CAPTURING NURSING EFFORT IN THE EMERGENCY DEPARTMENT TO IMPROVE SOCIOECONOMIC EFFECTIVENESS

by

Gai Cole

A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Public Health

Baltimore, Maryland
March, 2014
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Dissertation - Final: Gai Cole
I. INTRODUCTION

The Doctor of Public Health program administered through the Department of Health Policy and Management is focused on healthcare management and leadership\(^1\). Programmatic emphasis is on measuring, monitoring and improving the clinical and financial performance of health-services organizations, as well as the training of leaders for organizational change\(^1\). Per the guidelines of this program, I have selected the 'Workplace Challenge' option for the format of my dissertation. Under this format, I have completed a practice-based project focused on improving multiple aspects of organizational performance. The performance improvement effort was focused within the Department of Emergency Medicine at The Johns Hopkins Hospital.

The format of this dissertation follows the design of the workplace challenge as outlined by the Department of Health Policy and Management. This format is relatively new and somewhat uncharted and lacking in precedent. The layout for this workplace challenge involves first identifying an organizational need and then developing a plan for a new program or service to address that need. Programmatic design, and its rationale, are then followed by a description of programmatic evaluation. This evaluation includes evaluation design, program logic, and a discussion of results. Consequent to results, a depiction of organizational outcomes and impact is presented. This is followed by an economic evaluation of the study and its implications for program management. The economic evaluation largely takes the format of a cost-benefit analysis. The dissertation concludes with a discussion of implications and summarizes the lessons learned through the 'workplace challenge' experience. The role of leadership, implications for management, and policy implications are also examined.
BACKGROUND

The Department of Emergency Medicine has roots that began in the original “Accident Room” at The Johns Hopkins Hospital (JHH). As the use of ambulances was not yet prevalent, police patrol wagons would bring patients to this two-bed facility, where the injured were cared for free of charge.\textsuperscript{2} In the 1950s, Johns Hopkins created the Emergency Squad Doctor Plan, in which an on-call physician would go to an accident to provide on-the-scene patient treatment.\textsuperscript{2} The Emergency Medicine residency program at Johns Hopkins began in 1974 as a program within the Department of Surgery. In 1982, Emergency Medicine became a division within Surgery. In 1994, the Department of Emergency Medicine was established as a full, independent academic department within the School of Medicine,\textsuperscript{2} with Dr. Gabor D. Kelen as its first professor and chair.

Today, the Department of Emergency Medicine continues to grow. Emergency Department visits exceed sixty-five thousand patients per year, with FY13 volume at a record 66,527 patients (above the 50\textsuperscript{th} percentile for US academic and academic-affiliated teaching hospitals,\textsuperscript{3} that are included in the annual survey of emergency departments conducted by the Society for Academic Emergency Medicine’s Academy of Administrators in Academic Emergency Medicine). The admission rate ranges between 25.1\% (FY09) and 22.2\% (FY12). (The FY13 rate was 22.7\%). In FY11, 29.2\% of The Johns Hopkins Hospital’s patients were admitted through the Emergency Department (ED).\textsuperscript{3} The Department’s clinical operations have recently moved into a new facility four times larger than where they began; the residency program expanded from three to four years; and research space expanded by 5,900 square feet in 2011.

In May 2012, the ED moved from a 50-bed facility (including 4 beds in hallways) to a new 73-bed facility with all private patient rooms. The 73 beds are comprised of 6 trauma, 16 urgent care, 26 acute care, 17 observation and 8 psychiatric beds, and place the ED in the ~60\textsuperscript{th} percentile of peer institutions for total licensed beds.\textsuperscript{3} In FY11, the ED saw 1,740 patients per bed, placing it well above the 75\textsuperscript{th} percentile of peer institutions.\textsuperscript{4} Current staffing is comprised of 90 provider (“provider” is a generic term encompassing physicians, physician assistants, and nurse practitioners) full time equivalents (FTE, a unit of 40-hour-per-week staff) (including residents), 89 nursing
FTEs, and 184 other FTEs. The ED has computerized radiography capability in each trauma room with view capability at every computer; bedside ultrasound; a radiology suite with direct radiography, dual scanning (2x128 slices) CT scanner, and a bariatric-capable MRI; and an electronic documentation and patient-management system.

The Pediatric Emergency Department is a separate entity from the “Main” ED. The two departments, however, currently share the same electronic documentation and patient-management system called Allscripts. Because of this fact, decisions that impact clinical documentation (for both providers and nurses) are typically made jointly since systematic changes impact both departments. In the context of this study, programmatic goals relate only to the “Main” ED. All of the planning and work regarding changes to the electronic system, however, were undertaken in a joint and collaborative fashion involving the aligned efforts of both emergency departments.

SIGNIFICANCE

Socioeconomic effectiveness is a measure of organizational performance relative to social, economic and workforce variables. Quinn et al suggest that this concept of effectiveness incorporates measures of financial output and profitability, human capital factors such as employee loyalty and job satisfaction, and social welfare. The program described in this dissertation was intended to improve socioeconomic effectiveness in the Department of Emergency Medicine. This was achieved by building a facility billing program that emphasized the full capture of nursing effort (by maximizing compensated work and documenting non-billable labor) to improve financial, human capital and social outcomes. Physician effort was outside the scope of the program, and beyond the scope of this dissertation.

According to Tang et al. in JAMA (2010), from 1997 to 2007 ED visits in the U.S. increased by 23.1%, while the U.S. population grew only 12.5% in that timeframe. Adults with Medicaid represented the segment with the largest increase in visits. During this same period, the number of EDs in the U.S. fell by 5%. The ED at The Johns Hopkins Hospital has seen roughly a 20% increase in volume between 1997 and 2012, with a 6% rise occurring between 2011 and 2012. Medicaid patients represent
the largest segment in the ED, rising from 33% of all patients in FY10 to 41% in FY12. The percent of patients who leave the ED without being seen by a provider (LWBS) is in the 75th percentile, while the percent of patients who leave against medical advice (AMA) is the highest in the nation for U.S. academic and academic-affiliated teaching hospitals.3 This is indicative of a system not able to absorb its input volume efficiently. Concurrent with these stressors, increasingly “managed care and government payers [demand] greater ED efficiency and lower costs.”6 Positive financial outcomes and alignment between staffing levels and clinical demand allow the ED to adjust to meet growing demand and maintain an efficient entry portal for hospital admissions. Societal reliance on ED care as a substitute for primary care necessitates preserving the viability of EDs, even in markets where they are programmed to lose money (such as at JHH).

Such challenges necessitate ever-improving financial outcomes and budget alignment, particularly if an ED plans to adjust capacity to meet growing demand. This is important at the hospital level because EDs generate “a sizable and growing portion of inpatient admissions,” contributing to the hospital’s economic viability.7 According to Sacchetti et al. (2002), “Revenue generated by ED visits is a major contributor to overall hospital revenue [sic],” generating 34% of total hospital charges.8 As an example, in FY11, 36.5% of total JHH discharges were initially admitted to the hospital through the ED, generating 28.1% of total hospital inpatient charges.9 These figures were even higher in FY13, with 40.7% of total JHH discharges admitted thru the ED, generating 30.4% of total hospital inpatient charges.9 Each EMS admission from the ED represents a total net margin of $971.10

As published in the proceedings of the 9th International Congress on Nursing Informatics, in the last 20 years, nursing workload and intensity in the U.S. have “soared.”11 From a workforce perspective, frustrations associated with increasing patient volume and patient complexity/acuity12 erode nursing morale,13,14 thus increasing staff turnover.15-17 Nurses at the JHH ED indicate that their morale suffers when crowding conditions adversely impact quality and timeliness of patient care.18 The year 2011 saw a nursing turnover rate of 43% in the JHH ED.19 The program proposed here, which emphasizes capturing nursing effort to better align staffing levels with patient demand, is hypothesized to improve human capital outcomes such as budgeted
nursing resources and employee satisfaction. This is significant organizationally, because staffing levels that are properly aligned with patient needs contribute positively to quality of care, staff and patient satisfaction, and patient throughput. This proposed work is also relevant from a societal perspective, as demand for emergency nursing is projected to increase in the context of a rising overall nursing shortage. The topmost recommendation for the emergency nurse workforce by Schriver et al. (2008) is to improve the workplace environment. They stated: “Key to improving the workplace environment is addressing the adequacy of nursing staffing within the ED” and “Meeting targets for appropriate ED nurse-to-patient ratios needs to be a priority for hospital administrators…” The endeavor proposed here comports exactly with this recommendation.

The project’s hypothesis – that maximizing nursing clinical care effort capture through a comprehensive facility billing program can improve socioeconomic effectiveness in the ED – has not heretofore been explored in depth, and evidence supporting this method has not been comprehensive. For example, a review of the literature about organizational, socioeconomic, economic, and cost effectiveness in the ED yielded studies related to clinical and cost effectiveness of assorted ED-based interventions on various patient types (e.g., asthma, chest pain, alcohol); socioeconomic disparities in care delivery or access to care; or to patient care efficiency as it relates to teamwork, wait times, patient throughput, patient satisfaction, etc. but not related to improving overall departmental effectiveness.

According to Baraff et al. in the Annals of Emergency Medicine, facility costs (which include nursing costs) comprised an average of from 34% to 42% of ED costs for all patients and averaged 50.9% of costs associated with “non-urgent” ED visits. Despite this, Williams (1996), and Grannemann (2006), pointed to the dearth of studies on exploring methods to manage facility costs, maximize billing for appropriate costs and enhance collections. While Leeth et al. (2004) reminded us that a “lack of [nursing] clinical documentation is a leading cause for denials and underpayments,” the literature related to billing practices and improvement in the ED is dominated by studies related to professional fee (physician) billing or to how ED nurses can support professional fee (informally “profee”) billing. Thus, literature on improving
documentation in the ED tends to focus not on nurses, where effort capture is direct, but on physicians and residents.\textsuperscript{49,57,59-62}

Governments and insurers require “accurate measures of nursing service” to appropriately reimburse hospitals.\textsuperscript{63} Today in the U.S., Medicare and third-party payers reimburse hospitals for nursing care by bundling those services with fixed charges described as room and board.\textsuperscript{64-66} As such, “nursing care is not billed per patient for the number of hours of care delivered,” preventing accurate costing of such services.\textsuperscript{67} According to Beswick (2010), an “acceptable billing and reimbursement model for nursing” has yet to be developed.\textsuperscript{64} Thus, the preponderance of literature on nursing billing and nursing workload measurement is focused on reimbursement models and methods that capture the variability of nursing care associated with inpatient hospital stays, by including nursing diagnosis, interventions, outcomes and nursing intensity.\textsuperscript{11,64-70} The ED, however, is the only place in the hospital where actual nursing time is captured in a fairly direct and standardized method across the U.S.\textsuperscript{71} In this method, one of three described by Giovannetti (1984),\textsuperscript{72} “patients are independently assessed [by a nurse] on the basis of their need for each task or activity and the outcomes of the assessment yields [sic] a unique care time for each patient.”\textsuperscript{73}

Literature on the relationship between documentation and effort capture, and between effort capture and organizational (socioeconomic or otherwise) effectiveness is sparse. Examples were usually focused on cost-containment efforts, improved efficiencies, or both.\textsuperscript{45,74-77} Sacchetti \textit{et al.} (2001) propose using ED billing data “to monitor… performance improvement projects”\textsuperscript{78} while others indicate its usage for patient surveillance and monitoring.\textsuperscript{79-83} Work measurement and effort capture studies of nurses and providers “are rare.”\textsuperscript{84} While studies by Hollingsworth, \textit{et al.} (1998), Cornell, \textit{et al.} (2010), and national research initiatives such as The Robert Wood Johnson Foundation’s "Transforming Care at the Bedside," described the allocation of nursing and physician time spent in direct and indirect patient care,\textsuperscript{84-87} such studies did not inform us as to how to maximize that time by ensuring it was billed, documented or otherwise accounted for. Without this step, the value of this time was not optimized. This study attempted to redress some of these shortfalls. According to Heslop (2012) and Welton (2006), “further research is required on the frameworks or conceptual
Overview

Objective: This study was undertaken to create and examine a theoretical programmatic framework designed to improve socioeconomic effectiveness in the ED.

Methods: At the Johns Hopkins Hospital ED, our study utilized a case study design as its framework. We will then test the theoretical framework of our study through both literal and theoretical replication across multiple EDs to generalize the case studies to theory. That testing will employ a holistic multiple case study design, but is outside the scope of this dissertation.

The conceptual framework of the case study involved a program centered on maximizing nursing clinical care effort capture as a method to achieve improvements along three socioeconomic axes that collectively drove organizational effectiveness. The study team – a multidisciplinary assembly of clinical and administrative practitioners, subject matter experts from the ED and the hospital, and key opinion leaders from among the nursing staff – proposed fourteen “programmatic activities” designed to address identified shortcomings in nursing effort capture and to maximize compensated work through enhanced billing practices. These fourteen action items, grouped under three intervention areas, composed the Facility Billing Program that was our programmatic intervention. The activities of this billing program were structured to elicit short- and intermediate-term outcomes hypothesized to produce specific long-term departmental outcomes. This hypothesis was initially tested via a pilot program to improve nursing effort capture and improve revenue generation.

The long-term departmental outcomes of the billing program were grouped into eight measures hypothesized to quantify the effect of the intervention. They were then aligned under three outcome constructs. The constructs were Financial Outcomes, Human Capital Outcomes, and Social Outcomes. Each construct represented one of the aforementioned socioeconomic axes along which the ED operated and which
collectively drove its organizational effectiveness. As the eight outcome measures improved, we hypothesized the three outcome constructs they represented would also advance, and collectively energize improved socioeconomic effectiveness – the strategic outcome of this performance improvement initiative.

**Results:** In this study, we found that we were unable to demonstrate a relationship between clinical effort capture and workforce outcomes. We found that social outcomes were improved. The study reduced organizational risk by eliminating out-of-date patient charges and enhancing the level of compliance built into our patient billing structure. We found evidence suggesting a positive association between study efforts to capture clinical output and positive financial outcomes. Such was the case in both our outcome measures of interest – revenue and production efficiency. The net programmatic benefit of our effort capture project was $1,198,703 in revenue during FY13. Our program also improved the production efficiency of the nursing workforce. Controlling for observation RVUs, we observed an improvement of $0.73 (p<0.01, 95%CI: $1.26-$0.20) in the marginal product of capital between baseline and intervention timeframes.
SECTION II

~~ PROGRAMMATIC DESIGN ~~

OUTLINE

1. Programmatic Design: Plan for a New Program
2. Interventional Design and Methodology
3. Multiple Case Study Design
4. Organizational Resources
II. PROGRAMMATIC DESIGN

PROGRAMMATIC DESIGN: PLAN FOR A NEW PROGRAM

This study was designed to improve socioeconomic effectiveness in the ED. The conceptual framework for our program centered on maximizing nursing clinical care effort capture as a means to achieve improvements along three socioeconomic axes that collectively drive organizational effectiveness. Capturing nursing effort was achieved by maximizing compensated work (through enhanced billing practices) and documenting non-billable labor to more accurately measure and describe the scope of nurses’ clinical work. This was done in the context of a facility billing program (the programmatic intervention), and was hypothesized to lead to improvements in financial, workforce and social outcomes in the emergency department. Figure 1 illustrates the conceptual model.

Figure 1: Conceptual Model

Goal: Improved Socioeconomic Effectiveness

Maximize Nursing Clinical Care Effort Capture

Facility Billing Program

This conceptual model started out as a design concept focused on creating a billing maximization effort to contend with the ongoing economic downturn in 2011. I first identified how we could effect change and where that effort should focus relative to
facility billing. This led to the realization that practice and culture change would be needed among the nursing staff in order to sustain any effort. During discussions with the former Chief Operating Officer of the Bayview Hospital and with the current Chief Administrative Officer of the ED, we recognized that practice and culture change, if stimulated properly, would have a positive impact on workforce outcomes, not just revenue. Thus, the scope of outcomes would extend beyond just economic effectiveness, we hypothesized, and favorably contribute to socioeconomic effectiveness. As we began to examine the activities that would affect each of the intervention categories, we developed the concept of the facility billing program and some of the actions that later became interventional activities.

The project goal was theory development focused on enhancing socioeconomic effectiveness, which we hypothesized could be improved by building a facility billing program that emphasized capturing nursing clinical effort via optimal billing practices. As configured at the start of the study, the department’s facility billing program was actually a charge compliance program. Charge compliance was maintained as a facet of the program, rather than as its central theme. The new program targeted three distinct areas of clinical care interventions. “Interventions” are defined by the Maryland Health Services Cost Review Commission (HSCRC) as “clinical activities performed across the spectrum of care such as assessment, examination, monitoring, provision of care, disposition, etc.”

The three areas were activities that – at the project’s inception – were a) currently documented and billed, b) documented and not billed, or c) not documented and not billed (see bottom of Figure 1).

**Documented and Billed:** Clinical interventions that were documented and billed prior to the new facility billing program (“programmatic intervention”) were subcategorized into those interventions that nurses routinely documented and those that nurses under-documented (Figure 1). Nursing interventions routinely documented were likely to be those which were high-frequency, easy-to-document (see below), or had received previous scrutiny either through nursing education efforts or through billing audit follow-up. Examples of such interventions were triaging a patient, administering medications, and taking vital signs. Easy-to-document tasks were simple for nurses to find in the ED’s electronic clinical documentation system (called Allscripts), and did not
require a large number of “clicks” to either find or select. Interventions which were under-documented were either well-documented by some nurses and under-documented or undocumented by others, or they were sometimes documented and sometimes not documented by the same nurse. For instance, some interventions were well-documented when nurses were not overwhelmed with patients, but when the ED was extremely busy or when nurses covered for one another, the frequency or accuracy of documenting these interventions fell. Examples of under-documented interventions were administering comfort measures, and providing patient and family updates. Under-documented interventions represented uncompensated effort, since the nurse performed the task but it could not be billed as it was not documented. Our program was designed to minimize undocumented and uncompensated effort.

**Documented and Not Billed:** Clinical interventions that were documented and not billed fell into two categories as well. Some were billable (i.e., could be charged to the patient) while others were not. There were several reasons that may explain why an intervention that was documented by a nurse and was billable was not being billed. One reason was that the intervention may simply not have been connected as a billing element in the Allscripts documentation system. Thus, when the system calculated billable items, an intervention not connected as a billing element would not figure into the calculations that composed the patient’s level of billing. The colloquial term for this is “hooked to billing.” Interventions were not hooked to billing possibly because at the time of system implementation they were unbillable, thought to be unbillable, or simply overlooked. Additionally, some billable items may not have been hooked to billing because the intervention could be performed by either a physician or a nurse (e.g., patient allergies). In such cases, to avoid double-billing the patient for the same intervention, the billing was deferred to the physician practice (professional fee) rather than the hospital (facility charge); thus, the intervention was not hooked to (facility) billing. Another reason that may explain why an intervention that was documented by a nurse and was billable was not being billed was that the department was not aware that the item was not hooked to billing. (Before the programmatic intervention there was no routine comprehensive reconciliation of all nursing interventions against all items hooked to billing). Also, the department may not have been aware that the item in
question was actually billable and that such an intervention could legitimately have been connected as a billable element. Regardless of rationale, any billable intervention that was documented but not hooked to billing represented opportunity in the form of uncompensated effort (the only exception being those items billed via professional fee).

Falling into the second category of documented and not billed items were those clinical interventions that were unbillable for regulatory compliance reasons. There were a few reasons that explained why an intervention was “unbillable”. First, the activity may not have met HSCRC criteria. For example, services rendered after discharge are unbillable. Such services may be follow-up phone calls by nurses or case managers to a patient’s home, care provided in the ED while a patient is awaiting transport to another facility (when extended care service criteria are not met), or monitoring or management of patients “boarding” in the ED (still waiting in the ED after a decision has been made to admit them as inpatients). Second, the activity was related to organizational inefficiency, and thus not billable. One such example is ED nurses having to “call report” to an inpatient unit about to accept an admission from the ED. Occasionally, when the ED nurse called the unit to provide the patient’s information, the receiving unit indicated they were not ready to receive the report. When this happened, the nurse was forced to call back, sometimes several times. Each time, except for the first, was unbillable as it resulted from disorganization. Another example of disorganization was when a nurse cleaned a patient room (typically between patients). This service should have been performed by Environmental Services staff (who are hospital, not ED, employees), but their lack of responsiveness and speed often prompted the nurse to clean the room, rather than wait for Environmental Services. This activity, typically 3-5 minutes (citation) in duration, was unbillable nursing time caused by organizational inefficiency. Similarly, unbillable nursing time occurred when nurses were forced to transport patients due to lack of availability or responsiveness from patient escorts or support associates (whose role it is to transport patients). Third, administrative tasks are considered unbillable according to the HSCRC (the rate regulating entity in Maryland). Examples of such tasks were restocking supplies, checking equipment for functionality, and providing meal trays to patients.
Not Documented and Not Billed: Some interventions were neither documented nor billed. In accordance with HSCRC guidelines, “Patients are not to be [sic] charged, nor an RVU\(^1\) reported for a service or task that is not documented.”\(^{88}\) Interventions that were not documented and not billed were either billable (had they been documented) or unbillable. Those that were unbillable (for regulatory reasons) represent “uncaptured” effort. An example would be labor that was not included in any measure or description of the scope of ED nurses’ work (for budgeting, cost calculation, or otherwise). Those interventions that were billable represented a missed opportunity to bill and thus uncompensated labor. As they were undocumented, they, too, represent uncaptured effort.

Undocumented interventions either existed in the Allscripts software template or were missing. Those that were included were likely not documented by nurses because they were not easy to use, requiring “too many clicks” to either find or select. Other reasons were lack of education or lack of emphasis on documenting a particular intervention. Some interventions went undocumented as they did not exist in Allscripts. The nurses were doing the work, but the system did not require or allow them to document their effort. Whatever the reason for this was, such interventions needed identification and a subsequent decision about their potential inclusion in Allscripts. Adding too many items to Allscripts would increase the burden of documenting and could be counterproductive. Thus, a deliberate review of each item was needed while maintaining perspective of the added effort that documentation itself creates. Items that were added to Allscripts would be billed if appropriate and their inclusion would enable the ED to measure and describe the scope of nurses’ clinical work more accurately. Those not included would nevertheless be captured by this project and would thus also be included when examining the scope of nurses’ work in the future.

As an early illustration of the above discussion, some examples are discussed next. During the pilot phase of the facility billing program, two instances of interventions that were not documented and not billed were identified. Case managers, who were

\(^{1}\) RVU is the unit of measure for facility billing revenue is the “relative value unit” (RVU). In the State of Maryland, hospital rates are set by the HSCRC, with approved rates being applied to all payers. For facility billing, charges follow a tiered structure based on facility resources provided, generally attributed on a per patient basis by minutes of nursing clinical care time documented.
nurses employed by the ED, did not document their work in Allscripts, and the department did not bill for their time. Since certain aspects of case management met the criteria for clinical care time, as defined by the HSCRC, this represented a missed opportunity to both bill and capture the amount of work the case managers performed in the course of their intervention with patients. Likewise, certified nursing assistants (CNAs) who functioned as “sitters” (sitting with a patient to ensure no harm came to that patient) were performing a necessary clinical function that was not documented nor billed. Previously, this function was performed by security officers, who did not document and for whom the ED cannot bill. To reduce security labor costs, this role was shifted to CNAs. Although Corporate Compliance had indicated that this activity cannot be billed to the patient (i.e., it is unbillable), documenting the task in Allscripts allowed the effort to be captured, when previously it was not. This approach would at least recognize the effort, leading (we hypothesized) to potential workforce benefits. Other opportunities like these were identified as part of this program and are discussed later in this dissertation.
INTERVENTIONAL DESIGN AND METHODOLOGY

Our interventional design centered on a program composed of a group of activities that were designed to elicit a suite of outcomes along the aforementioned socioeconomic axes. To accomplish this, each activity was aligned with one or more of the three distinct areas of clinical care interventions discussed above. The nature of this alignment is depicted in Figure 2 to the left. Fourteen "programmatic activities" were proposed. These were:

1. Review percent documented report monthly
2. Monitor for and address problems
3. Monitor practice via hybrid audits
4. Team leader chart audits
5. Identify and educate underperformers
6. Incentivize high performers (develop an incentive program)
7. Conduct time studies of all billable nursing procedures
8. Observational audits
9. Update billing definitions
10. Create and reconcile list of documentable items not hooked to billing
11. Benchmark billable procedures against other EDs
12. Review 2010 external audit for opportunities
other EDs

A detailed discussion of the design (as originally conceived) and methodology
associated with each of these programmatic activities follows. During implementation,
some activities were modified for various reasons from their original design. Those
cases are discussed in the implementation section below.

1. **Review percent documented report monthly.** During each week of the
study, the ED produced an Excel based report called “Billing Level Analysis FY11 -
FY13 Individual Billing Items NO Admits-LBTs-Expired-Obs.” The report excluded
patients who were admitted, left before triage (LBT), passed away (expired), and those
in Observation status (Obs). Fifty nine billing elements were individually depicted in this
report (each in its own tab). Each item was graphed to depict the proportion of visits at
which it was billed over time. Once a baseline was established (e.g., previous fiscal
year levels), trends upwards or downwards alerted the reader as to changes in the
frequency with which the item was billed. A monthly review of this report, with follow up,
was the programmatic activity designed to identify and investigate changes in billing that
might signal changes in nursing documentation activity. The methodology utilized
involved each of the 59 elements in the report being reviewed monthly by the Co-Chairs
of the Facility Billing Committee (FBC); and items of interest added to the agenda of
FBC meetings. Items of interest consisted of nursing interventions with upward or
downward trends (both near-term and long-term trends). Upward trends were
investigated to identify and link to programmatic, operational, or educational
interventions with a positive impact on nursing documentation and/or billing activities.
Upward trends were also monitored by Corporate Compliance to ensure no
interventional changes overwhelmingly favored the institution at the expense of fair
patient treatment.

    Downward trends were likewise investigated when the trend was unanticipated.
The FBC worked with the billing staff, nursing leadership and the department’s data-
analysis team to analyze and understand these trends. Once causes were identified
(whether related to billing or documentation practice or other operational changes in the
ED), interventions were developed and implemented to counter the declining trend.
Those elements were then tracked prospectively to determine if the intervention was successful.

2. **Monitor for and address problems.** Initially conceived as a general intervention, in which problems with billing would be identified and addressed quickly, this intervention was quickly subsumed into intervention #1, “Review percent documented report monthly,” which identified problems and served as the platform from which to address and track them. Monitoring for problems also took the form of nursing leadership’s encouraging feedback from front-line nurses about their ongoing experience and perspective with the documentation system as changes were made and nursing practice was adjusted to meet the objectives of this program. Examples of this are discussed in the outcomes section below.

3. **Monitor practice via hybrid audits.** The existing mechanism to monitor nursing compliance with standards of practice enumerated in The Johns Hopkins Hospital Interdisciplinary Clinical Practice Manual (ICPM) and ED Policy Manual was a manual chart abstraction process. This manual records review, called a nursing documentation audit, was conducted monthly by one of the department’s Clinical Nurse Specialists. The purpose of the audit was to ensure nursing performance was compliant with institutional standards of practice and that clinical documentation reflected institutional policies. This audit assessed nurses' documentation skills and consistency between the care prescribed and the care provided to our patients. Clinical documentation served as the proxy for nursing performance. For example, reassessing a patient’s level of pain within one hour of administering pain medication is an institutional standard. The nursing documentation audit looked at the record for documentation of such reassessment within one hour of administration (all actions in the electronic record were automatically time stamped) to ensure compliance.
The audit examined 29 items across 10 patient care practice areas. Because the audit was limited by the amount of time the Clinical Nurse Specialist could devote to this task, the number of patient medical charts reviewed was limited. Between December 2011 and February 2013 the median number of patient records audited was 30.5 per month (range 23-55). Figure 3 below shows a small excerpt of the nursing documentation audit. The complete audit is shown in Appendix A: Hybrid Audit, Annex A: Nursing Documentation Audit Tool and Results. The audit shown is complete through May 2013, because, as of October 2013, the Clinical Nurse Specialist had not had time to complete the subsequent months (demonstrating another deficiency in the existing process). The excerpt below shows six audit items in three patient care practice areas. These areas, in the gray rows, are “Full set of Vital Signs” (abbreviated “VS”); First Nurse Guidelines (abbreviated “FNG”), and Pain Evaluation. For each documentation element (in white, in the first column), the figure shows a mean compliance rate for all charts audited that month. Means greater than or equal to 90% are highlighted in green. Those between 80% and 89% are in yellow. Means less than 80% are highlighted in red.

