners, but the prisoner unable to view the guard. This insinuates a degree of psychological power over the inmate, because the inmate never really knows if and when someone was watching (Barton & Barton, 1993). In the utilitarian philosophy, the design's overall usefulness supports a decreased need for prison guards, while decreasing the financial burden to society. The panopticon construction concept was never fully embraced. Today panopticon is a phrase used as a metaphor insinuating oppression and social control thanks to Michael Foucault's novel *Discipline and Punishment* (Foucault, 1975).

Currently, through the ethical principles of justice, healthcare leadership is challenged to provide care that is equal and fair to all, while being fiscally responsible. Evidence-based design provides guidance for construction so everyone – patients, family and employees – can have the same benefits from a healing environment. However, leadership is in a precarious position and must distribute funding fairly and equitably discerning the advantages of designing new units, with the best options from evidence-based design often incurring additional expense. The advantages of the design must be balanced with the costs and the long term effects that the environment will have on efficiencies over the useful life of the project.

Although no ethical issues were associated with the new ICU construction, there were moral decisions that required some financial decisions. The most significant issue, which surfaced during the design phase from the direct care clinicians, was numerous concerns articulated about the decrease in the line-of-sight. Morally, and in congruence with a Magnet culture, it would have been inappropriate to ignore this identified issue. Fortunately, senior leadership was financially supportive to exploring technologies and new staffing plans to mitigate the risks from a decreased line-of-sight.

There were no other identifiable ethical issues or conflicts of interest noted for this project. The Project Determination was submitted for approval in March 2014 and approved by faculty and chair (see Appendix F: Project Determination). Saratoga Hospital agreed to be transparent by allowing identification and using the hospital’s name in the document (see Appendix G: Letter for Name Disclosure).

Setting

The previously occupied ICU was comprised of 14 rooms in a contiguous loop (see Appendix H: Previous ICU Floor Plan). All rooms are single patient rooms. The line-of-sight is clearly defined from the nursing station. The nursing station is considered to be the desk areas in the middle of the concentric loop, with the majority of desk area facing five rooms and adjacent to five other rooms. For the majority of time, when clinicians are situated at the nursing station, they can directly see and hear 10 of the 14 beds. The other four beds can be directly viewed when seated at the secretary's desk area behind a medication-dispensing machine. This unit was 5,900 square feet. Although considered to be very tight quarters by today's standards, there was a level of comfort for the clinicians because once past the entry way, a quick environmental scan informed the clinicians exactly what was occurring in the ICU.

Staffing for this space-restricted area, when benchmarked against national comparisons, was in the 10th percentile for critical care units (see Appendix I: Benchmark Data). This was the direct result of always being able to retrieve assistance when needed. Each nurse cared for two patients during a 12-hour shift, which is the recommended nurse staffing from the Association of Critical Care Nurses. The remaining ancillary staff was minimal, simply because there was no need nor space accommodations. Clinicians could easily locate each other for assistance simply by glancing outside of the patient rooms. Any requests for assistance could be heard from any location due to the open and compact design.

The majority of the clinical workforce in the previous ICU, including nurses, technicians, respiratory therapists, physicians, and unit secretaries, have had many years of experience. Turnover rates for all employee groups were under 2% per year. There was a strong level of autonomy among work groups, and collaboration between work groups was strong. Tight coupling exists among team members with regard to respective roles; each depending on others to perform many of the patient care tasks. Physician relationships were also longstanding, with the primary intensivists using patient rounds for educational purposes.

Saratoga Hospital is a three-time recipient of Magnet Status, one of the highest levels of distinction for nursing and patient care. Consequently, the culture among most unit-based clinicians is one of autonomy and engagement. When planning for the new unit design, most nurses in the ICU participated wholeheartedly in the design process and all other end users where highly encouraged to participate. Initial solicitation started with two different unit design plans; each was placed on poster board in the main thoroughfare upon entering the unit. A banner placed above both design plans requested a staff signature on the corresponding sign-up sheet for the personal design of choice. The general public was also invited to vote. Each rendition of the design plans became more refined as a result of this iterative process until a final floor plan design was achieved.

All feedback was considered and design plans changed as recommended, if possible. The overall challenge, which evolved from the newly drawn floor plan, was the design could not correct the limitations created by the pre-existing building structure and the pre-selected window placement. The spatial layout of the floor created two adjacent hallways with significant space between rooms due to the requirement for windows in every patient room. The highest end users of the new unit – nurses, technicians, and respiratory therapist – continued to voice concerns about the size of the unit compromising the line-of-sight and the three identified functions – seeing, hearing, and teamwork. All three of these functions are vital for detecting risk and promoting patient safety, especially in the critical care environment.

Essentially the pre-constructed space with existing building structure and window and elevator placement was designated for the new ICU, but it was not constructed with the intent of maximal function for a critical care unit nor was it optimal for utilizing the line-of-sight, as identified and described by many clinicians. The old unit had significant safety challenges; the new unit, by design, created new and different safety issues. Consequently, to respond appropriately, the existing challenge quickly changed to design a pre-eminent ICU by mitigating risk due to the expected decrease of the line-of-sight and the three functions previously identified – seeing, hearing and teamwork. The second phase of the design was now to assess technology and staffing to determine what could be implemented to overcome the voiced trepidation from a decrease in the line-of-sight.

Planning the Initial Intervention

The initial intervention of building a new ICU had been in the mindset of all senior leadership and Board of Trustees for a number of years. The physical challenges of an over utilized and aged environment were obvious to all. Consequently, it was unanimous that both the surgical expansion and renovation project, along with the construction of a new ICU, needed to commence, while remaining fiscally responsible.

As with any major project which expends multiple dollars, it is prudent to complete a business plan. Components of the business plan, which assist in adhering to the identified goals, include a market analysis, SWOT analysis, identification and education of stakeholders, multiple timelines for the project, and financials analysis. Multiple project plans were created, keeping the various components of this project on target and to maintain budgetary control.

After a review of the business plan, the decision from the Board of Trustees to fiscally support this project began a cascade of actions. With any healthcare construction in NYS, a certificate of need (CON) is required. The CON for this project was completed by the Vice-President of Operations and submitted to NYS Department of Health by the Chief Executive Officer. Before the CON application can be submitted, all components of the application must be satisfied, including the architectural design plans, financial analysis of the construction project, and staffing models. The majority of this work was completed prior to the CON submission, which allowed physical construction to begin immediately upon CON approval. The timeline for completion of the ICU construction phase of the project was expected to be 14 months. The construction project timeframe was shortened due to the pre-existing edifice and windows on the second floor of the new building (see Appendix J: Gantt Chart).

Identification and Education of Stakeholders

Any public institution has stakeholders with vested interests in the organization. The following list of external stakeholders includes, but was not limited to, the Saratoga Springs community; local-elected officials; public services, such as fire, police, and local and state health departments; financing institutions; and medical companies. Some of the internal stakeholders include the Board of Trustees; medical staff; clinical staff working with the critically ill; senior leadership; and employees in the departments of Environmental Services, Pharmacy, Respiratory Therapy, Dietary, Laboratory, and Volunteer Services. Each one of the stakeholder groups was engaged appropriately at different times during the project planning via planned presentations and/or tours of the construction area and mock room set-up. Some of the key stakeholders participated in the design process.

Concurrently and throughout the project, the Executive Director and Vice President for Community Engagement and the Foundation coordinated multiple stakeholder meetings for fundraising purposes. A major fundraising drive to defray the costs of the building project was initiated, with a goal of securing $3 million from community support. These meetings engaged multiple groups, such as the Foundation, the Guild, subgroups of the Board of Trustees, and many key individual contributors. At this time, the campaign has exceeded expectations and has raised over $6 million.

To engage all stakeholders, both internal and external, a “topping off” ceremony occurred. Two weeks prior to the ceremony, the last beam to be hoisted into place was on display at the main entrance to the hospital. Everyone was encouraged to sign the beam. On the day of the ceremony, key public officials spoke, and the massive crane hoisted the final beam into place, while the crowd cheered.

Various stakeholder groups were invited to opening events, which were staged for the specific interests of each group. Many employees, but mostly the ICU clinicians who were heavily invested in the design, gave multiple tours. The opening event had much media coverage via print and media (see Appendix K: News Media Open House).

SWOT

The ICU and the surgical services are not new product lines, consequently not requiring a feasibility study; but, due to the large dollar amount associated with this project, a SWOT analysis was completed (see Appendix B: SWOT Analysis).

Market Analysis

Despite not requiring a feasibility study, a market analysis was performed. Both the ICU and OR construction projects create capacity within each service provided. Strategically, how to increase surgical and critical care volumes while meeting the needs of the community was addressed by a market analysis. Increased physician recruitment and development of collaborations with surgeons and gastroenterologists supplemented the current surgical volumes that simultaneously had a critical care component, such as thoracic and vascular surgery. Patients with extensive gastrointestinal diagnosis would no longer need to be transferred to other facilities.

A future marketing campaign is planned when the surgical services project is completed to penetrate into a group of patients seeking surgical procedures outside of the county. Additionally, Saratoga Hospital has been actively recruiting for interventional cardiologists, which will increase critical care patient days.

Financials

A combined ICU/OR project budget was developed to simplify the approval process for the NYS CON. The final proposed cost for the ICU/OR project is $36 million; $25 million will be funded through the purchase of bonds and the remaining amount funded with equity. Separating the costs, cost associated with the ICU are approximately $9 million and the OR costs are $25 million. The ICU will occupy space in the newest building, which was erected six years ago and has already been amortized. The expenses associated with this project are reflected in capital cost consisting mostly of construction, equipment and incremental staffing (Appendix L: Budget and Appendix M: Incremental Staffing).

Revenues will be generated from growth in patient days associated with increased surgical, gastroenterology, and cardiology volumes. The OR capacity will increase by three rooms, creating capacity for additional cases and allowing for increased revenues. Historical data and conservative assumptions will also be used to project revenue from the additional cases.

The profit and loss statement reveals the overall financial impact of this project (see Appendix N: Profit and Loss Statement). After Year 3, the project will generate positive net revenue. At the end of Year 5, the contribution margin will be $3.4 million.

Next Intervention: New ICU Design

The new ICU design was an iterative process involving multiple internal and external stakeholders. After a final design was achieved, a mock room set-up was constructed using the same iterative process for room design. A list of features decided upon using the process of evidence-based design can be seen in Appendix O. Each feature has been labeled alphabetically.

These labels correspond to the photographs of each feature (Appendices O – U: Design Features).

Some of the specific design elements incorporated in the room design included a family area within the room, allowing family to visit at any time. This included a couch, which easily converts to a sleep surface if the family requests overnight accommodations (see Appendix R: Design Feature ICU Room [G, N, M]). USB charging portals were provided for family in this area. Television placement was optimized and patient and family storage was accomplished with a large locker in the family area.

Another installed feature was ceiling booms for placement of necessary medical supplies, such as oxygen and suction portals and generated supported electrical outlets. The booms allow flexibility in the patient placement within the room, depending on the acuity requirements of the patient. Located on the booms are the cardiac monitors (see Appendix R: Design Feature ICU Room [C, H]). A feature purchased with the cardiac monitor is an internal personal computer (IPC). The IPC allows access at the bedside for the electronic medical record, including all laboratory reports, radiological studies, and medication administration records. The IPC facilitates access to reference materials. The IPC application also allowed the installation of an icon for "RN Anywhere." This proprietary icon, developed by Omnicell medication dispensing systems, allows the nurse to cue the dispensing unit for the medications needed while at the bedside. This has obvious implications for saving time for all medication administration, especially pain medications. An additional benefit of the IPC is replacing unit-based computers on wheels (COWS). The elimination of COWS reduces the congestion of floor space and decreases the risk of disease transmission.

Water imposes additional risks in the critical care environment. Consequently, all areas involving water received significant attention due to the affinity of certain bacteria to water. The main requirements for water in the ICU involve sinks and required dialysis connections. Every room is equipped with a separate dialysis box with direct connect inflow and outflow water connections. Hand washing sinks and surfaces had intense scrutiny and involvement from the infection preventionists before any decisions were made. The previously occupied ICU had some unfavorable experiences with standing water and post hand washing splashing around faucets. Pooling and splashing water infiltrated into sheetrock behind sink areas, creating potential bacterial reservoirs. To prevent any pooling water issues in the new unit, water faucets with spouts protruding from the walls were selected (Appendix O: Table of Design Features [E, E1, E2]). This eliminated the need for a large counter surface area, thus decreasing surface area for water pooling. Water splashing was resolved by continuing the solid surface counter top material up the wall surface for 18 inches. Placement of the paper towel dispensers was on the same solid surface material.

Design features included individual private rooms with large windows. A hybrid nursing station design was incorporated using mini nursing stations between each room with more centralized and larger nursing stations on the inside perimeter (see Appendix P: Design Feature Electronic Glass; Appendix Q: Design Feature Decentralized Nursing Station/Sinks [A, B, I]). The electronic glass can be seen in translucent and opaque states in Appendix P: Design Feature Electronic Glass, I. The mini nursing stations have access to window and lighting controls, a glucometer, Doppler, and a computer. Elevated chairs are located in the mini station for maximal visibility into both adjacent rooms.

Additional design features include a large and esthetically attractive waiting area. Pleasant staff lounge and a conference room were located on the periphery of patient care rooms. By design, the unit is large. To decrease walking distances for all clinicians, accommodations were made by locating duplicate pneumatic tube systems, ice machines, kitchenette areas, dirty utility rooms, and pharmaceutical dispensing machines on both sides of the unit (see Appendix T: Design Feature Nursing Station).

While all of the deficits from the previously occupied ICU were corrected with the new unit design, the final design created new challenges for safety, mainly due to a decrease in the line-of-sight. The significant decrease in the line-of-sight became evident when the clinicians vocalized concerns during the design phase and escalated during visits to the mock room in the pre-constructed area (see Appendix V: New ICU Plans).

To address these concerns, multiple technologies were investigated to ameliorate the risks associated with a decrease in the line-of-sight. The line-of-sight was addressed initially in the original design plans with decentralized workstations between two rooms (see Appendix P: Design Feature Electronic Glass). The V-shaped mini nursing station with windows was situated between two rooms (normal critical care nurse to patient ratios are 1:2), allowing the nurse to have full visibility of both patients. This allows for the clinical nurse to remain at the bedside of both patients for close surveillance. However, this feature was not deemed sufficient for overcoming the decrease in the line-of-sight due to the distance between rooms and cubicle curtain placement. Consequently, different types of solutions were investigated, such as placing the cubicle curtains differently in each room and mini-blinds situated in between windowpanes to remain open and then closing for privacy. The clinicians rejected both of these solutions, limiting the remaining solution to the application of electronic glass. Electronic glass is an application consisting of two panels of glass with electronically charged particles in-between the panels that changes the glass from opaque to translucent with the flip of a switch, allowing visualization to occur. An additional advantage to this glass application was the elimination of cubicle curtains. Often, depending on bed positioning, cubicle curtains, even when opened to the fullest extent, can limit the line-of-sight to a patient's head, chest, or critical pieces of life-sustaining equipment surrounding the head of the bed. Electronic glass eliminated the need for cubicle curtains, thus maintaining full view of the patient without any curtain obstacle. The additional benefits of the electronic glass are elimination of laundering the curtains and always questioning if the curtains are clean. Adding the electronic glass into the windows and doors delayed the project about six weeks, since the door framing had already been erected and sheet rocked into place. The doors became a specialty order with extra costs not budgeted; total additional costs were approximately $125,000 more than predicted.

Clinical stakeholders were re-engaged to assess different types of communication systems. Multiple communication systems were evaluated, including voice over internet phones, cellular phones, and Vocera (Vocera Communications Inc., San Jose, CA), a wireless communication device that operates hands free. Vocera is a wireless, voice-activated communication device in the shape of an oval badge. It is worn around the neck or clipped to the shirt in the upper torso area. This device weighs a mere two ounces and allows the end user to work completely hands-free while communicating. The hands free feature of the Vocera device allows the operator to multitask. In the healthcare setting, this type of device has multiple uses for clinicians who often are performing tasks rendering their hands incapacitated for a time period. The benefits of the Vocera Communication System include:

- Ability to call a single person (such as a physician, another team member) or a specific team of people (such as an emergency response team or cardiac catheterization lab team).
- Decreases the risk of infection or cross-contamination due to voice-activation capability.
- Saves time relative to tasks, such as medication orders.
- Increases provider safety (ability to discreetly call security if needed).
- Allow providers to spend more time with patients – without turning their backs or leaving a patient's room, keeping the patient in the line-of-sight.

The majority of end users immediately acknowledged an affinity towards the Vocera Communication System for its hands-free and voice-activated capabilities.

Implementation

The intervention was the design of the new ICU, and implementation occurred with the move and acclimation to the new environment. The physical move was initiated once regulatory agencies inspected and granted approval for occupancy. Concerns and challenges identified early required thoughtful planning and education to safely accomplish this move. The ultimate goal for the move was to maintain patient safety. Consequently, due to the dynamic nature of the move, multiple risk mitigation strategies were applied to equipment acquisition, the physical environment, and the act of transporting critically ill patients. Some identified patient safety risks included disconnection and reconnection of multiple life supporting equipment and name association with monitors and room numbers involving multiple support functions within the hospital, such as pharmacy and dietary. Compounding the move to the new ICU was a facility-wide monitor upgrade and migration of the central monitoring room. The facility-wide monitoring upgrade was required to standardize the monitoring platform to the same revision as the new ICU monitors.

Thoughtful Planning

In order to perform and monitor migration and the entire move of the ICU, two failure mode effects analyses (FMEA) were performed for each move approximately three months prior to the move, allowing for time to plan and coordinate. The intent of both FMEAs was to proactively evaluate moves and processes, identify where and how the systems might fail, and to change the process to mitigate any risks (Ashley & Armitage, 2010). The FMEAs for both moves – the physical ICU move and the migrations of monitors – were performed individually to derive specific actions for each; but, because both moves occurred simultaneously and there were interdependencies which were not mutually exclusive, the combined FMEAs are in one document (see Appendices W, X, and Y for the FMEA and minutes).

The FMEA called for the monitor move to included personnel from the hospital: biomedical engineer, the unit Director (author and DNP student), the clinical nursing educator, a nurse clinician, and the risk manager. Representatives from the monitor company were present, along with their own engineering specialist and nursing educator. The process of migrating risks associated with installing the new monitoring system in the ICU, while upgrading the monitoring platform and wireless infrastructure facility-wide, required approximately 16 hours of planning (see Appendix V: New ICU Plan).

The FMEA for the physical move of patients called for an ICU nurse and physician, a respiratory therapist who works in ICU frequently, the DNP student, biomedical engineers, the risk manager, the clinical educator, and an information systems analyst. This FMEA planning required approximately four hours, with a defined work plan, which included a critical system redundancy of running two monitor rooms and two ICUs with increased staffing until the entire move could be completed (see Appendices W, X, Y).

Implementation: The Move

The move began on Monday morning May 11th, with an assessment of all the patients and staffing. After collaborating with the identified intensivist physician, the plan was enacted. The plan had previously been discussed at staff meetings, but on the day of the move, all nurses, technicians, and respiratory therapist were first communicated with via a huddle, and the move commenced. Staffing for the move was identified as a critical component in both FMEAs. All staff were requested to work an extra 8-hour shift to accomplish the move. For both the monitor move and migration to the new monitoring platform, a new wireless infrastructure was required, as well as two centralized monitor rooms would need to run until the new monitoring systems were working efficiently. Newly identified patients requiring critical care were admitted into the new ICU first, while a triage assessment of the current acuity of ICU patients occurred. Next, the most critically ill and ventilated patients were moved during peak operational hours in anticipation of other ancillary supports within the facility being needed. Finally, the patients who could move out of the previous ICU were moved, as beds became available. Providentially, the entire move for all the patients occurred within six hours and without any adverse patient events. The two centralized monitor rooms functioned simultaneously for three days during the entire monitor upgrade in the two separate locations. After the final monitor wires were connected and performing flawlessly, all of the monitoring functions occurred in the new central monitor room. The entire unit move, upgrade, and migration of monitors occurred without any adverse events as well.

Implementation: Equipment and Environmental Education

All new equipment was vetted with the appropriate clinicians prior to acquisition. The cardiac monitoring platform had been selected through an extensive vetting process. Vocera devices and an upgraded nurse call system were the other major pieces of new equipment, which were also vetted appropriately with all clinicians at different times during the project. The nurse call system had been replaced in the previously occupied ICU three years prior. The same manufacturer was selected for a modernized nurse call system.

Successful transition to new equipment requires extensive and thorough education for the end users. Determining how and when to educate end users on multiple pieces of equipment, without overwhelming everyone, was a challenge complicated by the necessity to maintain patient safety in the new environment. Educating too early, prior to using the new equipment, could alter the effectiveness of the educational process. All of the crucial equipment required to function was prioritized for education. The nurse call system, monitoring system, Vocera communication devices, booms, multifunctional landlines, and electronic glass doors and windows were selected for the initial round of educational sessions.

Since the Vocera devices were a new product with the most significant workflow changes, it was decided to purchase and implement these devices before the opening of the new ICU. An additional benefit for the early implementation of the Vocera device was to assist with the physical move, giving the clinicians a sense of security during transport. Education and implementation for the Vocera devices occurred at the beginning of 2015, four months prior to the move. Vocera devices were initially implemented in the previously occupied unit; they were not consistently used and often seen as a burden rather than a benefit. However, once transitioned in the current ICU, adoption of the Vocera devices occurred immediately without any prompting because of the necessity and the ease of use.

It was decided to have educational sessions for the monitoring system two to three weeks prior to opening and to hold the educational sessions in the new unit. The new ICU monitoring system installation had been completed a month before expected opening, which allowed the educational session to occur in the new ICU. The monitoring education was selected for the early education since all clinicians were very familiar with the current monitoring platform and the upgraded system had many of the same functions, with enhanced improvements. To assure success with the new monitors and monitoring platform, the monitor company support occurred 24/7 for the first week of occupancy in the new unit. The educational sessions for monitoring occurred in the centralized monitor room and a patient room over two consecutive weeks. Holding the education sessions in the new unit accomplished some environmental self-learning, since all students would need to navigate their way to and around the new areas to find the location of the educational session.

Open house events provided another mechanism for environmental education. Multiple open house events were planned for the week prior to the new ICU opening, which coincided with some of the other scheduled educational sessions. Paid volunteers were solicited from the current ICU workforce to give tours for the open house times. This activity was highly encouraged for two reasons: to encourage more self-learning of the environment and associated features implemented from the evidence-based design process and to assist with the open houses. Since many of the ICU workforce had volunteered to give tours during the open house events, and to assist them with their time and schedules during the busy two weeks of opening, the educational sessions were held in conjunction with the open house tours. Most of the educational sessions were planned to overlap the hours prior to or after the open house tour times. Clinical educators from the various supply and equipment companies set up educational stations either in patient rooms or at the nurse's stations. To ensure everyone accomplished all the education, each ICU clinician had a check sheet to be signed after completing the specific company education. A second check sheet or the scavenger hunt was also required to familiarize everyone to the environment and all of the features. The scavenger hunt list required everyone to find the location for critical pieces of equipment, such as code carts and defibrillators; necessary supplies, including oxygen tubing, intravenous supplies and dressings; and environmental features, such as oxygen shut off valve and light switches.

Planning the Study of the Intervention

The intervention was the design of the new ICU utilizing the process of evidence-based design to guide decisions for layout and features that can affect patient, provider, and organizational outcomes. It was difficult for the ICU design team to comprehend or assess the line-of-sight to patients without a physical presence. However, once designed and construction started, clinicians were allowed into the space and concerns escalated about the reality of a decrease in the line-of-sight and the three functions of seeing, hearing, and teamwork in the new environment.

Early in the design phase, the original thought for evaluation included quality measurements for falls, healthcare-acquired infections, healthcare-acquired pressure ulcers, patient satisfaction, and adverse events. After implementing technologies to mitigate some of the identified risks from a decrease in the line-of-sight, additional measures were required for measurement. There were no measurement tools found specifically for measuring the clinicians' perceptions for the line-of-sight. The two main components extracted from the concerns expressed about the decrease in the line-of-sight were teamwork and communications. The Healthcare Team Vitality Index (HTVI) was the tool selected to measure both teamwork and communication due to the reliability of the tool and the multi-professional design. The HTVI tool survey tool was distributed pre-move and post-occupancy to all clinicians working within the ICU environment. The post-move survey was conducted three months after the move to allow for adjustment to the new ICU.

Methods of Evaluation

Evaluation of SWOT Analysis

A risk assessment of strength, weakness, opportunities, and threats analysis (SWOT) is frequently used with a new business venture that requires a substantial investment of dollars. The ICU project was preceded by a risk assessment utilizing a SWOT analysis format (see Appendix B: SWOT Analysis) to identify increased vulnerabilities concerning political, environmental, social, technological, economic, legal, regulatory risks, the environment of care, state law requirements for certificate of need (CON), contractual issues concerning project management, and potential architectural design flaws.

The initial assessment identified several strengths. Having strong collaborative relationships with the community to meet the healthcare needs of the county, positive financial metrics including AAA-bond rating, and a new unit/building allowing for open areas without restrictions for design and technology were three of the most notable.

The assessment also identified opportunities. These opportunities included fundraising prospects for tangible technologies; marketing opportunities to penetrate other markets, whereby recapturing the Saratoga County population going to other local hospitals; and potential decreases in liability with a new environment, which would meet contemporary codes and state of the art equipment.

Weaknesses and threats were evaluated, as well, and considerations were made to address and alleviate concerns or potential problems. Weaknesses included the current clinical workforce voicing that the new unit was unsafe due to a decrease in the line-of-sight. Another weakness experienced frequently with renovation projects at Saratoga Hospital is the unknown potential problems or risk behind walls when older building structures are removed. This often creates delays and expensive change orders. A significant potential issue is the political and safety risks associated with traffic being re-routed from a main thoroughfare in the City of Saratoga Springs.

Threats considered during the evaluation included the economical risks of increased operating costs of the occupied ICU beyond the previously occupied ICU, as well as the majority of senior staff are technology immigrants, and safety features associated with technologies may be bypassed.

Evaluation by Financial Metrics

Various methods of evaluation have been done and will be occurring for this large construction project. The financial metrics will include the timely completion of the project, since construction delays increase costs. Another metric for evaluation will be the final budget. The target is to remain within +/-10% of the allotted dollars sequestered for the project or $900,000 dollars. The finalizations of numbers have not been calculated for the new ICU construction. However, to date, the only overages were associated with the Vocera devices and the electronic glass, totaling approximately $550,000, which is under the 10% allotment or $900,000.

During the project, SH requested and received a grant to defray the costs of the Vocera communications system. The grant awarded $335,000 dollars but was restricted specifically for the Vocera communications system. Likewise, all of the campaign fundraising dollars were also restricted and designated to construction costs.

The budget for the entire project can be seen in Appendices L, M, and N. Overall staffing was increased to support the additional beds and the layout design of the unit. The design created a waiting area contiguous to the unit, but not accessible or near the main functions of the unit. See location of waiting area on floor plans, Appendix U: Design Feature Waiting Room. Consequently, a new greeter position was required during general hospital visiting hours. Registered nurse staffing increased by six RNs for 24/7 coverage, the majority of which were to staff for the additional bed compliment. One of these additional 24/7 nurses was requested to cover the "float" position to assist with the identified concerns of needing to have any team members available for consultations. Likewise, one additional 24/7 technician was requested and approved.

Total projected additional revenues generated by adding volume with the new ICU beds can be seen in Appendix N: Profit and Loss Statement. Once the surgical services construction has been completed, an extensive marketing campaign is planned for the community to introduce the new services and physicians. Physician recruitment for both surgery and cardiology product lines has been ongoing, due to the length of time to get physicians on boarded.

Evaluation by Quality Metrics

Once the move occurred, immediate feedback from everyone provided an evaluation of the environment. A tripod stand with blank poster paper was placed in a very accessible area of the newly occupied unit. All staff were encouraged to document any issues they found in the unit. This listing was reviewed daily, with many of these items placed onto the construction "punch list" to be repaired. At weekly staff meetings, all items were discussed with timeframes for resolution. Any unusual event classified as a failure or adverse event would be captured singularly via an event report form. Leadership and quality improvement staff would assess the severity of the event and the need for further investigation, such as a root cause analysis.

Comparison of the identified quality metrics pre-move and post-occupancy would explain the effects regarding the move or any influences from the environment. These metrics are organizational quality metrics currently generated and easily garnered.

Evaluation by Patient Satisfaction Metrics

Press-Ganey, a company contracted by Saratoga Hospital to gather patient satisfaction data, separates the patient satisfaction results by unit and information, which is readily available to leadership through a web-based program.

Evaluation by the Survey

A secondary set of metrics was obtained using the HTVI survey tool distributed to multi-professionals working within the ICU environment pre-move and post-occupancy. This tool will measure changes in teamwork and communication after the implementation of technologies and increased staffing. The HTVI survey tool uses a 5-point Likert scale with the participant circling a number from 5 (strongly agree) down to 1 (strongly disagree). A total of 10 items were scored with the Likert scale associated with each item. There were four items related to communication and three items related to teamwork. The remaining items asked about environmental issues, such as having necessary supplies. There were 30 pre-move surveys completed and 54 post-occupancy surveys completed among nurses, respiratory therapist, ICU technicians, and unit secretaries.

Evaluation by Regulatory Agencies

Prior to opening, a certificate of occupancy needs to be approved by the City of Saratoga Springs. This document certifies the building has met all of the local building and fire codes and is ready for occupancy.

Regulatory oversight provides another method for appraisal, and Saratoga Hospital is expecting The Joint Commission (TJC) survey process to transpire approximately 9 to 12 months post-occupancy. All components and functions of or in the new unit should be at maximum performance when TJC arrives. The gold standard for evaluation of the hospital environment can be found in the chapter for Life Safety and the Environment of Care by TJC (2013).

Analysis

Description of Quality Data and Patient Satisfaction Analyses

Overall evaluation for the design and implementation would be a safe move and successful acclimation into the new ICU environment. Analysis would require a comparison and contrast of preselected quality metrics and patient satisfaction metrics that are measured through quality monitoring currently. Patient satisfaction, healthcare-acquired infections, healthcare-acquired pressure ulcers, and falls are all measured and monitored monthly. Adverse event reporting occurs just in time and will be analyzed for any effects and environmental components. Any monitor move events would be indicated in this fashion.

Fortunately, the move of all the critically ill patients and the entire monitor upgrade and migration to a new central monitor room occurred without any adverse events. Both of these successful moves could be attributed to the preparatory work associated with and from the FMEA process prior to the move. Both FMEAs provided valuable insight into the required equipment, staffing, and processes to be followed. It was extremely helpful having participation from company attendance, company educators, and multi-professional insight with both of the FMEAs.

Findings from quality data analysis. The data for healthcare-acquired infections are interesting, with no initial increases in infections with the exception of ventilator associated events (see Appendix Z: Healthcare-Acquired Infections). The ventilator-associated events have had a slight increase, but timing was not consistent with the date of the move. Individual chart reviews are under investigation assessing for any trends.

Data from the National Database of Nursing Quality Indicators (NDNQI) shows falls with some variation over time, but consistently remaining below the 50^{th} percentile; while falls with injuries remain at zero (see Appendix AA: Falls; Appendix BB: Falls with Injury). Overall, falls are down below the mean and the under the 50^{th} percentile year to date. The healthcare-acquired pressure ulcer rate has been at zero for multiple quarters. The second quarter of 2015 (the move occurred in the last 6 weeks of the quarter) has had an unexpected increase in unit-based healthcare-acquired pressure ulcers. Reasoning for this effect could be a new unit-based skin prevention nurse, and there may have been a lack of interator reliability when the transition occurred (although, an iterator reliability does occur yearly, but not in sequence with this transition). The other possible explanation is a significant volume of newly recruited nurses who may not have adopted the present skin care practices in the ICU. A drill down of data indicates none of the healthcare-acquired pressure ulcers where associated with the time of the move (see Appendix CC: Health Acquired Pressure Ulcers). Historically, these indicators have created consternation because low denominator numbers significantly makes the rate appear inflated, even when there may be only one event.

Findings from patient satisfaction data analysis. The patient satisfaction survey through Press Ganey has shown an increase in scores on all environmental questions (see Appendix DD: Press Ganey). The quantitative data includes just three months of post-move data collection. Trending will continue through quality improvement efforts. Despite the smaller data set for post-occupancy, the scores for "pleasantness of room décor," "cleanliness," "accommodations for families and visitors" have increased significantly. One of the design flaws, not recognized until post-occupancy, was having one thermostat between every two rooms. This leaves one patient dissatisfied with the room temperatures. Consequently, this is revealed in the Press Ganey scoring, as well. Overall, the scores post-occupancy for room temperatures are slightly higher than pre-move scores, but this could have been an easy win. Scores for "noise at night" have significantly improved with the advantage of private rooms making a tremendous difference.

Description of survey data analyses. The HTVI survey tool was selected because of clinical feedback concerning teamwork and communication in the occupied ICU. Accordingly, the HTVI survey tool was completed pre-move and post-occupancy for the registered nurse, respiratory therapist, ICU technician, and unit secretary work groups to compare data objectively and assess for any changes in teamwork and communication. The supposition was if the results were neutral or had an increase, the use of technologies and increase in staffing patterns had a positive impact on teamwork and communication. If the results were a negative difference in mean scores, there was no impact from using technologies and staffing. This could support the justification for the money expended to technologies and additional staffing. Mean scores and standard deviations for pre-move and post-occupancy were calculated for each work group using Microsoft Office Excel 2011.

Findings from survey data analysis. The goal of the HTVI survey was to objectively measure a difference in the perception of teamwork and communication pre-move and post-occupancy. Pre-move and post-occupancy mean scores and standard deviations were calculated using Microsoft Office Excel 2011 software (see Appendices EE, FF, GG). When referencing these survey tools, the data statements will be explained as clinically significant; the data are not statistically significant.

There were 30 pre-move surveys completed and 54 post-occupancy surveys completed among nurses, respiratory therapist, ICU technicians, and unit secretaries. The increase in survey results post-occupancy can be attributed to additional staff recruitment. Thirty-five percent (35%) of the respiratory therapists, 62% of nurses, and 17% of ICU technicians completed the pre-move surveys. The surveys completed post-occupancy revealed completion by 28% of respiratory therapists, 60% of the nurses and 75% of the ICU technicians. The unit secretary and other workforce group were eliminated due to very small numbers.

The total scores did not show any difference from pre-move to post-occupancy; however, a comparison between the major three workforce groups showed some differences. The two identified workgroups, both respiratory therapist and ICU technicians, had little or negative mean score differences from pre-move to post-occupancy survey (see Appendices FF and GG). Interestingly, the nursing work group in this survey perceived the move, overall, as more positive. For the nurse clinicians, the HTVI items were evaluated by assigning all items into three groups: communication, teamwork and equipment/supplies. In the communication grouping, Item 7, *Important patient care information is exchanged during shift reports,* had the largest change in mean scores at 0.4. The teamwork items (Items 4, 6, 8) on the survey tool all had mean score changes of 0.6, 0.3, and 0.4 respectively (see Appendix D: Healthcare Team

Vitality Index). Lastly, the equipment and supply items also had positive mean score changes. The greatest difference in mean score was noted on Item 10, *Essential patient care equipment is in good working condition on this unit*, changing by 0.7. Although these scores are not statistically significant clinically, they all showed improvements. See Appendices EE, FF and GG for complete results with graphing of data.

Section IV. Results

Program Evaluation and Outcomes

Designing a new critical care unit can be exciting but daunting. Utilizing an evidenced-based design process guides decisions to achieve best environmental design that can affect patient, provider, and organizational outcomes. Designing the new ICU consisted of the following steps:

1) Performed a literature search of evidence-based design supporting critical care environments. Developed a library of relevant articles for all to access.
2) Educated all clinicians about the process of evidence-based design to guide design decisions that can affect patient, provider, and organizational outcomes.
3) Selected design and features applicable for the new ICU space.
4) Engaged stakeholders for feedback on the design process and features.
5) Accepted clinicians' feedback and made modifications to the design and/or features to make the environment safer and more functional.
6) Collected and analyzed data from selected metrics.
7) Summarized the project and goal accomplishments.

After constructive feedback concerning the design limitations, the overarching goal of this project was revised to utilize research-/evidence-based design and expert knowledge to guide decisions for a new critical care design in the pre-constructed space utilizing technology to mitigate risks associated with a decrease in the line-of-sight thus creating a safe healing environment for all. Falling short of the goal for opening on time, the move to the currently occupied unit was delayed for approximately six weeks while a secondary fire egress could be built to meet fire code. The 6-week timeframe just happened to coincide with the 6-week delay for the delivery of the electronic glass windows and doors. Once the new unit was occupied, overwhelming positive verbal feedback was received from multiple sources, such as clinicians, physicians, ancillary service staff, and visitors.

The design and implementation goals were all achieved through various processes and along different timelines. Involvement of all end users early in the process was one of the key successes for designing this preeminent ICU. The process of utilizing evidence-based design was used to guide the expert critical care clinicians to decide upon features. Throughout the design process, end users were consulted and their concerns addressed. Such was the case when clinicians were concerned about a decrease in the line-of-sight. To resolve the concerns, brainstorming occurred and solutions were sought from research and technologies as an approach for improvement. Select ICU photographs with the corresponding features are labeled and can be seen in Appendices O – T. The final floor plan can also be viewed in Appendix V.

Once the collaborative decision was made to implement these technologies, plans for measuring communication and teamwork metrics occurred via the HTVI survey. This survey measured pre- and post-move teamwork and communication among various work groups: nurses, respiratory therapists, and patient care technicians. The unit secretary group was excluded due to low volume. The pre- and post-move data can be found in Appendices EE, FF and GG. Although not statistically significant, there are clinical significances for the data. The result from all 10 items, pre-move to post-occupancy, shows nurses having a positive increase in the mean score; whereas, respiratory therapists and ICU technicians almost unanimously have slight negative changes in mean scores.

The design features, such as the mini nurses' station, the nurse servers loaded with supplies, and the technologies, afford an increase in efficiencies for the nurse work group. Unfortunately, the design did not accomplish the same effects for the respiratory therapists or the ICU technician work groups. Both of these workgroups must care for the same patient volumes in a much larger space, creating work inefficiencies. This assumption has had verbal affirmation from individuals in both work groups. There are some new technologies, which have not been implemented yet, which may help overcome some of the inefficiencies experienced by respiratory therapists and the ICU technicians' workgroups. Integration software will be installed at the end of the year, allowing the nurse call system, the monitor alarm management system, and Vocera communications to connect via a software package. Some of the advantages to this integration software will be that the respiratory therapist can be notified automatically when there is a ventilator alarming or the ICU technician can be notified of a call bell only when activated by a patient they are assigned. Furthermore, the ventilators will have electronic tablets installed on the top of the ventilators for efficiency with documentation, as well as cables for alarm management to go through the monitor alarm systems.

Another factor considered concerning the differences in the survey results is the impact from the volume of nurses both in the study and throughout the design process. The design process had much multi-professional involvement; however, the nursing workforce by sheer volume had a much stronger voice and the most recommendations. Another volume related impact could be that nurses, by the function of their work, have different concerns involving patients and the environments.