As stated above, the purpose of the audit was to ensure nursing performance was compliant with institutional standards of practice. The purpose of this audit was not to ensure that documentation was thorough, routine, nor accurately represented the work of the nurse caring for the patient whose chart was reviewed. In its present form, this audit had no relationship to billing maximization or effort capture. It functioned more as a bellwether of problem areas in nursing documentation compliance, which, in turn,
drove broad re-education efforts aimed at resolving the noted deficiencies. As is evident by Figure 3, such efforts were not successful as poor compliance was consistent in some activities.

Our project sought to expand the scope, purpose and utility of this audit. Nursing leadership indicated that the scope of the audit was limited by the availability of resources. Departmental administrative leadership had resources that could be allocated to this function, but with different functional expertise than that of the clinicians. Utilizing Teece & Pisano’s (1994) perspective on dynamic capabilities theory, in which management “redeploys” organizational skill sets “to create new products and processes”, we decided to bring together the expertise of the nursing team, with the chart auditing and reviewing skills of the billing team, to create a hybrid audit process, called the ‘Facility Billing/Nursing Documentation Audit Database’. We hypothesized that a collaborative “hybrid audit” would allow the department to better evaluate nursing documentation, and broaden the population of records reviewed. Dynamic capabilities theory emphasizes leveraging “inimitable combinations” of organizational resources that “cut across all functions” to achieve what Kohli and Grover (2008) call “business value”. Our concept was to blend different skills and technical competencies to achieve a process, in which the whole is greater than the sum of its parts. Kogut & Zander (1992) refer to this as combinative capabilities – synthesis and application of knowledge from different sources to create growth and opportunity – and Kohli and Grover (2008) describe this as co-creation of differential value. Co-creation denotes the notion that value is attained by the activities of multiple, complementary resources engaged in a robust collaborative effort.

The aim of the Facility Billing/Nursing Documentation Audit Database was to develop a web based nursing chart audit and facility billing/audit tool that allowed us to monitor nursing documentation. The purpose of the monitoring would be varied: 1. Compliance with standards of practice; 2. Monitor the thoroughness/completeness of documentation for medico-legal reasons; 3. Improve billing capture; 4. As an instructional tool for the nurses; 5. To facilitate other programmatic activities described below. The ease and accessibility of a web based tool would provide quick access to records (reducing a currently time consuming task), and facilitate more routine and
widespread documentation review. This tool would streamline workflow, create a paperless process, enhance data capture (of auditors/reviewers), speed data entry, and improve performance record storage and data reporting. The full scope document, detailing the design and features expected in this tool, is included in Appendix A: Hybrid Audit, Annex B: Hybrid Audit Scope Document.

4. **Team leader chart audits.** Nursing team leader chart audits were also an existing practice in the ED. The nursing organizational structure of our department follows a somewhat decentralized model\(^95\) that utilizes Team Leaders in lieu of a single nurse manager. Team Leaders are Nurse Clinician Level III (NCIII) nurses charged with administrative leadership of teams of eight to ten nurses. Team Leaders are responsible for providing each of their team members' annual performance reviews. As part of the review the Team Leader audits a single clinical record documented by the team member, to assess its completeness and compliance with nursing standards of practice. This is essentially a personalized (to the individual nurse) version of the department-wide nursing documentation audit described in the previous section. While an effective concept, the sample size is, of course, not meaningful\(^96\). The rationale for auditing a single chart is that a more meaningful sample is disproportionately time consuming and that documentation shortfalls are captured broadly in the department-wide audits and resultant department-wide nursing education (which we observed to be ineffective). Lack of guidance in nursing clinical documentation is seen as part of the reason for poor documentation.\(^97\)

The interventional activity planned to address this was designed to leverage the newly designed hybrid audit. This would provide Team Leaders a less time consuming method of assessing nurses’ documentation skills, consistency, and performance via clinical chart review. The project’s initial goal was to increase the frequency of Team Leader chart reviews (with feedback provided to their team members individually) from annually to quarterly. This would serve not only to increase the sample of charts evaluated for each ED nurse, but – more importantly – to keep the focus on 'documentation as a leadership priority' in the forefront of the nurses’ minds. A quarterly “reminder” of the need to thoroughly document all patient encounters – regardless of
prevailing conditions in the ED – including personalized performance feedback, was hypothesized to be a driving force in achieving the short-term project goals of ‘focusing on problem areas’ in documentation and ‘improving awareness among nurses’ (see figure 4a below). Positive reinforcement during such encounters would also help attain the short-term goal of ‘improving recognition of performance’ (ibid). Education regarding errors would serve to reinforce the interventional activity to identify underperformers and educate them (discussed next). Given the potential value of this activity, the Director of Nursing has agreed to evaluate the possibility of having Team Leaders review multiple charts per team member, quarterly.

5. **Identify and educate underperformers.** The underlying methodology for a portion of this project involves change in conduct among the department’s nurses and awareness relative to clinical documentation and its role. Identifying and educating underperformers was the interventional activity designed to facilitate shaping the conduct and awareness of our nurses. We know that nursing performance can be shaped by practice-based education. Particularly, the audit and feedback method can be effective. Therefore, we coupled this effort with Team Leader chart audits so that feedback would be provided in combination with education as recommended by Grol and Grimshaw in *The Lancet* (2003) to reinforce uptake. Furthermore, this methodology ensures that feedback and education would provide professional context and be performance-based, specific, current, and supervisor led. Because the evidence suggests that educational interventions do not impart a persistent effect, repetitive feedback and education are achieved via the quarterly Team Leader chart reviews discussed above. Recognizing that the effects of educational interventions are limited and that even the activities most associated with improved practice compliance (which were incorporated into the project’s interventional activities) could account for less than 20% of the variation in performance, educational activities could not stand alone in this project.

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2 These were all considerations given that Grol and Wensing (2001) have suggested that effect size of the audit and feedback method of education may be moderated by type of feedback, its source and format, and frequency or intensity of presentation.
This is why our approach was multifaceted and incorporated a suite of interventional activities rather than just a few.

6. Incentivize high performers. Early planning revealed the need to integrate an incentive methodology into this project. Nurses working in staff positions traditionally have been compensated based on hours of work. Aligning pay and rewards with individual (and team) performance was seen as a valuable means of supporting and reinforcing the documentation standards established in this program. Compensation based on improved compliance with documentation standards and departmental expectations, is consistent with the value that professionals (i.e., nurses) place on accountability for practice. The methodology to incentivize nurses to document better consisted of first identifying well performing nurses via the Team Leader chart audits. These nurses' names would then be published on a “High Performers Report,” coupled with public recognition from nursing leadership. The incentive would come from the department in the form of a small reward along with public recognition from nursing leadership. Blending nursing professional practice with the business aspect of providing patient care, and incentivizing nurses for their business contribution is not a new concept. Hill (1989) writes about the McCauley Health Center in Michigan that developed a program of nursing promotion and incentive pay based on expense management and revenue generation achieved while “meeting or exceeding specific quality and business operations standards”. She describes McCauley’s program as one of “…pay for clinical and business performance.” Others, too, have cited successful integration of nursing and business practice supported by incentives aimed at both clinical and commercial performance.

7. Conduct time studies of all billable nursing procedures. There are several billing methodologies employed in U.S. Emergency Departments across the U.S. Following are the most common:

A. Billing based on minutes of time associated with each nursing interventions. For example, Triage is 5 minutes, IV insertion is 10 minutes, giving medication is 2 minutes, etc. Nurses document what procedures they perform during a patient encounter, and
the nurse or a biller then tabulates the sum of all the minutes for that encounter. That total time (sum of minutes) is used to assign a billing level to the patient. This billing level dictates the charges the patient receives. This is the process used in our ED.

B. Billing based on “points” is a similar process to billing by minutes. Points are used to represent how long each nursing intervention lasts (relative to other interventions, not in actual time) or to represent the level of complexity of that intervention. In this method, every nursing procedure has points assigned to it. As with the previous method, nurses document what procedures they perform during a patient encounter, and the nurse or a biller then tabulates the sum of all the points for that encounter. That total point level dictates the “complexity” level of the patient, which in turn is used to assign a billing level to the patient.

C. Billing based on the highest complexity intervention is the third method. Here, assigning a billing level to a patient is based on the most complex nursing intervention that patient received during their ED encounter. The premise is that the highest complexity procedure tends to be an indicator of the overall level of involvement of that particular patient encounter. Of the three methods, this is the least precise.

With regard to ED bills which we based on nursing minutes: Time billed should be commensurate with the ED’s particular time standards\textsuperscript{71}; however, at the onset of this project it was not. Instead, time standards had been adopted (with Compliance approval) from a community hospital in Maryland. Time standards from that hospital did not include documentation time (the time it takes a nurse to enter a note in Allscripts), which, by HSCRC standards, is a billable component of patient care in the ED. To minimize the variance between billed and actualized nursing clinical effort, capturing the precise time of each intervention and the documentation time associated with it was critical.\textsuperscript{63} A detailed descriptive study of the time associated with each nursing intervention was the programmatic activity designed to unify documentable activities with the actual time they required. The closer the two were to each other, the more accurate a proxy billing data would be for volume of nursing clinical effort.

Observational time studies of common nursing (nurse and clinical tech) procedures were conducted in the Main and Pediatric Emergency Departments. The objective was to determine the average time that common procedures take to perform in
order to update resource times for facility billing charges. The Compliance Department was integral to our process to ensure no non-billable activities were incorporated into the times associated with each procedure. Although the Main ED fell under the Department of Emergency Medicine and the Pediatric ED fell under the Department of Pediatrics, both EDs shared the same clinical documentation system – Allscripts. Since Allscripts could not be compartmentalized, changes made to it affected both EDs. Because of this, decisions which impacted either clinical documentation or facility billing had to be made collaboratively by both departments working in concert. Since the original (prior to the project) 66 nursing interventions in Allscripts that were linked to billing were charged the same time in both EDs, any changes to them had to reflect the operations of both EDs’ nurses. As a result, the time study intervention was configured for and results applied in both EDs.

8. **Observational audits.** Some of the other activities and strategies of this study focused on improved capture of nursing effort via the documentation system. We hypothesized, however, that not all clinical activities of interest were associated with the documentation system in the ED. We decided that measuring known interventions and benchmarking activities to identify and capture clinical activity did not represent a comprehensive approach to understanding the clinical effort taking place within examination rooms, among clinicians, and between patients and staff. To enhance the breadth of our exploration, we initiated an activity that utilized direct observation of nursing activity. According to human factors specialists Stanton and Young (1999), observation is a constructive method of measurement because it provides direct information on human interactions within work environments.\textsuperscript{113} In doing this, observational methodologies can switch the focus from prescribed tasks to the actual tasks being carried out.\textsuperscript{114} A study conducted at the University of Wisconsin Hospital and Clinics used observational methodology to explore medication administration by nurses. The investigators found that the use of this observational methodology “allowed for an unbiased and nonjudgmental look at the actual nursing processes in place, as opposed to outlined procedures in the nursing policy and procedure manuals.”\textsuperscript{114} Our plan was to use a similar methodology to gain additional perspective on nursing tasks
and identify, firsthand, undocumented efforts not captured through other means. By leveraging the viewpoint of an outside observer, we hoped to expose nursing interventions that take time and consume effort but have not been fully recognized in the past. These “observational audits” were intended to reveal clinical activity performed by nurses but not subsequently documented in Allscripts. Any activity that either directly or indirectly involves patient care was considered clinical, while other nursing activities, such as taking breaks or speaking on the telephone, were considered non-clinical and therefore not within the scope of this study. A detailed discussion of the methodology used and observers selected, as well as the process of transforming observations into actionable results, is found in Appendix C: Observational Audits.

9. **Update billing definitions.** Facility billing definitions for nursing interventions are a required element of the department’s Facility Billing Manual. These definitions identify to the billers which interventions require a provider order and what action to look for in the nursing documentation to ensure accurate billing of each intervention. Such definitions should also guide anyone examining the length of time associated with nursing interventions. Prior to the initiation of the facility billing program, the definitions list, while current, was lacking in detail and specificity. Mostly, definitions were a simple indication the intervention was performed, but lacked any detail about what the intervention actually entailed. Table 1 below shows a sample of five definitions from before the programmatic intervention as an illustration of their brief composition.

<table>
<thead>
<tr>
<th>Nursing Intervention</th>
<th>Billing Definition (original)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Culture</td>
<td>Obtaining blood culture specimen</td>
</tr>
<tr>
<td>Blood Transfusion</td>
<td>RN transfuses blood</td>
</tr>
<tr>
<td>Cardiac Monitor</td>
<td>RN places patient on cardiac monitor</td>
</tr>
<tr>
<td>EKG</td>
<td>EKG performed</td>
</tr>
<tr>
<td>Enema</td>
<td>Enema administered</td>
</tr>
</tbody>
</table>

Our methodology utilized a comprehensive review process to update the billing definitions. Definitions were vastly expanded to indicate all-inclusive steps associated with each specific nursing intervention. Definitions were linked to the literature and
organizational protocols and policies. This is outlined in detail in Appendix D: Facility Billing Definitions - Methodology and Implementation. As other programmatic activities within this project identified previously uncaptured nursing activities, comprehensive definitions for those were also developed via the same methodology as the existing definitions. The goal of the updated billing definitions list was to contribute to improved billing accuracy. By involving nurses in the definition update/creation process, we also expected to improve awareness of our efforts among nursing staff – another programmatic short-term goal.

10. **Create and reconcile list of documentable items not hooked to billing.** The goal of this programmatic activity was to improve billing accuracy and revenue creation by initiating charges for items not previously billed (where allowable). The methodology centered on conducting a thorough review of all nursing documentation elements in the Allscripts clinical documentation system to identify which items are not hooked to billing (i.e., do not generate a charge to the patient\(^3\)). Once identified, those items not associated with a billing charge were reviewed individually to assess the appropriateness of being hooked to billing or remaining disconnected. In this manner, items that were overlooked during Allscripts’ initial configuration and implementation at Johns Hopkins, and items that were not hooked to billing for reasons discussed in the Programmatic Design section above, could be identified, reconciled and properly dispositioned as part of the Facility Billing Program. This activity had not been previously attempted, as evidenced by the fact that no list of documentable nursing interventions existed.

11. **Benchmark billable procedures against other EDs.** In the section titled “Measurement, Analysis, and Improvement of Organizational Performance,” Baldrige Framework’s *Health Care Criteria for Performance Excellence* asks hospitals, “How do you select and ensure the effective use of key comparative data and information to support operational… innovation?”\(^{115}\) Benchmarking has been noted by The Joint

\(^3\) A charge to the patient in the form of adding minutes to the overall length of the encounter, as the patient’s bill is based on total time of nursing care while in the ED.
Commission as an effective method to use key comparative data in healthcare.\textsuperscript{116} Known as competitive benchmarking,\textsuperscript{117} conducting comparative data analysis against other hospitals is a well-recognized practice in the U.S.\textsuperscript{118} Schmidt (1992) notes that this process involves identifying valid measures for comparing performance among peer or other companies.\textsuperscript{119} Our aim in this effort was to benchmark our own “valid measures” against other hospitals. In this case we sought to compare our own clinical nursing interventions to those of others to see what activities they were documenting and billing that may represent opportunities for us to do the same. By soliciting such measures we hoped to have a data rich source of comparison of ED nursing practice. We hypothesized that a majority of nursing practice in the ED setting was similar, and would overlap with our own (with variation associated with patient demographics), but that that there were likely some activities and interventions that others documented and billed that we did not. Those were our interventions of interest for this activity.

12. **Review 2010 external audit for opportunities.** In June, 2010, the consulting company Navigant conducted an examination of two hundred and fifty outpatient emergency room records with dates of service between October and December 2009. One hundred and fifty records were Main ED records and the remaining one hundred records were from the pediatric ED. Such a small sample size did not reflect a statistically valid sample, but did, according to hospital financial leadership, reflect a fair representation in order to review trends found during the audit process. The assessment compared both EDs’ original HSCRC facility billing level assignment to the assignment that the auditors determined based on the documentation found in the medical record. Auditors used the billing sheet provided by the ED for the point value assignment. This was relevant as it was the same billing sheet utilized prior to the initiation of our effort capture study. We hypothesized that the 2010 audit would contain recommendations and guidance relevant to any work associated with billing and nursing documentation practices in our ED. Our plan was to review the audit results in detail and ensure implementation of relevant proposals. The analytic framework of the audit was also of interest as a potential source of intelligence for our project.
13. **Reconcile provider orders against billable procedures.** As was noted previously, benchmarking is a useful business tool that can improve an organization's ability to manage its performance. One such method is internal benchmarking, where comparable elements of a company are reconciled against one another. Such was the objective of this programmatic activity. Nursing duties in the ED are based not only on nursing protocols, but also on provider orders. Our goal was to identify potential opportunities by benchmarking provider orders in Allscripts against documentable and billable nursing interventions and to look for gaps (undocumented nursing activities) and opportunities (documented activities that were not billed). To accomplish this, a list of provider order sets was generated from Allscripts and associated with a list of nursing activities that were ordered by providers via those order sets. This list was then reconciled with the list of billable items. After this initial evaluation, the interventions from the provider order list that were already billed were discarded, as they represented effort that is already captured and billed. The items from the provider order list that were not billed were then categorized and reviewed by a small expert panel of nurses who considered the gaps and opportunities and provided a recommendation or a disposition for each.

14. **Reconcile provider orders against other EDs.** Like item 11 above, this activity was designed to benchmark clinical documentation in our ED against that in other hospitals. Our intent was to identify provider orders utilized in EDs that were not part of our documentation system. Since provider orders drive nursing practice, we hypothesized that there was opportunity in looking at provider orders as an adjunct activity to benchmarking nursing documentation (via item 11). Here, again, we sought to be thorough in our exploration of “what we didn’t know” and take advantage of what other institutions were doing/had done. Our methodology was to solicit provider order “sets” from other institutions at the same time we were collecting their billable procedures lists. We then methodically compared those order sets with our own and developed a gap analysis. This was by an examination of what nursing interventions and activities were associated with individual provider orders. Items not currently
documented were evaluated for clinical and financial value and potentially added to Allscripts.

The programmatic activities outlined above have intricate and sometimes veiled relationships among them. By design, activities flow into one another, with outputs that drive other activities in the same suite. For example, hybrid audits (a programmatic activity) facilitate team leader chart audits (another activity), which, in turn, are necessary to identify high performers (a program output) who enable the nursing incentive program (another programmatic activity). Interventional outcomes are similarly related. Some outcomes are predicated upon – or, at a minimum, enhanced by – the outcomes of other activities. The relationships among the outcomes are discussed further in the Outcomes section below. The diagram in Appendix E: Elements of The Programmatic Intervention depicts the primary activities of the Facility Billing Program and illustrates the connections among programmatic activities and outputs. The graphic, known as a mind map, aids in visualizing the relationships among the various programmatic activities described above. The mind map was also useful as a planning tool in understanding decision pathways and dependencies among the various activities in the work plan.

The activities of this program, discussed above, are relatively modest and straightforward. This is by design. Grol and Grimshaw (2003) remind us that “change is rarely as easy if the innovation requires complex changes in clinical practice or… in the organization of care”. The series of programmatic activities composing the Facility Billing Program are designed to capture nursing effort but are not designed to cause complex changes in clinical practice. Clinical practice is already demanding enough in the ED, given the episodic nature of care, admission complexities, challenging patient population, high volume, and rapid throughput. Couple that with routine organizational demand (learning to function in a new space, departmental focus on culture of professionalism, ever-evolving internal processes, etc.), and one realizes that a complex project with little clinically-based incentive is predisposed to fail.
Therefore, the design of this endeavor employed a suite of simple, complementary activities to achieve the desired improvement in organizational effectiveness.

**MULTIPLE CASE STUDY DESIGN**

An objective of our study was theory development. At the Johns Hopkins Hospital, the study utilized a case study design as its framework. Single-case study design is vital to theory development. A case study is an “empirical inquiry” that explores a contemporary process (or series of interrelated processes) in depth and in its daily context, particularly when the subject of the study is not easily separated from its context (an actual working ED in this case). As Yin (2009) put it, “…you would use the case study method because you wanted to understand a real-life phenomenon… but such understanding encompassed important contextual conditions – because they were highly pertinent to your phenomenon of study.” This purposely differs from a controlled experimental method, in which the researcher tries to separate subject from contexts (and context is “controlled”). According to Patton (2002 and 2005), case studies add distinct value to evaluation research. Of the various applications of case studies in evaluation research, Yin (2009) offered that the most important is to elucidate causal relationships in real-life interventions that are too complex for survey or experimental methodologies. Beyond this point, he also offered that a case study strategy may inform researchers about circumstances in which their intervention does not have a clear, expected, single set of outcomes – as is most definitely the case in our project.

Process tracing, which examines the links between possible causes and observed outcomes, was used in our study. According to George and Bennett (2005), the researcher uses process tracing to examine whether the “causal process a theory hypothesizes… is in fact evident in the sequence and values of the intervening variables” in the case. Put more simply, the goal was to show which programmatic activities (variables) in our study, led to programmatic outcomes (e.g. improved compliance); in what Bennett (2004) called “an uninterrupted chain of evidence from hypothesized cause to observed effect.” He went on to point out the sharp contrast
between this methodology and statistical methods that rely on probabilistic relationships but do “not require continuity or completeness in any given case.”\textsuperscript{125} Yin (2009) characterized the case study inquiry as relying on “multiple sources of evidence, with data needing to converge in a triangulating fashion…”\textsuperscript{122} Process tracing ensured the converging lines, which occurred in the controlled chaos of daily operations in an academic ED, were part of the causal process of our study hypothesis.

To effectively measure experimental constructs (described later in the evaluation design), we utilized a holistic multiple case study design. There is mounting agreement that using a combination of “within-case analysis and cross-case comparisons” in a research program, leads to the most valid propositions and means of drawing conclusions from case studies.\textsuperscript{121} The multiple case study design is the methodology for exporting the results and lessons learned from the Johns Hopkins Hospital-based study to the other EDs in the health system. This will occur after the initial case study – located at Johns Hopkins Hospital’s (JHH) ED – has concluded. These subsequent case studies, planned for FY14 and FY15, are outside the scope of this dissertation, but are described in the following paragraphs for completeness of discussion.

In continuing the holistic multiple case study design, we will test the theoretical framework of our study through both literal and theoretical replication across multiple EDs to generalize our case studies to theory. This process is depicted in Figure 4 below, which derives inspiration from other non-healthcare related studies described in Yin (2009) and Bandara et al. (2005).\textsuperscript{122,126} To help control for single group threats to internal validity, the JHH study’s outcome measures will be compared to results from the Bayview Hospital ED, where the programmatic intervention will occur next, and then to other EDs as the case studies proceed. Social interaction threats such as imitation of treatment (diffusion) and compensatory rivalry are mitigated by the fact that nursing staff do not cross over between EDs and that leadership at the other EDs is not aware of the particulars of this program. Subsequent implementation at the other hospital’s EDs will enable additional refinement to improve reliability and strengthen external validity with each new case study. To avoid poor reliability of treatment implementation in other EDs, written protocols will be developed and leadership training provided prior to export.
As each case study is completed, data will be aggregated for the study EDs by outcome measure and period (pre- and post-intervention). A t-test for the significance of the difference between the means of two independent samples (unpaired t-test) will be carried out to test the improvement in the earlier case ED compared to the later-case ED (e.g., Case #1 compared to Case #2) between period 1 (pre-intervention) and period 2 (post-intervention) for each of the outcome measures.

A paired t-test will be used to test for significance in improvement in each measure between periods 1 and 2 within the case study EDs. Correction for multiple comparisons will be made. Factors causing variability among locations will be identified and captured (e.g., urban versus suburban, academic versus community, unionized versus non-unionized nurses, centralized nursing leadership structure {nurse manager} versus decentralized nursing leadership {team leaders}, HSCRC governed vs. not). Characteristics of each ED, and workforce and patient variables will be collected for use as covariates in a regression analysis examining variability across sites.

Figure 4: Holistic Multiple Case Study Design\textsuperscript{1,2}

\begin{figure}
\centering
\includegraphics[width=\columnwidth]{holistic_case_study_design.png}
\caption{Holistic Multiple Case Study Design\textsuperscript{1,2}}
\end{figure}

\textsuperscript{1} Yin (2009)  
\textsuperscript{2} Bandara et al (2005)
ORGANIZATIONAL RESOURCES

As the Assistant Administrator of the Department, a significant amount of my time was devoted to this effort. Measures associated with this project, and their alignment with department pillars, were also listed on my FY13 and FY14 job performance goals. To facilitate analysis and implementation of the facility billing program, I assembled an interdisciplinary committee focusing on the improvement efforts related to facility billing in the JHH ED. This committee consisted of the following members:

- Assistant Administrator, Main ED (co-chair)
- Clinical Systems Development Manager (RN), Main ED (co-chair)
- Assistant Administrator, Department of Pediatrics (ad hoc)
- ED Manager – Main ED
- ED Manager – Pediatric ED
- Administrative Coordinator to the Main ED Manager
- Information Systems and Technology Administrator, Main ED
- Nursing Informatics Coordinator - Pediatric ED
- Nurse Clinician III – Psychiatric ED
- Lead Biller, Main ED
- Clinical Nurse Specialist, Main ED
- Director of Billing Compliance, JHHS
- Director of Compliance Education, JHHS
- Director of Nursing, ED
- Director of Finance, ED
- Limited data support from: Project Analyst, ED

The Associate Director of Healthcare Life Sciences, Disputes, Compliance, and Investigations at Navigant Consulting was initially assigned to the committee prior to compliance leadership joining. Other staff and material resources were utilized during program implementation. These are enumerated in detail in the Economic Evaluation section to follow.
SECTION III

~~ PROGRAMMATIC EVALUATION ~~

OUTLINE

1. Evaluation Design

2. Process Results
   A. Pilot Results
   B. Programmatic Results
   C. Other Process Results and Implementation Topics
   D. Monitoring Unintended Negative Consequences

3. Outcome Results
   A. Workforce Outcomes
   B. Social Outcomes
      1) Social Equity
      2) Compliance
   C. Financial Outcomes
III. PROGRAMMATIC EVALUATION

EVALUATION DESIGN

The evaluation design – illustrated below – was used to assess the effectiveness of the facility billing program using measures intended to address three outcome constructs. This methodology was inspired by the “Outcome Measures and Scales” used by Morey et al, (2002) in a Brown University / Army Research Lab study that evaluated the effectiveness of teamwork training in nine U.S. EDs. The constructs for our evaluation design were Financial Outcomes, Human Capital Outcomes, and Social Outcomes (Figure 5). Each was a critical-to-quality (CTQ) construct for social and economic effectiveness. Each mirrored one of the Baldrige Framework’s Health Care Criteria for Performance Excellence “Results” subcategories. The constructs were also consistent with the multiple-constituency approach to organizational effectiveness assessment proposed by Connolly et al. and Bluedorn. Further, they comported with Quinn’s (1978) perspective on effectiveness, in which “the administrator” defines organizational performance in terms of “their own organizational context and situation” and incorporates measures of financial output and profitability, human capital factors such as employee loyalty and job satisfaction, and social welfare.