The initial evaluation of selected pre-move and post-occupancy quality data are publicly reported and benchmarked by the NDNQI. The quality indicators selected were the healthcare-acquired infections, central line bloodstream infections, catheter associated urinary tract infection, and ventilator associated events. Other quality metrics also reported through NDNQI are falls, falls with injury, and healthcare-acquired pressure ulcers. All of the key metrics have either remained at the same level or gone down, giving credence to a successful transition into the new environment. It is too early to determine if the design elements incorporated into the environment will have any long-term effects on healthcare-acquired infections.

The more impressive data, which was predicted, has been the dramatic improvements in the Press-Ganey scores on items concerning patient and family satisfaction. The pre-move and post-occupancy data can be seen in Appendix DD. The items concerning the environment all increased significantly. Although these data are early in the evaluative phase, it is anticipated they will continue. The largest percentage changes in score are “noise at night,” “amenities for families,” and “staff attitudes towards families.” This could possibly be attributed to the new environment, but also the practice change of more liberal visiting hours.

A newly designed facility allows for a fresh start with some new behaviors. Knowledge of change management is a skill necessary for nursing leadership, especially advanced practice nurses. Understanding change management theories and processes allows for better planning, education, and abilities to overcome the resistance when new concepts are implemented. The DNP student encouraged adoption of new or rejuvenated behaviors in this state-of-the-art environment, such as bedside reporting and involving families even more with the plans of care. Since the currently occupied ICU does not have the same limitations of the previously occupied ICU, new visiting hours were established, allowing more liberal visitation with families. Liberal visiting hours are supported through evidence and the issuance of a practice alert from the American Association of Critical Care called, *Family Presence: Visitation in the Adult ICU*

(Bell, 2011). Many of these newly encouraged behaviors have met resistance from some of the strong opinion leaders, who have longevity in the ICU; newer and younger clinicians have adopted them much more easily. Different strategies have occurred to assist the stronger opinion leaders to adapt to these changes. Changing culture is exhausting, but it is the work of leadership; consistent and constant follow-up helps with the adoption of new behaviors.

Another concern voiced by the clinical staff was the need for additional staff to be available and assist when help is needed, reducing a sense of isolation and a lack of teamwork. This identified position would be considered a float nurse without a patient assignment. The float nurse would also be assigned charge responsibilities and would perform surveillance for the entire unit, rounding with patients and families, and assisting for consults, emergencies, and urgent patient care needs (see Appendix M: Incremental Staffing).

Much time was spent on the design phase and modifications of the new ICU rooms and spatial floor layout. Despite all of this planning, there were some design features that were a surprise. The first, one thermostat was place for every two rooms with adjustments limited to plus or minus three degrees. Unfortunately, there will probably be one patient unhappy with the room temperature. The centralized lighting features were the second surprise. The central lighting around the perimeter of the nursing station for the entire unit was extremely bright and could only be turned either on or off (see Appendix S: Design Feature Bathroom / Nurses Station [2]). The centralized lighting control for the nursing station also controlled the down lights in the “V” mini stations. The first night of occupancy in the new ICU, it was quickly discovered that all of the lighting was connected and not adjustable. Currently, this situation is being addressed by placing both the down lights and the centralized nursing station light on dimmer controls with wireless remote controls.

It has been said that most nurses will be lucky if they design one patient care unit in their lifetime. Designing this preeminent ICU has been an incredible learning experience for everyone. Many of the staff employed after the design and construction was completed may not realize the knowledge and thought processes for the design and features incorporated into this environment. Dissemination of knowledge in evidence-based design and why features were selected will be incorporated into critical care orientation through a Power Point session in the learning system. Included in this session will be how to accomplish monitoring and surveillance with all of the design features selected.

To assist others who may be designing a unit in the near future, dissemination of the lessons learned could best be published in a healthcare design journal or a critical care publication. The Society of Critical Care Medicine, in conjunction with the American Association of Critical Care Nurses and the American Institute of Architects Academy on Architecture for Health, co-sponsor a design citation award for critical care design (http://www.sccm.org/Member-Center/Awards/Pages/ICU-Design-Citation.aspx). The Saratoga Hospital application will be submitted for the next citation in August 2016. The awards are given to units with functional design that supports critical care. Brainstorming for the documentation has already begun. Many of these award-winning units have been utilized for research (Rashid, 2014).

Section V. Discussion

Summary

The key success was designing the contemporary and pre-eminent ICU for Saratoga Hospital, which will be utilized for many years. This goal was accomplished through iterative processes of listening and utilizing the ideas of multiple expert clinicians who work within the critical care environment. The concerns of the clinicians illuminated the functional design flaws. Overcoming these flaws required different solutions, like additional staffing or new technologies, such as electronic glass or Vocera devices. The effects of the

iterative process were measured through the HTVI study results, with the nursing workforce showing clinically significant changes in teamwork and communication post-occupancy in the new unit.

Another success has been the involvement of the multiple stakeholders. Through these efforts, many opportunities presented for fundraising endeavors. The overall outcome for the fundraising campaign was double the initial goal.

Throughout the design process, many lessons were learned. The first was the importance of clinical expertise in the evidence-based design process**.** The design of the unit would not be as functional or successful if the clinical experts were not included or involved. The second and very similar to the prior lesson was involving all of the stakeholders early in the process. This assisted with collaborative decision making, which could have had political overtures. The involvement of external stakeholders also provided the remarkable financial support harvested through the fundraising efforts. Linking the technologies with tangible fundraising efforts made the campaign efforts successful.

Living with design flaws will occur well into the future. Unfortunately, some of the design flaws occurred because it was difficult for the ICU design team to comprehend or assess the line-of-sight to patients without a physical presence. Other design flaws occurred because clinicians' opinions were not sought and others decided the options for thermostats and lighting. The lighting has been corrected with wireless dimmer controls. Unfortunately, the thermostats would require too much time and financial resources to change.

Relation to other Evidence

This project began with the premise of having a void in knowledge of evidence-based design. Consequently, an open web page was developed as a repository for the articles. Articles placed in the repository were about critical care designs, features for the environment, and certain pieces of equipment. There was a paucity of research concerning the line-of-sight and the three functions of hearing, seeing, and teamwork. Most of the articles about the line-of-sight listed in the evidence-based table were available in the repository. Despite the lack of evidence, most clinicians were able to describe the trepidation caused by a decrease in the line-of-sight.

Some of the other evidence not explored with much detail has been the environmental effect on teamwork. Teamwork and communication were components identified within the line-of-sight. Both of these functions were addressed with the Vocera technology. If team members cannot be seen or heard, the impacts within a healthcare setting can be devastating. However, the socialization aspect of teamwork has not been previously addressed. In some of the literature, socialization has been found to be an important component of teamwork (France et al., 2005). To avoid the untoward effects due to a lack of socialization, teambuilding efforts at Saratoga Hospital will need to be considered after acclimation to the new environment occurs.

Preliminary articles have been published concerning human factors engineering and critical care design (France et al., 2005; Harder & Marc, 2013). Research conducted by France et al. (2005) suggested safety concerns when an "inadvertent overemphasis is placed on patients' needs in hospital design" (p. 153), with the relationship between spatial design and the end users. They recommend engaging a human factors engineer into the design phase of critical care units. Signal detection theory, contextual cueing theory, and patient risk detection theory all support patient safety and would further enhance the efforts produced by human factors systems engineering. Research focused on these areas may contribute significantly to the environmental design in critical care and patient safety.

The current design at Saratoga Hospital is a marked improvement from the previously occupied unit. Many of the flaws were corrected in the new design. This was accomplished by engaging all of the clinicians to design the currently occupied ICU. However, involving a human factors engineer may have assisted and translated the line-of-sight to the architectural team, creating a superior design and decreasing some of the barriers encountered during the design process.

Barriers to Implementation/Limitations

The design and acclimation to a new critical care unit is a major undertaking for any hospital, because of the risk associated with the move, as well as the safety concerns associated with a high intensity environment. Any physical obstructions created by building structures or voice concerns for patient safety must be considered as a barrier in order to plan appropriately.

With any new equipment, educating the end user is critical for safe application. Moving into the new unit and operating out of this new environment is a risk. Compounding this unfamiliarity is the additional unfamiliarity with the multiple pieces of new equipment. Due to the vast and dynamic nature of this project, it was physically impossible to accomplish implementing all the technologies and education at the time of the move. Consequently, there has been a time lapse for some equipment with associated efficiencies.

Finances often times create barriers and may complicate new construction projects, creating tension between work groups and people with differing goals. This is especially true for the person responsible for the overall budget and the clinicians who know the functions and long term applicability of some of the more expensive features. Some initial design features were excluded immediately due to expense. There were two major features which created significant financial burden and required resolution and final CEO approval. The two features were the booms and the electronic glass. The booms were identified very early in the project and became a budgeted item. The electronic glass was a much later decision and, consequently, was a change order and budget variance.

Conclusions

Contemporary design in healthcare facilities has progressed towards decentralization and private rooms. This accomplishes increased patient satisfaction scores, as well as ease of patient placement and throughput. However, creating larger units has generated some unintended consequences, such as increased stress for nurses, decreased visibility, and inadvertent compromises to patient safety (France et al., 2005; Hua et al., 2012; Lu et al., 2014; Zborowsky & Bunker-Hellmich, 2010)

Teamwork and communication play a critical role in patient care. Spacious units with a decentralized nursing station design are locating healthcare professionals closer to the patients, but at greater distances from each other. These distances and physical building structures obstruct the line-of-sight and impede teamwork functions, which are critical for patient safety.

Critical care environments are dynamic and complex, with innate risks. The theories of contextual cueing, signal detection, patient risk detection, and surveillance all have significant relationship with patient safety and could provide invaluable insight for the field of human factors systems design. Maybe the next generation of critical care design will be the benefactors of such research.

Section VI. Other Information

Funding

Funding for the surgical services addition and the ICU has been supported entirely by the Saratoga Hospital budget. The total cost was $35 million, of which, the ICU expended $9 million. The project was funded through the purchase of bonds (Saratoga Hospital maintains a AAA- bond rating) and the remaining amount funded with equity.

Most not-for-profit organizations have the ability to fundraise, and simultaneously, with the groundbreaking ceremonies, the Foundation began a major strategic fundraising initiative within the Saratoga County community. A prominent Saratoga resident was named as chairperson of the Campaign for Surgical and Intensive Care Services. The original target for fundraising was set at $3 million. Currently the campaign has far exceeded expectations and raised slightly over $6 million.

An additional funding source was endowed when a grant application was awarded. The Capital District Physician Health Plan (CDPHP) is a not-for-profit health insurance with strong roots in the Capital District of NYS. The CDPHP has the largest market share for health plans within this community and as a not-for-profit also supports the community. The grant was written during the construction phase after the identified need for a new communication device was recognized. A meeting was attended by stakeholders from both Saratoga Hospital and CDPHP and a presentation was given in favor of the Vocera communication devices. The award for $365,000 was announced in December of 2014.

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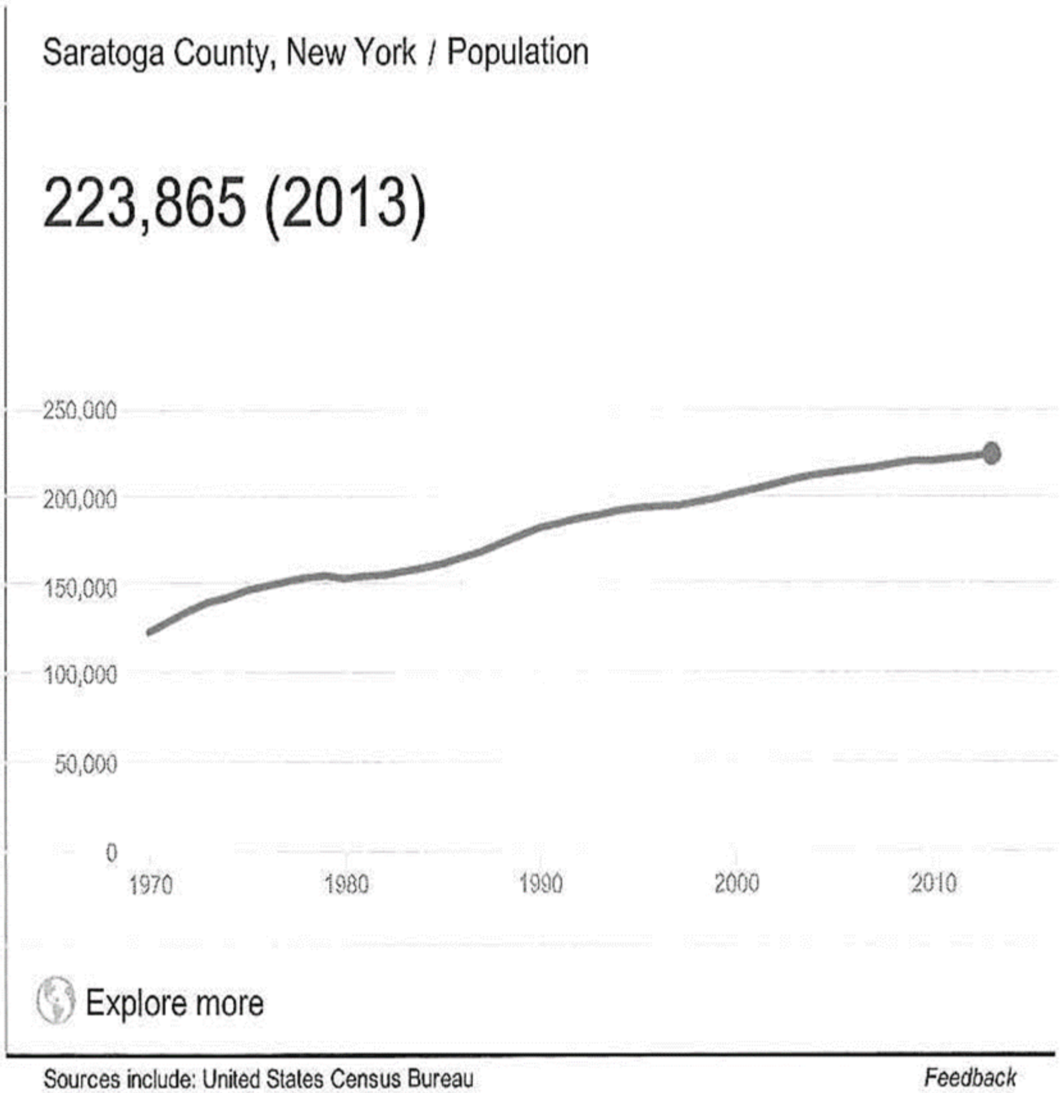
Section VIII. Appendices

Appendix A: Population Saratoga County



Appendix B: SWOT Analysis

Analysis of a new critical care environment

The below SWOT analysis is structured by political, economic, social, technological, legal and environmental factors. (PESTLE)

Strengths

Political

- Senior leadership and Board of Trustee supportive of long-range goal for new ICU and surgical suite expansion.
- City of Saratoga supportive of new construction.

Economic

- Business plan identifies a positive bottom line with the combination of new revenue generated by additional operating rooms from surgery
- Low maintenance cost for a number of years
- Gains from return on investments for the evidence based design features utilized
- Capacity increased to market additional services
- Increased nurse retention

Social

- Allow for an assessment of teamwork and communication in new environment and in old environment to determine effectiveness of technologies and other changes needed
- Community recognition and name branding
- Increased patient, family and staff satisfaction

Technological

- New open space is not restrictive to equipment and technologies. Ability to freely place design
- Incorporation of multiple new technologies

Legal

- Certificate of need to be filed with NYS Department of Health. CON reviewed by hospital attorneys and submission filed.

Environmental

- New environment is conducive for assessment and reassessment of systems and processes for improvements to use technologies for risk mitigation.

Weaknesses

Political

- Five additional beds to be staffed as a higher level medical-surgical patient acuity instead of true critical care beds creating possible discontent with existing critical care nurses.
- Clinicians lack positive perception for new environment. Regarded as unsafe due to inability to see and know what is going on within the unit.

Economic

- Potential exposure of new risks when older building structures are removed for the new design plans. Change orders has potential to be very expensive not knowing what is behind some of existing walls.
- Potential lack of incremental positive changes in pre-determined key metrics ie noise at night, nurses communicating well, decrease overall hospital length of stay creating decreased patient satisfaction affecting bottom line.

Social

- Teamwork and communication disintegrate within the new environment microsystem.
- Bordering neighborhood upset about traffic re-routing and noise from construction.

Technological

- Inability of technologies to interface together safely due to multiple proprietary vendors.
- Even when technologies can interface together, inability of the vendors to work together.
- Clinicians unable to adapt to multiple new technologies since many are technology immigrants.

Legal

- Increase risk due to traffic re-routing and large construction vehicles on site creating greater safety risk and need for regulatory approval.

Environmental

- Designated 2nd floor space was pre-determined not allowing for design around function, creating a large unit with 2 separate hallways.
- Environment is too large; need to increase staffing to accommodate consequently increasing operating dollars.
- Delay in opening due to mechanical, building, regulatory and change issues

Opportunities

Political

- Ability to market premier state of art technologies and new unit to community.
- Ability to seek donor's support for identified needs with new technologies and unit.

Economic

- Ability to capitalize on dollar savings from having evidence based design implemented.
- Ability to market reinvestment into the facility for improvements in the environment to workforce.
- Potential to decrease insurance costs because of risk reduction strategies.

Social

- A before and after survey to be completed by clinicians to assess changes in communication and teamwork.
- Ability to market to all clinicians the benefits of technologies utilized.

Technological

- To assess and maximize future technologies integration with current and future technology platforms.
- Ability to market all of the new technologies

Legal

- Potential decrease in liability

Environmental

- Once transition occurs to the new area an assessment of the new critical care environment by all clinicians to receive suggestions for alterations to be made in the new environment. This daily review should be viewed as a positive intervention to assist with adjustment to the new unit

Threats

Political

- Clinicians perceive new environment as unsatisfactory for safety due to impediments to teamwork and communication.

Economic

- Much higher operating cost for new critical care environment

Social

- Teamwork and communication deteriorate creating factions among clinicians.

Technological

- Technologies do not integrate creating work-arounds by clinicians minimizing safety features of new technologies.
- Adoption of new technologies may not occur because many of current clinicians are technology immigrants.

Legal

- Unable to obtain a certificate of occupancy
- Inability to pass NYS Department of Health inspection without alterations to environment
- Liability concerns with migration and updating of facility wide monitors.
- Liability concerns with moving from old unit to new unit.

Environment

- New environment may be seen as unsafe if teamwork and communication is identified as issues for patient safety.

Appendix C: Definitions of Terms

Critical care: The delivery of medical and nursing care to an individual who requires constant monitoring due to life threatening illness or injury. This usually occurs in a specialized unit with appropriate equipment and supplies. Care can be delivered elsewhere by deploying staff with the required skills. Also known as intensive care with the location being intensive care unit (ICU).

Evidence-based design: The concept of synthesizing and applying research to facilitate and influence the planning process that ultimately designs and constructs an environment which is safe, assists patients recovery, and provides a setting conducive for staff, patients, and visitors interacting within the environment.

Human factors system design: The work of designing systems (including work processes and technology) to improve human performance as human factors systems design; the term "human factors systems design" communicates that a systems approach is used when tackling problems, recognizing that phenomena occur within a system not as independent elements, and that ripple effects need to be carefully anticipated and considered when designing interventions to remediate or solve issues/problems (Harder & Marc, 2013, p. 152).

Healing environment: The result of a design that has demonstrated measureable improvement in the physical state of patients and/or staff, physician, and visitors.

ICU: Intensive Care Unit. The title Saratoga Hospital has used to designate critical care services in a environment combining medical/surgical and coronary care patient populations.

Line-of-sight: A term coined by clinical nurses for a quick assessment of a patient performed while multitasking, allowing clinical judgment to stop current tasks and mitigate risk, perform needed care or treatment to the patient. The area of a patient visualized by a clinical nurse usually includes the head and chest of a patient. The line-of-sight has multifactorial functions encompassing more than just "sight" inclusive of the visual function, an auditory function (hearing alarms), as well as team work functions involving communications and being able to obtain physical or consultative assistance. All three of these identified functions – visual and auditory fields and communication/teamwork availability – has significant impacts for potential patient safety issues.

Operating Room (OR): The area where surgery is performed

Appendix D: Healthcare Team Vitality Index[1]

The following questions ask you about your current work environment. Circle the number that most closely indicates the extent to which the item is present in your current job:

Please specify by checking the Respondent Type that most closely matches your position:

- ☐ Registered Nurse
- ☐ Case Management
- ☐ Unit Secretary
- ☐ ICU Technician
- ☐ Dietary Personnel
- ☐ Physician
- ☐ Respiratory Therapist

Circle the correct numeric response to each question:

Scale 1= Strongly Disagree 2 = Disagree 3 = Neutral 4= Agree 5= Strongly Agree

1)	I have access to the supplies and equipment I need to do my work on this unit.	1	2	3	4	5
2)	The support service to this unit responds in a timely way.	1	2	3	4	5
3)	I can discuss challenging issues with care team members on this unit.	1	2	3	4	5
4)	My ideas really seem to count on this unit.	1	2	3	4	5
5)	I speak up if I have a patient safety concern	1	2	3	4	5
6)	Care team members on this unit feel free to question the decisions or actions of those with more authority	1	2	3	4	5
7)	Important patient care information is exchanged during shift changes	1	2	3	4	5
8)	If I have an idea about how to make things better on this unit the manager and other staff are willing to try	1	2	3	4	5
9)	Care professionals communicate complete patient information during hand-offs.	1	2	3	4	5
10)	Essential patient care equipment is in good working condition on this unit.	1	2	3	4	5

[1] Permission to use tool obtained from Valda Upenieks, PhD, Research Scientist, Swedish Hospital, Seattle, WA.[1]

Appendix E: Evidence-Based Table

JHEBP Summary of Evidence-Based Design

Author/Date	Evidence type	Sample Size	Study Findings	Limitations	Evidence Rating	
Hua et al., 2012	Pre- and post-move research design	33 day shift RNs before the move; 68 day shift RNs after the move; Press Ganey HCAHPS score pre- and post- move	Patient satisfaction improved significantly on the 3 units, which moved. The control unit, the patient satisfaction remained the same. The decentralized nursing station did not improve nursing satisfaction. This was significant for younger and less experienced nurses. Using current evidence-based design in this study with decentralized nursing station not all the stakeholders equally benefit. While patient satisfaction increased nursing felt a loss of communication and teamwork.	Press Ganey score could not be stratified for specific patient care areas, results are one aggregate score. From the pre- to post-move data collection and number of organizational changes occurred, including one unit with a nurse leader change, a bed tracking system, an acuity system, and a new electronic care plan nursing were all implemented. Although nurses were surveyed before and after the move, there were natural turnover metrics, such as disabilities, vacations, and transfers that occurred.	3	A
Leaf et al., 2010	Retrospective study	664 patients in a high acuity city hospital	Patient mortality did not differ in low visibility versus high visibility rooms. Severely ill patients had higher mortality when admitted to low visibility rooms.	Single center design. Limited time frame of 1 year.	3	A
Lu et al., 2014	Conceptual replication study	664 patients in a high acuity city hospital	A 30% significantly higher ICU mortality in rooms with a small field of view.	Nursing skill level assumed to be equal. Field of view did not consider equipment.	3	A
Pati et al., 2008	Qualitative design	48 stakeholders in 6 different hospitals across the U.S.	This study explores the usefulness of flexibility for all stakeholders in 6 different medical surgical units. Flexibility was determined to affect the design of the unit. Line-of-sight and line to peers was identified as variables affecting flexibility by both management and caregivers.	Small sample size; exploratory in nature	**3**	**A**

Appendix F: Project Determination

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DNP Project Approval Form: Statement of Determination

Student Name: Diane Comeau Bartos

Title of Project: Architectural codes and the effects on team work and communication

Brief Description of Project: The latest rendition of architectural codes requires larger units due to square footage requirements from prior codes. This larger footprint challenges clinical nurses from using the common tool or the "line of sight" for a quick assessment hence creating a sense of trepidation. The "line of sight" has been a hallmark for a quick assessment by the clinical nurse who often is multitasking. The line of sight is often multifactorial encompassing more than just "sight". Lack of communication can be identified by a loss in the "line of sight" as well as the security of other team members close by. Identifying and mitigating the concerns for loss of sight, teamwork and consequently communication will allow a successful transition into the new critical care unit and promote patient safety.

Currently Saratoga Hospital is constructing a new 19-bed critical care unit. The basic design is linear in nature and three times the square footage of the traditional open-bay concentric design currently inhabited. Risk strategies will be implemented to mitigate concerns by optimizing technologies to enhance teamwork, communication and ultimately patient safety in the new critical care unit. A baseline measurement for teamwork and communication will be obtained through validated assessment tools in the current critical care area. The same tool will be used to measure after the move into the new unit. To monitor for quality, metrics already in place will be analyzed for variation.

A) Aim Statement:

To open a new 19 bed critical care unit by January 2015. We will accomplish this by implementing a multitude of technologies to enhance communication and teamwork therefore promoting patient safety.

We will accomplish this through the following interventions:

1. Education of new cardiac monitoring and alarm system for the clinical nurse and the ICU technicians.
2. Education of hands free communication devices for expedited communication

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simultaneously assisting with alarms management.

3. Education of workflow processes in the new unit.

4.

B) Description of Intervention: Education is the essence of successful implementation of all technologies. Consequently, each technology being implemented in the newly constructed critical care unit will require education and competency assessments.

B) How will this intervention change practice?

Hopefully teamwork and communication with the assistance from new technologies will enhance patient safety.

D) Outcome measurements:

Survey results of teamwork and communication before and after the move.

Monitoring of all quality metrics with emphasis on falls and family satisfaction

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

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

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

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Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

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

Project Title:	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.		
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.		
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.		
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.		
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.		
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.		
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.		
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."*		

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.

DNP Department Approval 5/8/14 3

UNIVERSITY OF SAN FRANCISCO | School of Nursing and Health Professions

STUDENT NAME (Please print):

____

Signature of Student:

____**DATE**____________

SUPERVISING FACULTY MEMBER (CHAIR) NAME (Please print):

____

Signature of Supervising Faculty Member (Chair):

____**DATE**____________

Appendix G: Letter for Name Disclosure

SARATOGA HOSPITAL
people you trust. care you deserve.

tel: 518.587.3222

211 Church Street
Saratoga Springs, NY
12866-1090

September 22, 2015

To Whom It May Concern,

Diane Bartos, MS, RN, is currently enrolled as a DNP student at the University of San Francisco. She is also a full-time employee at Saratoga Hospital, serving as the Administrative Director of ICCU and Interventional Cardiology.

Diane has permission to utilize and/or reference the Saratoga Hospital name and the Saratoga Hospital logo in any and all coursework associated with obtaining her DNP.

Please feel free to contact me with any questions or concerns at 518-583-8481.

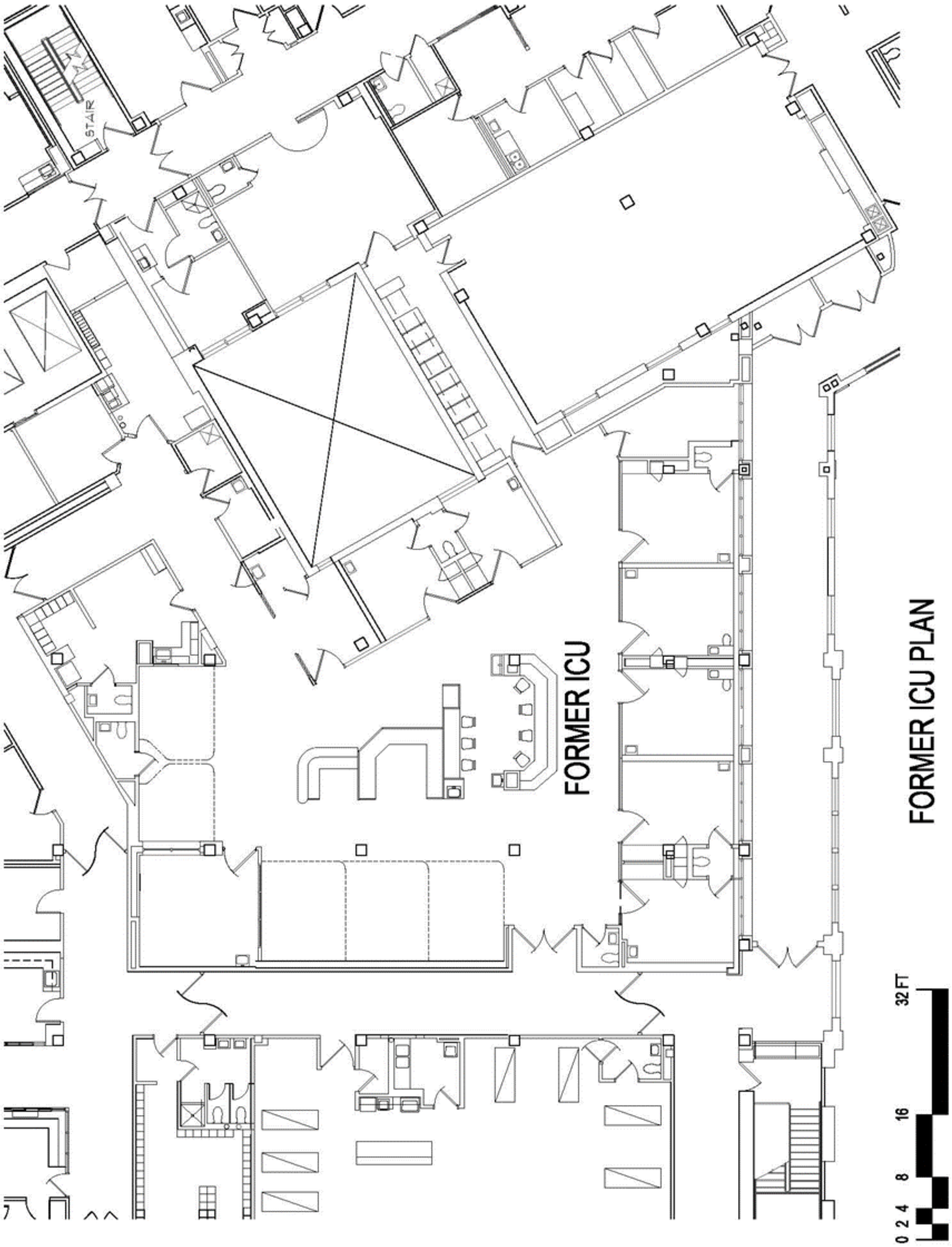
Sincerely,

Mary Jo LaPosta

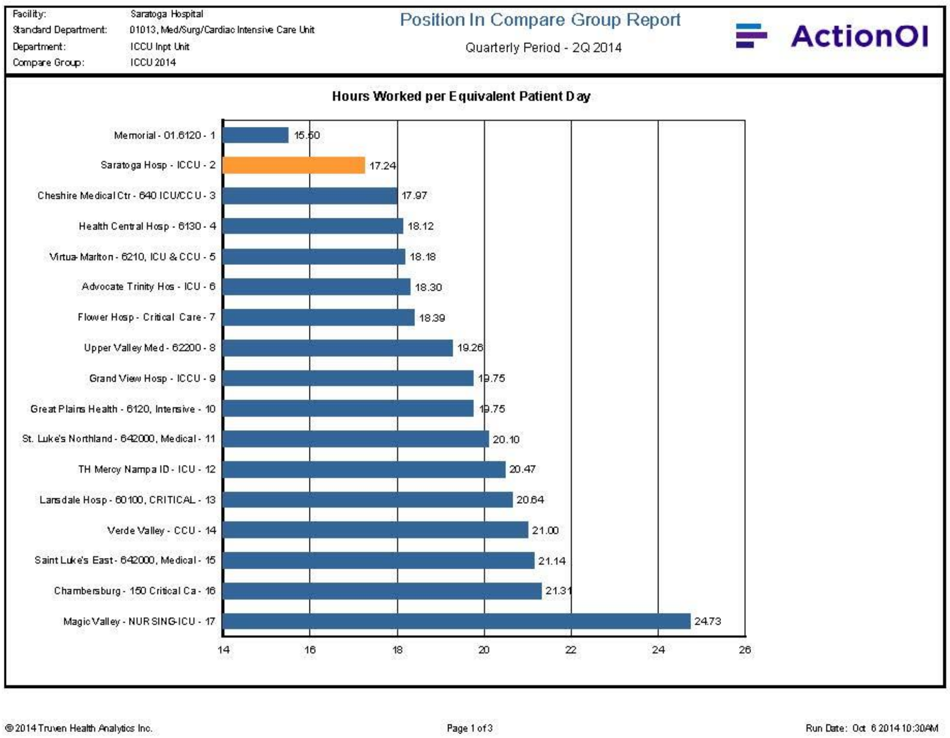
Mary Jo LaPosta
Senior Vice President/
Chief Nursing Officer

MAGNET RECOGNIZED
AMERICAN NURSES CREDENTIALING CENTER

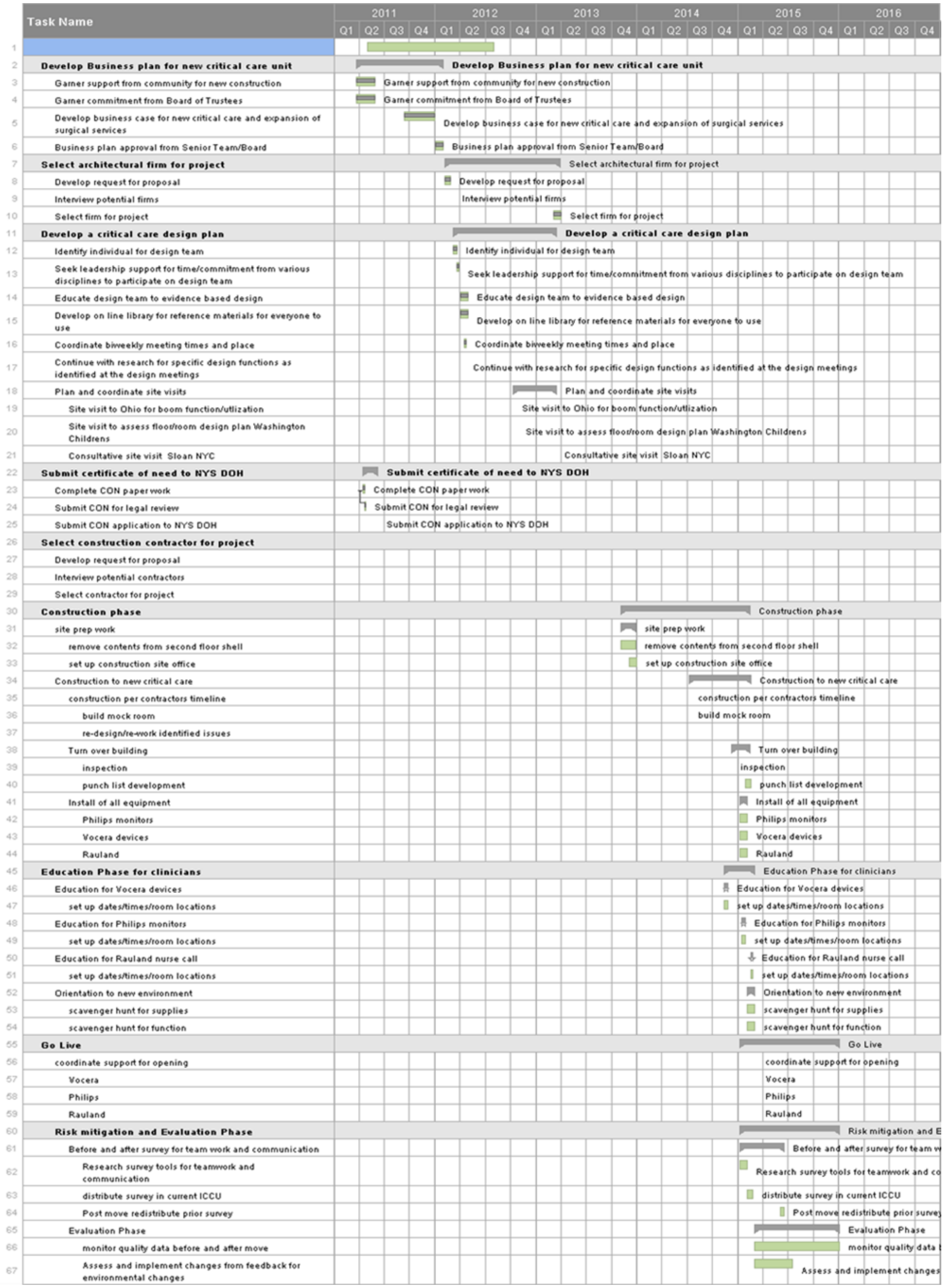
Appendix H: Previous ICU Floor Plan



Appendix I: Benchmark Data



Appendix J: Gantt Chart



Appendix K: News Media Open House / New ICU

THE SARATOGIAN

Friday, May 8, 2015 75 CENTS FACEBOOK.COM/SARATOGIAN TWITTER.COM/SARATOGIANNEWS sara

SARATOGA HOSPITAL

INTENSIVE CARE

Saratoga Hospital unveils $34M, 19-room expansion

PHOTOS BY J.S.CARRAS — JCARRAS@DIGITALFIRSTMEDIA.COM

Angelo Calbone, Saratoga Springs Hospital president and chief executive officer, and Diane Bartos, director of intensive care services, look on as Marylou Whitney and Dr. Desmond DelGiacco cut the ribbon during the dedication of the Marylou Whitney and Desmond DelGiacco, MD Intensive Care Unit Thursday at Saratoga Hospital in Saratoga Springs.

By Lauren Mineau
lmineau@digitalfirstmedia.com
@LaurenMineau on Twitter

SARATOGA SPRINGS » Intensive care isn't always a pleasant process, but Saratoga Hospital is hoping the new Marylou Whitney and Dr. Desmond DelGiacco Intensive Care Unit will be able to make the process as easy as possible.

Saratoga Hospital celebrated the new ICU Thursday with a ribbon cutting and open house. The new unit will bear the names of Saratoga's "first lady" Marylou Whitney and Dr. Desmond DelGiacco, a Saratoga Hospital doctor for more than 30 years.

"This is a great day," Dr. DelGiacco said. "Thank you for the honor, the privilege to continue to work here and practice here. I am humbled."

The $34 million expansion will house 19 private rooms with advanced medical equipment, from in-room dialysis and high-tech patient monitoring systems. Each of the spacious rooms have high tech features that benefit patients and their guests as well, including windows that fade from translucent to opaque and hand wash stations that eliminate stagnant water and a window to the outside in each room. Many features are both high-tech and aid in the reduction of infection.

EXPANSION » PAGE 2

POLITICS

GOP's Saffo runni for ma

Campaign to focus on job smart develo

By Lauren Mineau
lmineau@digitalfirstmedia.con
@LaurenMineau on Twitter

SARATOGA SPRINGS » John
himself a politician. But, he
of Saratoga Springs.
Safford, a Republican
nounced his candidacy for
at the Hampton Inn and Su
Lake Avenue Thursday. T
he's never run for office b
he said he is looking forw
a chance to make a change
city.
"It seems to be rules b
function, bickering and s
tion," he said. "It's clear to
back and take more of the
Safford works as a man
chairman of the Commun
stitute, where he manges
homeowners associations.
a business called Retco In
computer systems and soft
enforcement agencies. He

Expansion

FROM PAGE 1

The windows eliminate curtains, which can sometimes spread infection, upgrades to air handling systems also promote ideal temperatures for healing.