Each construct in the evaluative model represented a socioeconomic thrust along which the department operated. The constructs were thus aligned with the performance improvement (PI) goal of increased socioeconomic effectiveness in the ED and measured the success of the PI initiative. Each outcome construct followed one of Cunningham’s (1977) and others’ managerial models as they relate to...
measurement of organizational effectiveness: The **Financial Outcomes** construct closely aligned with the Managerial Process Model, in which “productivity of the managerial process for attaining [financial] goals” is a key measure of effectiveness. The **Workforce Outcomes** construct paralleled the Systems Resource Models, which strives to optimally distribute resources to, and align them with, organizational demands. The **Social Outcomes** construct conformed to aspects of the Functional Model which measure the social consequences of the organization’s actions as a determinant of effectiveness. The frame of reference for the Functional Model is not the organization itself; rather, the frame is how the organization’s activities benefit society and serve the needs of its patients.

The three outcome constructs in the evaluative model (Figure 5) were represented by eight measures hypothesized to quantify the effect of the intervention. These eight measures, designed to minimize mono-method bias, were the long-term outcomes of the programmatic intervention. The activities of the billing program (the intervention) were designed to elicit short- and intermediate-term outcomes which then impelled these long-term departmental outcomes (Figure 7a below). As these long-term outcomes would improve, we hypothesized the outcome constructs they represent would also advance, and collectively drive improved socioeconomic effectiveness – the strategic outcome this program sought to attain.

The theoretical framework of our study (Figure 6), attempted to illustrate the relationships between billing & documentation and nursing effort; and between nursing effort and the elements of organizational effectiveness. One of the goals of our study was to gain insight into these relationships and then generalize the findings of our study to the theoretical framework.
The programmatic framework was designed around a suite of targeted activities. There activities were tracked using specified output indicators. Programmatic outcomes were measured via outcome indicators (detailed in Figures 7b and 7c). These were measured directly through the efforts of the department’s Facility Billing Committee, drawing upon existing departmental and/or hospital mechanisms and systems (e.g., JHHS DataMart). More details, specific measures, indicators, and desired indication (for success) are depicted in the program’s logic and evaluation model, shown below in Figures 7a-c.
Figure 7a: Logic and Evaluation Model

SOECIOECONOMIC EFFECTIVENESS

Outputs

Strategic

Outcomes

Financial Outcomes

Long-Term

Intermediate

Short-Term

Activities

Resources / Inputs

Patient Satisfaction

Quality of Care

Employee Retention

Patient Throughput

Workforce Outcomes

Employee Satisfaction

Resource Matching

Budget Alignment

Social Outcomes

Spacial Equity

Outcome Indicators

Social Equity

Compliance

Outcome Indicators

Social Equity

Compliance

1. Monthly audit identifying updates trends in documentation between
2. Monthly audit identifying updates trends in documentation between
3. Monthly audit identifying updates trends in documentation between
4. Monthly audit identifying updates trends in documentation between
5. Monthly audit identifying updates trends in documentation between
6. Monthly audit identifying updates trends in documentation between
7. Monthly audit identifying updates trends in documentation between
8. Monthly audit identifying updates trends in documentation between
9. Monthly audit identifying updates trends in documentation between
10. Monthly audit identifying updates trends in documentation between

Figure 7a: Logic and Evaluation Model
Figure 7b: Logic and Evaluation Model: Output Indicators & Linkage to Outcomes
Figure 7c: Logic and Evaluation Model: Outcome Indicators and Linkage of Short/Intermediate-Term Outcomes to Long-Term Outcomes
The facility billing program was built to capture nursing effort by describing it more accurately. On inpatient units, nursing effort relates to “predicted and [broadly] averaged rather than actualized care requirements.” In the ED, nursing effort is documented and billed directly for work conducted (based on that ED’s time standards). A strength of this study is that the variance between billed and actualized effort is minimized in the ED setting, underscoring the validity and utility of billing data as a proxy measure of nursing effort, but limiting ability to generalize results to non-ED settings. Beyond documented work, what remains is to capture the undocumented labor to portray an accurate image of nursing clinical effort in the ED.

**PROCESS RESULTS**

Following is a discussion of the implementation process and its results. We first describe the results of our pilot program. The implementation of pre-planned programmatic activities follows. Lastly, we discuss other topics, such as the results from newly devised programmatic activities. Outcome measures are reviewed and discussed in the next section of the paper after process results. Appendix F: Implementation Plan contains a brief implementation plan in Gantt chart format.

**PILOT RESULTS**

In January 2011, we launched a pilot program to improve nursing effort capture and improve revenue generation. This minimalistic variant of the subsequent project successfully increased billed RVUs per patient, and lent insight into pre-operational explication of the constructs utilized in this study, thus strengthening construct validity. Another benefit of this pre-study pilot was that it helped mitigate mono-operation bias – a threat to construct validity. The pilot also helped estimate reliability after the full program was implemented via examination of the correlation between the outcomes.

Table 2 below shows the elements added to the billing scheme as part of the pilot in Jan-Feb 2011. These items were time studied prior to being added to Allscripts. Items 1-6 had all been previously documented in Allscripts, but were not billed until this
pilot (in other words, they were documented nursing interventions, but they did not contribute to the calculation of clinical care time the patient received). Item 7 had been previously billed as “Labs- other specimen” and billed at six minutes. Implementation of the CareFusion barcoding patient safety system had led us to believe this intervention now took longer than the previously billed six minutes. Time studies confirmed this, and the pilot separated this item as its own intervention and assigned it a value of 16 minutes. Item 8 had not previously been documented nor billed. As part of this pilot, it was defined, time studied, added to Allscripts under the ‘procedures’ tab and connected to billing with a value of two minutes. Billing for all elements in the table was simultaneously activated on February 13, 2011.

Table 2: Interventions Added During Pilot Program

<table>
<thead>
<tr>
<th>Item</th>
<th>Calculation Description</th>
<th>allow Multiples</th>
<th>weight (minutes)</th>
<th>Tab</th>
<th>Question</th>
<th>List</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Home medications list</td>
<td>N</td>
<td>2</td>
<td>CC Focus</td>
<td>Home Medications</td>
<td>Medications</td>
<td>Nasal Cannula, Face Mask, Nonrebreather, Venturi, Blowby O2, Trach</td>
</tr>
<tr>
<td>2</td>
<td>Oxygen application</td>
<td>Y</td>
<td>3</td>
<td>Proc/Prog</td>
<td>Supplemental oxygen</td>
<td>Delivery Method</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Past Medical History</td>
<td>N</td>
<td>2</td>
<td>CC Focus</td>
<td>Medical History, Surgical History</td>
<td>Medical History, Surgical History, OB-LMP, N/A Menses, Birth control method</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Safety screen (Domestic violence, fall history)</td>
<td>N</td>
<td>3</td>
<td>Safety</td>
<td>Fall Risk Assessment, Domestic Violence Screen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Airborne Precautions</td>
<td>N</td>
<td>2</td>
<td>Proc/Prog</td>
<td>Isolation Precautions</td>
<td>Isolation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contact Precautions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Droplet Precautions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Patient belongings</td>
<td>N</td>
<td>3</td>
<td>Dispo/Aff</td>
<td>Discharge, Expir, Transfer OSH pathways, Patient property inventory form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Blood culture</td>
<td>Y</td>
<td>16</td>
<td>Proc/Prog</td>
<td>Lab Specimens-Microbiology</td>
<td>Specimen</td>
<td>Blood</td>
</tr>
<tr>
<td>8</td>
<td>RASS Score (Richmond Agitation Sedation Scale)</td>
<td>Y</td>
<td>2</td>
<td>Proc/Prog</td>
<td>RASS Score</td>
<td>Score</td>
<td></td>
</tr>
</tbody>
</table>
Below are the definitions refined or developed for each element examined during the pilot. Compared to definitions developed later in the program, these are rudimentary and imprecise. Further discussion about billing definitions is found in Appendix D: Facility Billing Definitions – Methodology and Implementation.

**Figure 8: Nursing Intervention Definitions for Pilot Procedures**

**Definitions**

<table>
<thead>
<tr>
<th><strong>Home Medications</strong></th>
<th>completion of the patient's home medication list</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oxygen application</strong></td>
<td>application of nasal cannula, face mask, oxygen source</td>
</tr>
<tr>
<td><strong>Blood Culture</strong></td>
<td>obtaining blood culture specimen</td>
</tr>
<tr>
<td><strong>Past Medical/Surgical History</strong></td>
<td>completion of past medical/surgical history</td>
</tr>
<tr>
<td><strong>Safety Screen</strong></td>
<td>completion of domestic violence and/or fall history</td>
</tr>
<tr>
<td><strong>Isolation Precautions</strong></td>
<td>includes all types of isolation, contact, droplet, airborne, dawning and removal of required PPE (gown, gloves, mask, Dragger)</td>
</tr>
<tr>
<td><strong>Patient Belongings</strong></td>
<td>Discharged pts documentation of the patient belongings on the patient belongings form (gathering, accounting for, placing in a belonging bag)</td>
</tr>
<tr>
<td><strong>RASS</strong> (Richmond Agitation Sedation Scale)</td>
<td>Assessment of patient for alertness, restlessness or agitation, score given</td>
</tr>
</tbody>
</table>

In the immediate timeframe following the pilot, we observed a steady increase in the average RVUs per patient (RVU/pt - our metric of interest) being generated through nursing effort in the department. The graph in Figure 9 shows the monthly rise in average RVUs per patient (value shown on the Y axis) in the six months after the pilot,

**Figure 9: RVUs per Patient" Pre & Post Pilot**
as compared to the preceding six months. The trendline for each period is shown with a comparison of the slopes of each trendline.

The results of the pilot showed that RVUs per patient in the six-month period after the pilot averaged 11.19 RVU/pt as compared to an average of 10.31 RVU/pt in the six months preceding the pilot. Table 3 below contrasts these periods. This change represented a 0.88 RVU per patient increase in the six months after the pilot (p<0.0001, 95%CI: 1.13-0.62). Some of this was related to an increase in observation RVUs, which the pilot did not impact (observation RVUs are generated based on linear time the patient spends in the ED, not the amount of care the patient received: One hour of time in the ED equals one observation RVU). When we held observation hours constant, the average RVU/pt for the post-pilot period was 11.01; translating into an average increase of 0.70 (p<0.0001, 95%CI: 0.91-0.48) RVU/pt in the six months after the pilot. The results of the pilot remained unattenuated for at least the 12 months after activation. In the 12-month period following the pilot (March 2011-February 2012), the department averaged 11.09 RVU/pt when controlling for observation RVUs. Compared to the six-month period before the pilot, this equated to an average increase of 0.78 (p<0.0001, 95%CI: 0.96-0.60) RVU/pt for the year after the pilot. Based on calculations which are explained later in this paper, a variable cost analysis showed that a 0.1 RVU/pt increase equates to $280,202 increase in annual net profits. So our pilot yielded $2,185,576 (7.8 x 280,202) in annual variable net profits to the hospital.

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4 Data for the 12-month period before the pilot were not available. Therefore only the 6 months before the pilot could be used.
5 Section V: Economic Evaluations and Appendix G: Analysis Of Revenue Implications
As was discussed earlier, patients who receive care in the ED are billed facility charges based on nursing Clinical Care Time (CCT, as differentiated from professional fee charges associated with physician or mid-level provider care). Patients are assigned the same facility billing level regardless of admission or discharge status. Billing levels work on an opposite scale from patient acuity. An acuity level 1 patient is considered the highest (sickest) acuity level, whereas a billing level 1 patient is the lowest billing level. The association between the amount of clinical care time provided, the billing level and the charges billed to the patient is shown in Table 4 below. Table 4 shows FY11 figures as this was the timeframe of the pilot. The more clinical care time documented by the nursing staff (quantified in strata of minutes), the higher their billing level and the more RVUs (and thus billable charges) generated.
The mechanics behind the RVU/pt increase resulting from the pilot involved a change in the distribution of billing levels across ED patients. As can be seen in Table 5 below, the proportion of patients receiving level 1 and level 2 bills (for both admitted and discharged patients) declined by a combined average of 10.25% for the six months after the pilot as compared to the preceding six-month average. Simultaneously, the proportion of patients receiving level 3-5 bills (for both admitted and discharged patients) increased by a combined average of 10.51% for the six months after the pilot.

![Graph showing changes in billing levels.](image)

**Table 4: FY11 Billing Levels and Patient Charges**

<table>
<thead>
<tr>
<th>CCT Strata</th>
<th>Billing Level</th>
<th>RVUs Billed</th>
<th>Rate per RVU (FY11)</th>
<th>Total Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>Level 1</td>
<td>1</td>
<td>$76.86</td>
<td>$76.86</td>
</tr>
<tr>
<td>15-29</td>
<td>Level 2</td>
<td>3</td>
<td>$76.86</td>
<td>$230.58</td>
</tr>
<tr>
<td>30-59</td>
<td>Level 3</td>
<td>6</td>
<td>$76.86</td>
<td>$461.16</td>
</tr>
<tr>
<td>60-119</td>
<td>Level 4</td>
<td>12</td>
<td>$76.86</td>
<td>$922.32</td>
</tr>
<tr>
<td>120-over</td>
<td>Level 5</td>
<td>16</td>
<td>$76.86</td>
<td>$1,229.76</td>
</tr>
</tbody>
</table>

The mechanics behind the RVU/pt increase resulting from the pilot involved a change in the distribution of billing levels across ED patients. As can be seen in Table 5 below, the proportion of patients receiving level 1 and level 2 bills (for both admitted and discharged patients) declined by a combined average of 10.25% for the six months after the pilot as compared to the preceding six-month average. Simultaneously, the proportion of patients receiving level 3-5 bills (for both admitted and discharged patients) increased by a combined average of 10.51% for the six months after the pilot.

**Table 5: Proportion of Patients at Each Billing Level – Pre and Post-Pilot**

<table>
<thead>
<tr>
<th>Billing Level of Patient</th>
<th>Pre-Pilot (Aug10-Jan11)</th>
<th>Post-Pilot (Mar11-Aug11)</th>
<th>Pre to Post-Pilot Delta</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 + Level 1 Admit</td>
<td>9.71%</td>
<td>2.77%</td>
<td>-6.93%</td>
<td>p&lt;.0001</td>
</tr>
<tr>
<td>Level 2 + Level 2 Admit</td>
<td>10.57%</td>
<td>7.25%</td>
<td>-3.32%</td>
<td>p&lt;.0001</td>
</tr>
<tr>
<td>Level 3 + Level 3 Admit</td>
<td>21.95%</td>
<td>29.54%</td>
<td>7.59%</td>
<td>p&lt;.0001</td>
</tr>
<tr>
<td>Level 4 + Level 4 Admit</td>
<td>28.42%</td>
<td>28.76%</td>
<td>0.34%</td>
<td>p=.55</td>
</tr>
<tr>
<td>Level 5 + Level 5 Admit</td>
<td>28.43%</td>
<td>31.02%</td>
<td>2.58%</td>
<td>p&lt;.0001</td>
</tr>
</tbody>
</table>

* p-value based on means of specified months, not the aggregate mean.

This change is significant from a financial perspective, as level 1 and 2 visits to the ED generate only one and three RVUs, respectively, while level 3, 4, and 5 charges generate six, 12 and 16 RVUs per visit, respectively. The trends associated with billing level distribution are more easily followed when depicted pictorially as is done in the graph in Figure 10 below. Here, the proportion of patients at each billing level is seen. The Y axis denotes the percentage of patients who were billed at each billing level. The blue and red lines, representing level 1 and 2 patients, are noted to drop after the pilot.
(green dotted line). The green, purple and light blue lines representing level 3, 4 and 5 (respectively) patients are noted to rise after the pilot, demonstrating the increase in proportion of patients billed at a higher level.

**Figure 10: Proportion of Patients at Each Billing Level – Pre and Post-Pilot**

![Proportion of Patients at Each Billing Level – Pre and Post-Pilot](image)

We attributed the strong financial impact of the pilot to the fact that four of the eight nursing interventions we hooked to billing were typically performed very early during the patient’s visit. These interventions – home medications list, past medical/surgical history, safety screening, and blood culture – were often undertaken in conjunction with patient triage. These interventions were also done frequently (more on this below), thus they affected a sizable proportion of patients coming to the ED for care. The fact that they occurred early in the patient’s visit to the ED meant that the CCT stratum to which they contributed time was narrow – only 14 or 15 minutes long (see Table 4 above). This made it much more likely for these interventions (some of which were only two or three minutes long) to “bump” the billing level from level 1 to level 2, or from level 2 to level 3. This “redistributed” patients from the lower billing strata (level 1 and 2) to the higher strata (level 3 and 4). The impact of the nursing interventions – even ones with more CCT than two or three minutes (of which there was only one in the pilot) was not as visible in the higher billing levels where CCT strata are
30 and 60 minutes long. Here, an additional few minutes was less likely to “bump” the billing level upwards due to this larger size of each CCT stratum. It is worth noting that the majority (seven of eight) of items driving this increase in billing levels were nursing interventions that had been routinely documented prior to the pilot, but had simply not been billed or (in the case of one of the seven) was not billed at a correct time value. Thus the results of the pilot could be attributed to the capture of uncompensated effort, not the creation of new work.

PROGRAMMATIC RESULTS

Our interventional methodology consisted of a program built upon 14 programmatic activities. The process results for these activities are discussed next.

1. **Review percent documented report monthly** and 2. **Monitor for and address problems**. As part of the study we routinely monitored changes in the frequency with which nursing interventions were billed. Typically, downward trends in documentation were remediated with an email reminder to nursing staff from nursing leadership or study leadership, education during a variety of routine nursing forums, or both. An example where a more comprehensive effort was applied, relates to documentation of pain assessment. In November 2012 we noticed a three-month downward trend for this intervention. If a patient is evaluated at triage (or later) as having a pain level of greater than four (on a 10-point scale), then nursing standards require that a nurse reevaluate the patient’s pain every four hours. At a minimum, one such pain assessment must be conducted prior to discharge (if patient is present less than four hours). Provided with heavy input from front line nurses about how to improve their compliance with this documentation element, our project team added an electronic “pop-up” reminder in Allscripts (Figure 11) in

Figure 11: Allscripts “Pop Up” Message for Nursing Pain Assessment

![Allscripts “Pop Up” Message for Nursing Pain Assessment](image)
January 2013, to prompt nurses to conduct a full pain assessment (on patients requiring one) prior to discharge. This cue was inserted into the nurses’ electronic discharge pathway. It improved compliance so that even for patients short ED stays, a required element of care (by hospital policy) – and one that is billable – was less likely to be missed or skipped over purposely.

To augment this aide-mémoire, another change we made in our documentation system, was the creation of a new “pain icon” (Figure 12). Allscripts relies heavily on icons to highlight patient status and provide reminders to clinicians about steps in, and aspects of, the plan of care. Our project team added the “frown face icon” to the documentation system’s Tracking Board as a reminder to nurses to include the pain reassessment in their four hour workflow (Figure 13). For patients meeting the criteria described above, the pain icon is triggered by the triage nurse. The icon stays up as a reminder to the nurse that the patient is experiencing pain, and requires pain assessment every four hours. As a result of this, the downward trend in the frequency of documentation reversed. In the three months prior to these changes, pain assessment had been documented 9,415 times. In the three months after, that number rose to 13,044. Unrelated to the three-month trend, a six-month comparison shows pain assessment documented 18,963 times in the six months prior to the changes and 26,384 times in the six months after. That increase, when controlled for (scaled to) patient volume, represents a 37% increase in documentation.

3. **Monitor practice via hybrid audits** and 4. **Team leader chart audits.** As discussed in Section II above, the aim of the hybrid audit was to develop a web-based nursing chart audit and facility billing/audit tool that allowed us to monitor nursing documentation. Not only would the hybrid audit allow us to better scrutinize nursing documentation and practice, but it would facilitate three other programmatic activities:
Identifying underperformers and educating them, team leader chart audits, and incentivizing high performers. Unfortunately, at the time of this writing, this activity is only beginning to move forward. Despite production of a detailed scope document (included in the appendix) that was submitted for acceptance in September 2012, other information technology (IT) projects took precedence. Competing with our request was implementation of the new EPIC clinical documentation system in other health system EDs. Therefore, the project planning meeting for the hybrid audit did not occur until late August 2013. This project is now in the design phase with dedicated resources assigned. We anticipate an alpha test version in mid-November 2013.

Failure to implement this programmatic activity had negative downstream effects on the other activities connected to it (see Appendix E: Elements of the Programmatic Intervention). Since the department’s Director of Nursing made the hybrid audit a prerequisite to expansion of the team leader audits, this meant that team leader assessments had not moved beyond their annual lifecycle. Lacking an electronic audit tool, easily accessible by nurse team leaders, meant that they could not conduct quarterly reviews of their team members’ documentation practices. This had a very important negative impact on the project. First, we had no capability to detect or quantify individual nursing performance as it related to clinical documentation. This is fundamental to targeted education (i.e., individualized to specific nurses), enhanced leadership focus (from team leaders), and the development of a valid incentive program. Second, the short-term project goals of focusing on problem areas, improved recognition of performance, and improved awareness among nursing suffered as their success became a function of other programmatic activities. Third, failure to implement this programmatic activity and its second and third order effects (just described) resulted is an asynchronous, fragmented implementation of what should have been a well-coordinated multifaceted study, such that some aspects lurched forward while others lagged behind. This discussion is expanded upon in the Lessons Learned section at the end of this dissertation.

5. **Identify and educate underperformers.** As was just mentioned, identifying nurses who were not meeting existing performance measures associated with
documentation is requisite to individualized (or targeted group) education aimed at performance improvement [what Werle, Dobbelsteyn, et al. (2010) call performance-focused methodology\textsuperscript{138} and others (2013, 2008) performance-focused or performance-oriented education\textsuperscript{139,140}]. Lacking a functional team leader audit tool linking patient charts to individual nurses, we were unable to move this programmatic activity forward. The popularity of this project among nursing leadership, however, did pose an educational opportunity. As the Director of Nursing was moving the staff closer to a professional practice model,\textsuperscript{107,111,141} this project highlighted a prospect for nurses to make a connection between clinical practice and organizational outcomes. As part of the practice model, there was a desire to improve the knowledge base of ED nurses regarding their role in revenue generation. Specifically, nursing leadership sought to engender among the staff an understanding of the relationship between nursing documentation and patient billing. This resulted in the development of a ‘billing education’ module that became a component of nursing departmental professional education and will soon be incorporated into the education that nurses receive as part of departmental orientation. This comports well with Havens and Mills’ (1992) citing of Hall (1967), who noted that professional rewards typically included opportunities to participate in “the affairs of the profession”.\textsuperscript{109,142}

6. **Incentivize high performers.** Two short-term goals were directly linked to the programmatic activity of incentivizing high performers. These were ‘improved recognition of performance’ and ‘improved awareness among nursing.’ These, in turn, drove the long-term goals of ‘employee satisfaction’ and ‘compliance,’ and indirectly the goals of ‘revenue’ and ‘production efficiency.’ Since incentivizing performance relied on identifying individual nurses’ performance, which was only possible via the hybrid audit, this portion of the program was not implemented. Despite this impediment, the nursing incentive program actually met with some strategic success during implementation. This success exceeded original programmatic expectations for the extensiveness and sophistication of the incentive program.

As originally conceived, incentivizing high performers relied on a simplistic program of material “gifts” (e.g. branded merchandise, Starbucks Corporation gift cards,
etc.) and public recognition by nursing leadership, to distinguish nurses demonstrating exceptional documentation practice. Havens and Mills (1992) described this as a level II reward mechanism, which is characterized by “recognition of professional achievements through ongoing… recompense” but is not linked to self-motivation.\(^\text{109}\) This, however, evolved into a more professional and sophisticated program, with level III reward mechanisms (called “motivationally rooted,” and more comprehensive in their evaluative approach\(^\text{109}\)), with the help of the Director of Nursing.

While the Director of Nursing secured commitment from the Department Chair and Administrator to fund an incentive program, she favored a more broad-based or “strategic” approach, one that went beyond one specific aspect of clinical performance (e.g. documentation practice). In line with recommendations that compensation and reward systems be aligned with improved effort, competence, increased productivity, better outcomes, and improved compliance with documentation standards\(^\text{107,110,143,144}\), the Director of Nursing and project leadership decided to include documentation compliance as a component of a nursing report card. Nursing and project leadership jointly drafted a template of this report card which can be seen in Figure 14.

**Figure 14: Draft Proposed Nursing Report Card**

<table>
<thead>
<tr>
<th>Provider: Johnson, Rosemary</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY13 JOHN HOPKINS EMERGENCY MEDICINE NURSING REPORT CARD</td>
</tr>
<tr>
<td><strong>METRIC</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Overall Patient Satisfaction</td>
</tr>
<tr>
<td>Overall Nurse Satisfaction</td>
</tr>
<tr>
<td>Pain Management</td>
</tr>
<tr>
<td>Number Surveys Retrieved</td>
</tr>
<tr>
<td>Nursing Quality</td>
</tr>
<tr>
<td><strong>SERVICE / PERSPECTIVE OF CARE</strong></td>
</tr>
<tr>
<td>Close to Triage Time</td>
</tr>
<tr>
<td>Discharge Order in Time</td>
</tr>
<tr>
<td>Admitted Bed Ready to Pt. Left Dept.</td>
</tr>
<tr>
<td>Quality</td>
</tr>
<tr>
<td>Vital Signs within 1hr of DC</td>
</tr>
<tr>
<td>Fall Assessment</td>
</tr>
<tr>
<td>Rhythm Interpretation for Pts On Monitor</td>
</tr>
<tr>
<td>Initial ECG &amp; Assessment of Admit</td>
</tr>
</tbody>
</table>
This report card – individualized by nurse – would serve as the foundation from which nursing incentives were allocated. To this report card template we added a pillar called "Practice" that combined elements of financial performance (via documentation compliance), regulatory compliance and nursing standards of practice. Suggested elements for inclusion in this pillar are:

- Vital signs within 1 hr of d/c
- Initial pain assessment completed
- Home meds list completed
- Rhythm interpretation for pts placed on a monitor
- Initial ROS and reassessment for admitted patients
- Fall assessment
- Response to medication is documented (for medications that require a response.)

It was our objective that an upcoming “bonus” system of financial rewards for the performance measures seen on the nursing report card would induce emphasis and performance incentive for improved documentation practice among nurses.

7. **Conduct time studies of all billable nursing procedures.** Observational time studies of common nursing (nurse and clinical tech) procedures were conducted in the Main and Pediatric Emergency Departments to align documentable activities with the actual time they required. The objective was to determine the average time that common procedures demand in order to update resource times for facility billing charges. The time study methodology, tools, observer selection and observer training are all detailed in Appendix B: Time Studies. Prior to our project there were 57 billable procedures (two were pediatric specific). We added eight new items during the pilot. In February 2012, our team added case manager time as a billable element, bringing the total to 66 billable items. If we attempted to gather the proposed minimum of 10 observations per intervention, we were facing a minimum of 660 separate observations, many of which targeted procedures that were only done a few times a year. Given limited resources available to dedicate to time studies in both EDs, we decided to streamline our process.
We began by examining the 66 billable nursing interventions that existed in Allscripts between January and June 2012. We used the number of times a procedure was billed as a proxy for the number of times it was conducted on a patient. Of the 66 interventions, the most frequently occurring in both EDs was Vital Signs (six month combined n=143,840 for both EDs). The least frequent interventions were Gastric Lavage in the Pediatric ED (n=1) and Eye Shield Application in the Main ED (n=2). We began by “weighting” the value of the interventions so that the relative importance of each was represented not just by its frequency but by the number of minutes it contributed to the RVU value.\textsuperscript{145} Thus, a procedure like Patient Status that was billed 105,331 times in six months (Main ED) at one minute per intervention was valued at 105,331 minutes when its frequency (105,331) was multiplied by its billing time (one min). In contrast, a procedure like IV Insertion was conducted 21,001 times in the same period – roughly one fifth the frequency of Patient Status. But, IV Insertion accounted for 20 minutes of billing time, so its weighted value was 420,020 minutes – roughly four times the value of Patient Status. We called these values “Weighted Procedure Minutes”. This method was used to rank order all nursing interventions from both EDs from those that contribute the most to the least billable time.