Those features were added after input from employees. Hospital officials said employees had input throughout the building process.

"Without everyone's input, this unit would not be where it is today," said Diane Bartos, director of intensive care services.

The project is one of the hospital's largest projects to date. In addition to the 19 patient rooms, the renovation also includes a surgical pavilion with 10 operating suites and areas for both preoperative and postoperative care. The waiting area is expected to be open in August and seven of the 10 operating suites soon after. The entire surgical pavilion is expected to be open by the beginning of 2016.

Angelo Calbone, Saratoga Hospital's President and CEO, said the improvements were in large part to the donations from the community. $6.5 million of the total project funds came from the community-wide Campaign for Surgical and Intensive Care Services. The campaign's goal is to raise $8 million by 2016.

The facility will also for less invasive techniques, faster healing, shorter waiting times and a more healing environment for patients and their families. The facility was built entirely using local labor, local engineers and designers and design input from employees at the hospital. The local influence even hangs in the waiting room, local artists contributed pieces to hang in the visiting areas.

"This has truly been the people's campaign," Calbone said. "We've had an overwhelming 1,440 donors to date contribute... Thank you all for your unwavering, loyal support of this hospital and this entire region we all call home."

Appendix L: Budget

Capital Costs
Proposal to Expand ORs & ICCU
2/28/2013

	Project Costs	
Construction/Renovation	3,169,206	
Design Contingency	324,979	
Construction Contingency	162,490	
A& E Fees	220,500	
Other Fees	59,400	
Moveable Equipment	1,384,200	
Telecommunications	180,000	
Subtotal		**5,500,775**
Capitalized Interest	325,346	
Deferred Costs	922,145	
CON Filing & Processing	17,860	
Total Project Costs		**$6,766,126**

Capital Costs
Proposal to Expand ORs & ICCU
2/28/2013

	Cost	Useful Life (Years)	Depreciation Year 1	Year 2	Year 3	Year 4	Year 5
Construction/ Renovation							
Space above ED							
ICCU Fit-up - 2nd floor	2,557,348	25	51,147	102,294	102,294	102,294	102,294
2nd Floor Connectors	540,347	25	10,807	21,614	21,614	21,614	21,614
New Addition at Cramer House							
Addition-Shell, Basement, Penthouse	0	25	0	0	0	0	0
2nd Floor Addition - OR Fit-up	0	25	0	0	0	0	0
OR Offices & Locker Room	0	25	0	0	0	0	0
PACU Renovation - Old Or Suite	0	25	0	0	0	0	0
Post -Op Renovation - C2	0	25	0	0	0	0	0
CM Fee	71,511	25	1,430	2,860	2,860	2,860	2,860
Moveable Equipment							
Equipment Estimate 2/20/13	1,296,000	7	92,571	185,143	185,143	185,143	185,143
Furnishings, Window Tx, Artwork, etc	54,000	7	3,857	7,714	7,714	7,714	7,714
Other Equipment							
Security Systems/Camera/Hardware/Keys	27,000	7	1,929	3,857	3,857	3,857	3,857
Signage - Interior/Exterior	3,600	7	257	514	514	514	514
Donor Signage	3,600	7	257	514	514	514	514
Telecommunications Equipment							
Computers, Phone, Networks, etc	180,000	7	12,857	25,714	25,714	25,714	25,714
A&E Fees/Soft Costs							
Design Contingency	324,979	25	6,500	12,999	12,999	12,999	12,999
Construction Contingency	162,490	25	3,250	6,500	6,500	6,500	6,500
Architecture & Engineering	220,500	25	4,410	8,820	8,820	8,820	8,820
Equipment Consultant	23,400	25	468	936	936	936	936
Civil Engineer	8,100	25	162	324	324	324	324
Other Consultants	4,500	25	90	180	180	180	180
Inspections - City/Construction	9,000	25	180	360	360	360	360
Interior Design Fees	5,400	25	108	216	216	216	216
Misc Soft Costs	9,000	25	180	360	360	360	360
Capitalized Interest	325,346	25	6,507	13,014	13,014	13,014	13,014
Deferred Costs	165,986	25	6,639	6,639	6,639	6,639	6,639
CON Fees	17,860	25	357	714	714	714	714
Total Project Costs	**6,009,967**						
Total Depreciation			203,964	401,288	401,288	401,288	401,288

Appendix M: Incremental Staffing

The Case for Intensive Care
Business Plan
Incremental Salary and Wages Schedule

Postion	*FTE's*	*Hours Per Day*	*Hours Per Year*	*Coverage Factor*	*Total Hours*	*Pay Rate*	*Total Dollars*
RN	3.00	24.00	26,280.00	1.16	30,484.80	$45.00	$1,371,816
ICCU Tech	1.00	24.00	8,760.00	1.10	9,636.00	$18.00	$173,448
Totals	4.00		35,040.00		40,120.80		$1,545,264

Appendix N: Profit and Loss Statement

The Case for Intensive Care
Business Plan
Incremental Revenue and Expenses

Profit and Loss Statement
The Saratoga Hospital
Forecast Statements of Operations
Proposal to Expand ICCU

	Per Case Values	1.03 Year 1	1.03 Year 2	1.03 Year 3	1.03 Year 4	1.03 Year 5	Cummulative	
Incremental Volume, (Based on Addition of 5 Beds)								
Inpatient Cases		339	486	486	486	486	2,283	**Input**
Incremental Net Revenue								
Inpatient Cases	$15,853	$5,374,167	$7,935,695	$7,935,695	$7,935,695	$7,935,695	$37,116,946	**Calculated**
Incremental Operating Expenses								
Variable Expenses:								
Salary & Wages	See Tab for FTE's	1,545,264	1,591,622	1,639,371	1,688,552	1,739,208	8,204,016	**Input on FTE Tab**
Employee Benefits	24%	370,863	381,989	393,449	405,252	417,410	1,968,964	**Calculated**
Medical Supplies	725	245,775	362,921	362,921	362,921	362,921	1,697,457	**Calculated**
Other Variable Expenses	850	288,150	425,493	425,493	425,493	425,493	1,990,122	**Calculated**
Total Variable Expenses		2,450,052	2,762,025	2,821,233	2,882,218	2,945,032	13,860,559	**Calculated**
Fixed Expenses:								
Non-Salary Expenses	450	152,550	225,261	225,261	225,261	225,261	1,053,594	**Calculated**
Minor Equipment	1,220	413,580	610,708	610,708	610,708	610,708	2,856,410	**Calculated**
Interest Expense		182,552	180,277	177,693	147,611	171,037	859,170	**Input**
Depreciation		203,964	401,288	401,288	401,288	401,288	1,809,115	**Input**
Contingency		100,000	125,000	150,000	175,000	200,000	225,000	**Input**
Total Fixed Expenses		1,052,646	1,542,533	1,564,949	1,559,867	1,608,293	7,328,289	**Calculated**
Total Operating Expenses		3,502,698	4,304,558	4,386,182	4,442,085	4,553,325	21,188,849	**Calculated**
Contribution Margin		**$2,924,115**	**$5,173,670**	**$5,114,462**	**$5,053,477**	**$4,990,663**	**$23,256,387**	**Calculated**
Net Income or (Loss)		**$1,871,469**	**$3,631,137**	**$3,549,512**	**$3,493,610**	**$3,382,370**	**$15,928,097**	**Calculated**

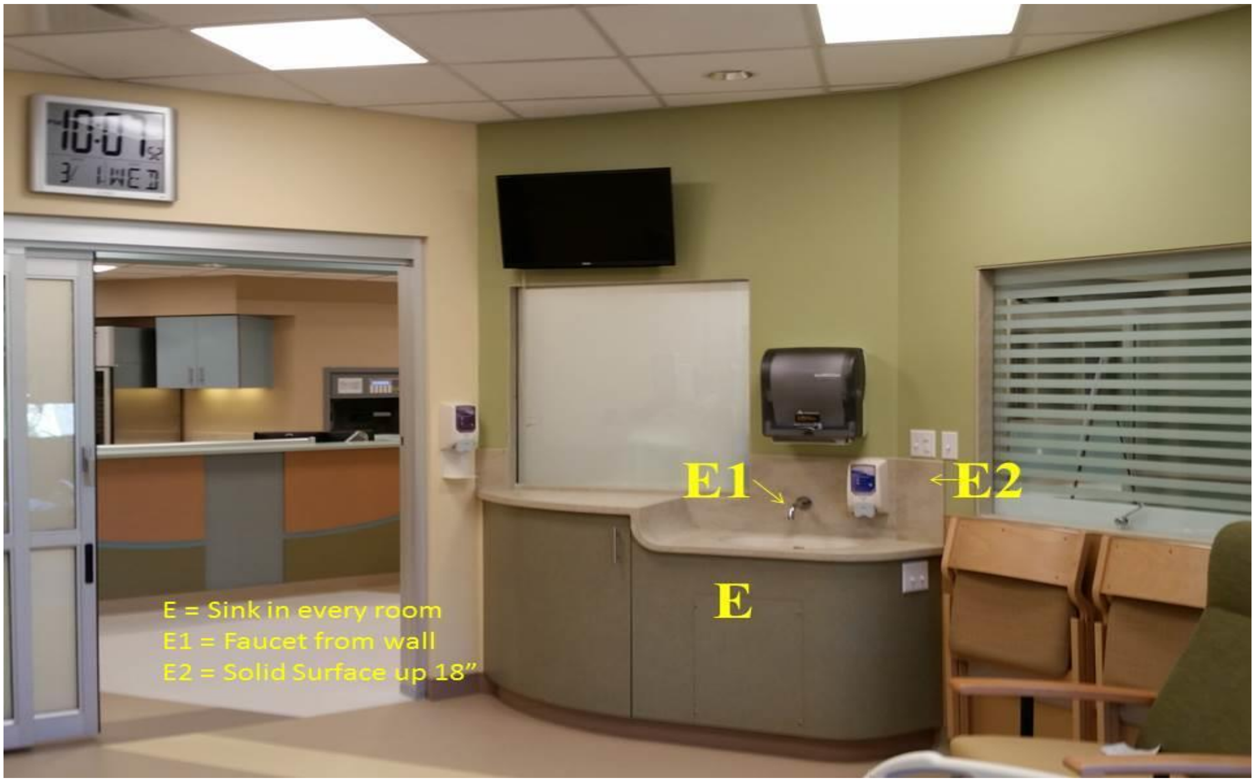
Appendix O: Table of Design Features

Feature letter	Feature	Quality/Safety Advantage	Reference for Evidence	Year of reference	Discipline recommending
A	Private Rooms	Decrease in infections	Teltsch et al.	2010	Architect
B	Large windows	Increased orientation, decrease pain	Keep Rashid Thompson et al	1977 2006 2012	Architect
C	Booms	Improved room flexibility to adjust to patient acuity, access to head of patient, no tripping on cords/wires	Pati et al. Rashid Thompson et al	2008 2011 2012	Nursing
D	Family waiting rooms	Family waiting rooms in close location to unit	Rashid	2006	Architect
E E1 E2	Sink in every room Faucets from wall Solid surface continues up wall	Promotes hand washing, decreases infections, decreases water pooling/splashing	Kaplan &, McGuckin Thompson et al	1986 2012	Nursing Architect
F	Dialysis connection	Decrease in infections	Bartley, Olsted, Haas	2010	Nursing
G	Family section within patient room	Promotes communication and trust with family members	Joseph & Rashid	2007	Architect
H	Monitor with internal personal computer	Decreases medication errors, increases timeliness of medication, allows access to EMR at bedside	Functional implementation		Nursing
I	Electronic glass	Increases visibility Removes curtains	Functional implementation		Nursing
J	Vocera communication devices	Improves communications, saves time	Functional implementation		Nursing
K	Decentralized nursing stations	Allows more time with patient, increased visibility			Architect
L	Nurse servers	Decreases travel distances	Functional implementation		Nursing
M	Patient/Family locker	Family convenience	Functional implementation		Nursing

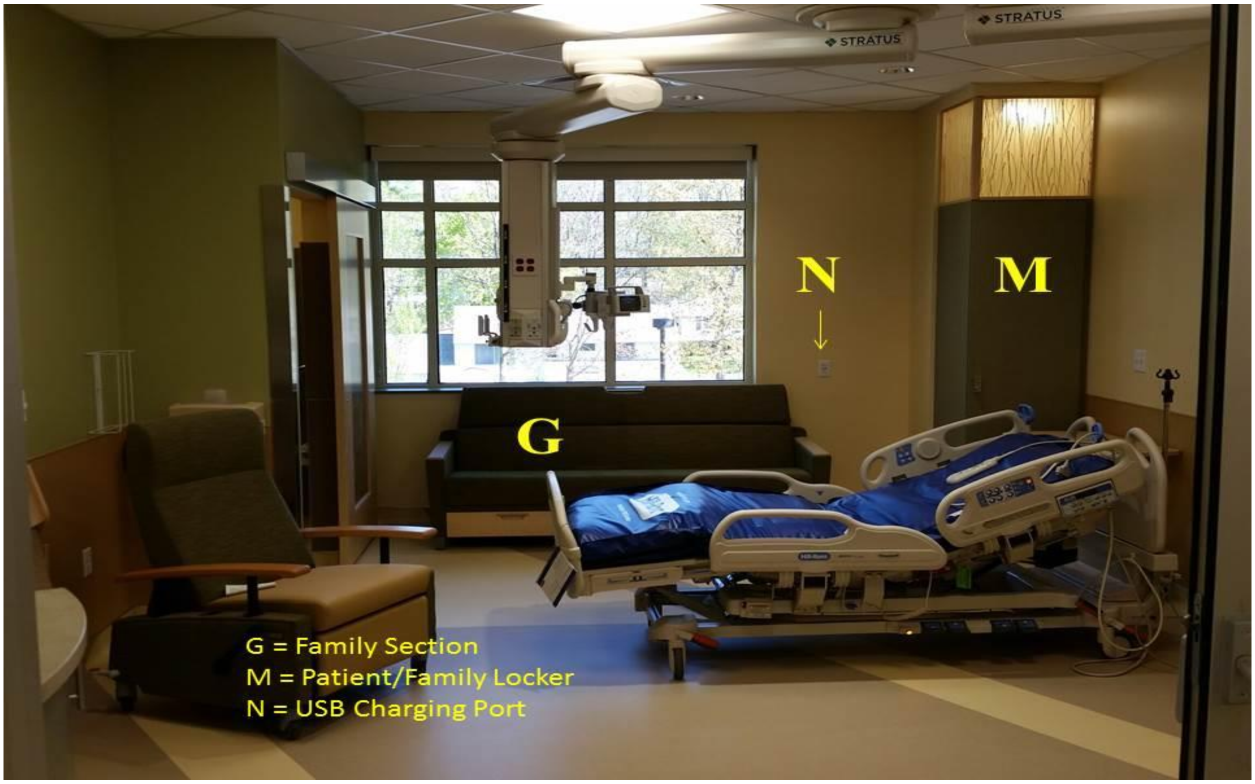
N	USB charging station	Family convenience	Functional implementation		Nursing
O	Bright perimeter lighting	Lighting for tasks	Thompson et al	2012	Architect
P	Decentralized Nursing station	Decreases travel distance Increase line-of-sight	Zborowsky & Bunker-Hellmich	2010	Architect
Q	Bathroom in every room	Decreases infections Decreases carrying waste Increase comfort for recuperating patient	Rashid Thompson et al	2006 2012	Architect

Appendix P: Design Feature Electronic Glass

Appendix Q: Design Feature Decentralized Nursing Station/Sinks



Appendix R: Design Feature ICU Room



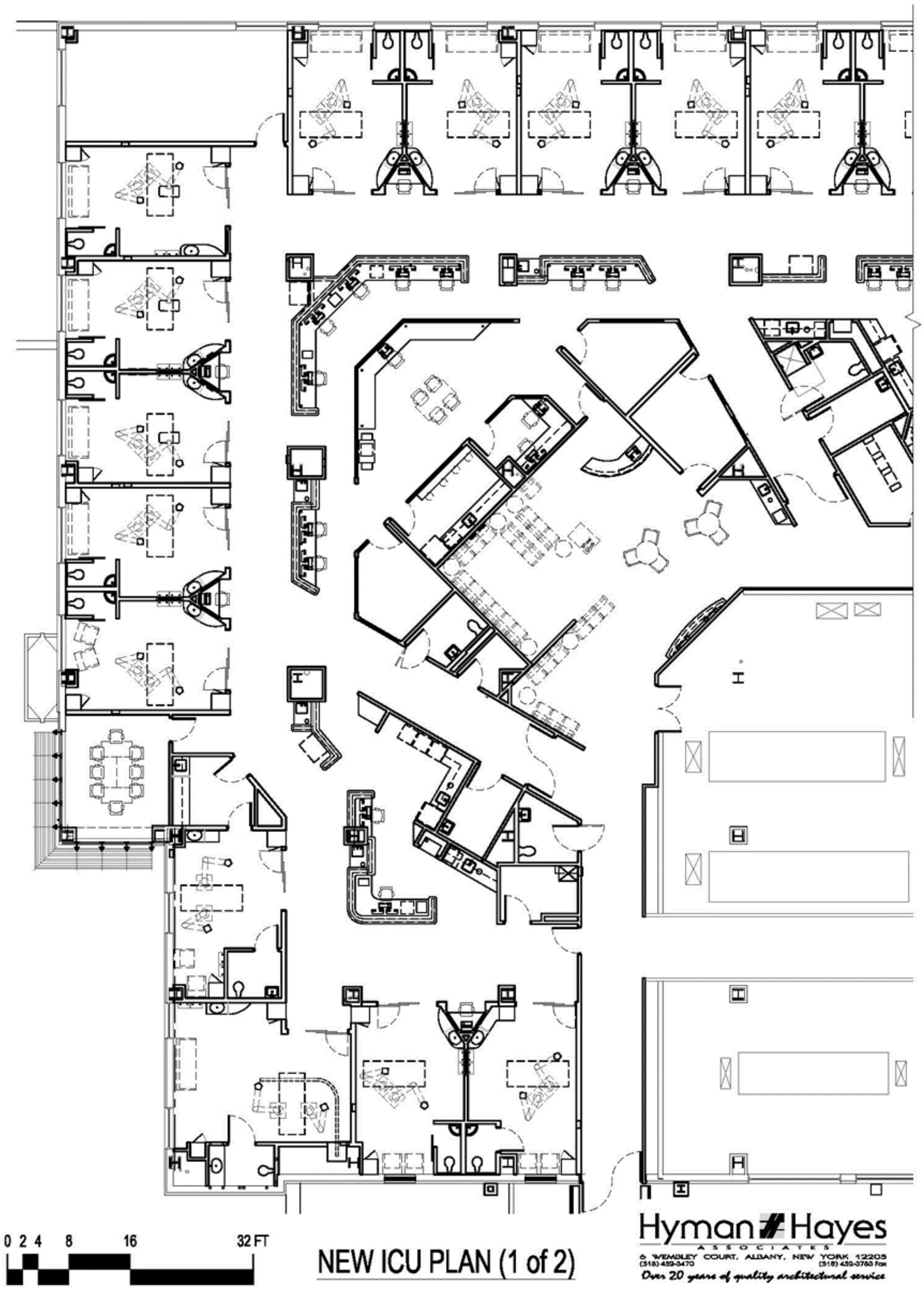
Appendix S: Design Feature Bathroom / Nurse Server