The next step was to ascertain which procedures accounted for the highest proportion and cumulative proportion of the billed minutes in the time period examined. Initially this was done to enable us to prioritize the order in which the 66 procedures would be time studied. Surprisingly, the top 19 interventions (by weighted time) accounted for just over 90% of the billable minutes. The 18\textsuperscript{th} and 19\textsuperscript{th} interventions each accounted for less than 1% of billable minutes. In fact, each of the “bottom” 43 interventions (65%) accounted for less than 0.5% of billable time. The decision was thus made, to time study only the “top” 19 interventions. The prospect of time studying 19 interventions as opposed to 66 was much more appealing. Table 6 below depicts the top 19 contributors to billable time from both EDs as well as the relative weights assigned to each.
In February 2013, while time studies were still being conducted, the list was updated using a full year of data on the number of times each procedure was billed. This allowed us to utilize not only a year of data, as opposed to the initial six months, but this was the first full year of data in our new clinical building. This enabled us to account for any unknown and unrecognized nursing practice changes associated with the change in location (or, potentially, with any change in patient demographics). During the time studies, we also identified opportunities to improve documentation accuracy and fair billing practices. These are discussed in detail below, but for time study purposes, this led to certain elements being “split” and each “sub-element” being timed separately. These “sub-elements” are highlighted in yellow in Table 9 below.

Time studies consumed significantly more time than anticipated. This was due to the fact that, to mitigate bias, we required observers to collect data from multiple locations in each ED. This increased observers’ movement time during each shift and prevented them from “homesteading” in one location where an intervention may be performed frequently. Further consuming time was the fact that observers had to spend non-productive time “hunting” for interventions they needed to capture. Observers enlisted their colleagues help, and leveraged our internal mobile phone system to receive advance notice of interventions they wanted to time. From 10 December 2012
to 18 June 2013 we spent 384.7 hours to time study 47 interventions. We used 5 nurse observers (4 in the Main ED and 3 in the Pediatric ED) to complete a total of 969 individual observations in six locations within the Main ED, and four locations within the Pediatric ED. Table 7 summarizes these numbers to provide a sense of scope to this effort. In six cases (Blood Kiosk, Central Line Dressing Change, C Spine Immobilization, Implantable Port Deaccessed, Suture/Staple Removal, Urinary Catheter Removal), our study team opted to time study simulations of interventions. Simulations were conducted either on staff or on a Laerdal Medical SimMan patient simulator. This helped capture some of the less frequent interventions of interest. In all other cases, time studies were of “actual” patient encounters.

Table 7: Time Study Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Number of Nursing Interventions Studied</th>
<th>Number of Observations</th>
<th>Number of Observers</th>
<th>Total Observer Hours</th>
<th>Mean Hours per Observer</th>
<th>Mean Minutes per Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main ED</td>
<td>47</td>
<td>566</td>
<td>4</td>
<td>174.7</td>
<td>43.7</td>
<td>18.5</td>
</tr>
<tr>
<td>Pediatric ED</td>
<td>38</td>
<td>403</td>
<td>3</td>
<td>210.1</td>
<td>70.0</td>
<td>31.3</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>969</td>
<td>5</td>
<td>384.7</td>
<td>76.9</td>
<td>23.8</td>
</tr>
</tbody>
</table>

Table 8, summarizes the results and summary statistics from the time studies in both EDs. The interventions shown in this table are based on the annual data from Table 9 below, not the six-month data shown in Table 6 above, so the interventions are slightly different. The table shows only the top 19 interventions (in terms of contribution to overall billable minutes); however, the other interventions we time studied are shown in Appendix B: Time Studies. Since billing must be done in whole minutes, mean total times from Table 8 were rounded to the nearest whole number when applied in other tables in this document, and within Allscripts itself.
Table 8: Results and Summary Statistics from the Time Studies in the Main and Pediatric EDs at The Johns Hopkins Hospital (Top 19 Interventions)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Adult</th>
<th>Pediatric</th>
<th>N</th>
<th>Mean Intervention Time</th>
<th>Mean Documentation Time</th>
<th>Mean Total Time</th>
<th>Std Deviation</th>
<th>Coefficient of Variation</th>
<th>Min</th>
<th>Max</th>
<th>Documentation as % of Total Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission Preparation</td>
<td>n=12</td>
<td>14.1</td>
<td>1.5</td>
<td>15.5</td>
<td>6.8</td>
<td>43.3%</td>
<td>6.5</td>
<td>29.0</td>
<td>9.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Culture</td>
<td>n=10</td>
<td>21.5</td>
<td>2.0</td>
<td>23.6</td>
<td>12.2</td>
<td>51.8%</td>
<td>13.6</td>
<td>51.2</td>
<td>8.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Monitor - Lead Placement</td>
<td>n=12</td>
<td>6.0</td>
<td>0.7</td>
<td>7.5</td>
<td>4.0</td>
<td>52.7%</td>
<td>3.0</td>
<td>13.2</td>
<td>8.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge/AMA with Instructions</td>
<td>n=14</td>
<td>7.6</td>
<td>1.9</td>
<td>9.5</td>
<td>4.6</td>
<td>48.8%</td>
<td>3.5</td>
<td>19.1</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKG - Bedside Monitor</td>
<td>n=9</td>
<td>4.4</td>
<td>0.6</td>
<td>5.0</td>
<td>1.7</td>
<td>35.0%</td>
<td>2.5</td>
<td>7.1</td>
<td>13.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKG - Cart</td>
<td>n=18</td>
<td>8.7</td>
<td>1.0</td>
<td>9.8</td>
<td>2.7</td>
<td>27.8%</td>
<td>4.8</td>
<td>13.8</td>
<td>10.6%</td>
<td></td>
<td></td>
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<tr>
<td>IV Insertion - Attempt</td>
<td>n=7</td>
<td>17.3</td>
<td>0.8</td>
<td>18.1</td>
<td>5.6</td>
<td>31.2%</td>
<td>11.7</td>
<td>28.0</td>
<td>4.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV Insertion - Successful</td>
<td>n=14</td>
<td>12.5</td>
<td>1.0</td>
<td>13.5</td>
<td>6.8</td>
<td>50.3%</td>
<td>6.0</td>
<td>22.2</td>
<td>7.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labs - Blood Specimen</td>
<td>n=16</td>
<td>12.6</td>
<td>1.0</td>
<td>13.6</td>
<td>4.7</td>
<td>34.2%</td>
<td>6.6</td>
<td>20.8</td>
<td>7.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medications Given</td>
<td>n=28</td>
<td>6.7</td>
<td>0.7</td>
<td>7.4</td>
<td>4.1</td>
<td>55.5%</td>
<td>2.8</td>
<td>16.6</td>
<td>9.5%</td>
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<td></td>
</tr>
<tr>
<td>Nursing Assessment/Reassessment</td>
<td>n=13</td>
<td>8.5</td>
<td>3.4</td>
<td>11.9</td>
<td>4.1</td>
<td>34.5%</td>
<td>5.8</td>
<td>19.7</td>
<td>28.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Eval/Assessment</td>
<td>n=10</td>
<td>1.6</td>
<td>1.1</td>
<td>2.7</td>
<td>1.3</td>
<td>49.4%</td>
<td>1.2</td>
<td>4.9</td>
<td>39.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Status</td>
<td>n=19</td>
<td>1.8</td>
<td>0.9</td>
<td>2.7</td>
<td>1.6</td>
<td>65.2%</td>
<td>0.4</td>
<td>6.4</td>
<td>32.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport by RN/CT</td>
<td>n=31</td>
<td>14.4</td>
<td>0.7</td>
<td>15.1</td>
<td>6.5</td>
<td>50.3%</td>
<td>2.0</td>
<td>35.8</td>
<td>4.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vital Signs</td>
<td>n=28</td>
<td>4.1</td>
<td>0.6</td>
<td>4.7</td>
<td>1.7</td>
<td>35.2%</td>
<td>2.1</td>
<td>7.3</td>
<td>13.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient History (Med &amp; Surge)</td>
<td>n=13</td>
<td>0.5</td>
<td>0.3</td>
<td>0.8</td>
<td>0.9</td>
<td>110.7%</td>
<td>0.2</td>
<td>3.0</td>
<td>35.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Screening*</td>
<td>n=10</td>
<td>3.1</td>
<td>1.54</td>
<td>4.94</td>
<td>1.1</td>
<td>57.7%</td>
<td>3.1</td>
<td>5.7</td>
<td>47.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Conducted during pilot phase (adult only), documentation and intervention time not separated.
The impact of the time study outcomes on billable minutes can be seen in Table 9 (above). This summary only shows the outcomes connected with the interventions associated with the most billable minutes. All other nursing interventions and their associated minutes are presented in Appendix B. The time studies resulted in additional time being added to the billable CCT for seven interventions. The exact number of minutes added to each of the seven, can be seen in the table highlighted in green. Four interventions did not change time. These are shown with the number “0” highlighted in purple. The time studies resulted in time being subtracted from the billable CCT for eight interventions. The exact number of minutes by which each of the eight was decreased, can be seen in the table highlighted in red. Four interventions in the table are highlighted in gray. Of the four items, three, ‘IV Insertion/Attempts’, ‘EKG’, and ‘Cardiac monitor’ were eliminated from Allscripts as billable items in favor of more specific intervention nomenclature, which is highlighted in yellow under each of these three interventions. The new times associated with each of the six new items is shown in the table and computed against the original interventions’ time in the “Change in minutes” column. The fourth item with gray highlight is the ‘Peds Social Work Time’ intervention. This intervention was not time studied and therefore shows no new post...
time study data. This intervention is billed in 15 minute increments based on the actual work time documented by the social worker. Of interest is the fact that the Pediatric ED may bill for their social workers' time, but the Main ED may not. This is driven by the regulatory parameters set forth by the HSCRC,\textsuperscript{88} which indicate that any employee generating billable time for the ED must be on the payroll of the ED. Such is the case in the Pediatric ED, while Main ED social workers are on the payroll of the hospital’s central social work department.

While our time studies were conducted jointly with the Pediatric ED, of interest were the outcomes associated with the Main ED. The impact of the changes described in Table 9 (above) on future Main ED billing drew particular attention by the study team. One way we predicted this impact was to examine anticipated long term impact of the increase or decrease in billable CCT. To accomplish this we took the most recent annual billing volume (our proxy for how frequently an intervention was performed by nurses in our ED) and recreated the weighted procedure minutes for both the pre time study period and the post time study period. The delta between these two is a measure of CCT minutes lost or gained. The results are tabulated in Table 10 below. Note that the interventions listed in this table differ somewhat from those in the two tables above as these are based on a full year of only Main ED data while the ones above combine data from both EDs. The expected outcome for the time study (likely to occur in FY14 – after all the time study changes were implemented) was 499,524 incremental minutes of billable clinical care time per annum. This change is not limited only to the one-year period immediately following the program. This incremental CCT should increase revenue for years to come, as it provides an accurate measure of clinical time spent by nurses caring for their patients.
The almost half a million incremental minutes of CCT in Table 10, is projected to yield 42,224 incremental RVUs in FY14. This equates to a 5.6% increase in total RVUs in FY14 as compared to FY13. That projection has already been built into the budgeted RVU level for FY14.

Noteworthy in the above analysis was the reliability of the observers who conducted the time study. Since we know “...judgments made by humans are especially plagued by [measurement error],” some assessment of such error in our time studies would prove of value in estimating the “extent that [our] measurements are measuring anything.”\textsuperscript{146} Formal measures of reliability, such as intraclass correlation coefficients, all rely on partitioning of variance in some method.\textsuperscript{146,147} Because we did not have multiple measurements of the same “target” (i.e., the same intervention conducted by the same nurse), we were unable to assess reliability in this manner.\textsuperscript{147,148}
As a proxy for reliability, we chose to examine the observers’ association with the reported intervention times. In order to gain insight into the association between our observers and our observers’ measures, we conducted multiple linear regression analysis using time study variables and outcomes data. Linear regression analysis can be used to draw inferences about the strength of the relationship between dependent and independent variables.\textsuperscript{149} Since variables such as location and observers were different between the two EDs, we focused our modeling on the department of interest – the Main ED. In the Main ED model, our dependent variable was intervention time (per intervention, not the aggregated figures shown above). Our independent (or explanatory) variables were the type of intervention (e.g., Allergies, Home Meds, Blood Culture, etc.); the shift in which the intervention was observed (‘shift’); the location of the ED in which the observation occurred (‘location’; e.g., triage, trauma, etc.), the observer who time studied the intervention (‘observer’); and the type of employee who performed the intervention (‘employeetype’ [sic]; i.e., either a nurse or a clinical tech). We left the time of day and date of the observations out of the model because we saw no rationale for them to impact the length of time it took a nurse or clinical tech to perform that intervention. It is conceivable that the later into a clinician’s shift we extend, the slower his/her performance; but this was not of interest in this study. Also, to add that many variables would have strained the degrees of freedom of the model. Regression analysis was conducted using StataCorp Stata 13. Stata output is shown in Annex I.

Because the relationship of interest in this exploration was that of the observer and his/her impact on intervention time, the first regression model, called Model 1 and shown in Figure 15 below, excluded the observer as a variable. Model 1 suggested that 73.5% of the variation in the intervention time could be explained by the independent variables (type of intervention, shift, location, and employee type). The remaining 26.5% may be attributable to the variables we did not include (observer, date, time of day); unknown, hidden or confounding variables; and inherent variability. Model 1 also suggested that location and shift were not statistically significantly related to the intervention time, but that employee type was. It suggested that, when a clinical tech performed an intervention he or she was 1.7 minutes (p=0.002, 95%CI: 2.7-0.64) faster.
than a nurse. This was not surprising since techs tend to specialize in a smaller subset of interventions based on their scope of practice.

The next regression model, Model 2 (Figure 16 below), included observers as a term in the model. We hypothesized that this model would explain a significantly larger amount of the variation in the intervention time, because we suspected that, despite rigorous observer training, different nurses would inherently create variability. Of interest, Model 2 suggested that 74.0% of the variation in the intervention time could be explained by the independent variables which now included the observers. This ½% seemed practically insignificant. Like Model 1, Model 2 also suggested that location and shift were not statistically significantly related to the intervention time. This model suggested that, on average, clinical techs are faster than nurses by 1.8 minutes (p=0.001, 95%CI: 2.8-0.80), comparable to Model 1’s average difference of 1.7 minutes. Model 2 also suggested that, among the four observers, the strength of the relationship between intervention time and observer was only statistically significant for observers 2 (p=0.03) and 3 (p=0.03). It suggested that, on average, observer 2’s observations tended to be 1.5 minutes (95%CI: 2.8-0.14) longer than the reference group (which was observer 1), and, on average, observer 3’s observations tended to be 0.99 minutes (95%CI: 1.8-0.11) faster than the reference’s. Since the adjusted coefficient of (multiple) determination (adjusted $R^2$) increased – even if only slightly – when we added the observer term, we inferred that the added variable does improve the model.

To assess the statistical significance of the difference between the two models, we conducted a likelihood-ratio test, which suggested that the ½% difference in the contribution of the independent variables to the variation in the intervention time was statistically significant. This was adduced because the difference in the residual sums of squares between the two models was statistically significant (p=0.003), and corroborated by an ANOVA, which also showed statistical significance in the difference between the models (p=0.005). We also re-calculated both models while excluding the independent variables for location and shift that were found by Model 1 and 2 not to be significantly related to our dependent variable. We recalculated, with and without, the observer variable and found similar results to those with Model 1 and 2, with a
difference of less than ½% between the models, and with statistical significance in the
difference (based on a likelihood-ratio test). Statistical outputs are shown in Appendix I.

Our last model, Model 3 (Figure 17 below), excluded location and shift that we
found not significant and maintained the observer variable. This seemed to be the
“cleanest” model. Similar to Model 1, Model 3 suggested that 73.5% of the variation in
the intervention time could be explained by the independent variables (type of
intervention, observer, and employee type). It suggested that clinical techs are, on
average, 1.8 minutes (p=0.001, 95%CI: 2.9-0.80) faster than nurses. Unlike the
previous model, it suggested that observer 2’s observations were not statistically
significantly related to intervention time (p=0.13); nor were observer 3’s (p=0.07, slightly
above the generally accepted threshold of 0.05 for statistical significance).

Our interpretation of this modeling is that, despite our inability to estimate formal
reliability among the observers, the regression models suggest that differences among
the four Main ED observers did contribute a statistically significant amount of variation
to the measurement of clinical intervention time for ED nurses and techs. The applied
impact of this, however, seems to be minimal, suggesting that training nurses to be
observers, and then having them follow our time study methodology, is a practical and
reasonable approach to capturing accurate measures of nursing effort in the ED.
Figure 15: Model 1 (Observer Left Out) – Regression of Intervention, Shift,
Location and Employee Type on Intervention Time
Source

SS

df

MS

Model
Residual

17851.9699
5683.26882

49
499

364.325917
11.3893163

Total

23535.2387

548

42.9475159

Number of obs
F( 49,
499)
Prob > F
R-squared
Adj R-squared
Root MSE

549
31.99
0.0000
0.7585
0.7348
3.3748

time

Coef.

action
Allergies
Arrival Patient Info
Blood Culture
Blood Glucose - POCT
Blood Kiosk (Simulation)
CAP
Cardiac Monitor Lead Placement
Central Line Dressing Change (Simulation)
Chief Complaint Quote
Discharge/AMA with Instructions
EKG (bedside monitor)
EKG (cart)
FNGs
Home Meds
ILI
IV D/C
IV Insertion - Attempt
IV Insertion - Successful
IV Tubing Set Up
Implantable Port Deccessed (Simulation)
Labs - blood specimen
Labs - other specimen
Lead Cardiac Rhythm Interpretation
Medication Prep (mixing)
Medications Given, IV, PO, IM and Fluids
Neb Treatment Set Up
Nursing Assessment / Reassessment (ROS)
Pain Eval/Assessment
Patient History (Med & Surge)
Patient Status
Port - a - Cath Accessed
Pulse Ox (applied)
SAT
Transport by RN/CT (External)
Transport by RN/CT (Internal)
Urinary catheter removal (Simulation)
Visit Overview Screen
Vital Signs
c spine immobilization (Simulation)
suture/staple removal (Simulation)

-12.97921
-12.56702
10.05972
-9.205947
-11.71384
-12.93895
-6.21495
-4.79605
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1.360503
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-4.26
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-8.01
-8.48
-7.69
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2.59
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-6.35
0.23
-6.16
-8.00
-8.12
-6.24
-7.94
-2.18
-8.42
-7.85
-10.16
-0.02
-10.20
-8.39
4.81
-4.17
-5.01
-7.68
-7.71
-5.10
-6.16

0.000
0.000
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-8.193174
-3.095154
-5.257092
1.34577
-9.37384
-9.313248
-9.526056
-9.361832
7.698909
3.141452
-9.471265
-7.905505
3.059288
-5.703448
-8.939008
-8.564947
-5.099791
-8.384802
-.2992007
-9.39863
-9.316106
-10.33039
5.048005
-10.53701
-9.956818
8.957939
-2.993844
-5.673289
-9.614159
-6.932691
-5.839955
-7.131607

shift
2
3

.1185185
-.7666787

.3653929
.5461291

0.32
-1.40

0.746
0.161

-.5993797
-1.839675

.8364167
.3063172

location
1
2
3
4
5
6

-.6171743
1.371086
.8789468
3.594999
.8665745
.6071882

2.482706
2.401156
2.425778
2.583667
2.408353
2.476175

-0.25
0.57
0.36
1.39
0.36
0.25

0.804
0.568
0.717
0.165
0.719
0.806

-5.49502
-3.346536
-3.88705
-1.481207
-3.865187
-4.257825

4.260671
6.088707
5.644943
8.671204
5.598336
5.472201

2.employeetype
_cons

-1.693116
13.79802

.5351067
2.581484

-3.16
5.34

0.002
0.000

-2.744456
8.726107

-.6417763
18.86994

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Std. Err.

=
=
=
=
=
=

t

P>|t|

[95% Conf. Interval]

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Figure 16: Model 2 (Observer Included) – Regression of Intervention, Shift, Location, Employee Type and Observer on Intervention Time

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 549</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>17995.2437</td>
<td>52</td>
<td>346.264302</td>
<td>F(52, 496) = 30.98</td>
</tr>
<tr>
<td>Residual</td>
<td>5539.89505</td>
<td>496</td>
<td>11.1691432</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td>Total</td>
<td>23535.2387</td>
<td>548</td>
<td>42.9475159</td>
<td>R-squared = 0.7646</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Adj R-squared = 0.7399</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>23535.2387</td>
<td>548</td>
<td>42.9475159</td>
<td>Root MSE = 3.342</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 549</th>
</tr>
</thead>
<tbody>
<tr>
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<td>52</td>
<td>346.264302</td>
<td>F(52, 496) = 30.98</td>
</tr>
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<td>5539.89505</td>
<td>496</td>
<td>11.1691432</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
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<td>548</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Adj R-squared = 0.7399</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>23535.2387</td>
<td>548</td>
<td>42.9475159</td>
<td>Root MSE = 3.342</td>
</tr>
</tbody>
</table>
Figure 17: Model 3 (Observer & Employee Only) – Regression of Intervention, Employee Type and Observer on Intervention Time

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 549</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>17791.3127</td>
<td>44</td>
<td>404.348016</td>
<td>P( 44, 504) = 35.48</td>
</tr>
<tr>
<td>Residual</td>
<td>5743.92605</td>
<td>504</td>
<td>11.3966787</td>
<td>R-squared = 0.7559</td>
</tr>
<tr>
<td>Total</td>
<td>23535.2387</td>
<td>548</td>
<td>42.9475159</td>
<td>Adj R-squared = 0.7346</td>
</tr>
</tbody>
</table>

| Source          | Coef.     | Std. Err. | t    | P>|t|   | [95% Conf. Interval] |
|-----------------|-----------|-----------|------|------|---------------------|
| Action          |           |           |      |      |                     |
| Allergies       | -14.98691| 1.300078  | -11.53| 0.000| -17.54115 -12.43267 |
| Arrival Patient Info | -14.75629| 1.36466 | -10.81| 0.000| -17.43742 -12.27517 |
| Blood Culture   | 10.32192| 1.526941  | 6.76  | 0.000| 7.321965 13.32187 |
| Blood Glucose - POC | -9.857035| 1.463796 | -6.73 | 0.000| -12.73293 -6.981141 |
| Blood Kiosk (Simulation) | -12.11807| 1.379325 | -8.79 | 0.000| -14.82801 -9.40814 |
| CNS             | -15.35672| 1.36419  | -11.26 | 0.000| -18.03962 -12.67652 |
| Cardiac Monitor Lead Placement | -6.103595| 1.438337 | -4.24 | 0.000| -8.929471 -3.277719 |
| Central Line Dressing Change (Simulation) | -5.726438| 1.484332 | -3.86 | 0.000| -8.642678 -2.810199 |
| Chief Complaint Quote | -13.14443| 1.325642 | -9.91 | 0.000| -15.75066 -10.35819 |
| Discharge/AMA with Instructions | -5.26166| 1.34544 | -3.91 | 0.000| -7.908528 -2.621805 |
| ERG (Bedside monitor) | -8.472123| 1.489763 | -5.69 | 0.000| -11.39886 -5.545389 |
| ERG (Cart) | -3.783798| 1.362569 | -2.77 | 0.000| -6.466117 -1.101479 |
| FREG | -14.28961| 1.326568 | -10.77 | 0.000| -16.8967 -11.68253 |
| Home Meds | -13.49713| 1.292247 | -10.44 | 0.000| -16.03599 -10.95828 |
| ILL | 14.91246| 1.463828 | -10.16 | 0.000| -17.80625 -12.03666 |
| IV D/C | 14.93182| 1.22383 | -9.83 | 0.000| -14.43625 -9.627379 |
| IV Insertion – Attempt | 4.302584| 1.654283 | 2.60 | 0.010| 1.052443 7.552724 |
| IV Insertion – Successful | -29.20642| 1.385281 | -0.21 | 0.833| -3.0137 2.429572 |
| IV Tubing Set Up | -12.12916| 1.364585 | -8.89 | 0.000| -14.81013 -9.448182 |
| Implantable Port Decommed (Simulation) | -12.29337| 1.692677 | -7.25 | 0.000| -15.62601 -8.960724 |
| Labs - blood specimen | -15.75859| 1.357315 | 0.12 | 0.908| -2.509016 2.824278 |
| Labs - other specimen | 8.320778| 1.338686 | -6.24 | 0.000| -10.94914 -5.700156 |
| Lead Cardiac Rhythm Interpretation | -11.78218| 1.462434 | -8.06 | 0.000| -13.33122 -9.21706 |
| Medication Prep (mixing) | -11.45387| 1.394354 | -8.24 | 0.000| -13.93934 -9.87398 |
| Medications Given, IV, In, IM and Fluids | -7.496005| 1.371079 | -6.40 | 0.000| -9.796803 -5.195206 |
| Neb Treatment Set Up | -12.22065| 1.385758 | -8.10 | 0.000| -14.93222 -8.498073 |
| Nursing Assessment / Reassessment (ROS) | -3.113693| 1.554691 | -2.03 | 0.022| -5.75723 -4.521562 |
| Pain Evaluation/Assessment | -12.47146| 1.45584 | -8.57 | 0.000| -15.33122 -9.61706 |
| Patient History (Med & Surgery) | -14.33111| 1.363289 | -10.60 | 0.000| -17.10887 -11.57557 |
| Patient Status | -12.46464| 1.253927 | -9.94 | 0.000| -14.92821 -10.00107 |
| Port - a Cath Accessed | -0.039786| 2.580727 | -0.01 | 0.990| -5.10287 5.03933 |
| Pulse Ox (applied) | -13.23996| 1.240159 | -10.88 | 0.000| -15.67647 -10.80344 |
| SAF | -15.51938| 1.36419 | -11.38 | 0.000| -18.19958 -12.83981 |
| Transport by RN/CT (External) | 6.32106| 1.298547 | 4.87 | 0.000| 3.771874 8.874339 |
| Transport by RN/CT (Internal) | -6.0274 | 1.317763 | -4.57 | 0.000| -8.616385 -3.438415 |
| Urinary catheter removal (Simulation) | -10.69004| 1.692777 | -6.30 | 0.000| -14.02268 -7.357391 |
| Visit Overview Screen | -14.54505| 1.481096 | -9.82 | 0.000| -17.45493 -11.63516 |
| Vital Signs | 9.94706| 1.747343 | -5.81 | 0.000| -12.30268 -7.686727 |
| c spine immobilization (Simulation) | -10.8567| 1.692777 | -6.40 | 0.000| -14.18935 -7.524058 |
| suture/staple removal (Simulation) | -10.6133| 1.6291 | -6.51 | 0.000| -13.81401 -7.412686 |
| 2.employertype | -1.822567| 0.5214418 | -3.50 | 0.001| -2.847034 -1.7980997 |
| observer | 2 | 0.916961| 0.603598 | 1.52 | 0.129| -0.268929 2.102834 |
| 3 | -7.281152| 0.403762 | -1.82 | 0.070| -1.514727 0.0584967 |
| 4 | -1.958663| 0.61026 | -0.32 | 0.749| -1.396338 1.004605 |
| cons | 15.27004| 0.988933 | 15.44 | 0.000| 13.32718 17.21229 |
8. **Observational audits.** Eight observers (four billers, two Main ED nurses, two Pediatric ED nurses) conducted a total of 266 observations during 53 hours in the Main EDs (mean 5.02 observations/hr). No observational audits were conducted in the Pediatric ED due to resource availability. 29.3% of observations took place in the ED’s Emergency Acute Care Unit (EACU), 26.3% in the Main section of the ED, and 44.4% in the other areas of the ED including the Psychiatric Care Unit (12.0%). A detailed geographic distribution is found in Appendix C: Observational Audits. From the 266 observations our study team extrapolated 399 activities of interest (as some observation may have revealed more than a single activity). These 399 activities were then each assigned to one of 10 categories as described in Appendix C. The category names also found in Figure 18 below, which shows the flow of observations (red numbers) through the decision making process utilized for our study’s observational audits.