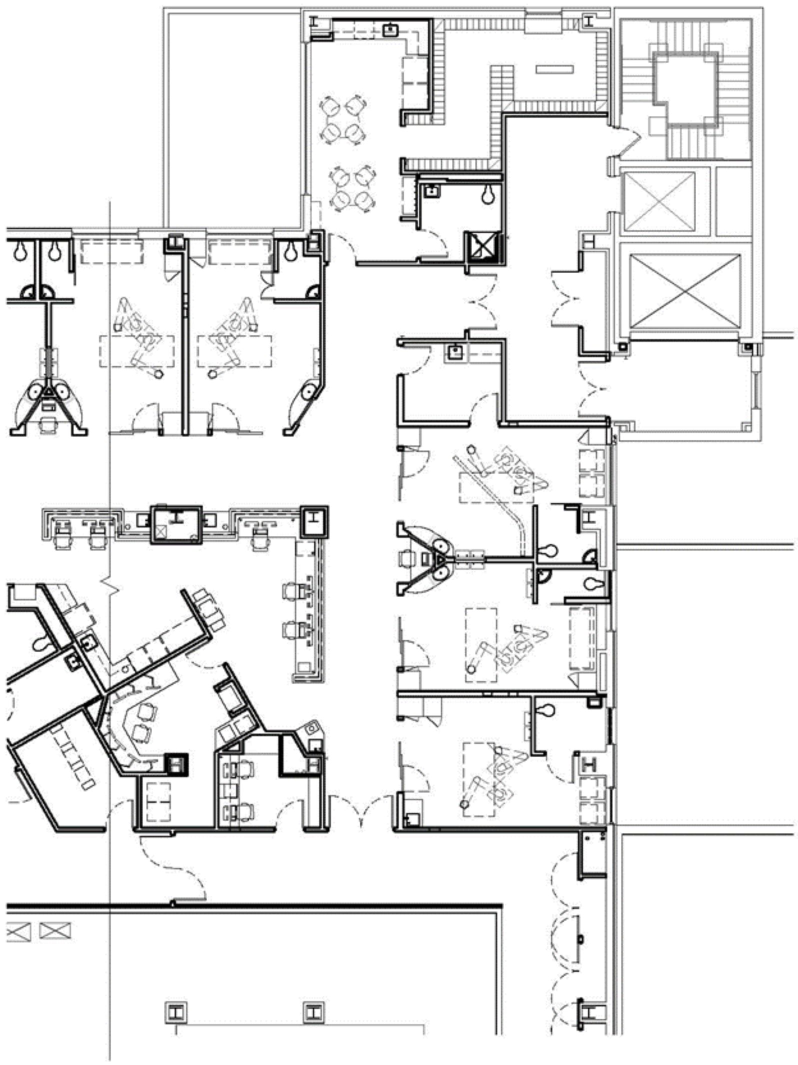
Appendix T: Design Feature Central Nursing Stations

Appendix U: Design Feature Waiting Room


D
D = Waiting Room

Appendix V: New ICU Plans





0 2 4 8 16 32 FT

NEW ICU PLAN (2 of 2)

Hyman Hayes
ASSOCIATES
6 WEMBLEY COURT, ALBANY, NEW YORK 12203
(518) 452-3470 (518) 452-3783 Fax
Over 20 years of quality architectural service

Appendix W: Final Monitor Plan

Saratoga Hospital
The following pages are running notes & discussions maintained by Mike Kauffman, Philips SDC related to the Saratoga Hospital PIIC iX Upgrade.
Questions/Comments should be directed to Mike at:
Michael.Kauffman@Philips.com
Last Updated 10/15/2014

ICU

- New 19-Bed ICU (PIIC iX Upgrade)
  - QTY-19 MX800's w/iPC.
  - FMS on 2nd Boom.
- QTY-1 24-Bed PIIC iX Dual Display Surveillance Station will be placed in CMR. 19" Displays will be supplied by hospital for this PIIC.
- QTY-4 PIIC iX Overview Stations will be located in the ICU.
- ~~Printing proposed is across firewall to Hospital LAN Printers.~~ 10/15/2014. Hospital will use Ethernet to USB adapters to feed their printers. They will be responsible for all configurations for this configuration.

Central Monitoring Room (CMR)

- CMR located in ICU
  - Watching ED, Tele Floor & Med Surg
  - ICU Surveillance (Listed above) will also be in the CMR.
- D1 – 48-Bed Telemetry Unit. The majority of tele patients are housed here.
- A3/C3/D3 – All on same level. Hospital *may* be able to move patients on these floors to D1 during network upgrade.
- QTY-14 or QTY-15 PC's will be located in this location in a rear section of the CMR.
  - Cabling will need to be 30' for furthest PC to Display/Keyboard & Mouse

Network Upgrade

- Network Upgrade from Ring to Star. Do as much in advance as possible.
- DBS's located in Main IT Room.

Additional Notes

Network Endo & SDS for EMR
IEM (Using Vocera) in conjunction with ICU Opening.
Hospital will use 3rd party interface to Meditech. Iatrics. IBE was not sold.
4 Total Floors in Hospital.
Wiring & Fiber by Hospital.
Removing remote PC's from Chapel Closet. PC's will be placed on floors.

Network and ITS Components on Order:

ICCU/Wireless Infrastructure:
QTY-12 AP's
QTY-2 POE Switches
QTY-1 APC
QTY-14 RA's
QTY-2 Sync

ICCU Order:

QTY-2 12-Port all SFP Routers
QTY-2 2960-S
QTY-4 2960-TC
QTY-8 100-Fx MM GBICs
QTY-8 1GB-Fx SM GBICs
QTY-20 Copper GBICs

Existing Hardware:
2nd Floor Closet: Old ICU, PACU/Recovery - QTY-7 AP's
APC APC3 – 172.31.241.2 – RF Code 66
2960TC Ports 25/26: 1-FX, 1-Copper – PACUEDGE3 – 172.31.0.14 – 1-17 10H, 18-24 100F – 10 Avail Ports
SYNC & POE UNIT
2960TT Ports 25/26: 1-Copper, 1 n/c – ITSEDGE2 – 172.31.240.13 -
2960TT Ports 25/26: 1-Copper, 1 n/c – ICUEDGE1 – 172.31.0.12 – 1-18 10H, 19-24 100F – 6 Avail Ports
APC APC2 – RF Code 66

Chapel Closet: RACK1
SYNC & POE Unit
2960TC Ports 25/26: 2-FX, - ITSEDGE1 – 172.31.240.12 – 1-6 10H, 7-22 100F, 23/24
2960TC Ports 25/26: 1-FX, 1 n/c – EDEDGE3 – 172.31.8.13 – 1-6 10H, 7-22 100F, 23/24
Only QTY-2 End-Devices are connected to this switch.
APC 172.31.241.0 – RF Code 66
2960TC Ports 25/26: 1-FX, 1 n/c – ICUEDGE2 – 172.31.0.13 – 1-6 10H, 7-22 100F, 23/24 SW-SW n/c's

Chapel Closet: RACK2 (Stand-Alone Nursery LAN)
2960TT Ports 25/26: 2 n/c,
SYNC & POE

Old Data Center:
SYNC & POE Unit
2960TT Ports 25/26: 1-Copper, 1 n/c – ITSEDGE3 – 172.31.240.14
- -
2960TC Ports 25/26: 2 n/c, - CATHSW1 – 172.31.0.100, 1-18 10H, 19-24 100F VLAN101
Juniper Firewall

3rd Floor Wireless:
2960TT Ports 25/26: 1-Copper, 1 n/c – ITSEDGE5 – 172.31.240.163

CMR Closet
2960TC Ports 25/26: 2 n/c, - EDEDGE4 – 172.31.8.14, 1-4 10H, 5-24 100F
2960TC Ports 25/26: 2 n/c, - ICUEDGE4 – 172.31.0.15, 1-4 10H, 5-24 100F

ED Closet
SYNC & POE Unit
2960TC – ITSEDGE4 – 172.31.240.15
2960TT – EDEDGE1 – 172.31.8.11 – 1-22 10H, 23-24 100F
2960TT – EDEDGE2 – 172.31.8.12 – 1-22 10H, 23-24 100F

Main Data Center
3550 Router
3550 Router
2960TC

2960TC
2960TC
2960TC

Questions / Discussion October 15, 2014
RF Code 66. Are there other RF Codes in use? - No
What goes to iX?
ENDO/SDS ____________
ICCU (New) ____________
CMR (New) ____________
TELE: D1 ______________; A3/C3/D3 ____________
PACU Monitors: ________
Nursery - Will remain as the only Non PIIC iX Unit. Remains a Rev. "L" PIIC Classic Stand-Alone Unit.
OR Monitors: Will not connect to a Central Station at this time.

Central Monitoring Room (CMR)

CMR Wiring: Philips will need to provide everything to remotely locate PC's where former SDC approved. 30' VGA Cables, USB Extenders, Very Long Patch Cables (f/USB Extenders) will be needed. **A PO Mod will be required for these devices.**

STP for USB Recorders. – YES! PO MOD NEEDED

PIICs in CMR: (All Connected to PIIC iX DBS)
ICCU: QTY-1 A24, Dual Display
B1: QTY-3 A16, Single Display (Total of 48-Beds)
A3/C3: QTY-1 A10, Single Display
D3: QTY-1 A10, Single Display
ED: QTY-3 A12, Single Display (Total 36 Beds)
Cath: Move existing S.Alone iX to CMR – Install new Overview in Cath Area.
- - - - - - - - - - Additional (Non- PII iX) PC's in CMR - - - - - - - - - -
QTY-1 Guardian Client
QTY-1 IEM Client

Order Summaries:

New ICU
QTY-19 MX800's
QTY-19 Wireless X2's
QTY-1 A24 PIIC iX DD SS S19 Video & UPS
QTY-2 2960-S GB Switches
QTY-4 2960TC Switches
QTY-8 100Fx MM GBICs ?
QTY-8 1GB SX MMF GBICs ?
QTY-20 Copper SFP's
QTY-2 UPS's
QTY-4 A24 PIIC iX DD OV S19 Video & UPS's
IEM Platform
QTY-19 SRL Cables & QTY-38 Faceplates ?
MX800 Mounting, X2 Mounting, PIIC Mounting - Hospital Provided

New ICCU/Wireless Infrastructure
QTY-12 AP's
QTY-2 POE Switches

QTY-1 APC
QTY-14 RA's
QTY-2 Sync
A07=$6,440
iX Upgrades
QTY-4 Classic Upgrade to iX A16 SD Surveillance Stations 3 Day FD
QTY-9 C67 ADI Upgrades
QTY-9 CX2 ADT Upgrade
QTY-20 MP30 "J" Upgrades HW/SW
QTY-4 MP70 "J" Upgrades HW/SW
QTY-3 Classic Upgrade to iX A16 SD Overview Stations
QTY-3 Classic Upgrade to iX A12 SD Overview Stations
QTY-3 Classic Upgrade to iX A08 SD Overview Stations
QTY-2 Classic Upgrade to iX A06 SD Overview Stations
QTY-1 Classic Upgrade to iX A12 SD Surveillance Stations 3 Day FD
QTY-2 Classic Upgrade to iX A12 SD Surveillance Stations 3 Day FD
QTY-2 Classic Upgrade to iX A12 SD Surveillance Stations 2 Day FD
QTY-6 MP5 "J" Upgrades
QTY-1 New PIIC iX A12 SD Overview Station
QTY-1 New Server iX Hardware & UPS
QTY-1 New PIIC iX A12 SD Surveillance Station
QTY-1 DBS Upgrade with Hardware & 12 30S Connections
QTY-1 DBS Upgrade Software for Web with QTY-1 3WE Session
QTY-2 MP5 Upgrades to "J"

PO's received for above.
No PO's received for: Surgical Services (Anes/OR); PACU; Pre/Op (Existing ICU Area); Endo/SDS (C2 Area, aka "Phase 2")

---------12/3/2014 Notes--------

As soon as possible: Philips to complete CAV!

Install Phasing:

1. Install as much new infrastructure as possible prior to patient/clinical moves.
   a. Philips to pull QTY-1 APC from old network and use (Install) for new network.
   b. Upgrade all bedsides to "J". (Including ED)
2. Hospital to confirm no monitored patients on 3rd floor.
   a. Philips - Move 3rd floor components to new iX Network.
   b. DO NOT TURN ON AP's.
   c. Est Time: 2 Hours.
3. Determine location of Master Sync and reconfigure IF needed. Found in Chapel Closet.

DAY#1: FTE in Old CMR for ICU & ED Hardwired Beds. FTE in New CMR

4. 0700 hrs - Disconnect ED Wireless.
5. 0715 hrs – Disconnect C2 and Old Data Center (Cath Lab) Closet.

Note: Only AP's on D1 working on old Classic Network.

6. 0800 hrs - Hospital will discharge, clear sector and move patients from D1 to the new ICU area. Patients monitored in new CMR. Patients will be seen in Old CMR until (1 at a time) discharged and admitted to ICU area wireless network where they will be seen in the New CMR.
   a. Note: Additional Overviews will be in place in ICU for monitoring as well.
   b. Hospital will supply MP5T's if desired while moving patients.
   c. All patients must be moved out of D1 before proceeding. May take 3 hours.
7. 1100 hrs - D1 Work Est Time: 4 Hours

a. Move D1 ITS Switch to new distribution pair.
b. Move QTY-2 Sync Units, APC and AP's to iX network.
c. Install QTY-3 new iX Overview Stations.
d. NOTE: ICU and ED Switch remain on Classic Network.
e. Turn on C3 closet components.
f. Ideally it is now 1500 hrs.

8. Move patients back to D1. Estimated to take hospital 2 hours.
9. Note: D1 and entire 3rd Floor & New ICU now on new iX network. Time is now 1700 hrs.
10. Move the final QTY-3 existing ITS Switches to the new iX Network.
    a. ITSEDGE4 – ED Closet
    b. ITSEDGE2 – C2 Closet
    c. ITSEDGE3 – Old Data Center Closet

End of Day #1. Still running QTY-2 Command Centers. ED and remaining house have wireless.

DAY #2: Note: In the rare event the hospital may need to staff both Old and New ICU.

1. Hospital Moves ICU patients to new ICU.
2. Philips to complete ED Work. (Note: Bedside SW Upgraded in advance)
    a. Move QTY-2 Switches to iX Network
    b. Install QTY-8 Overview Stations

End of Day #2.
DAY #3:

1. Cath Lab Closet & Hardwired Beds

-------------------END OF NOTES FROM 12/3/2014---------------------------------

1. Existing PACU moves to Old ICU
    a. QTY-10 iPC's were purchased for PACU MX700's.
2. Renovate Existing PACU (No monitoring in this renovated area)
3. Move PACU to final Location.

The following is the **Draft** Saratoga Hospital Patient Monitoring Implementation Plan:

Project Scope ICCU Wireless and Network:
Installation of ITS wireless coverage for the ICCU. (New telemetry system coverage includes the new ICCU, PACU, and transports corridors on the second floor. Refer to the attached Saratoga Coverage Area Document)
Conversion of the existing network from routed ring to star topology.
The customer will provide all cable, AP, & RAP installation.
APs & RAPs to be mounted above ceiling with antenna whips pointing down thru ceiling tile.
Wireless checklist to be completed with Tom and Bernie today.
Telemetry Stack Equipment to be installed in ICCU IT closet 2135. New stack equipment to be installed in new equipment rack by Saratoga.
Discuss PACU closet for potential equipment.
WMTS registration by Philips.
Conversion of the existing network from routed ring to star topology.
Equipment Delivery: 1/19
AP & RAP Delivery: 1/19
Cable Installation: to be complete by 1/12 (Saratoga)
AP Install: 1/19 thru 1/23 (Saratoga)
Education: TBD (Rich to provide a proposed Education Letter)
Install Prep: 1/26 thru 1/30 (IFSE and 3rd party support to be determined)
Staging Area: TBD
Technical Go-Live: 1/30

Project Scope New ICCU:
Installation of new monitoring system in the ICCU.

19 MX800 monitors will be customer mounted on mounting hardware that they will provide.
Remote rack cable termination for the 19 monitors.
New dual screen PIC to be installed in the monitoring tech room.
4 Overview PICs to be installed at nurse stations.
PIC displays to be provided by Saratoga.
Equipment Delivery: 1/26
Cable Installation: to be complete by 1/12 (Saratoga)
Education: TBD (Rich to provide a proposed Education Letter)
Training Equipment Set Up: TBD
Training Room: TBD.
Install Prep: 2/2 thru 2/20 (IFSE and 3rd party support to be determined)
Staging Area: TBD
Technical Go-Live 2/13
Go Live: 3/2

Project Scope Monitoring System Upgrades:
Overall System upgrade to PIC iX.
Upgrade all existing PICs and clients to PIC iX. (3 PIIC Classic Overviews D1, 3 PIIC Classic Overviews ED 3-12s, PIIC Classic Overviews ED 3-8s, PIIC Classic Overviews ED 2-6s, PIIC Classic Overviews PACU 1-12, PIIC Classic Overviews 1-AC 3C 12 & 1-D3 12, PIIC Classic Upgrade ED War Room, 1 PIIC Classic Overview Cath Lab, etc.) New PCs will be mounted on existing mounting equipment.
Upgrade 2 existing servers to new PIC iX server.
Upgrade the following bedside monitors to Rev. J.0:
ED 4 MP70s CPU & SW
ED 20 MP30s CPU & SW
ED 6 MP5s SW
ED 2 MP5s SW
Verify quantity of upgrades required.
Equipment Delivery: 2/2
Cable Installation: to be complete by 2/2 (Saratoga) verify infrastructure.
Education: TBD (Rich to provide a proposed Education Letter)
Install Prep: 1/26 thru 11/30 (IFSE and 3rd party support to be determined)
Staging Area: TBD
Technical Go-Live: 2/20

Appendix X: FMEA Meeting Minutes

Present:	D. Bartos, RN, Director of ICCU D. Cirillo, RN, Quality Manager B. Nikolski, Bio Med Desmond Delgiacco MD, Medical Director ICCU L Knapp, RN ICU	**Absent/Excused:** **None**	

Topic/Problem	**Discussion/Analysis**	**Conclusions/ Recommendations**
Review of minutes	No minutes to review Team formulation and dates were determined to meet and initiate a plan for transition from the current ICCU to the New ICCU and implementation of the new early warning monitoring system as well as all new equipment located on centralized boom workstations in the new ICCU. A central monitoring room is also in the plan design, along with IS integration of new computer stations. Multiple layers of planning and coordination were discussed and placed in motion once a staged planning session was completed. FMEA was completed to ensure safe risk reduced process for movement of the current ICCU to the new updated state of the art ICCU complete with central monitoring capabilities. The new ICCU has brought the implementation of an early warning system that was noted to be an opportunity for process improvement for patients housed externally to the ICCU as well.	Informational/ action items
Scheduling Subcommittee	Team member roster was established for future meetings / initial team meeting to develop a pathway for the full team process. FMEA Framework in progress	Informational and Follow-up
Consent Process	Senior Team EOC if required will be engaged throughout the process	Informational and Follow-up
Sentinel Event Mapping	The discussion was comprehensive of the following items that will need to be addressed internally and via Phillips who will be implementing the switch in tandem with the facility execution of the ICCU physical unit move. Those items are as follows: • Phone numbers / change and mapping old numbers to the new numbers in the event an old number is resourced roll over will take place for 6 months following the move. • Mass email notification of the move to all areas of the organization / utilization of the Amerilert system will be considered if possible. • Physical Man power – Scheduled staffing, (additional staffing) / facility departmental assist transportation, (respiratory therapy, nursing staff IS / ED, D1 , pharmacy , material management, OR and other units as determined), Bio med , all resources will be established and mapped out in accordance to patient acuity .Transition of critical patients will be determined by the Medical Director of ICCU and if required two units will run in tandem until the patients are stable enough for transport to the new unit. Nursing 1. Nursing 10 extra nurses / shift	Informational and Follow-up/ action items

	2. 20 extra shifts 3. Diversion Plan if required 4. Respiratory Therapy extra staff on that Mon/ Tue of the move to the new ICCU 5. Transportation assistance • Table top Education for visitors and staff sharing the timeline of events / move and open house for the new ICCU Unit. • Courtesy letters to patients families currently in ICCU at the time of the move. • Discussion on the grade / ramp for moving patients to the new ICCU and will look at utilization of freight elevators if required / Infection Prevention will provide input on physical needs related to cleanliness if that option is utilized. • Mock bed trial in the elevator will be completed in advance of the move in the event that option is required. • Ramp into ICCU will be marked as threshold was noted to be incomplete at the time of this meeting , will ask for engineering to assist in assembling a transition threshold for ease of transport and safety. • Equipment – Education session prior to the move related to new equipment 1. Phones 2. Pre-stock all rooms / materials management 3. Beds (5 Different than the current beds in use)(beds are same size /same mobility) 4. Doors 5. Nurse Call System 6. Monitor equipment- staff and provider education 2 weeks / 24/7 education by Philips /Training attendance sheets/Respiratory Therapy training as well Ventilators plug into swing arm system. 7. Phillips will be onsite for the move all three days to ensure conversion of the monitoring system 8. Scavenger Hunt Training – Nursing Supervision / Staff Nurses/ Ancillary staff Security Nursing educators etc. 9. Open House – May 5 730-11/6pm-9pm May 7 1-4 pm Ribbon Cutting New ICCU waiting room 10. Volunteers at the doors of the New ICCU to assist patients and families when opened • Wizard Wall notes to write what went wrong in the process and use that for process improvement • Post recognition unit specific staff and hospital employees that assisted in this ICCU move. • Please see detailed timeline of the ICCU Monitors and IS computer conversion that has been outlined and staged over a 3 day period of time to	

<table>
<tr><td></td><td>go live. Planning was completed preemptively with both internal departments and external companies involved in equipment install. Biomed was a leader in this process and coordination of the staging of this roll out.
Implementation of Voice activated messaging (Respiratory Therapy/ RRT /etc.)
Extensive discussion and planning with ED portable monitoring system to transport patients from the ED to ICCU /D1) was discussed and staged. Total number of available rolling monitors was determined and deployment discussed. Downtime was reviewed all details of Day1 – Day 3 staging discussed (see detailed staging plan/ monitor move sequencing).</td><td></td></tr>
<tr><td>Policies Required</td><td>It was noted that as part of the FMEA, policies currently in place would be utilized to support the transition.</td><td></td></tr>
<tr><td>Meeting Schedule</td><td>Meetings with the initial core group were initiated and additional meetings summarized within the body of this summary to memorialize plans and staging of events related to this critical transition and move..

FMEA Scoring : (Please see FMEA Scoring template for details)
Patient Safety -5
Patient Satisfaction -3
Outcome of care-5
Staff / Provider Education transition-5
Visitor safety-5
Visitor Satisfaction -3/4
Environmental Safety-5
Work Flow -4
Budget Operation-2
Compliance / Regulatory -3
5=Catastrophic effect
4=Long term effect
3=Moderate effect
2=Unlikely effect
1=Rare effect

The categories were prioritized as follows:

<u>Ranked under # 1 priority</u>
Patient Safety
Outcome/ Care
Staff / Provider Education
Environmental Safety
<u>Ranked under # 2 Priority</u>
Visitor Safety
Visitor Satisfaction
Workflow
<u>Ranked under # 3 priority</u>
Patient Satisfaction</td><td>Informational and Follow-up/ action items</td></tr>
</table>

	• Compliance Regulatory **Ranked under #4 priority** • Budget / Operational finances	

Appendix Y: FMEA Chart

Failure Mode, Effect, and Analysis (FMEA)								
ICU Move and Monitor Migration planned date 5-11-15								
How To:								
1.. Select a Process to evaluate.								

2. Select a multidisciplinary team. Include EVERYONE involved at any point in the process.								
3. Team meets to:								
3a. Flow chart the selected process as it is routinely conducted (the actual process)								
4. & 5. Identify and list the steps in the process where there is a difference between the intended and "real-worl" process, or where there is potential risk or known failure modes.								
6. List all potential (or known) failures during each step (or that may be "between" steps								
7. List causes of Failures								
8. Note the potential effect for each failure noted								
#9 1=insignificant; 2=short term; 3=moderate; 4=long term, 5=catastrophic;								
#10 1=rare; 2=unlikely; 3=possible; 4=likely; 5=almost certain								
#11 1=fully; 2= adequately; 3=moderately; 4=somewhat; 5=not at all								
#12 – Auto Multiplication								
#13 Prioritize Highest Score to Lowest Score								
5	6	7	8	9	10	11	12	13
Step or Link in process	**List all potential Failure Modes**	**List Failure Causes**	**Potential effect**	**Severity of effect**	**Prob-ability of failure-effect**	**Visibility of failure**	**Critic-ality (8x9x10)**	**Rank (Order 12)**
Patient Safety			5	5	5	1	125	1
Patient Satisfacton			3	3	3	1	27	4
Care/outsomes			5	5	5	1	125	1
Staff/Providers			5	5	5	1	125	1
Visitor satisfaction			4	4	4	1	64	2
Enviromental safety			5	5	5	1	125	1
Budget/ operations			2	2	2	4	12	5
Work flow			4	4	4	1	12	5
Regulatory compliance			3	4	4	3	48	3

Appendix Z: Healthcare-Acquired Infections

Figure 1

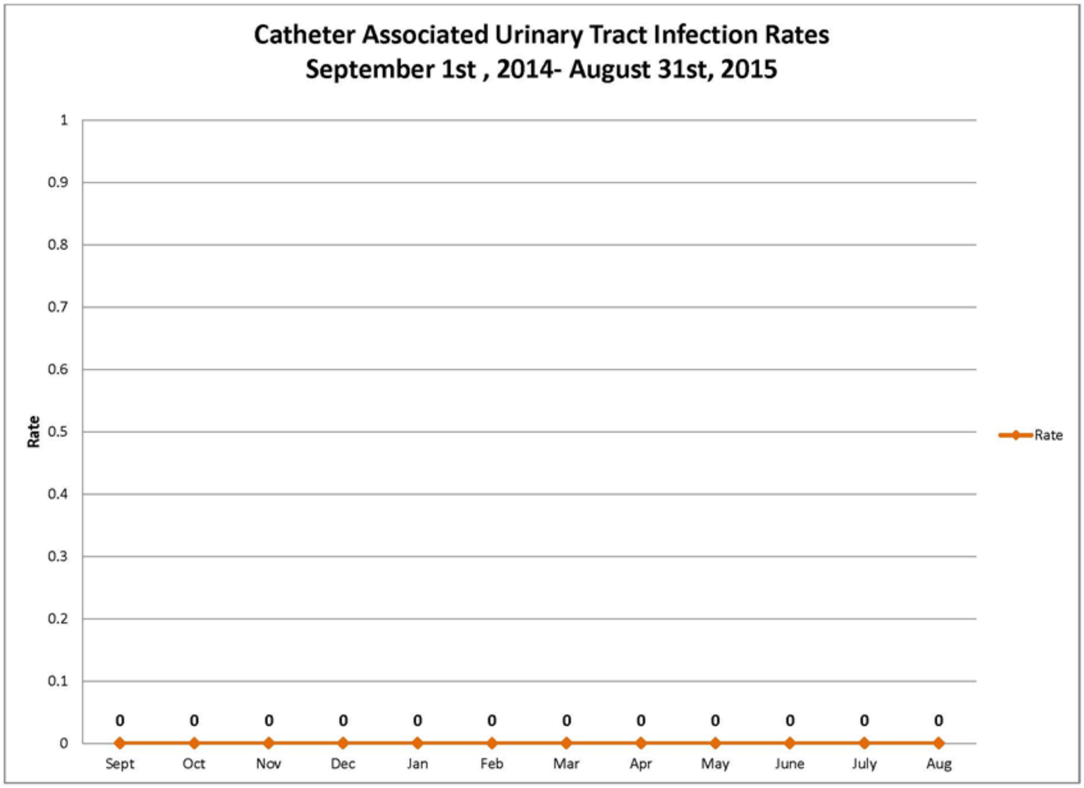
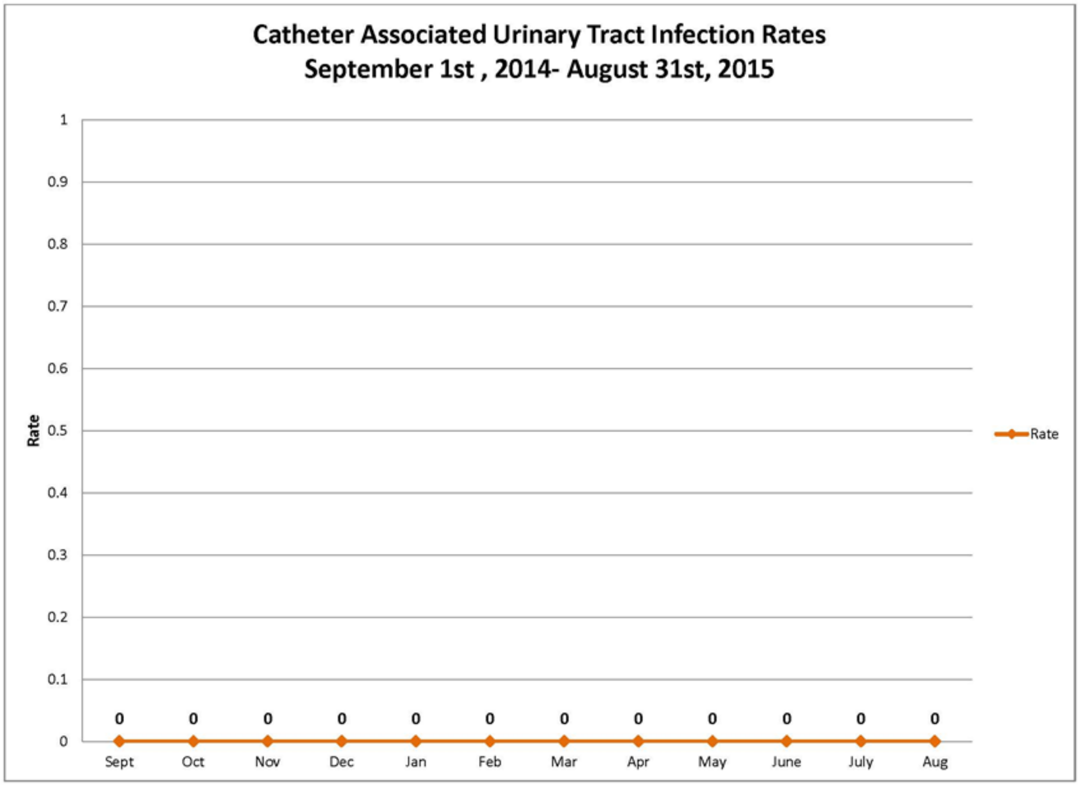


Figure 2


Catheter Associated Urinary Tract Infection Rates
September 1st , 2014- August 31st, 2015
Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 0 0 0 0 0 0 0 0 0 0 0
Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug
Rate

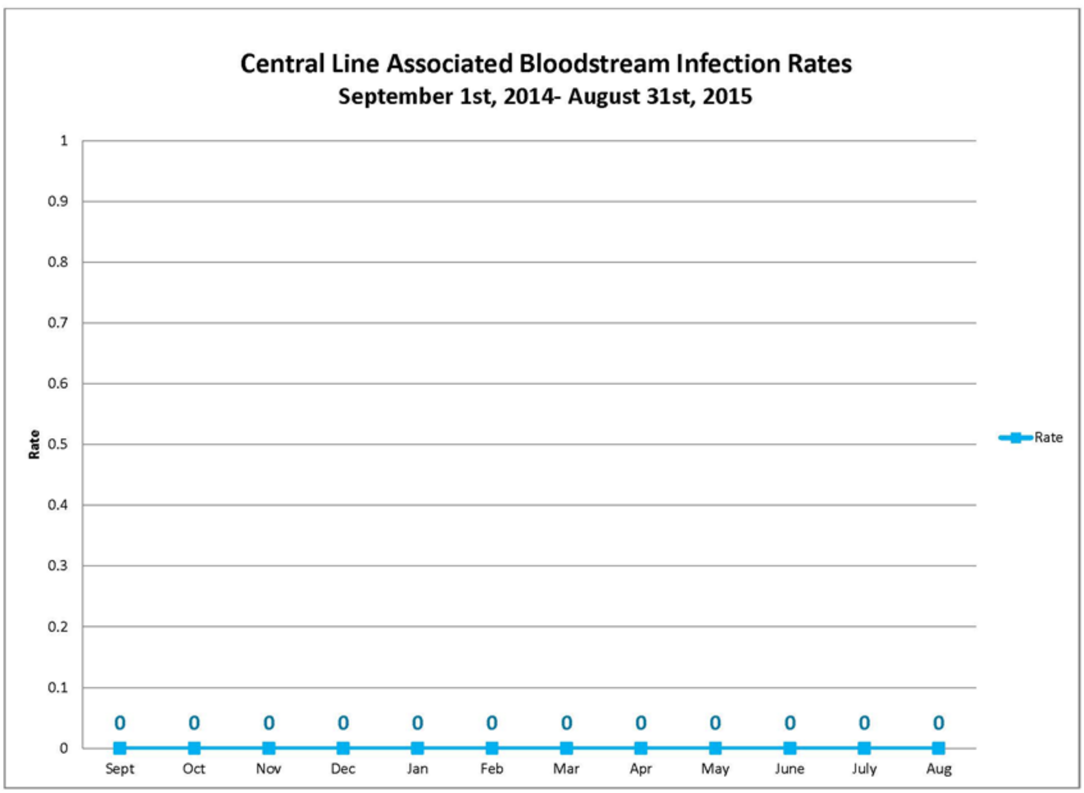
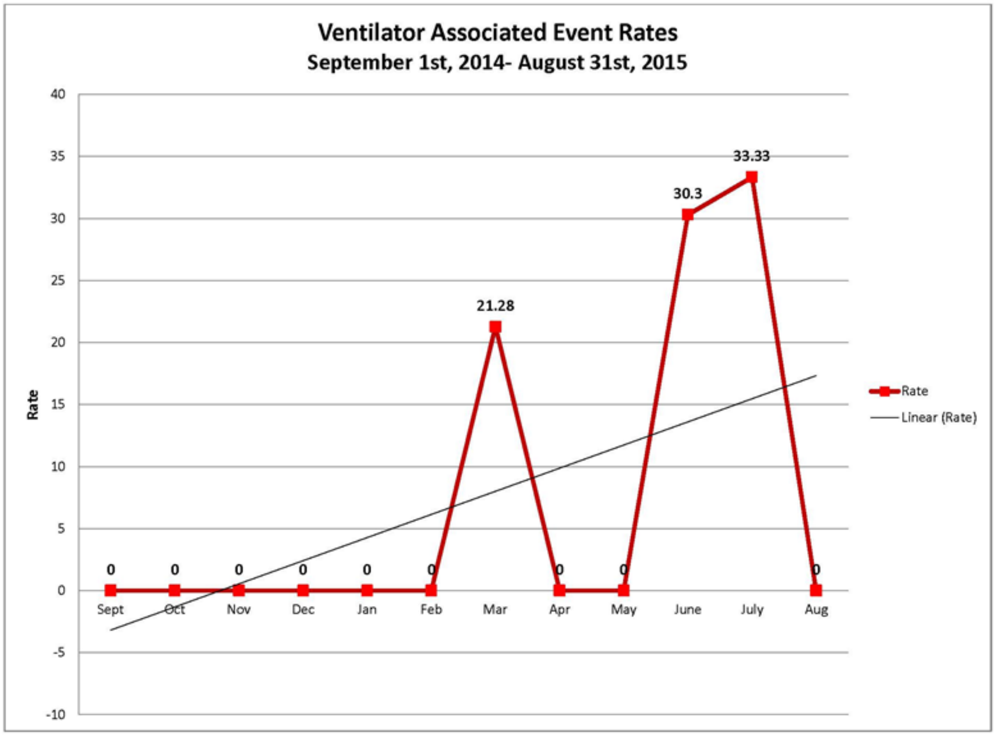

Central Line Associated Bloodstream Infection Rates
September 1st, 2014- August 31st, 2015
Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 0 0 0 0 0 0 0 0 0 0 0
Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug
Rate

Figure 3

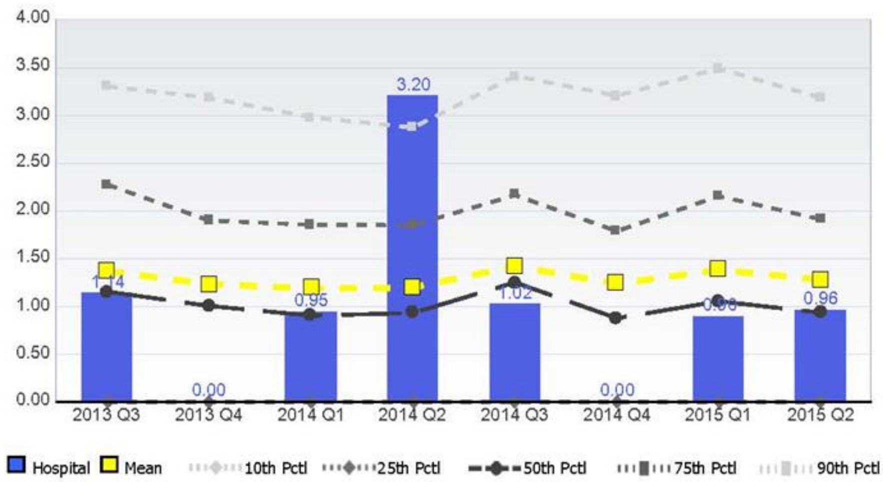

Ventilator Associated Event Rates
September 1st, 2014- August 31st, 2015
Rate
40
35
30
25
20
15
10
5
0
-5
-10
0
0
0
0
0
0
21.28
0
0
30.3
33.33
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug
Rate
Linear (Rate)

Appendix AA: Falls

NDNQI
A Press Ganey Solution

Saratoga Hospital

Compared by: Bed Size
Peer Group: Bed Size 100 - 199
Unit Type: Adult Critical Care
Unit: ICCU
Measure: Total Patient Falls Per 1,000 Patient Days



Quarter	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	Average
Unit	1.14	0.00	0.95	3.20	1.02	0.00	0.90	0.96	**1.02**
Mean	1.37	1.23	1.19	1.20	1.42	1.24	1.38	1.28	**1.29**
Standard Deviation	1.54	1.52	1.42	1.53	1.52	1.63	1.68	1.52	**1.54**
10th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
50th Percentile (Median)	1.16	1.01	0.90	0.93	1.25	0.88	1.05	0.94	**1.01**
75th Percentile	2.28	1.90	1.86	1.85	2.17	1.79	2.16	1.91	**1.99**
90th Percentile	3.30	3.18	2.98	2.87	3.41	3.21	3.49	3.18	**3.20**
# Units	473	472	469	468	469	475	481	476	**473**

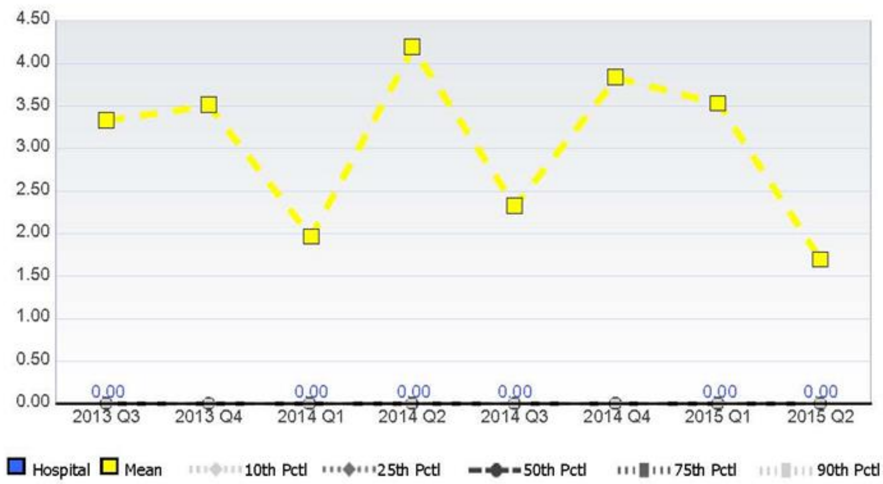
If the number of units or hospitals is less than five, comparison data are suppressed to maintain confidentiality. If the number of units or hospitals is less than 20, comparison data may vary substantially over the time period and should be used with caution. For additional information, please refer to NDNQI reference documents.