![Figure 18: Observation Process Flow with Outcomes](image-url)
As noted in Figure 18, category four (Patient Care) was the largest, containing 44% of all activities, while category nine (Pharmacy Related) was the smallest, with 1%. Of the 399 original activities, the numbers of activities that fell into decision groups “No,” “Maybe,” and “Yes” were 344, 35, and 20, respectively. In other words, 86% of the activities were evaluated and discarded, 9% were selected to move forward for further discussion and review, and 5% were immediately actionable. Figures 19 and 20 below illustrate the decision group distribution for each category.

Figure 19: Decision Group Distribution per Category

*"No" in Category 4 reached 160. To better view the other results, we cropped the preview of the graph.

Categories one (Discussion with Clinician/Staff) and six (Patient / Family Education) had the largest proportion of “Maybe” and “Yes” responses (as compared to “No” responses), with 44% and 27% “Maybe” and “Yes” items, respectively. Categories two (Gather Equipment), three (Room Preparation), eight (IT Related), and ten (Misc.) had the highest percentage of “No” items, constituting 100% of activities in each of these four categories (as exemplified by the solid bar in Figure 20).
The numeric size of the decision group is misleading, however, because many observations were redundant and could be classified together. For example, in the “Yes” decision group, six of the twenty activities referred to a transfer of care or handoff report among nurses. We classified these together as “transfer of care / handoff report.” As a result of this consolidation, the “Yes” decision group contracted from 20 activities to 9. Similarly, the “Maybe” group consolidated from 35 to 18 activities. The “No” decision group had a great number of redundant observations. For example, 13 observations all pointed to nurses disinfecting their hands prior to caring for patients, 12 observations discussed nurses providing comfort measures to patients, and 10 observations cite nurses cleaning the room. Thus, the 344 activities in the “No” group, were reduced to 199 activities or categories of activities.

Although billing staff (“billers”) (not nurses) only accounted for 36% of the total observation time during this project, they accounted for 74% of the total activities recorded. Further, 83% of the “Yes” group and 61% of the “Maybe” group were attributed to the observations of the billers. Also noted was variation in observation productivity between Main ED nurse observers and Pediatric ED nurse observers. While the two nurses from the Main ED accounted for 65% of the total time nursing spent on the observational audits, they only recorded 37% of the activities observed by nurses. This suggests that our decision to use “external” and “non-nurse” observers to examine nursing activity was a useful one.
9. **Update billing definitions.** During this programmatic activity, 73 nursing intervention definitions were updated or developed *de novo*. Another 15 existing interventions still require updating (programmed for FY14 second quarter). Definitions will likewise be developed for any new interventions selected for addition to Allscripts. Below is an “old” (pre Facility Billing Program) definition contrasted with a programmatically developed definition. The purpose of this comparison is to illustrate the expansion of detail, and enhancement of specificity associated with this effort.

Pre-intervention definition for Arterial Blood Gas (ABG) Draw:

**ABG** * - Blood drawn from arterial line or artery - Automatic Supply Charge

Post-intervention definition for Arterial Blood Gas (ABG) Draw:

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Brief Definition</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>(M) (S) * ABG (Arterial Blood Gas) closed system</td>
<td>To account for ED staff resource consumption associated with the procedure for drawing/obtaining, sending to the lab and documentation of obtaining an ABG from closed system</td>
<td>1. Review the orders 2. Identify your patient 3. Explain procedure to patient 4. Gather supplies 5. Log into workstation 6. Open Care fusion application 7. Log into Care Fusion 8. Scan the patient's armband 9. Accession your labels 10. Gather patients labels (they will auto print after accessioning) 11. Obtain blood sample 12. Prepare the arterial line stopcock: 13. Remove the non-rented cap from the port of the three-way stopcock Cleanse the needless cap of the stopcock of the hemodynamic monitoring system with an antiseptic solution (chlorhexidine-based preparation, tincture of iodine, povidone-iodine, or 70% alcohol) and allow solution to dry 14. Attach syringe 15. Turn the stopcock off to the flush solution... 16. Obtain the blood sample(s) and discard 17. Turn stop cock off to syringe 18. Change syringe to ABG syringe 19. Obtain Specimen 20. Turn the stopcock off to the patient. 21. Fast-flush the remaining blood from the top port of the stopcock onto a sterile gauze pad, into a discard syringe, or into a blood specimen tube. 22. Turn the stopcock off to the top port of the stopcock 23. place non-rented cap or a needleless cap on the top port of the stopcock 24. Zero the line 25. Label syringe 26. Scan the label on syringe 27. ICE/Bag and walk the samples to the pneumatic tube and send to lab 28. Place the samples in the pneumatic tube and send to the lab 29. Document the procedure in the patient’s chart</td>
</tr>
</tbody>
</table>

The development process and additional examples of new definitions are found in Appendix D: Facility Billing Definitions - Methodology and Implementation.
10. **Create and reconcile list of documentable items not hooked to billing.** As no list of documentable nursing interventions existed prior to this study, our first step was to undertake a manual review of Allscripts and capture all documentable nursing activities contained therein. This yielded a 13-page list of documentable nursing activities organized by ‘tab’, ‘section’, ‘subsection’ and associated billing element (where applicable). An example is shown in Figure 21, which displays the Triage Tab and its contents. We captured and reviewed 457 documentable elements (about 15% of the list is redundant). Of these, 32 nursing activities were selected for evaluation as potentially billable interventions. Another 13 were added as billable nursing activities. One was programmed for addition after being time studied; 17 are pending review by the appropriate ED committees for decision on adding or discarding them; and one was assessed as non-clinical in scope and discarded.

Figure 21: Triage Tab Elements from Allscripts Nursing Documentation List

<table>
<thead>
<tr>
<th>TRIAGE TAB</th>
<th>Hooked to Billing Element</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRIMARY TRIAGE</strong></td>
<td></td>
</tr>
<tr>
<td>Chief complaint quote</td>
<td>Triage</td>
</tr>
<tr>
<td>Vital signs/Pain level</td>
<td>Vital signs</td>
</tr>
<tr>
<td><strong>ALLERGIES</strong></td>
<td></td>
</tr>
<tr>
<td>Mandatory screening questions:</td>
<td></td>
</tr>
<tr>
<td>Identify CAP criteria</td>
<td></td>
</tr>
<tr>
<td>ILI Screening (Influenza Like Illness)</td>
<td></td>
</tr>
<tr>
<td>Adult nursing order sets</td>
<td></td>
</tr>
<tr>
<td>Special Healthcare needs:</td>
<td>Communications Assistance, Mobility Assistance</td>
</tr>
<tr>
<td>Physical/Sensory/Language Barriers</td>
<td></td>
</tr>
<tr>
<td>High risk for infection</td>
<td></td>
</tr>
<tr>
<td>Reason for high risk of infection</td>
<td></td>
</tr>
<tr>
<td>Critical Care Patient Designation</td>
<td>Triage</td>
</tr>
<tr>
<td><strong>MISCELLANEOUS</strong></td>
<td></td>
</tr>
<tr>
<td>Called to Triage - no answer</td>
<td></td>
</tr>
<tr>
<td>Patient was re-registered</td>
<td></td>
</tr>
<tr>
<td>Assessment deferred d/t pt condition</td>
<td></td>
</tr>
<tr>
<td>See Arrest Record for documentation</td>
<td></td>
</tr>
<tr>
<td><strong>Down Time Documentation</strong></td>
<td></td>
</tr>
</tbody>
</table>
11. **Benchmark billable procedures against other EDs.** Between August 2012 and March 2013, we contacted 24 of the 48 hospitals in Maryland, and requested a copy of either their ED billing sheet or a list of their ED nursing interventions (billable or otherwise). We explained the nature of the study and offered to share results openly. Only four hospitals unaffiliated with Johns Hopkins responded (Dorchester General, Atlantic General, Civista Medical Center, Western Maryland Health System) by providing us with information. One hospital, Harford Memorial Hospital, provided its information on 19 September, 2013 – a full seven months late – and was not included in this analysis. Three Maryland-based (Suburban, Bayview Medical Center, Howard County General) and one D.C.-based (Sibley Memorial) Johns Hopkins Health System hospitals also contributed their lists, bringing the total benchmark group to eight hospitals. It should be noted that, although the five Johns Hopkins affiliated EDs have always had a very collegial and collaborative relationship, at the time of this study there was absolutely no relationship among the EDs relative to nursing practice. There was also no overlap in nursing staff.

From the eight hospitals, we compared 769 interventions against those of our own ED. We selected 103 interventions for evaluation as potentially billable. Of those, 27 were assessed as immediately actionable opportunities. Of the 27, we added 15 as billable nursing activities, and 12 were programmed for addition after being time studied. An additional 13 interventions are pending review by the appropriate ED committees for decision on adding or discarding them. We evaluated and discarded 63 interventions. A few examples of rationale for discarding these interventions were that they were performed by non-ED staff in our ED (e.g., by OB, L&D, Radiology, Respiratory Therapy); were not performed in our ED (e.g., assist with ADLs, peritoneal dialysis, irrigation via Foley Catheter); or were documented by subcomponent (e.g.; newborn delivery is documented via elements such as mother/child nursing assessment, medication administration, isolette set up, etc.).

During our benchmarking we noted that two hospitals (Sibley Memorial, Suburban) documented and billed for additional staff required when performing a nursing intervention. According to the HSCRC,
“With the use of CCT as a measurement of [emergency medicine] resource consumption, it is possible for multiple [emergency medicine] personnel to be providing CCT to the same patient simultaneously. Therefore, in a given time interval, the facility may record and report CCT greater than the actual clock time that has elapsed.”

Based on this, we set forth to obtain Corporate Compliance approval and identify interventions where the support of an additional clinician could be “clinically necessary” in certain situations. An example is an extra nurse who is needed to pull the skin of a pediatric patient in a manner that doesn’t roll the vein while another nurse is inserting an IV or drawing blood. Allscripts was then structured to allow nurses to document additional clinical staff who supported an intervention under clinically necessary circumstances. A total of 33 new “nursing assist” interventions were added to Allscripts by our team.

12. **Review 2010 external audit for opportunities.** We hypothesized that the 2010 external audit would contain recommendations and guidance relevant to any work associated with billing and nursing documentation practices in our ED. We found the audit to be simplistic. Auditors reviewed 150 Main ED patient records. One record had documentation that supported a lower HSCRC level than originally assigned (i.e., it was over billed). Documentation in eight of the records supported a higher HSCRC level than originally assigned. Auditors noted that clinical care time was documented in the patient record but not consistently picked up in the billing process. Auditors, however, made no recommendations.

An analysis of the billing structure in Allscripts (which calculates billing levels automatically) revealed that the triggers, which indicate to Allscripts what clinical care time should and should not be applied to the patient’s bill, were not optimally placed. Some documentation aspects of Allscripts involved multiple “layers.” For example, documenting the collection of a blood specimen required the nurse to select the “lab specimens” question, followed by selecting, from a ‘list’, the appropriate specimen source. This was then followed by documenting the ‘element’ of the question which indicated the number of cultures taken from the aforementioned source. The ‘question’, ‘list’ and ‘element’ each represented a different “layer” the nurse had to document. In many cases we discovered that the trigger to bill was “buried” in the lowest “layer” of
documentation (the ‘number of cultures taken’ in the previous example). What resulted is suboptimal billing as nurses did not always document the final portions of each question. For example, nurses routinely documented an IV insertion (the ‘question’), and the associated ‘list’ location (an arm, for example). Oftentimes they did not document which arm was used (the ‘element’).

To mitigate this, we moved the billing trigger to the question level (the highest “layer”) wherever possible in an activity we titled the “Billing Trigger Initiative”. One constraint to this initiative was compliance considerations – where a subordinate “layer” of a question was required by policy or for patient safety. We also ensured that billing triggers could not be activated when a nurse merely opened a documentable item, but did not select it as a performed intervention. Under the watchful eye of the Compliance Department, we monitored each adjusted intervention for the four months following the change to ensure there were no disproportionate changes in documentation or billing that could indicate over billing our patients. No such changes were noted. This programmatic activity moved the billing trigger for exactly 35% of all nursing interventions. The result was an increase in RVU/pt of 0.26 for the four months after this activity, as compared to the four months prior to the change.

13. **Reconcile provider orders against billable procedures.** For this effort, we reconciled 43 provider orders, in six categories, with 71 nursing activities that resulted from those orders. Of the 71, 27 activities were not documentable in Allscripts, while the other 44 were. Of the 44 documentable activities, 32 were not hooked to billing. Of the 27 not documentable items, and 32 unbilled items mentioned, our expert panel selected 35 for evaluation as potentially billable interventions. No new items were selected to add to Allscripts for documentation purposes. Of the 35 activities, 12 were added as billable nursing activities (they were previously documented but not billed), three were programmed for addition after being time studied, and 20 are pending review by the appropriate ED committees for decision on adding as a billable item or discarding.

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6 We compared a four-month period because on the fifth month after this activity, another intervention was applied that elevated RVU/pt further.
14. **Reconcile provider orders against other EDs.** After discovering that a list of provider orders available in Allscripts did not exist, we were not surprised to discover the same was true for other hospitals we contacted. Our own list had to be generated in a time consuming manual process. After contacting 5 Maryland hospitals outside the Johns Hopkins Health System, it became apparent this effort was futile. At this stage of the study (early summer 2013) we also recognized that this activity was likely to yield very little payoff. Based on our experience with the provider orders list we created for our own ED, we expected results from this activity to overlap with other programmatic activities. Due to these facts, we abandoned this activity altogether.

Based on the preceding activities, our department added or changed 91 nursing interventions. These are listed in Tables 11 and 12 below. Of the 91 interventions, 15 were documented and billed previously, and we merely updated their times to reflect an accurate mean procedure time for our own two EDs. Four additional interventions were assessed as too vague and broad, deleted, and replaced by more specific interventions (labeled in Table 11 as “Split from a previously existing item”). For example, “Central VAD Access” was deleted and replaced with “Implantable Port Accessed”, “Implantable Port Deaccessed” and “Central line dressing change”. This led to the “creation” of nine new billable interventions to replace the four that were deleted. Another 23 interventions were already being documented by our nurses, and we hooked them to billing. To 33 items that were previously documented, we added the ability to document additional nurses or techs assisting with the procedure. We call these assist procedures, and they are enumerated in Table 12 below. Finally, the remaining seven items were newly added as they were neither previously documented nor billed. These seven interventions, and five of the newly “split” items, represent the incremental documentation burden placed on the nursing staff as a result of this project.
Table 11: Consolidated List of Interventions Added or Modified (part 1)

<table>
<thead>
<tr>
<th>Nursing Intervention Title</th>
<th>Previous Minutes Billed</th>
<th>New Minutes Billed</th>
<th>Date Added/Changed</th>
<th>Type of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aggressive Patient Mgmt</td>
<td>NEW 10</td>
<td>5/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>2 Blood Hock</td>
<td>NEW 25</td>
<td>5/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>3 Coping Mechanisms - Peds ED Only</td>
<td>NEW 30</td>
<td>5/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>4 Maxi Move lifts (lith, mobile, ceiling)</td>
<td>NEW 40</td>
<td>5/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>5 Patient/Family Education</td>
<td>NEW 50</td>
<td>5/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>6 Rapid Infuser</td>
<td>NEW 60</td>
<td>6/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>7 Suicide Screening</td>
<td>NEW 70</td>
<td>6/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>8 Burn Care</td>
<td>NEW 80</td>
<td>6/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>9 C Spine Immobilization</td>
<td>NEW 90</td>
<td>6/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>10 Capnography Monitoring Continuous</td>
<td>NEW 100</td>
<td>6/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>11 Capnography Monitoring Initial</td>
<td>NEW 110</td>
<td>6/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>12 Continuous Bladder Irrigation (CBI)</td>
<td>NEW 120</td>
<td>7/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>13 Cooling blanket</td>
<td>NEW 130</td>
<td>7/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>14 CPR</td>
<td>NEW 140</td>
<td>7/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>15 Doppler for peripheral blood flow</td>
<td>NEW 150</td>
<td>7/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>16 Gastric (NG/OG) Tube removal</td>
<td>NEW 160</td>
<td>7/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>17 Isollette - Peds ED Only</td>
<td>NEW 170</td>
<td>7/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>18 Nurse Heparin Protocol</td>
<td>NEW 180</td>
<td>8/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>19 Ostomy Dressing Change</td>
<td>NEW 190</td>
<td>8/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>20 Overhead Warmer</td>
<td>NEW 200</td>
<td>8/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>21 Photo Therapy Intensive - Peds ED Only</td>
<td>NEW 210</td>
<td>8/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>22 Photo Therapy Std - Peds ED Only</td>
<td>NEW 220</td>
<td>8/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>23 Ring Removal</td>
<td>NEW 230</td>
<td>8/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>24 Suture/Staple removal</td>
<td>NEW 240</td>
<td>9/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>25 Swallow Screen</td>
<td>NEW 250</td>
<td>9/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>26 Transcutaneous Cardiac Pacing Continuous</td>
<td>NEW 260</td>
<td>9/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>27 Transcutaneous Cardiac Pacing Initial</td>
<td>NEW 270</td>
<td>9/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>28 Urinary Catheter Removal</td>
<td>NEW 280</td>
<td>9/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>29 Warming blanket (bear hugger/Gaymar)</td>
<td>NEW 290</td>
<td>9/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>30 Rhythm interpretation modified procedure</td>
<td>NEW 300</td>
<td>10/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>31 Cardiac Monitor Lead Placement</td>
<td>NEW 310</td>
<td>10/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>32 Central line dressing change</td>
<td>NEW 320</td>
<td>10/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>33 EKG (bedside)</td>
<td>NEW 330</td>
<td>10/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>34 EKG (cart)</td>
<td>NEW 340</td>
<td>10/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>35 Implantable Port Accessed</td>
<td>NEW 350</td>
<td>10/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>36 Implantable port deaccess</td>
<td>NEW 360</td>
<td>11/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>37 IV Insertion - Attempt</td>
<td>NEW 370</td>
<td>11/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>38 IV Insertion - Successful</td>
<td>NEW 380</td>
<td>11/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>39 Rhythm (Cardiac) Interpretation</td>
<td>NEW 390</td>
<td>11/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>40 Cardiac Monitor</td>
<td>NEW 400</td>
<td>11/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>41 EKG</td>
<td>NEW 410</td>
<td>11/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>42 IV Insertion/Attempts</td>
<td>NEW 420</td>
<td>12/5/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>43 Central VAD Access</td>
<td>NEW 430</td>
<td>12/10/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>44 Admission Prep</td>
<td>NEW 440</td>
<td>12/15/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>45 Blood Culture</td>
<td>NEW 450</td>
<td>12/20/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>46 Discharge/AMA w/instructions</td>
<td>NEW 460</td>
<td>12/25/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>47 Home Meds</td>
<td>NEW 470</td>
<td>12/30/13</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>48 IV DVC</td>
<td>NEW 480</td>
<td>1/5/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>49 IV Tubing set up</td>
<td>NEW 490</td>
<td>1/10/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>50 Labs - Blood specimen</td>
<td>NEW 500</td>
<td>1/15/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>51 Labs - other specimen (Throat, Sputum,Vag,Urine,Stool)</td>
<td>NEW 510</td>
<td>1/20/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>52 Medication/IV Fluid(s) Given</td>
<td>NEW 520</td>
<td>1/25/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>53 Neb Treatment Setup</td>
<td>NEW 530</td>
<td>1/30/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>54 Nursing Assessment/Re-Assessment</td>
<td>NEW 540</td>
<td>2/5/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>55 Patient History</td>
<td>NEW 550</td>
<td>2/10/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>56 Patient Status (Status check) -&gt; name</td>
<td>NEW 560</td>
<td>2/15/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>57 Pulse Oximetry Probe Applied</td>
<td>NEW 570</td>
<td>2/20/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>58 Transport by RN/CT</td>
<td>NEW 580</td>
<td>2/25/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
<tr>
<td>59 Transport by RN/CT</td>
<td>NEW 590</td>
<td>2/30/14</td>
<td>Previously documented but not billed</td>
<td></td>
</tr>
</tbody>
</table>
Table 12: Consolidated List of Interventions Added or Modified (part 2)

<table>
<thead>
<tr>
<th>Nursing Assist Intervention Title</th>
<th>Previous Minutes Billed</th>
<th>New Minutes Billed</th>
<th>Date Added/Changed</th>
<th>Type of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>59 ABG - Assist</td>
<td>NEW 6</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>60 Ace Wrap/Sling/Velcro Splint - Assist</td>
<td>NEW 6</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>61 Bathroom Assist - Assist</td>
<td>NEW 10</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>62 Blood Culture - Assist</td>
<td>NEW 18</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>63 Blood Glucose POCT (RN/CT) - Assist</td>
<td>NEW 3</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>64 Central Line Dressing Change - Assist</td>
<td>NEW 6</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>65 Cooling Blanket - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>66 C-Spine - Assist</td>
<td>NEW 3</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>67 Doppler Blood Flow - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>68 Ear Irrigation - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>69 Enema - Assist</td>
<td>NEW 14</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>70 Eye Irrigation - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>71 Eye pH - POCT - Assist</td>
<td>NEW 2</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>72 Gastric lavage - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>73 Gastric Tube Removal - Assist</td>
<td>NEW 5</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>74 Implantable Port Accessed - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>75 Implantable Port De-accessed - Assist</td>
<td>NEW 2</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>76 Incontinent Clean-up - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>77 IV Insertion/Attempts - Assist</td>
<td>NEW 14</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>78 IV Insertion/Successful - Assist</td>
<td>NEW 10</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>79 Labs - Blood specimen - Assist</td>
<td>NEW 9</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>80 Labs other specimen - Assist</td>
<td>NEW 5</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>81 Maxi Lift - Assist</td>
<td>NEW 16</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>82 Medications given - Assist</td>
<td>NEW 5</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>83 NG Tube insertion - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>84 Ostomy Care - Assist</td>
<td>NEW 17</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>85 Post Mortem Care - Assist</td>
<td>NEW 35</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>86 Procedure Assist - Assist</td>
<td>NEW 16</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>87 Restraints initial - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>88 Suctioning - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>89 Urinary Catheter insertion - Assist</td>
<td>NEW 12</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>90 Urine POCT - Assist</td>
<td>NEW 4</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
<tr>
<td>91 Wound Irrigation - Assist</td>
<td>NEW 8</td>
<td>8/1/13</td>
<td>Newly added</td>
<td></td>
</tr>
</tbody>
</table>
Streamlining Nursing documentation. Nurses do not regard the time spent documenting patient care as being patient care, despite it having a Nursing Intervention Classification (NIC) term. Hardey et al. (2000) found that nurses viewed documentation as “excessively time consuming”.

Streamlining nursing documentation was not a programmatic activity originally conceived as part of this study’s interventional design. Very quickly, however, it became apparent that there was great interest in this among nurses, department leadership, and most audiences to whom we presented the study’s design. In recognition of this, we made several attempts to improve the structure of nurses’ documentation. Following are a few examples of this and the associated process results we observed:

- In February 2013, we undertook an effort to better align documentation with clinical practice. Our team rearranged the patient triage section (called a “tab”) in Allscripts. The goal was to make documenting in the triage tab more consistent with nurses’ workflow at triage. For example we created a ‘history’ tab to make collecting patient medical and surgical history at triage easier (previously this was buried in the ‘chief complaint focused assessment’ tab). Another change, involved adding a pain assessment element in the triage tab to allow easier documentation of the initial pain assessment by the triage nurse. Previously, the pain assessment element existed in the ‘procedures’ tab, requiring several steps and valuable time to find it, followed by more clicks and time to return to the triage tab upon completion. We also changed the color of the safety screening element from black (suggested) to blue (required) to make it stand out and improve compliance with completing this evaluation. As a result of these changes, we received positive feedback from triage nurses; safety screening documentation improved from 18,903 in the six months prior to the change to 26,245 in
the 6 months after (a 27% increase when controlled for patient volume), and RVUs increased from 11.57 RVU/pt in February to 11.68 RVU/pt in March.

- Work by Korst et al. (2003) suggested that, on average, nurses spent 15.8% of their time on documentation. Cognizant of such studies, we were careful not to contribute to that average whenever appropriate. Rhythm (Cardiac) Interpretation was a documentable element we added to Allscripts based on the aforementioned programmatic activities (it was one of two interventions to replace “Cardiac Monitor”). We realized that in order for the intervention to be documented whenever an interpretation occurs, and not add additional ‘clicks’ to the nurses' workload, it needed to synchronize seamlessly with nurses' workflow. To this end, we integrated the rhythm interpretation question into the documentation of both performing an EKG and placing a patient on a cardiac monitor (both situations where an interpretation may occur). In this manner, the option to document the interpretation was easily found and did not require the nurse to click on a separate section to access the question. Figure 22 and 23 below show what this looks like in Allscripts.

Figure 22: Cardiac Monitor Section with Cardiac Rhythm Interpretation Options Clearly Visible and Accessible in One Screen

7 A comparison beyond March cannot be made, because on April 4th we activated the EPIC registration system (not related to this study), which wreaked havoc on the billing system for the following month. After April new study-related changes were implemented that would skew any subsequent comparison.
‘IV tubing set up’ was a documentable nursing intervention in Allscripts worth three minutes of clinical care time. Before our study, nurses would document this element each time they documented ‘IV bolus hung’, ‘IV continuous fluids hung’, IV infusion pump’ ‘IV syringe pump’ and ‘rapid infuser’. Since IV tubing set up is done as a prerequisite to all these interventions, to reduce the documentation burden on nurses, we removed the requirement to document it. Instead, we connected the trigger to bill the three minutes of CCT to the items that required IV tubing set up. In this manner, the effort associated with the setup was captured and billed but required no nursing effort to document. Since tubing set up was only done once, the system was structured with the logic to bill this item only once, even if the associated interventions were documented multiple times. In the three months after this change was initiated (April 2013), documentation for IV tubing set up increased by 11%, when controlled for patient volume, as compared to the three months prior.

- Application of a pulse oximetry sensor was an intervention documented under the respiratory section of the procedure tab in Allscripts. Since the intervention was
often done in conjunction with cardiac monitoring, and since the nurse was required to
document connecting a patient to a cardiac monitor, we added the option for nurses to
indicate connecting a patient to a cardiac monitor with or without a pulse oximetry
sensor. In this manner nurses did not have to return to the respiratory section from the
cardiac monitor question, saving them time. This same change was applied to the
rhythm interpretation intervention, which had resided in the monitoring section of the
procedure tab. To simplify documentation, rhythm interpretation was also added as an
option in the cardiac monitoring question.