Appendix BB: Falls with Injury

NDNQI
A Press Ganey Solution

Saratoga Hospital

Compared by: Bed Size
Peer Group: Bed Size 100 - 199
Unit Type: Adult Critical Care
Unit: ICCU
Measure: Percent of Patient Falls that were of Moderate or Greater Injury Severity



Quarter	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	Average
Unit	0.00	No Data	0.00	0.00	0.00	No Data	0.00	0.00	**0.00**
Mean	3.33	3.50	1.96	4.18	2.32	3.83	3.53	1.69	**3.04**
Standard Deviation	15.44	15.08	11.12	18.97	13.50	16.56	15.85	10.24	**14.59**
10th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
50th Percentile (Median)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
75th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
90th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
# Units	285	269	277	287	312	288	299	298	**289**

If the number of units or hospitals is less than five, comparison data are suppressed to maintain confidentiality. If the number of units or hospitals is less than 20, comparison data may vary substantially over the time period and should be used with caution. For additional information, please refer to NDNQI reference documents.

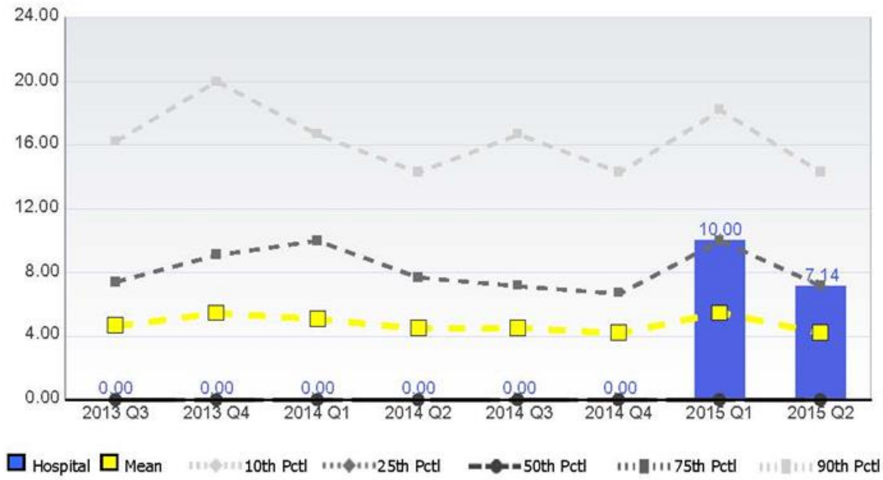
Appendix CC: Healthcare-Acquired Pressure Ulcers

5 of 14

NDNQI
A Press Ganey Solution

Saratoga Hospital

Compared by: Bed Size
Peer Group: Bed Size 100 - 199
Unit Type: Adult Critical Care
Unit: ICCU
Measure: Percent of Surveyed Patients with Hospital Acquired Pressure Ulcers



Quarter	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	Average
Unit	0.00	0.00	0.00	0.00	0.00	0.00	10.00	7.14	2.14
Mean	4.64	5.44	5.09	4.48	4.52	4.19	5.48	4.19	4.75
Standard Deviation	9.23	9.79	8.76	8.72	8.51	8.92	9.34	8.48	8.97
10th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50th Percentile (Median)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75th Percentile	7.42	9.09	10.00	7.69	7.14	6.67	10.00	7.14	8.14
90th Percentile	16.23	20.00	16.67	14.29	16.67	14.29	18.18	14.29	16.33
# Units	460	455	454	450	465	458	461	453	457

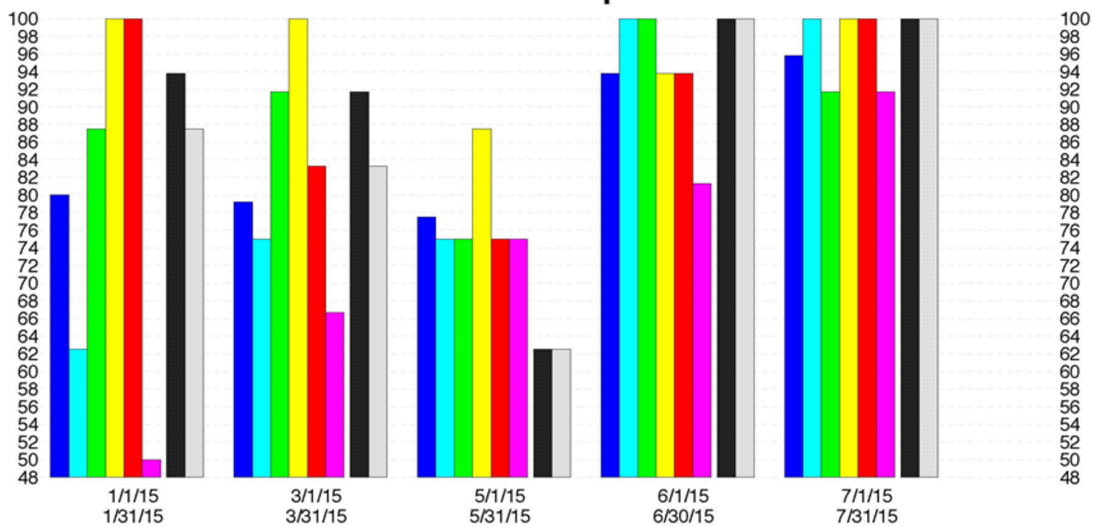
If the number of units or hospitals is less than five, comparison data are suppressed to maintain confidentiality. If the number of units or hospitals is less than 20, comparison data may vary substantially over the time period and should be used with caution. For additional information, please refer to NDNQI reference documents.

Appendix DD: Press Ganey

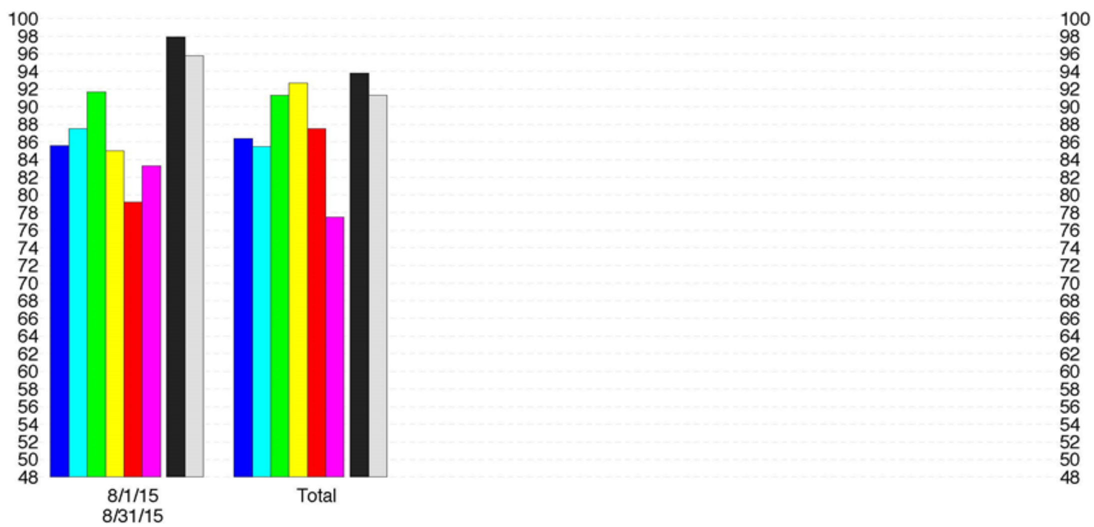
Saratoga Care infoEDGE

INPATIENT REPORT

Mean Graph



Room
Pleasantness of room decor
Room cleanliness
Courtesy of person cleaning room
Room temperature
Noise level in and around room
Visitors and Family
Accommodations & comfort visitors



Room
Pleasantness of room decor
Room cleanliness
Courtesy of person cleaning room
Room temperature
Noise level in and around room
Visitors and Family
Accommodations & comfort visitors

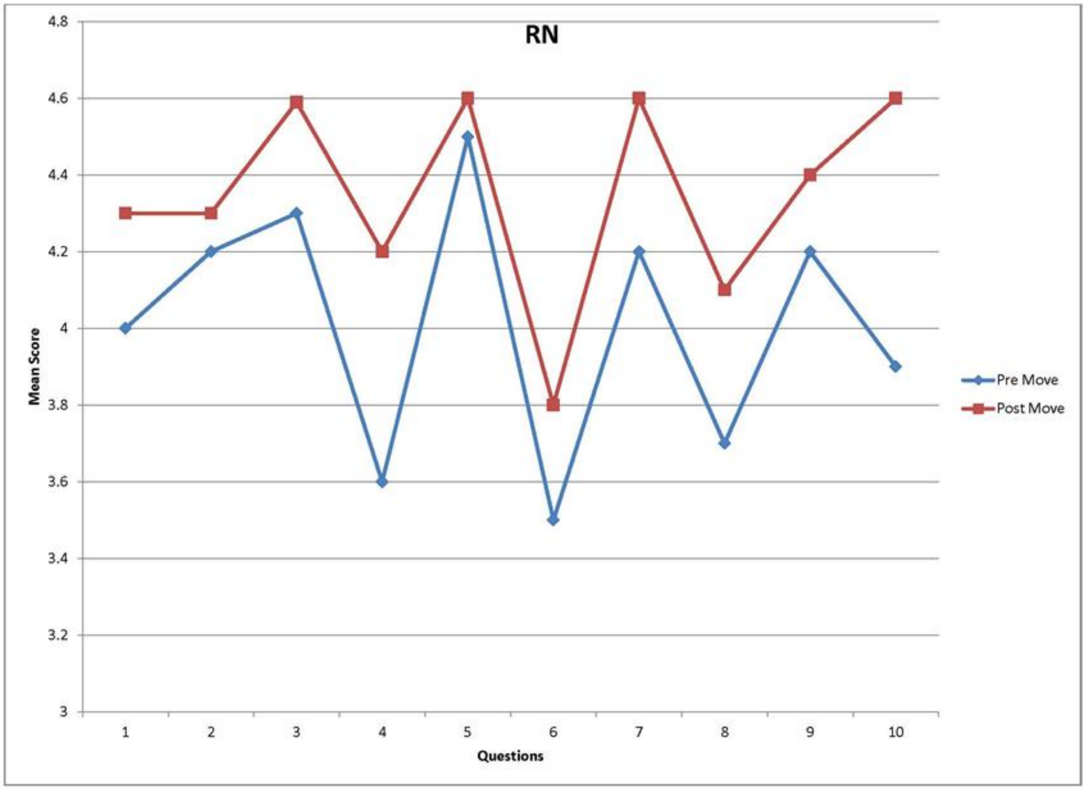
10/02/2015 21:06:20 EST

PRESS GANEY

For a list of filter and benchmark definitions, click here.

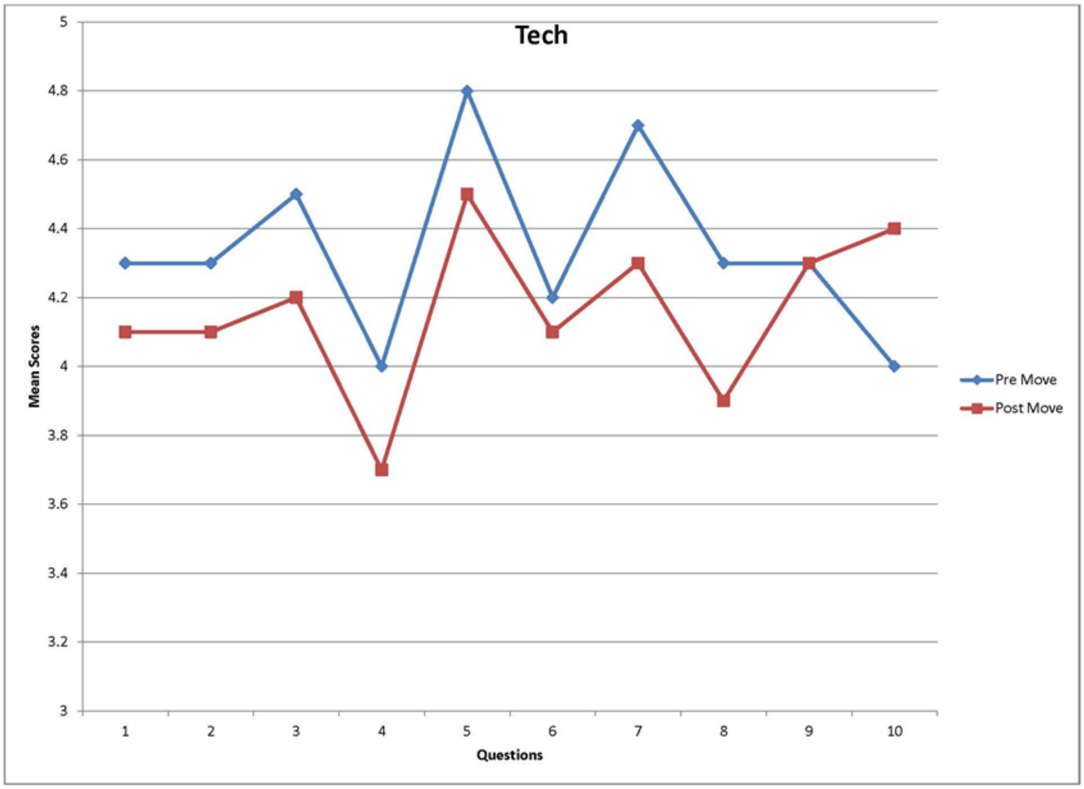
1-800-232-8032

Appendix EE: RN Results from HTVI



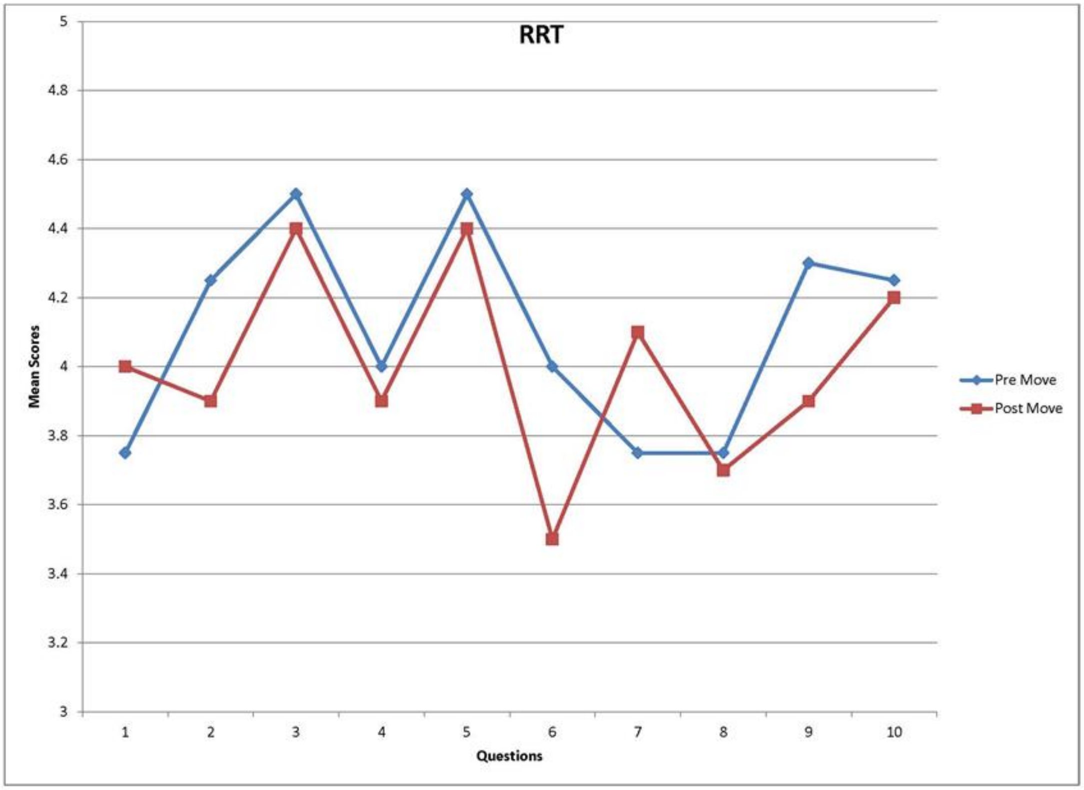
	All respondents			RN respondents		
	Pre move total avg	Post move total avg	Change	Pre move total RN avg	Post move total RN avg	Change
n=	30	54	24	18	27	9
Question						
1	4.1	4.2	0.1	4	4.3	0.3
2	4.2	4.1	-0.1	4.2	4.3	0.1
3	4.4	4.5	0.1	4.3	4.59	0.29
4	3.8	3.8	0	3.6	4.2	0.6
5	4.6	4.6	0	4.5	4.6	0.1
6	3.8	3.9	0.1	3.5	3.8	0.3
7	4.3	4.5	0.2	4.2	4.6	0.4
8	3.8	4	0.2	3.7	4.1	0.4
9	4.2	4.3	0.1	4.2	4.4	0.2
10	4	4.5	0.5	3.9	4.6	0.7

Appedix FF: Technician Results from HTVI



Tech respondents			RRT respondents		
Pre move	Post move	Change	Pre move	Post move	Change
total tech avg	total tech avg		total RRT avg	total RRT avg	
6	15	9	4	8	4
4.3	4.1	-0.2	3.75	4	0.25
4.3	4.1	-0.2	4.25	3.9	-0.35
4.5	4.2	-0.3	4.5	4.4	-0.1
4	3.7	-0.3	4	3.9	-0.1
4.8	4.5	-0.3	4.5	4.4	-0.1
4.2	4.1	-0.1	4	3.5	-0.5
4.7	4.3	-0.4	3.75	4.1	0.35
4.3	3.9	-0.4	3.75	3.7	-0.05
4.3	4.3	0	4.3	3.9	-0.4
4	4.4	0.4	4.25	4.2	-0.05

Appendix GG: Respiratory Therapy HTVI Results



Tech respondents			RRT respondents		
Pre move	Post move	Change	Pre move	Post move	Change
total tech avg	total tech avg		total RRT avg	total RRT avg	
6	15	9	4	8	4
4.3	4.1	-0.2	3.75	4	0.25
4.3	4.1	-0.2	4.25	3.9	-0.35
4.5	4.2	-0.3	4.5	4.4	-0.1
4	3.7	-0.3	4	3.9	-0.1
4.8	4.5	-0.3	4.5	4.4	-0.1
4.2	4.1	-0.1	4	3.5	-0.5
4.7	4.3	-0.4	3.75	4.1	0.35
4.3	3.9	-0.4	3.75	3.7	-0.05
4.3	4.3	0	4.3	3.9	-0.4
4	4.4	0.4	4.25	4.2	-0.05