As a result of the above change, compliance with documentation of pulse
oximetry application increased by 77%, when controlled for patient volume, in the six
months after the change as compared with the six months prior. Besides an increase in
effort capture for nursing effort, this represented a financial improvement as well. To
further streamline documentation, we connected the trigger which activated the supply
charge for pulse oximetry (the disposable “oxisensor”) to the “cardiac monitor with pulse
oximetry” item. Thus, whenever that item was documented, a supply charge of $9.88
was billed to the patient to cover the cost of the oxisensor. Since there was a roughly
40% institutional inflation in the price of the device, 40% of the charges represented a
net profit for the hospital. In the six months after the change (January 2013) we billed
$16,941 in oxisensor charges. Annualized, this represented a $25,925 increase in what
we would have billed under the previous methodology, when controlling for patient
volume. That amounted to a $10,370 incremental net profit for the hospital.
**Hawthorne Effect**: From early in the implementation, particularly of the time studies, nursing staff were aware of the activities of our study (by design). One of our goals was for staff to understand how their documentation responsibilities related to the organizational mission; and how those responsibilities affected nurses directly. Part of the Director of Nursing’s vision for a professional practice model among the nursing staff was fostering a better understanding of these linkages. Also, she sought to develop among the staff a working comprehension of the impact of documentation on billing; and billing on nursing budgets, resources and staffing levels. Thus, a great deal of attention was placed on the efforts of our program. As an example, the email below was sent from the Director of Nursing to all nursing staff in the department:

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**From:** Katherine DeRuggiero  
**Sent:** Friday, November 16, 2012 10:28 AM  
**To:** EMD_RN; EMD_ClinicalTechs; EMD_SupportAssociates  
**Cc:** Gai Cole  
**Subject:** Time Studies

For those who do not already know, the hospital bill for patients that visit our ED is generated by the work we do for the patient. Everything "**you document**" doing for the patient is associated with minutes. The minutes are added up and a bill is generated for the time you devoted to caring for that patient. Periodically we need to validate these minutes. As you know, there are things that take us much longer to do now than they did in the past (i.e. the documentation in the electronic patient record, or correctly obtaining blood cultures!). To validate the correct minutes we periodically do "time studies" (i.e. someone actually watches the procedure from start to finish and times it). This process is very important to us because the time spent with the patient generates our revenue. Because this additional revenue reflects additional work done, that money then goes towards the purchase of more staff.

Myra, Nancy, Lesley and Gwen are currently assisting us with these time studies. I appreciate your cooperation in assisting them to complete this task.

Any questions or concerns, please contact me.  
Kathy

Kathy DeRuggiero, RN, MSN  
Director of Nursing  
Department of Emergency Medicine

The Hawthorne effect is a concept often referenced as a possible explanation for, or confounder of, interventional study outcomes.\(^{153}\) “The term is mostly used to refer to the behavior-modifying effects of being the subject of social investigation, regardless of the context of the investigation.”\(^{154}\) The name ‘Hawthorne effect’ originates from a
series of Harvard- and MIT-led experiments conducted during 1924 – 1932 at the Hawthorne Works (a Western Electric factory outside Chicago).\textsuperscript{153,155} Hawthorne researchers investigated the relationship between illumination and workers’ productivity. Worker productivity was initially assessed as unaffected by adverse conditions (lower factory light levels), but the changes were later causally associated with the fact that workers were being openly observed by researchers and observed and encouraged by plant management.\textsuperscript{155,156} The investigators concluded “… that the increase in [worker] output was partly caused by the experimental set-up… and by the experimenters themselves.”\textsuperscript{153} Hence, it is reasonable to conclude that “an assessment of Hawthorne effect in practice-based research is important because practical studies in real world settings may be vulnerable to unintended effects on intervention outcome.”\textsuperscript{157}

Also called the observer effect, the Hawthorne effect has been well described in the healthcare setting.\textsuperscript{158,159} Leonard and Masatu (2006) observed that clinicians' behavior changes while being observed by the research team.\textsuperscript{158} They concluded that the quality of care for patients increases while under external observation.”\textsuperscript{158} Nurses with whom study leadership discussed this topic, indicated openly that the observer effect associated with our study had a noticeable impact on nursing behavior in the clinical area. Nurses, who were well aware of the time studies, were more apt to document thoroughly in spite of conditions (how many patients were in the department, how many were waiting to be seen) and despite their own patient load. Nurses indicated that interventions that were skipped frequently “when it’s busy”, were skipped less often when time study nurses were around (even though the nurse performing the intervention was not being observed) or merely as a result of heightened awareness of the project to increase nursing effort capture. Nurses were also more likely to think about the relationship between their activities, billing and the documentation system, as evidenced by the following examples:

- Nurse Whalen emailed study leadership suggesting there should be a way to document IV insertion attempts that were unsuccessful due to inability to locate a vein as “…I and other staff…want [the department to receive] credit for this work".
o Nurse Pontone requested study leadership add aggressive patient management as a documentable item so “her nurses” can get credit for what she called a “significant amount of nursing effort”.

o Nurse Coburn indicates to study leadership that a significant amount of “unaccounted clinical time” is spent between nurses conducting a transfer of care or patient handoff.

o Nurse Pontone recommends to leadership of the study that since both EDs conduct suicide screening for certain patients, this item should be added to Allscripts and billed as clinical care time.

There is no disputing the observer effect was prevalent in the course of this project. This observer effect heightened awareness among the staff as to the value of documentation in characterizing nursing effort and its impact on billing. We anticipate that as elements of this study that were designed to alter nursing culture on a more permanent basis (e.g., nursing incentives, team leader quarterly evaluations) are implemented, this awareness (which previously resulted from the Hawthorn effect) will become a permanent aspect of the ED nursing culture.
Since the program is ongoing and has no anticipated end, results were collected in conjunction with program initiation and maintenance. To ensure that the program, which had the potential to tax nursing time, did not impede care quality, a few clinical quality measures were monitored throughout the course of the implementation. First among these was nursing compliance with adherence to vital signs. Vital signs were the most frequently documented nursing intervention and generated the second greatest billable time. As an element routinely documented on all patients, we monitored compliance with conducting the initial set, typically at triage; repeat vital signs for patients requiring them every four hours; and vital signs within one hour of discharge or transfer. Below are the trends associated with the three types of vital signs.
Nursing compliance with pain reassessment was selected as a quality measure prior to our decision to improve its documentation structure. Compliance with pain reassessment had historically trended low. We opted to utilize not only measures that typically did well, but ones that were more challenging.

![Graph of % Compliance with Pain Reassessment minimum q4 hours]

Nursing compliance with discharge order to discharge time was selected as it is a quality measure associated with ED throughput. If nurses do not discharge the patient in a timely manner after the discharge order has been written, then dwell time in the bed increases, thus needlessly consuming a critical ED resource. Tracking this quality indicator enabled us to monitor a potential negative influence that our study was having on patient throughput in the ED.

![Graph of % Compliance D/C order to D/C time (RNs) < 30 min]
Our hospital uses a Patient Safety Network (PSN) for self-reporting of staff safety concerns or threats to patient safety. PSN is an on-line safety event reporting system available to all employees at Johns Hopkins Hospital, via an internal website. PSN is an integral aspect of hospital and departmental “Infrastructure for Patient Safety.” As such, it was our most direct mechanism to ensure none of the activities of our study adversely impacted the safe performance of nursing duties. PSN is imperfect in that it relies on self-reporting. However, this has been found to be an effective means of measuring clinical practice associated with negative or potentially negative outcomes.161,162
OUTCOME RESULTS

Project outcomes are discussed in detail below. Additional detail is captured in the various appendices. Outcomes were subdivided into 1) workforce outcomes, 2) social outcomes, and 3) financial outcomes: Our three core tributaries that collectively drove socioeconomic improvement for the department. Financial outcomes were clearly a principal objective within this endeavor. As such, financial outcomes are presented separately, and in the context of an economic evaluation. This economic analysis serves not merely to demonstrate fiscal outcomes, but to build a “business case” for this performance improvement program, so as to justify the literal and theoretical programmatic replication proposed for other EDs in the study design.

Although much of this study’s effort involved interventions in both the Main and Pediatric EDs, the focus of the study was the Main ED. Therefore, Pediatric ED results are not discussed below. This, in fact, understates the impact of our study, as financial outcomes in the Department of Pediatrics were positive, while their costs were minimal, as program costs were largely borne by the Department of Emergency Medicine.

1. WORKFORCE OUTCOMES

The long-term goals of improved employee satisfaction and reduced staff turnover were driven by the intermediate goal of improved recognition of performance. That intermediate-term goal cross-walked back to programmatic activities that have yet to be implemented. Specifically, improved recognition of performance and an incentive plan for nursing performance have not yet been implemented via the nursing report card, as we await the operationalization of the hybrid audit and team leader audits. Since this portion of the facility billing program has not yet been implemented, claiming an association between the project and employee satisfaction (or other workforce outcomes) is inappropriate.

Thus, for academic purposes only, and based on the literature and our own previous data, this workforce outcome is examined below. Evidence suggests that job satisfaction is a critical variable in nursing turnover and patient satisfaction. 163,164 If the
overall satisfaction of a nurse with his or her workplace is high, then the likelihood of him/her resigning from the health organization is reduced. Other variables such as economic status or individual differences have a weaker relationship to job satisfaction than an employee’s work content and work environment. Following is an examination of past data on nursing satisfaction and nursing turnover within the Main ED.

**Nursing turnover.** We explored nursing turnover data from FY2009, the baseline period before the pilot program, up until the end of the fiscal year 2013. Data were divided into two groups: ED and EACU. This is because prior to 2012’s transition to the new building, the ED and EACU were not contiguous geographically, and were classified as separate units by the hospital and by the survey methodology. These data are maintained internally by departmental nursing leadership.

We found that nursing turnover in both groups was steady for the first two years of the sample, but peaked in 2011, shortly before the move of the ED to a new, larger facility. The peak was more significant in the ED group, with the turnover rate reaching 43%. While the ED group returned to normal rates after 2011, the EACU group dropped to 0%. Figure 24 below illustrates the nursing turnover trend for both the ED and EACU groups.

Figure 24: Nursing Turnover Rates in the Main Emergency Department
Nursing perceptions of workplace environment: The National Database of Nursing Quality Indicators (NDNQI) is an American Nurses Association managed national database that provides “reporting of structure, process, and outcome indicators to evaluate nursing care at the unit level.”\textsuperscript{165} NDNQI surveys tend to focus on “nursing-sensitive indicators” which, according to Montalvo (2007) are “distinct and specific to nursing, and differ from medical indicators of care quality.”\textsuperscript{165} The survey is administered at The Johns Hopkins Hospital every other year. The categories of measurement used in our analysis were again chosen for their relevance to improving workforce outcomes through the facility billing program. The items were:

Unit-Level Subscale Items:
1) Job Enjoyment
2) Task Saturation
3) Decision Making

Individual-Level Subscale Items:
1) Satisfied with My Job
2) Time for Patient Care

Quality of Care:
1) Quality of Care in General

The unit-level items were specific to the functionality of the ED, while the individual-level items denoted the environment of the specific nurse completing the survey. Scoring was standardized, with each item represented by a T-score. Scale scores were standardized by taking the average of individual scale scores and aggregating them to the unit level. They were then converted to T-scores which represented unit averages, with the highest score representing the highest level of satisfaction.\textsuperscript{166} The ‘Quality of Care’ measure was not standardized in the aforementioned manner; rather, it was measured on a categorical scale of one through four, with ‘1’ representing “poor” clinical care quality and ‘4’ indicating “excellent” care delivery as perceived by the nurse.

Figure 25 below shows the results for the unit and individual-level measures. For the individual-level measurements in 2009, the ED showed moderate-to-high
satisfaction. Individual nurses in both groups were highly satisfied with their job, and moderately and highly satisfied with time for patient care. In 2011, the scores dropped in the two individual-level items. Nurses in the ED were moderately satisfied with both their job and time for patient care. For the unit-level measurements in 2009, nursing staff were satisfied with both tasks and job enjoyment. In 2011, we experienced a drop in scores, and respondents were moderately satisfied in all five of the measures. Every item decreased between 2009 and 2011, and then increased between 2011 and 2013. Employees were moderately satisfied in five of the six areas on the 2013 survey, while being highly satisfied with one.

Figure 25: NDNQI: Unit and Individual-Level Measures
As depicted in Figure 26, nurses in the ED rated quality of care for patients as “good” for all three years shown. From 2009 to 2011, the ratings were 3.0, 3.1, and 3.1 respectively.

Figure 26: NDNQI: Quality of Care in General

Employee engagement. The Gallup Organization conducts staff engagement and patient perception of care surveys for numerous healthcare organizations, including The Johns Hopkins Hospital. Workforce surveys consist of 13 standard items that measure overall staff satisfaction and the features of employee engagement that correlate, according to Gallup, to business performance and outcomes. Of the 13 factors considered, we identified three that were relevant to the proposed outcomes of the facility billing program:

Q0. “How satisfied are you with Johns Hopkins Medicine as a place to work?”
Q4. “In the last seven days, I have received recognition or praise for doing good work.”
Q8. “The mission or purpose of my organization makes me feel my job is important.”

We chose these three because they focused on overall satisfaction, employee recognition, and agreement with the ED mission, all of which were tied into the outcomes of concern in this study, particularly Q0 and Q4. Questions were scored on a
Likert five-point scale, whose psychometric properties are well established\textsuperscript{170,171} with ‘1’ being the lowest score (strongly disagree/extremely dissatisfied) and ‘5’ being the highest score (strongly agree/extremely satisfied). The graphs below show the multi-year progression of each of the three Gallup survey questions including 2010, the baseline year prior to our program, and 2013, the programmatic implementation year.

Figure 27: Gallup Employee Engagement Survey Select Question Trends
2. SOCIAL OUTCOMES

The social outcomes construct of our study is associated with two outcome measures: Social Equity and Compliance. A review of both outcome measures follows.

SOCIAL EQUITY

Micro-economic process changes, like those emanating from the efforts of this study, may potentially influence and even shape the quality of the relationship that exists between an ED and the community of patients it serves. This concept, builds upon Baum (1999), who underscored the importance of understanding the public health impact of macro-economic policies on the association between people and the institutions that serve them, and how the nature of such association shapes their perceptions of social fairness. The challenge to the administrator is to ensure that such changes do not favor or penalize any segment of the patient population. Better yet, administrators should establish changes that improve the equity with which patients are treated, thus advancing the quality of the relationship with their patient community.

Much of the relationship between a community and an ED is based on trust. Trust is a relational concept, “…describing a voluntary relationship between a person and an institution (institutional trust).” A decision to implement a poorly structured process change designed to improve an ED’s economic effectiveness can erode trust. Degradation of trust can have adverse economic, public health and mission-related repercussions. Public health repercussions may manifest as patients who delay or avoid care seeking, who fail to comply with follow-up care directions, or who fail to comply with preventative health instruction. Economic impact occurs through the same mechanisms, as well as undesirable influence on organizational reputation. Mission impact for an academic medical center like Johns Hopkins may appear as patients’ declining willingness to consent to or participate in research. This, in turn, has its own negative economic impact.

Social equity emphasizes “responsibility for decisions and program implementation” for healthcare leaders. Social equity also stresses “responsiveness to the needs of citizens.” As responsible healthcare administrators, we must take
care not to maximize our organizations’ utility at the expense of our patients. This is particularly relevant in projects such as this, where the distribution of services to the patient did not change, so detection of an inequity requires a greater degree of sensitivity. Including social equity as an analytic construct in organizational research (such as ours) is one method to keep this concept in the forefront (or at least on par with other variables) of research, business process improvement, clinical enhancements, and policy development. This approach was endorsed by Frederickson (1990), from a public administration research perspective; and by Krieger et al., from a public health research perspective.

In Johns Hopkins’ March 1873 letter to the first Board of Trustees of The Johns Hopkins Hospital, he clearly articulates his vision for the institution and the social mission it was expected to uphold. In directing how this hospital should be a “substantial benefit to the community” he wrote:

The indigent sick of this city and its environs, without regard to sex, age, or color, who may require surgical or medical treatment, and who can be received into the Hospital without peril to the other inmates, and the poor of this city and State, of all races, who are stricken down by any casualty, shall be received into the Hospital, without charge, for such periods of time and under such regulations as you may prescribe.

As beneficiaries of Johns Hopkins’ charity and as stewards of his vision, we included social equity as an outcome construct of this study. While working through the numerous facets of this project we endeavored to maintain balance between institutional imperatives (e.g., generate more revenue) and the patient. We also actively pursued opportunities to improve the fairness with which we treat our patients. While our goal was to maximize the capture of nursing effort, in no way did we want this to take advantage of the patient.

Leonard, et al. (1994) remind us that organizations that endeavor to deliver outstanding service must also prioritize being fair to their patients. Customers, for whom being treated equitably is a standard expectation of service providers, become “resentful and mistrustful” when they perceive their expectations have not been upheld. For the patient, equity is not a separate aspect of service; rather, it is an expectation of every patient-clinician interaction. When it comes to the ED billing process, the patient is at a distinct information disadvantage because of the bundling of
ED nursing charges. If the hospital took advantage of this situation, the patient would most likely go unaware. However, both ED and study leadership place ethical corporate conduct and patient trust over short-term profitability. After all, we have an institutional legacy to uphold. Nevertheless, to help mitigate our own unintended institutional bias (as administrative, financial and clinical leaders in the department), project leadership included the Compliance Department in the development and implementation of all our efforts.

Beyond merely having social equity function as a touchstone for the project, we endeavored to bring about quantifiable improvements in the social outcomes construct. During the course of this study, we actively sought items that did not meet the parameters for billing, as set forth by the HSCRC and/or our own Compliance Department, and proceeded to disconnect them as billable items. These items were:

- Mobility Assistance
- Comfort Measures
- Meal Tray
- Report Attempts
- Cardiac Monitor During Transport

Mobility assistance was a billable item designed to account for the additional time it took nursing staff to provide care for patients with physical or sensory barriers and/or those who relied on items such as canes, crutches or wheelchairs. It also extended to patients with language barriers, whether they required translation services or not. Our team considered this at odds with Johns Hopkins’ guidelines as spelled out above. The Compliance Department considered this a violation of the Americans with Disabilities Act (1990). Thus, it was disconnected from patient billing. The next item, comfort measures, triggered two minutes of CCT whenever a nurse provided an item such as a blanket, water, juice, etc. to a patient. This item was disconnected from billing because we assessed this as an administrative task that does not require skilled nursing or clinical tech staff to perform, and, therefore, by HSCRC guidelines cannot be billed as an item requiring a skilled clinician. This same logic was applied when we decided to disconnect meal tray from billing. Meal tray was another intervention that involved nursing staff providing food to a patient.
Calling report is a clinical activity in which an ED nurse calls an inpatient unit nurse about a patient about to be admitted there. The report is a formal transfer of information relative to the patient’s condition between the “sending” and “gaining” clinical units. Often (679 times in FY13), the inpatient unit does not have time to “take” the report and asks the ED nurse to call back. The attempted report is then documented, and the ED nurse calls back later. Once the report is successfully accomplished, the ED nurse documents it as a successful report. Unfortunately, the unsuccessful reports are a byproduct of organizational inefficiency. Billing the patient for our own disorganization was not only viewed as a violation of trust, but contrary to HSCRC guidelines, which advise against billing CCT for shortcomings in hospital efficiency and management.

Another way in which organizational disharmony manifests is related to patient transport. Patients moving (typically via stretcher) from the ED to another part of the hospital should be transported by a nurse or clinical tech only when clinically required. When clinical escort is not required, transport should be facilitated by an orderly from the hospital’s transport team. Often, clinical staff cannot, or choose not to, wait for the transport staff (usually in the interest of maintaining ED efficiency). Instead they transport the patient themselves. When nursing time is billed for an activity requiring only an unlicensed transporter, the same violation occurs as discussed in the ‘calling report’ paragraph above. To prevent this, as part of our program, both EDs re-wrote their patient transport policies to clearly indicate when nurses are required and when not. Nursing staff in both EDs were then trained on the revised policy. We also disconnected the cardiac-monitor-during-transport item, since now only transports requiring nursing support were billed. By policy, a patient requiring a cardiac monitor was to be transported by a nurse. Therefore, billing additional CCT for checking the cardiac monitor during transport was double billing for the same nursing time.

These five interventions discussed above were disconnected from billing throughout FY13 (our interventional period). Collectively they represented 3.8% of the billable time in the two EDs (in the baseline period before our program. After our program, they would represent 2.1% if they were still billed). In FY12, 50,467 patients were billed for these five items (combined) in both EDs. The exclusion of these items
equated to the elimination of $2,602,297 per annum in inappropriate patient charges (in FY13 dollars, $1,835,371 in the Main ED, and $766,926 in the Pediatric ED). Costs from potential sanctions from external regulatory agencies for inappropriate billing could have been even higher.\textsuperscript{189}

A cynical argument could be made that these changes do not represent improved social equity for the patient, but a cost savings for the insurer picking up the cost of emergency visits. This, however, would not hold for the 21.2% (over 14,000) of FY13 ED patients who were classified as “self-pay” (i.e., not covered in any way). It is understood that a significant portion of this population does not pay their bills for pecuniary reasons, but for the small segment that does, a change in billing level brought about by some of these charges is significant. A change from billing level 1 to level 2 equates to a $177.04 more in ED charges, while a change from level 2 to level 3 adds $265.56 to the bill. A patient might pay $88 for an ED bill, but not $265. The economic impact of small changes is significant to a patient population living below or even slightly above the poverty line.

Furthermore, 57.3% of ED patients are covered by government-payer programs (Medicare, Medicaid, others). In a gross, macroeconomic sense, these are programs funded by a large segment of the general population. Sub-optimally applied patient charges incurred by such programs are the eventual burden of that segment of society. Nothing is more socially equitable than ensuring one group of citizens does not bear the healthcare burden of another. So, in this case, while our changes may represent a cost savings to the government payer rather than to the patient, these savings are eventually passed on to the broad base of people funding such programs.

In the course of conducting time studies we sought to validate the accuracy of the clinical time being billed to the patient. We discovered eight interventions that were being billed at a higher rate of time than they were being performed, and we updated the system accordingly.

- Admission Preparation
- Discharge/AMA w/Instructions
- Home Medications
- IV Tubing Set Up
From these eight items, 20 minutes of unnecessary billing time were removed. The exclusion of these minutes equated to the elimination of $2,126,367 per annum (in FY13 dollars, $1,722,054 in the Main ED, and $404,313 in the Pediatric ED) in patient charges stemming from out-of-date and imprecise information. Additional reductions in time billed are noted in the four interventions discussed next.

During our study, we assessed four interventions as having titles that were too unspecific or broadly defined. In some cases this led to patients being charged more CCT than appropriate, while, in the case of others, CCT was understated or not charged when it should have been. Each of these interventions was eliminated entirely in favor of more specifically focused interventions better aligned with our own patient care operations and enhanced bedside monitoring capabilities associated with the new building. There were:

- IV Insertions/Attempts (billed 20 min) – deleted and split into:
  - IV Insertion – Successful ~ (billed 13 min)
  - IV Insertion – Attempt ~ (billed 18 min)
- Central VAD Access (billed 12 min) – deleted and split into:
  - Implantable Port Accessed ~ (billed 15 min)
  - Implantable Port Deaccessed ~ (billed 3 min)
  - Central line dressing change ~ (billed 8 min)
- EKG (billed 10 min) – deleted and split into:
  - EKG (bedside) ~ (billed 5 min)
  - EKG (cart) ~ (billed 10 min)
- Cardiac Monitor (billed 18 min) – deleted and split into:
  - Cardiac Monitor Lead Placement ~ (billed 6 min)
  - Rhythm (Cardiac) Interpretation ~ (billed 3 min)

Since billing under the new structure only started in FY13, it is difficult to predict the fiscal impact of this system enhancement. Our team is confident, however, that based
on these changes, patients will be billed in a more equitable fashion, where patients receiving a short length intervention, such as a bedside EKG, will not be billed the same as a patient receiving a lengthier version of the same procedure.

COMPLIANCE

Ilinitch and Soderstrom (1998) categorized regulatory compliance as an outcome measure of corporate performance. Our comprehensive review of ED nursing documentation and billing practices has enhanced regulatory compliance. Improved compliance is also noted to enhance organizational efficiency. Potoski and Prakash (2005) suggested that superior regulatory compliance is a “public good”. As noted earlier, our ED underwent a billing audit in FY10. One of the goals of our study team was to have the same auditors return in FY14 for an external assessment of the changes and enhancements implemented during this study. This would provide empirical pre- and post-intervention data from an expert outside perspective to help quantify our level of compliance. Upon consultation with the Compliance Department, to make this request, study leadership was informed that, in light of our efforts, Compliance leadership had concluded that ED leadership routinely incorporated compliance and regulatory tools, considerations, and checks and balances into our business and clinical operations improvement efforts. As a result, Compliance leadership indicated that they did not consider the ED’s billing practices to constitute an institutional risk and concluded that the expenditure of resources to examine it, especially by an outside firm, was unwarranted. Since other suggested measures for compliance are most often associated with negative consequences derived from violations (e.g., “[number of] violations,” “[number] of fines, decrees, corrective actions, government proceedings against the company,” “amount of fines,” and “number of [external, CMS, etc.] audits.”), and since our organization had no such violations against which to benchmark ourselves, quantifying the compliance improvement associated with our effort was not undertaken, but merely accepted at face value given feedback from Compliance leadership.

Associated with improved regulatory compliance is a decline in organizational risk. Noted, too, is a strong inverse association between robust hospital compliance
program was the reduction in risk associated with the enhanced level of compliance built into our patient billing structure. Runge (1984) and Sutinen (1999) offer that the better the compliance by one organizational entity, the stronger the incentive for other entities within that organization to comply.\textsuperscript{195, 196} While we do not suggest that compliance in the Department of Medicine or Surgery will improve because of our efforts, it is conceivable that compliance in the Pediatric ED or the professional fee billing process in the Main ED may.

3. FINANCIAL OUTCOMES

For ease of reading, and to avoid a potentially redundant display of financial outcomes in this "Outcome Results" section, and then again in the economic evaluation below, financial results are only presented once. They are found in the economic evaluation below, in the “Benefits” section.
SECTION IV
~~ ECONOMIC EVALUATION ~~
OUTLINE

1. Evaluation Design

2. Costs

3. Cost Details: Measurement and Valuation
   A. Labor Costs
   B. Non-Labor Costs
   C. Other Costs

4. Benefits

5. Benefit Details: Measurement and Valuation
   A. Revenue
   B. Return on Investment
   C. Production Efficiency
IV. ECONOMIC EVALUATION

Economic evaluation – “the comparative analysis of alternative courses of action in terms of both their costs and consequences”\(^\text{197}\) – is often undertaken in the healthcare domain to inform decision makers on the allocation of scarce resources.\(^\text{198,199}\) There are four most commonly used forms of economic evaluation: Cost-benefit analysis, cost-effectiveness analysis, cost-minimization analysis, and cost-utility analysis\(^\text{200}\). A fifth type of economic evaluation, cost-consequence analysis, in which interventional costs and outcomes are listed separately, without aggregation\(^\text{201}\), represents a variation on this concept.\(^\text{202}\)

In their discussion on the integration of healthcare-based economic evaluation methodologies in hospital quality improvement programs, Hagg et al. (2009) indicated that, “The process of linking quality initiatives to financial results has been termed ‘building the business case’ for quality improvements within healthcare.”\(^\text{203}\) The economic evaluation of the ED’s facility billing program served a critical role in building a “business case” for the program, and was undertaken largely from the perspective of the ED. An operational definition of the term “business case” was offered by Leatherman, et al. in 2003:

> A business case for a health care improvement intervention exists if the entity that invests in the intervention realizes a financial return on its investment in a reasonable time frame, using a reasonable rate of discounting... In addition, a business case may exist if the investing entity believes that a positive indirect effect on organizational function and sustainability will accrue within a reasonable time.\(^\text{198}\)

The purpose of this economic evaluation was to make the business case for the performance improvement goal of increased socioeconomic effectiveness in the ED.
EVALUATION DESIGN

Of the four main forms of economic evaluation,\textsuperscript{197} cost-benefit analysis (CBA) was used to evaluate the costs and consequences of this workplace challenge. Unlike a cost utility analysis, the CBA does not monetize all intangible benefits, such as improved quality of care or patient satisfaction by using quality-adjusted life year (QALY) or willingness-to-pay measures. In addition, as it was undertaken from the perspective of the ED, the CBA did not address the perspective of payers, including private and public insurers. The evaluation did, however, incorporate some patient related costs and benefits, including the opportunity cost of patients as recommended by Frick (2009).\textsuperscript{204} The framework used for the CBA was based on a framework by Drummond \textit{et al.} (2005) in \textit{Methods for the Economic Evaluation of Health Care Programmes [sic]}.\textsuperscript{197} This framework compares resources consumed (costs) as a result of the intervention with the benefits (outcomes) of the intervention. We measured and then assigned monetary valuations (positive or negative) to both costs (inputs) and benefits. The components of this analysis are delineated in Appendix H: Economic Evaluation, Annex A: Components of the Economic Evaluation.

In the ED, context-specific challenges made monetization of some workforce and societal outcomes impractical.\textsuperscript{205} While data were available to analyze changes in patient and employee outcomes on a pre- and post-program implementation basis, attribution of such changes to the facility billing program was complicated by ongoing departmental efforts to improve key metrics in throughput, employee wellness, quality of care, and patient satisfaction (as was discussed earlier in this paper). Therefore, this analysis was limited in scope to include only those outcomes which could be reasonably attributed to the facility billing program within practical and study design constraints, and which would best inform ED decision-making around allocation of department resources. Since the impact of the facility billing program on the department’s workforce and patients was an important consideration for our study, a cost consequence analysis (CCA) incorporating those outcomes will be used to supplement the CBA in later portions of the study, but not within the scope of this dissertation. In this manner, a broader spectrum of business and patient outcomes can be factored into
the analysis. The CBA quantified the “financial return,” while a future CCA would detail the “positive indirect effects” described above. More discussion about the rationale for choosing to enhance the CBA with a CCA is presented in Appendix H: Economic Evaluation, Annex C: Cost Consequence Analysis.

The cost-benefit analysis utilized a return-on-investment (ROI) methodology to contrast the costs and benefits of the program. Since the CBA evaluated our short-term 12-month implementation period, no discount rate has been applied. Where a Net Present Value (NPV) calculation was needed, we used a discount rate of 5%. The CBA demonstrated whether the revenue gains and cost avoidance of the intervention offset or exceeded the costs of implementing the program. Since it was too early in the study to claim any impact on workforce outcomes, indirect financial benefits (typically cost-avoidance) associated with hypothesized decreases in nursing turnover will be included at a later date, and will be estimated based on published studies of such outcomes. We may also consider cost savings per discharge associated with lowered nurse turnover, and benefits in risk-adjusted mortality and severity adjusted LOS. One-way sensitivity analysis was conducted to assess the sensitivity of the NPV to key cost and benefit drivers (e.g., labors costs, revenue increase, incremental documentation time), with results presented as tornado diagrams in Appendix H: Economic Evaluation, Annex B: Sensitivity Analysis.

Cost and benefit information captured for our facility billing program runs from July 1, 2012 through June 30, 2013 (FY13), with one exception. Costs incurred in January 2011 for the initial pilot, which consisted largely of time studies of several nursing procedures, are also included, since the benefits incurred as a result of this pilot (increased RVU/patient) remained in place during the 12-month intervention period. All captured costs represent incremental costs. No baseline cost data is included. Benefits captured represent changes incremental to the 12-month baseline data covering the second six months of FY10 and the first six months of FY11 (January 1, 2010 through December 31, 2010 – all of CY10).
Both direct and indirect costs are generally considered in an economic evaluation. Direct costs, which “include the value of all the goods, services, and other resources that are consumed in the provision of an intervention or in dealing with the side effects or other current or future consequences linked to it,” consisted largely of labor costs associated with our program. Indirect costs, which in economic evaluations of health interventions generally refer to “productivity gains or losses related to illness or death,” could, for example, be described as productivity changes among patients experiencing different (lower) health outcomes as an indirect result of our program. However, given the scope of our program and the lack of correlation between our efforts and such outcomes, such indirect costs and benefits were not considered.

Given our desire to be as comprehensive as practicable within the constraints of our study design, the incremental time spent by nurses on documentation as a result of the program was considered as an opportunity cost. Incremental patient time spent in the ED due to increased nursing documentation requirements was also assessed as an opportunity cost, since the additional patient time consumed during their ED visit represents a real change in time resources of patients as a result of the intervention. However, under a criterion referred to as the “rule of reason,” if such costs “are trivially small… their inclusion will have little effect on the final results of an analysis, and they may therefore be omitted.”

COST DETAILS: MEASUREMENT AND VALUATION
LABOR COSTS

Labor costs encompassed the vast majority of resources consumed in implementing the facility billing program. While two new employees (summer interns) were hired to assist with program implementation and data management, all other labor costs reflected the time allocation of existing ED employees. Therefore, the costs of their time devoted to the efforts of this study were considered as opportunity costs (since if they were not engaged in the program, the department would still have borne their salary costs).
For program leadership and implementation staff, estimated percent efforts dedicated to the facility billing program were applied to actual base salary plus benefits rates for those positions. For other staff involved in the programmatic intervention, costs were generally calculated based on hours allocated to the program and valued at their pro-rated individual salary plus benefits rates. In some cases, there was internal sensitivity around the use of individual salary figures in the CBA (i.e., concern about disclosure of the salaries of particular employees). For nursing staff, for example, we used median hourly salary rates for ED nurses based on nursing level, and on years of experience for specific key participants. For the ED Director of Nursing’s (DON) salary, we used the median salary of all DONs at the hospital. For the ED Director of Finance, we used the median of the salary range for this grade and position.

Since this analysis was conducted from the perspective of the ED, external costs were excluded \textit{a priori}. Labor time by non-ED employees was included in some cases (where the ED bore the cost), but not others (where it did not). For example, labor hours of Pediatric ED employees were excluded from program costs even though these employees were integral to our efforts. Since any benefits resulting from the intervention were realized by each department independently, and the benefits captured by the CBA pertain only to the Main ED, costs to the Pediatric ED were not considered. The same approach was taken with the resource hours from the Compliance Department. Since involved individuals from this department were employed by the Johns Hopkins Health System and not paid by the ED, their time was left out.

Incremental nursing time associated with increased documentation times was also included as direct labor (opportunity) costs. The weighted\textsuperscript{8} median hourly wage of nursing staff (nurses and clinical techs) providing clinical care was included as the valuation for this cost. This figure entailed factoring in the estimated percent of time spent by each nurse providing clinical care time and applying median salary level valuations to each position based on nursing level and years of experience. To calculate the cost of the incremental documentation time, we started by collecting all the newly added interventions that were not previously documented as noted in the

\textsuperscript{8} Weighted by the FY13 distribution of actual nurse staffing in the ED
‘Consolidated List of Interventions Added or Modified’ in Table 11 (page 77) and Table 12 (page 78). For each of the 40 new interventions, we identified the documentation time associated with the intervention and the number of times it was documented per year. For newly implemented interventions, we annualized the current utilization rate (volume) and inflated by 15% to account for adoption rate.\textsuperscript{212-214} We then multiplied each intervention’s annual volume by the documentation time, and summed the 40 values. As summarized in Table 13, we added a yearly documentation burden of 8,689 minutes (145 hours) to the nursing staff. Distributed across all 141 FTEs of nursing staff, this averaged to an additional one hour of documentation time per nurse yearly, or 10 seconds of extra time per nurse per day. On an individual basis, it is conceivable that a nurse could document multiple “new” interventions in one shift on one or more patients. We estimated a plausible scenario where one nurse could incur four minutes and 34 seconds of incremental documentation in a single shift. But, as stated, over time and across staff, the impact is blunted to an insignificant amount of time.

Table 13: Incremental Time Cost of Newly Added Nursing Interventions

<table>
<thead>
<tr>
<th>Total Incremental Minutes per Year</th>
<th>Total Incremental Hours per Year</th>
<th>RN FTE (FY13)</th>
<th>Incremental Hours per Nurse per Year</th>
<th>Incremental Minutes per Nurse per Year</th>
<th>Incremental Seconds per Nurse per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,688.95</td>
<td>144.82</td>
<td>141</td>
<td>1.03</td>
<td>61.62</td>
<td>10.13</td>
</tr>
</tbody>
</table>

For valuation, we multiplied the weighted median hourly wage of nursing staff by the incremental hours in Table 13 to estimate $5,876 (including a 34% FY13 benefits rate) in annual incremental costs due to newly documented nursing interventions.

Table 14, below, summarizes the labor costs associated with the facility billing program during the interventional period of July 1, 2012 through June 30, 2013. Programmatic leadership and oversight costs accounted for the bulk of the labor costs, at $77,611. The labor associated with implementation of the programmatic activities added an additional $23,617 in labor costs. Coupled with the $5,876 in incremental documentation time cost, discussed above, total labor costs amounted to $107,103. Of this total, $17,854 (17%) represented a direct cost to the Department (that it would not
have borne were it not for this program), while $89,250 (83%) represented an
opportunity cost of labor (dollars the Department would have incurred regardless of this
program, but which represented labor that could have been directed at other activities
that may have generated value). Overall, labor cost represented 95% of total project
cost.
Table 14: Facility Billing Program Cost: Labor Costs

<table>
<thead>
<tr>
<th>Program Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Billing Meetings (FBM)</td>
<td>$23,616.67</td>
</tr>
<tr>
<td>Time Study Training</td>
<td>$23,616.67</td>
</tr>
<tr>
<td>Observation Audit Observer Cost</td>
<td>$23,616.67</td>
</tr>
<tr>
<td>Pilot Study Cost</td>
<td>$23,616.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Leadership and Implementation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Administrator</td>
<td>$31,249.00</td>
</tr>
<tr>
<td>Manager of Systems Development</td>
<td>$23,482.76</td>
</tr>
<tr>
<td>Administrative Coordinator</td>
<td>$5,025.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% FTE Allocated</th>
<th>Salary</th>
<th>Benefits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Assistant, part time</td>
<td>100%</td>
<td>$8,295.00</td>
<td>25.0%</td>
</tr>
<tr>
<td>Summer Interns (10 weeks) X2</td>
<td>100%</td>
<td>$6,000.00</td>
<td>0%</td>
</tr>
<tr>
<td>External Consultant - Navigant</td>
<td>4.5</td>
<td>$330.00</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time Study Training</th>
<th>Hours Allocated</th>
<th>Hourly Rate</th>
<th>Benefits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Nurse Specialist (CL)</td>
<td>25.5</td>
<td>$79.94</td>
<td>34.0%</td>
<td>$2,731.55</td>
</tr>
<tr>
<td>Nurse Clinician IIE-PACE (MK)</td>
<td>1.5</td>
<td>$37.19</td>
<td>34.0%</td>
<td>$74.75</td>
</tr>
<tr>
<td>Nurse Clinician III-PACE (NB)</td>
<td>1.5</td>
<td>$35.32</td>
<td>34.0%</td>
<td>$90.23</td>
</tr>
<tr>
<td>Nurse Clinician III-PACE (PP)</td>
<td>1.5</td>
<td>$44.89</td>
<td>34.0%</td>
<td>$90.23</td>
</tr>
<tr>
<td>Nurse Clinician III-PACE (PP) (simulations)</td>
<td>2.75</td>
<td>$44.89</td>
<td>34.0%</td>
<td>$165.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observation Audit Observer Cost</th>
<th>Hours Allocated</th>
<th>Hourly Rate</th>
<th>Benefits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biller 1-4 (JA, LG, AJ, CW)</td>
<td>20.17</td>
<td>$28.08</td>
<td>34.0%</td>
<td>$758.94</td>
</tr>
<tr>
<td>Clinical Nurse Specialist (NB)</td>
<td>18.25</td>
<td>$44.89</td>
<td>34.0%</td>
<td>$1,097.78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pilot Study Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,474.50</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incremental Documentation Time Cost</th>
<th>Weighted Hourly Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing opportunity Cost</td>
<td>144.82</td>
<td>$30.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Labor Costs</th>
<th>$107,103.44</th>
</tr>
</thead>
</table>

Notes:
1. Salary & benefits expressed for the proportion of time dedicated to this study.
2. These items are depreciable. We chose not to depreciate them to simplify the analysis. This overstates cost slightly.
3. This hourly rate includes nurses and clinical techs since both techs and nurses shared incremental documentation time.
NON-LABOR COSTS

Non-labor costs, including materials, food and office supplies, were tracked during the project implementation period. Printing costs were roughly estimated based by number of copies made and per-copy variable costs. Some of the non-labor costs were depreciable over time. To keep the analysis simpler, based on the “rule of reason,” (discussed above) we chose not to depreciate non-labor costs. Doing so would have had a negligible impact. Total non-labor costs for this study were $1965, representing 2% of total study cost. 100% of this non-labor cost was a direct cost to the Department.

OTHER COSTS

Additional costs included incremental patient time spent in the ED as a result of increased nursing documentation times stemming from the intervention. Patient time could, in theory, be excluded from the CBA, since potential benefits to patients (discussed earlier) resulting from the initiative were not included. Also, it can be argued that the marginal documentation time associated with programmatic outcomes might have added between a few seconds to a few minutes to each patient, which would seem inconsequential from the perspective of each patient’s opportunity cost of time. However, we opted to include incremental patient time costs due to social and efficiency concerns around average length of stay and for mere intellectual curiosity.

The simplest way of valuing patients’ opportunity cost is by their wages, which “can be taken as an indicator of the shadow value or marginal opportunity cost of time”. The Panel on Cost-Effectiveness in Health and Medicine “recommends that age-sex specific wages be used to value patients’ time”. However, these guidelines for cost-effectiveness analysis generally relate to comparisons of varying courses of medical treatment, where patient times, including transit time, may vary significantly from one course of treatment to another. Given our results in Table 13 above, incremental documentation time on a per-patient basis was estimated from a few seconds to a few minutes. We did not expect these costs to be significant relative to other elements of the CBA. So, since over 70% of our patients come from the
This hourly rate was likely a significantly high estimate of the opportunity cost of patient time in the ED. The reason was that Medicaid patients represented the largest customer segment (37.88% in FY13) followed by self-pay patients (21.16% in FY13). We believed, however, that erring on the side of a high estimate was appropriate since the incremental opportunity cost of family members or friends who accompany patients to the ED and also spend additional time waiting was not included (since there was no way to measure it). The hourly rate was multiplied by the 144.82 hours shown in Table 13 to estimate $3,568 in annual incremental opportunity costs to patients due to newly documented nursing interventions. Temporally, this equates to an added length of stay of 7.8 seconds per patient per visit. Had the sensitivity analysis shown patient time considerations to have a greater influence on CBA results than anticipated (they did not; see below and Annex G), further disaggregation by location, patient age, and gender, could have been attempted.

Table 16, below, summarizes the non-labor and other costs associated with the facility billing program during the interventional period. Patient opportunity costs accounted for the larger of these two costs at $3,568. The non-labor costs associated with implementation of the programmatic activities were responsible for an additional $1,965 bringing the total non-labor associated costs to $5,532 or 5% of total project costs. Total project costs, shown in the last row of Table 16, were $112,636. Of this total, $19,818 (18%) represented a direct cost to the department, while $92,817 (82%) represented an opportunity cost. Labor costs, at 95% of total project cost, represented the largest single expense category.
Table 16: Facility Billing Program Cost: Other, Non-Labor, and Total Costs

<table>
<thead>
<tr>
<th>Other Cost</th>
<th>Incremental Documentation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient opportunity Cost</td>
<td>144.82</td>
<td>$24.64</td>
</tr>
</tbody>
</table>

Total Patient opportunity Cost $3,568.26

<table>
<thead>
<tr>
<th>Non-Labor Cost</th>
<th>Unit Cost</th>
<th>Qty</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuwzz App. License and Change Fees¹</td>
<td>$1,000.00</td>
<td>1</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Printing</td>
<td>$0.04</td>
<td>500</td>
<td>$18.50</td>
</tr>
<tr>
<td>Office Supplies¹</td>
<td>$65.00</td>
<td>1</td>
<td>$65.00</td>
</tr>
<tr>
<td>FBM Meeting Meals</td>
<td>$36.71</td>
<td>24</td>
<td>$881.13</td>
</tr>
</tbody>
</table>

Total Non-Labor Cost $1,984.63

Total Non-Labor Costs $5,532.89

Total Cost $112,636.33

Notes
¹ These items are depreciable. We chose not to depreciate them to simplify the analysis. This overstates cost slightly.
BENEFITS
(FINANCIAL OUTCOMES)

As depicted in the Theoretic Framework, this project has two distinct outcome measures associated with the financial outcomes construct: Revenue and Cost Efficiency. Both outcome measures are discussed below.

For purposes of the CBA, the primary and most direct benefit associated with our program was the increase in ED facility billing-generated revenue, i.e. RVUs. The ED does not actually receive revenue directly from patients or payers, as facility billing is a centralized function at The Johns Hopkins Hospital. Each year, the ED hospital budget is set, based on expected patient volume and a target number of RVUs per patient (in FY13, the target was 11.2 RVUs/patient). The ED then accrues facility billing revenue as a functional unit to the hospital based on the total RVUs billed, with additional budget allocations in the form of a “flex budget” possible if patient volume and/or RVUs per patient (which reflects a higher level of resource intensity per patient) outpaces the annual target.

The revenue accrual process at the hospital actually reduced some complexity as to how revenue benefits were captured in a cost benefit analysis undertaken from the ED’s perspective. For example, it eliminated the need to include the collection rate for ED bills from the revenue calculations. The overall collection rate for ED facility bills was approximately 50%, which meant that approximately 50% of patient bills remained uncollected and were ultimately written off as “bad debt”. It also reduced complexity and uncertainty in calculating the ED’s revenue benefits that were accounted for in accounts receivable at the hospital, as patient bills sometimes remained unpaid for a long time.216 For purposes of this ED-perspective CBA, therefore, revenue increase benefits were based on RVUs billed. If the CBA were being undertaken from a hospital-perspective, this would have been adjusted by the collection rate to accurately portray the actual benefit.

Improved billing compliance through thorough and appropriate documentation of nursing care may also have benefited the ED through reduced risk of noncompliance
during audits (as mentioned earlier), and possibly decreased denial of bills from payers. These types of benefits are typically more difficult to measure and value. They also may not have benefited the ED directly. For example, the majority of facility billing for the ED was handled directly through the hospital’s Central Billing Office. Decreased denials may have avoided costs by saving rework time for resubmissions, but this would have benefited the Central Billing Office, not the ED.

An additional consideration of the programmatic intervention was excluded from the CBA for practical reasons. This related to the ED’s contribution margin – budgeted as a loss of $27.4MIL in FY13 – which captured the net of all fully costed profits and losses of the ED, including its facility billing revenue and all departmental expenses, and further allocations of fixed and overhead costs from the hospital as a whole. The ED had an incentive to improve its budgeted contribution margin over the course of a year or, expressed differently, to minimize its fully-costed losses. At year end, 30% of the ED’s contribution margin that exceeded the budgeted contribution margin was transferred to a savings account which our department was able to access through specific requests for approved categories of expenses. The fund status and the spending approval process related to this are opaque and complex; and given the multiple variables that affect the final contribution margin, would be nearly impossible to quantify in the CBA.

**BENEFIT DETAILS: MEASUREMENT AND VALUATION**

The primary benefit of our study was the increase in billed RVUs, which translates into additional accrued revenue for the ED at a valuation of $88.52 per billed RVU during FY13. However, given increases in patient volume at the JHH ED (from an average of 4,866 patients/month during the baseline period to 5,544 per month in FY13, or an increase of 13.9%), the appropriate outcome measure is not total RVUs billed, but rather RVUs controlled for patient volume, or RVUs per patient. While this measure over a short period of time might vary based on patient complexity/acuity trends, for purposes of the CBA it was assumed that the patient acuity mix remained relatively constant over aggregate periods of time. Increases in RVUs billed per patient were
related directly to better capturing nursing efforts through improved documentation and
were thus considered a direct outcome attributable to our study.

REVENUE

Table 17 below compares the project’s 12-month baseline period (January 2010 –
December 2010) and the intervention period of FY13. Contrasted are ED patients per
month and the RVUs generated per patient (RVU/pt). RVU/pt is a measure that is
controlled for changes in patient volume. What is interesting to note is that RVU/pt – a
measure of workforce productivity or output – increased by 3.6% while monthly patient
volume – a measure of demand on the workforce – simultaneously rose by 13.9% between
the periods. This suggests that output increased even as demand grew.

In Appendix G: Analysis of Revenue Implications, we present a comprehensive
analysis, prepared by the Johns Hopkins Health System’s Financial Analysis Unit, of
fixed and variable profitability associated with incremental RVUs. This analysis
demonstrates that a 0.1 RVU/pt increase is commensurate with $332,759 in variable net
revenue for the ED. This analysis disambiguated RVU calculations for admitted,
discharged and observation patients and accounted for differences in
patient type while presenting results on a fixed-cost basis and a
variable cost basis (in which rising workforce output is associated with rising workforce-
driven costs). That analysis served as the foundation for our estimation of
programmatic benefits. This was estimated by summing $332,759 (in variable net
benefit) for each 0.1 increase in RVU/pt. This resulted in a positive revenue impact of
$1,311,340.

Table 17: Baseline vs. Intervention - Volume, RVUs and Revenue Impact

<table>
<thead>
<tr>
<th></th>
<th>Baseline Period</th>
<th>Intervention Period</th>
<th>Increase</th>
<th>Increase Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average pts/month</td>
<td>4,866</td>
<td>5,544</td>
<td>678</td>
<td>13.9%</td>
</tr>
<tr>
<td>Average RVU/pt</td>
<td>10.95</td>
<td>11.34</td>
<td>0.394</td>
<td>3.6%</td>
</tr>
<tr>
<td>Variable Net Profit</td>
<td></td>
<td>$332,759</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from 0.1 RVU/pt increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programmatic Benefit</td>
<td></td>
<td>$1,311,340</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RETURN ON INVESTMENT

Ward (1994) states that return on investment (ROI) is the “single most important ratio because it measures overall management effectiveness.” Mansfield (1996) proposes the following formula for ROI calculation:

\[
\text{ROI} = \frac{\text{Gain from Investment} - \text{Cost of Investment}}{\text{Cost of Investment}}
\]

Using the above numbers, we then get

\[
\text{ROI} = \frac{\$1,311,340 - \$112,636}{\$112,636} = 10.64
\]

Our return on investment for this project is therefore 10.64. This means that for every $1 we invested in this study, we experienced a revenue return of $10.64. The net programmatic benefit of our effort capture project was $1,198,703 in FY13 revenue.

Another, more traditional approach to ROI is described by Ward (1994) utilizing average gain and average investment.

\[
\text{ROI} = \frac{\text{Mean Gain}}{\text{Mean Investment}}
\]

Using this approach, we examined ROI over one and three year periods.

1 Year ROI \(= \frac{\$1,311,340 - \$112,636}{\$112,636} = 10.64\)

3 Year ROI \(= \frac{\$942,848 - \$37,545}{\$37,545} = 22.11\)
Our return on investment for this project after three years' time is therefore 22.11. This means that for every $1 we invested in this study, we experienced a revenue return of $22.11. For this analysis we assumed a conservative 70% carryover in RVU/pt from year to year and a 90% carryover in the marginal variable net profit (0.1 RVU/pt). Net Present Value used a discount rate of 5%.\textsuperscript{202,206}
Of interest to our study, was the change in production efficiency between the period prior to our program and the period of its implementation. We employed the input/output ratio from Mansfield (1996) to provide insight into cost efficiency by exploring his methods for return on investment analysis.

\[
\text{Production Efficiency of Workforce} = \frac{\text{Revenue Generated}}{\text{Cost of Labor (during revenue generation)}}
\]

RVU production was used as the measure of workforce clinical output. It is worth mentioning again that the scope of this study focused on productive clinical care among the ED’s nursing staff i.e., time spent caring for patients and generating RVUs. Total working hours were excluded as an appropriate indicator of productivity because some functions included in total working hours were outside the scope of our study, vide infra. According to HSCRC guidelines Clinical Care Time (CCT) is defined as “Total direct and indirect patient care activity/time performed by clinical personnel.” The scope of our effort did not include non-clinical time (also called administrative time), education time, or non-productive time (e.g., socializing with peers).

While the programmatic intervention of our study was targeted exclusively at nurses (and not clinical techs who also document and generate RVUs), the production efficiency calculations discussed next had to include clinical techs. The reason for this was that we had no way to separate RVUs generated by nurses from RVUs generated by clinical techs. Both positions document concurrently on a patient chart, and RVUs are calculated based on minutes of care from both types of staff. There is no mechanism to untie “nursing minutes” from “clinical tech minutes.” Although the effort is combined for both staff types, we refer to it collectively as “nursing productivity,” since both staff types are aligned under the nursing functional group within our department.

To determine production efficiency we divided the output by the cost of input. For this analysis, the output – or product – is the number of RVUs generated. Here we opted to exclude observation RVUs, because they are fixed hourly inputs governed by
HSCRC standards and not reflective of nursing effort in any way. For the denominator of the equation (shown below), we utilized CCT multiplied by the respective salary rates of nurses and clinical techs as the measure of cost of labor or input. These are also referred to as the variable factors of production by Yotopoulos (1973) and others. Since the productive clinical time of nurses and techs is a variable figure, modulating with patient volume, there is no need to adjust production efficiency for patient volume differences in the pre- and post-study phases. Despite the fact that some fixed inputs (number of beds) changed from the baseline period to the study period, to keep analysis simple, we held fixed inputs constant. The rationale for this had to do with operational “workarounds” in which ED staff compensated for inadequate supply of beds by treating some patients in incremental “hallway beds” or waiting areas.

Production efficiency = \frac{\text{product}}{\text{variable factors of production}} = \frac{\text{workforce clinical output}}{\text{cost of labor}}

Production efficiency = \frac{\text{RVU}_{\text{Total ED}} - \text{RVU}_{\text{Total Observation ED}}}{\sum_{i=1}^{n} t_{RNi} * s_{RNi} + \sum_{j=1}^{n} t_{Techj} * s_{Techj}}

Notes:
Total observation RVUs include RVUs generated through extended care services.
t_{RN} and t_{Tech} are Clinical Care Time (CCT) only.

One limitation presented by removing observation RVUs from the equation is that this understates the workforce output because there is CCT occurring during observation hours. Since there is no way to extract an equivalent volume from the denominator of the equation – cost of labor for CCT generated during observation hours is inseparable from that generated during non-observation time – we are faced with a lopsided calculation. For this reason, we show calculations with observation RVUs excluded from (as shown above), and included in (as shown below), the product. It stands to reason that nurses’ documentation performance does not vary during observation time, and that during this time they are still producing a level of output.
commensurate with patient acuity and status. Therefore, it can be argued that including clinical output associated with observation is entirely appropriate.\(^{223}\)

\[
\text{Production efficiency} = \frac{\text{RVU}_{\text{Total ED}}}{\sum_{i=1}^{n} t_{RNI} * s_{RNI} + \sum_{j=1}^{n} t_{Techj} * s_{Techj}}
\]

The calculation of cost (denominator) was detailed and cumbersome. We wanted to be as precise as possible and exclude any non-CCT from our analysis. From the Department of Human Resources we collected the nursing salary structure so that we could account for PACE and BASE salary structures. Table 23 in Appendix H: Economic Evaluation, Annex D: Production Efficiency, shows the salary information used in our calculations (we used median figures). Our project team collaborated with the hospital’s Central Nursing Department to identify the actual amount of CCT worked by ED staff. The hospital tracks all nursing time in an electronic system called Work Force Management (formerly called Nightingale Time Management System). This system is fed – by ED nursing leadership – with detailed schedules of actual time worked by nursing staff (categorized by shift and by type of time e.g. clinical, orientation, education, etc.). Nursing shifts are managed on an every-two-hours basis, so they are very detailed and accurate. A month-long project was undertaken by the Work Force Management team in collaboration with our project leadership to create a report that accurately filtered out non-productive and non-clinical time. Samples from this report are shown in Appendix H, Annex D.

Data elements included position budget type and type of hour (regular, overtime, high needs, double overtime, etc) for each month since January 2010. Having the type of hour, allowed us to apply the correct salary figure, adjusted by type of hour worked. For example, to hours indicated as double overtime we applied 200% of the hourly rate. We also had shift type as a data element. This characterized the role taken during the hours specified. Some shift types were “RAP Lead”, “Main Lead”, “Shift Coordinator”, or “Nursing Supervisor”. These were roles which carry administrative obligations in addition to patient care responsibility. Shift type could also indicate a nurse functioned as an “RN,” or “EACU RN” meaning he or she did not have administrative duties. Shift
type could also designate a nurse in “orientation,” meaning some of the shift was instructional, and some functional. Various budget types (Nurse Clinician (NC), NCIIE-PACE, NCIII, etc) could function in multiple given shift types. This was relevant because the same nurse could function in multiple shift types in the same month.

To improve precision, we identified roles that were categorized by Work Force Management as 100% clinical, but which we assessed as having a mixture of CCT and administrative time. These positions were often leadership positions during a clinical shift. Because we were able to analyze the data by shift type, we could apply factors which adjusted for the fact that not all shift types generated equal proportions of CCT. Prior to our analysis there was no methodology to separate CCT from non-CCT on a given shift. To develop our CCT factors, we surveyed nurses who functioned in the shift type of interest a minimum of six months. We surveyed five nurses from each shift type to ascertain their assessment of how much patient care time they accomplished when functioning in the various shift types with administrative duties. The mean figures from each set of five nurses were applied as CCT factors to the hours associated with each shift type. For example, nurses functioning as nursing supervisors, indicate that on average they only spend 29.17% of their time in direct (i.e. revenue generating) patient care activities while the rest of the time is spend on tasks that may be clinical in nature (e.g. facilitating patient throughput, managing clinical staff), but are not direct patient care. We then took the hours of nursing supervisor time for each month and multiplied them by 29.17% before calculating salary costs associated with those hours. As a result, only 192.52 of regular time hours were factored into our calculations during May 2013. To account for the fact multiple budget types (types of nurses) functioned in the various shift types (roles), and that each shift type has a different salary rate, these calculations were conducted at the individual nurse level for all 6535 lines of data. In this manner we were able to exclude “administrative” time for the aforementioned shift types; account for differences in orientation between new and experienced nurses; account for CCT produced by nurses who have non-clinical roles, yet periodically “help

<table>
<thead>
<tr>
<th>Shift Type</th>
<th>% Clinical Effort</th>
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<tbody>
<tr>
<td>RN</td>
<td>29.17%</td>
</tr>
<tr>
<td>Nursing Supervisor</td>
<td>19.83%</td>
</tr>
<tr>
<td>Shift Coordinator</td>
<td>19.83%</td>
</tr>
<tr>
<td>Triage RN</td>
<td>19.83%</td>
</tr>
<tr>
<td>RAP LEAD</td>
<td>19.83%</td>
</tr>
<tr>
<td>RAP RN</td>
<td>19.83%</td>
</tr>
<tr>
<td>Supertrack</td>
<td>19.83%</td>
</tr>
<tr>
<td>Main LEAD</td>
<td>19.83%</td>
</tr>
<tr>
<td>RN</td>
<td>19.83%</td>
</tr>
<tr>
<td>Trauma RN</td>
<td>19.83%</td>
</tr>
<tr>
<td>Orientation</td>
<td>19.83%</td>
</tr>
<tr>
<td>EACU LEAD</td>
<td>19.83%</td>
</tr>
<tr>
<td>EACU RN</td>
<td>19.83%</td>
</tr>
<tr>
<td>Tech</td>
<td>100.00%</td>
</tr>
<tr>
<td>TECH</td>
<td>100.00%</td>
</tr>
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out” in the clinical area (e.g. when multiple traumas arrive simultaneously); and exclude the lunch breaks nurses take. Our CCT factors would have been more accurate had we spent time observing and calculating the ratios of CCT to non-CCT for the various roles, but that would not have been a sensible use of the nursing resources needed for such a task. More detail about the methodology for this effort is included in the appendix.

Below are calculations we used to ascertain our production efficiency ratio of the product to the variable factor of production of interest. These ratios include observation RVUs. Calculations with observation RVUs excluded are shown in the appendix.

\[
\text{Baseline Production Efficiency} = \frac{639264}{156350.47 \times $31.55 + 49477.08 \times $15.35} = 0.11230
\]

\[
\text{Interventional Period Production Efficiency} = \frac{754504}{183442.36 \times $30.21 + 60608.86 \times $15.29} = 0.11665
\]

A comparison of labor efficiency between the baseline (pre-program) period and the intervention period of our study (FY13) is shown in Table 19. Figures represent 12 month means of the two respective periods. The first column (labeled “Mean MPK”) of the table indicates mean production efficiency as the ratio of revenue generated to cost of labor.\textsuperscript{217} Said differently, this is the mean number of RVUs generated by nursing staff for each dollar of labor; also referred to as the marginal product of capital (abbreviated as MPK).\textsuperscript{224,225} We found, in the baseline period, the mean marginal product of capital was 0.1123 RVUs generated for every dollar spent on nursing labor. Not accounting for inflation, this equates to $9.01; or $9.66 in inflation adjusted dollars.\textsuperscript{226} Thus for every $1.00 spent on labor during the baseline period, we generated a mean of $9.66 in 2013 revenue dollars. For the intervention period, the marginal product of capital was 0.1166 mean RVUs generated for every dollar spent on nursing labor. This was a positive difference in MPK of 0.0044 RVUs from the baseline period to the intervention period. The p value for this difference was not statistically significant (p=0.16, 95%CI: -0.002-0.010), which was not surprising given such miniscule differences in numbers and only 12 months in each comparison period. The difference in MPK, when valued in dollars
was statistically significant. In unadjusted dollars, we observed an improvement of $1.32 (p<0.0001, 95%CI: $1.83-$0.80). In inflation adjusted dollars we observed an improvement of $0.76 (p<0.01, 95%CI: $1.30-$0.22).

Mean MPK comparison and value figures excluding observation RVUs are also shown in Table 19. The differences in the means of the baseline MPK, unadjusted values, and adjusted values between the ‘Observation Included’ and ‘Observation Excluded’ groups was not statistically significant (p=0.07 for all three). The differences in the means of the intervention period MPK, unadjusted values, and adjusted values between the ‘Observation Included’ and ‘Observation Excluded’ groups was statistically significant (p<0.02, for all three). This suggests that excluding observation RVUs from our calculations of labor efficiency had a statistically significant impact, but does not suggest whether this was methodologically appropriate. Detailed labor efficiency figures, by month, are included in the appendix.

A Production Theory based examination of the ratio between incremental changes in capital as they relate to incremental changes in output was also appropriate for this analysis.\textsuperscript{227} One metric that assesses the marginal amount of factors of production (typically capital) needed to generate a marginal unit of production is the incremental capital-output ratio (ICOR).\textsuperscript{228} In our context, ICOR measured the increment in capital required to produce one additional RVU worth of output.\textsuperscript{228} This is also the inverse of the marginal product of capital found in Table 19 and is shown in that table for both study periods. Since this is an inverse indicator of production efficiency\textsuperscript{229}, a higher ICOR “is not preferred because it indicates that the entity's production is inefficient.”\textsuperscript{228} In our mean labor efficiency comparison we observed that in both cases in which observation RVUs were included or excluded, the ICOR was higher in the baseline period as compared to the intervention period (8.90 vs. 8.57 including observation, and 9.44 vs. 9.08 excluding observation), suggesting decreased returns in efficiency of investment in labor. Put simply, to achieve the same level of output, the baseline period required a greater capital investment in labor than the intervention period. For example, when observation RVUs were included in the analysis (top of Table 19), an investment in labor of $8.90 yielded one RVU of output ($86.05 in FY13 dollars). But for the intervention period, to create one RVU, the department only
had to invest $8.57; or 33 cents less. When the magnitude of output is on the order of 754,000 RVUs, 33 cents worth of improved production efficiency per RVU becomes an enhancement worth $248,986 (in FY13) as compared to baseline. Thus, our analysis suggests that the productivity of capital is lower in the baseline period and higher in the intervention period. We should acknowledge that we are “corrupting” the use of ICOR by pulling it away from its macroeconomic roots. To our knowledge this measure has never been used as an indicator of firm productivity (like MPK above); rather, it is typically used in determining a country’s level of production efficiency using GDP as the measure of output.\textsuperscript{228,230,231}

Table 19: Mean Labor Efficiency Comparison (Output per Unit of Input)

<table>
<thead>
<tr>
<th>Mean Labor Efficiency Comparison</th>
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<tbody>
<tr>
<td><strong>Observation Included</strong></td>
</tr>
<tr>
<td>Mean MPK</td>
</tr>
<tr>
<td>Baseline</td>
</tr>
<tr>
<td>Intervention</td>
</tr>
<tr>
<td>Delta</td>
</tr>
<tr>
<td>p value</td>
</tr>
<tr>
<td>95% CI</td>
</tr>
<tr>
<td><strong>Observation Excluded</strong></td>
</tr>
<tr>
<td>Mean MPK</td>
</tr>
<tr>
<td>Baseline</td>
</tr>
<tr>
<td>Intervention</td>
</tr>
<tr>
<td>Delta</td>
</tr>
<tr>
<td>p value</td>
</tr>
<tr>
<td>95% CI</td>
</tr>
</tbody>
</table>

 Notes:
MPK = marginal product of capital
95% CI = 95% confidence interval
p value based on means of each month in comparison periods, not the aggregated means
ICOR = Incremental Capital-Output Ratio
Inflation adjusted per US Dept. of Labor, Bureau of Labor and Statistics
SECTION V
~~ DISCUSSION ~~
OUTLINE

1. Discussion
2. Strengths and Limitations
3. Lessons Learned
4. Role of Leadership, Implications for Management
5. Policy Implications
   A. The Fine Line Between Patient Needs, Staff Workload and Regulatory Compliance
   B. Implications for ED Staffing Models
V. DISCUSSION

This study explored a theory based on the hypothesis that maximizing nursing clinical care effort capture can improve socioeconomic effectiveness in the Department of Emergency Medicine. Heretofore not explored in depth, this was achieved by building a facility billing program that emphasized the full capture of nursing effort. The study utilized a case study design as its framework. The conceptual structure of this program focused on maximizing nursing clinical care effort capture as a means to achieve improvements along three socioeconomic thrusts that collectively actuate organizational effectiveness. This was done in the context of a facility billing program (the programmatic intervention), and was hypothesized to lead to improvements in workforce, social, and financial outcomes in the ED. Capturing nursing effort was achieved by a series of programmatic activities designed to maximizing compensated work through enhanced billing practices.

In this study, we found that we were unable to demonstrate a relationship between clinical effort capture and workforce outcomes. This was largely due to our inability to complete the programmatic activities designed to elicit the hypothesized workforce outcomes, so it came as no surprise. While these efforts currently continue to demonstrate progress and have strategic promise, they were not completed during the study timeframe. We found no degradation in workforce outcomes such as employee engagement, nursing perceptions of individual and unit oriented workplace measures, perceptions of quality of care delivery, and staff turnover. It may be reasonable, then, to offer that there is not an inverse relationship between clinical care effort capture and workforce outcomes, which itself is a valuable proposition. It is certainly worth studying further.

We found that social outcomes were improved, which is heartening given the concerted focus of the study team on this outcome construct. We also realized (as any former hospital patient probably has) that the patient billing system is shockingly opaque and places the patient at a distinct information disadvantage because of the bundling of ED facility charges. This lack of transparency would have made it easy for the study to maintain an organizational perspective, rather than a balanced one. Had this been an
economic study rather than a socioeconomic one, the interests of the patient could easily have been overlooked or evaded. Had this occurred, the patient would likely go unaware. We found that having an ethical cornerstone for this study, clearly integrated patient-centric objectives, and external participation, were invaluable to maintaining objectivity and balance between ED and patient perspectives.

We also found evidence suggesting a positive association between our efforts to capture clinical output and positive financial outcomes. Such was the case in both our outcome measures of interest – revenue and production efficiency. From a revenue perspective, we experienced a positive return on investment of 10.64. Every $1 we invested in this study, returned $10.64 in revenue. The net programmatic benefit of our effort capture project was $1,198,703 in revenue. Our program also improved the production efficiency of the nursing workforce. Results demonstrated a statistically significantly improved inflation adjusted marginal product of capital. Controlling for observation RVUs, we observed an improvement of $0.73 ($<0.01, 95%CI: $1.26-$0.20) in the marginal product of capital between baseline and intervention timeframes. Our analysis suggested that the productivity of capital also improved during the study. Production efficiency for the nursing workforce increased, thus requiring a $0.33 lower capital investment per RVU in the intervention period as compared to the baseline period. It should be noted that all outcomes are expressed for the one year intervention period. However, these outcomes are cumulative and will repeat in FY14 and as time moves forward. Programmatic costs, on the other hand, were only incurred once.

Finally, we observed that there was significant overlap among our programmatic activities. Of the 25 items newly added interventions in the Main ED, 60% were identified in more than one activity. Of that 60% of redundant items, 33% were identified in more than two activities. For example, the idea of billing for spinal immobilization came from benchmarking against other hospitals, reconciling our own provider order sets, and reviewing our own list of documentable items not connected to billing – three separate activities. While this approach was certainly thorough, and the overlap added to the validity of the decision to bill certain items, each activity consumed

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9 Newly added, or previously documented but not billed, not including the 33 newly added "nursing assist" procedures.
program time and expense. Likewise activities such as monitoring for billing and documentation problems, and reviewing monthly documentation reports were redundant (though we addressed this early in the program).

We found significant intersection among activities that did not contribute additional value to the programmatic outcomes. From this we concluded that future iterations of this project, in other EDs, should be streamlined significantly. Of the 14 programmatic activities 8 should be eliminated and 6 maintained. Given the amount of resources consumed, and considering the amount of overlap with other activities, the following activities did not yield sufficient value, independently, to merit inclusion in future studies:

1. Monitor for problems and address
2. Identify underperformers and educate
3. Observational audits
4. Update billing definitions
5. Create and reconcile list of documentable items not hooked to billing
6. Review external audit for opportunities
7. Reconcile provider orders against billable procedures
8. Reconcile provider orders against other EDs

We anticipate no degradation in programmatic outcomes or efficacy following such consolidation. We do anticipate much less time, effort and salary dollars spent implementing this condensed interventional design.

We also concluded that, while we were able to show a relationship between social equity, compliance, and clinical effort capture, the association is predicated on an *a priori* intent to focus on these factors. Social outcomes – in the form of patient fairness – certainly improve when nurses document, and EDs bill in a more consistent manner. When EDs reduce the fluctuation that differentiates busy and quiet times, everyone benefits. Risk of litigation is mitigated when documentation standards are consistent and more so when they are consistently high.\(^{194}\) When EDs bill with less micro-volatility patient parity is improved.\(^{232}\) Such equity develops as consistency of documentation emerges. Each patient’s documentation is more reflective of what clinical effort was actually delivered during the encounter. Patients who are treated
when the ED is full do not benefit from reduced documentation, because the nurses and techs are busy. Thus, extending this argument to its macroeconomic framework, the societal cost of emergency healthcare is more consistently (and equitably) distributed to those that consumed this resource.

While this “social fairness” may have been intrinsic to our study efforts, other aspects of social equity were not. A comprehensive review of the implications of how interventions are billed and how CCT is distributed among patients was an aspect of this program that leadership embraced and sustained. Had this not been a stated project objective, however, this effort could easily have languished or been ignored entirely. The same can be said for improving compliance and reducing risk. Had these items not been a component of programmatic design, and had study leadership not fostered a collaborative and collegial relationship with the Compliance Department, those objectives might not have been attained. We concluded that improving social equity, enhancing compliance, and reducing organizational risk must be factored into study design and articulated as goals. Doing so will assure that the project will achieve some measure of improvement along this socioeconomic pathway.

Regarding the financial outcomes of this study, we observed that they convincingly made a business case for the facility billing program. Given both a positive ROI and improved production efficiency, the program was financially successful and worth repeating elsewhere. We concluded that the incremental cost of documentation (62 minutes per nurse or tech per year) was not a significant burden to the nursing workforce. The added load on the staff, from having new interventions to document, represented a “tradeoff in value” – a widely accepted economic concept.\textsuperscript{91,233} Nursing staff worked harder to document incremental interventions, but the consequence was improved economic output through improved billing. Incremental hires were not added to achieve this outcome, further enhancing the value of the tradeoff. The opportunity cost imposed on the patients was also deemed to be minimal. Apportioned over the FY13 patient volume, our program represented a cost to the patient of five cents per patient per visit. We concluded that the program made no unreasonable demands on patient time, and did not represent a significant burden to the patient.
STRENGTHS AND LIMITATIONS

Study design. As stated earlier, one of our goals was theory building. One strength of theory building from case studies is its “likelihood of generating novel theory.” Exploring theory development from case studies enables researchers to “reconcile evidence across cases, types of data, and different investigators, and between cases and literature; increasing the likelihood of creative reframing into a new theoretical vision.” Likewise, resultant theory is more apt to have empirical validity because the theory-building process is so closely linked to the evidence. Because of this, the theoretical construct is likely to be consistent with the researchers’ empirical observations. Emergent hypotheses are likely testable, as constructs developed during the case study were likely measured (or at least are measurable) during the process of theoretical design and theory building.

A risk associated with our case study design is that the theory being investigated “describes a very idiosyncratic phenomenon.” Certainly this study can be described as studying a narrow aspect of the broad discipline of hospital operations and finance. A limitation of this study is that the hypothesis under scrutiny supports a theoretical construct that is very specific to facility billing in Emergency Departments. Bandara (2005) offers that while theories so examined are likely to be novel and “empirically valid”, they “lack the sweep” of broader, more generalized theories. Case study methodology is also noted to be limited in its ability to demonstrate causal relationships, control case comparisons effectively, and control for selection bias.

Confounding and effect modification through third variables. Of concern was the presence of “third variables” that offer highly plausible alternative explanations to some of the results observed as programmatic outcomes. For example, association of one of the outcome measures – compliance – with the facility billing program may have been confounded by ongoing departmental efforts to improve regulatory compliance. This was of particular concern in the measures of workforce outcomes since there are ongoing departmental efforts to improve workforce outcomes such as staff moral and patient satisfaction (which is highly correlated with staff satisfaction). Since most
such efforts (e.g., patient satisfaction, improved throughput, reduced wait times) have remained steady between the baseline and interventional periods, we did not suspect confounding to be a strong source of bias. Nevertheless, we did not try to draw a correlation between this programmatic intervention and some organizational performance outcomes, since we could not show a valid relationship void of any outcome modifiers or confounders.

**Generalizability.** In a project such as this, with internal procedural implications for the organizational workforce and with possible policy implications, generalizability was an important consideration. One of the explicit “core values” of the Malcolm Baldrige National Quality Program is “to facilitate communications and sharing of information on best practices among healthcare organizations and among U.S. organizations of all types.”\(^{237}\) To achieve this goal, our approach utilized technical, “theoretically grounded tools,”\(^{238}\) and we strove to be transparent and inclusive in our methodology. To enhance exportability, care was taken to structure the effort in a manner that optimized reliability and validity (as discussed earlier), yet remained grounded in everyday reality of a functioning ED and was flexible and responsive to unanticipated challenges. While there exist outcome measures and factors that were not considered in the initiative at The Johns Hopkins Hospital, they were nevertheless included in the model (though not used) so that others choosing to follow this methodology may make use of them in circumstances where they would be appropriate. For example, the cost benefit analysis did not examine factors such as productivity loss or health state change. These elements, however, remained in the economic evaluation model (Appendix H, Annex A) so they could be utilized by others who choose them as measures in appropriate circumstances.

**Data shortfalls.** A constraint recognized when looking at billing data in Allscripts was that such data excluded admitted patients (22.7% of visits in FY13) as well as trauma and critical care patients (3.7% of FY13 volume), because these populations were manually billed. The 22.7% admission figure already included the 60% of traumas and critical cares that were admitted. The remaining 40% non-admitted trauma’s and critical
cares only accounted for 1.5% (40% of 3.7%) of total patient volume. Therefore the total impact of manual billing (the component of volume not described by readily accessible Allscripts data) represented 23.5% (22%+1.5%) of total ED volume.

**CBA scope limitations.** The limited scope of the cost benefit analysis did not fully incorporate potential societal costs and benefits of the facility billing program, including improvements to quality of care (though we assumed none) and transfers from government payers. However, since the purpose of this CBA was to build a business case for the programmatic intervention, the government/social welfare perspective was not thought to be necessary. Another limitation was that the hospital, in an attempt to minimize its overall financial losses in a more demanding economic climate, could escalate the expected RVUs per patient as documentation improvements are made and sustained. The hospital has a strong history of “raising the bar” for departments that exceed targets (a negative incentive certainly). Thus, an increase in budgeted RVUs would make any benefits from this program short-lived. As of this writing that has not happened; rather, the department raised its own RVU/pt target for FY14 in a successful attempt to avert hospital-wide cuts to the nursing budget.

**LESSONS LEARNED**

Regarding the implications of this study, an epigram captures this spirit: "Every defect is a treasure." In the discovery of imperfection lies the chance for processes to improve. Edward Deming (1986) relays that “Long-term commitment… is required of any management that seeks transformation. The timid and the fainthearted, and the people that expect quick results, are doomed to disappointment.”

1. “Inter-rater reliability studies are frequently conducted prior to the initiation of a research undertaking in order to ascertain how reliable the ratings to be obtained in the major study may be expected to be.” Our experimental design could have been improved had we incorporated steps to assess measurement error among our time study observers. Formal measures of reliability, such as intraclass correlation
coefficients, would have been possible had we developed a study design that took this into account early. Since measurement error can greatly hinder statistical analysis, interpretation, and outcomes, future studies would benefit from calculating a reliability index to assess the amount of such error.\textsuperscript{146} This approach consumes more resources. However, this study made it clear that it is vital to accurately estimate measurement error since the validity of the financial outcomes are in question without it.

2. The project would have occurred in a more holistic manner, and certainly been much more successful had the hybrid audit been implemented when it should have been. It would have allowed for deeper more meaningful culture change among the nurses had it occurred simultaneously with the rest of the facility billing program. A lesson learned is that before initiating a project of this scope, with an IT project as a sub-component, the lead investigator (or project leader) must get ED leadership “buy in” and commitment on a timeline for the IT project. In this manner, it gets on the “menu” of projects on which the IT team is working. The dynamic that plagued us was that the Department’s Administrator for Information Systems and Technology takes her priorities from the Administrator and the Vice Chair for Clinical Operations, neither of whom was invested in the hybrid audit, because our project team never presented it to them as an integral component of this program. The lesson learned was to ensure prioritization of programmatic efforts through early (and frequent if needed) engagement with departmental leadership.

3. The lessons learned about program and project management relate to Berwick’s theory of continuous improvement (which he links to the work of Deming\textsuperscript{240}). Berwick states that this leadership method, where professional healthcare providers are fully engaged in a PI initiative,

\[\ldots\text{is consistent… with modern theory about quality, which holds that improving the quality of goods and services in any sector of the economy – including the health care sector – requires active participation and leadership by the people who do the day-to-day work of producing those goods and services. By this standard, the involvement of physicians and other health care professionals in the measurement and management of quality is not simply desirable but also essential to the improvement of quality}^{238}\ldots\]
He goes on to note that when the “hearts and talents of all workers are enlisted” in investigating methods of process and quality improvement, the prospects for success are “nearly boundless.” Others have addressed these implications as well. Ham cites Henry Mintzberg’s 1979 work, in which he proposes that professional workers are able to exert a large amount of control. He states that managers are thus more constrained in their ability to influence decisions when working among professionals (such as nurses). Managers must, therefore, identify methods to engender change from the bottom-up, such as by engaging the professionals in the change process right at inception. We accomplished this by first working with nursing leaders to ensure the program had support. We then enlisted key opinion leaders and invited their participation in study design and planning. Involvement of these ‘thought leaders’ allowed this program to be perceived as not only nursing driven (as opposed to through Administration) but also as taking a “bottom up” or “grassroots” approach where the opinions of front line nurses were valued (indeed they were). The lesson learned was that this was the correct approach to engendering culture change among nurses. Future case studies in other EDs should emulate this approach. A project in which the Assistant Administrator was a key leader, and which involved “measuring nurses” (vis a vis time studies, hybrid and team leader audits, observational studies, etc.) could easily and quickly have been viewed by the nursing staff as an infringement on their professional autonomy (as discussed by Ham) and something to avoid, or worse, undermine. The study authors believe such could be the case in any ED. Early and appropriate engagement with formal and informal leaders is a key factor in the success of a project of this nature.
ROLE OF LEADERSHIP, IMPLICATIONS FOR MANAGEMENT

Hagg et al. (2009) suggest that “Ultimately, the successful implementation of optimization and continuous improvement initiatives necessary to promote efficient, patient-centric care within a healthcare organization is dependent on management support…” Donald Berwick (1989) goes even further asserting that “leaders must take the lead in quality improvement.” Fundamental to the success of this PI initiative was the leadership of two key departmental figures. First was the ED’s Director of Nursing (DON), without whom access to nursing operations and education was not possible. The DON not only provided access but also served as a regular participant and operational expert on the Facility Billing Committee – the forum through which this initiative was driven. The DON was committed to supporting this initiative and saw its inherent value to both the financial and workforce objectives of the department while simultaneously ensuring synchronicity between the various efforts pursuing those objectives. Collaborative effort between the study leaders and the DON led to the development and ongoing refinement of the nursing report card as a tool to incentivize nurses across a spectrum of professional practice expectations including those related to documentation practice. Second, the Director of Finance (DOF) lent technical expertise and perspective to the initiative. His role was to focus the scope of the effort and provide insight into the complexities of costs and revenues in a unique State regulated by the HSCRC. Both leaders functioned to provide what transformational leadership theory calls ‘individualized consideration’ in that they mentored and educated members of the project leadership; and ‘idealized influence’ in that they served as role models, were respected and trusted team members. Donabedian (1988, 1996) reminds us that leadership involvement in PI initiatives may have “several formulations” depending on where the leaders are “located in the system of care and on what the nature and extent of [their] responsibilities are.” The DON and the DOF worked collaboratively, supportively and from different organizational perspectives to sponsor, and impart guidance to this project.

Leadership should set the conditions for coordination and cooperation to occur among the clinical disciplines. As Stein and Pinchot (1995) indicate, “Coordination from
above has decreased while coordination among peers has increased.\textsuperscript{249,250} This comports with Senge’s (1994) vision of a learning organization as a group of people who continuously work to advance their capabilities.\textsuperscript{251} In such organizations, learning and the attainment of goals are enhanced by coordination and interaction among high-functioning professionals working towards the same mission. According to Bass’s (1985, 2006) transformational leadership theory, “The leader emphasizes the importance of having a collective sense of mission.”\textsuperscript{244,252} This was a key function for our study leadership: To ensure all involved and all affected shared a common sense of purpose and collective aspiration to achieve the aims of our program. Kuokkanen and Kilpi (2000) and Vogt and Murrell (1990) indicate that organizations that encourage nurses to work towards organizational goals create empowerment among those nurses.\textsuperscript{253,254} Kuokkanen and Kilpi (2000) and others have shown that such empowerment correlates with nurse perceptions of increased autonomy, job satisfaction, and commitment to the organizational mission.\textsuperscript{253,255,256} This was achieved to some extend as part of this project, however, pending the implementation of the nursing incentive program and team leader chart audits, we do not claim an association between this study and those factors of empowerment and job satisfaction (as discussed above). When the full complement of programmatic activities is finally realized, then a valid association may be examined.

As Deming stated: “Everyone doing his best is not the answer. It is first necessary that people know what to do.”\textsuperscript{240} One of our leadership responsibilities was to ensure that nursing staff fully knew “what to do”. This went beyond simply telling nurses they “needed” or “must” document. We sought to ensure staff understood how their responsibility was linked to the organizational mission, i.e., how their level and quality of documenting was linked to the quality of care for the patient, how the billing process was driven by their documentation, and what the links were between that revenue and their day-to-day priorities at the bedside. Such an approach comports with aspects of the theory of transformational leadership whereby leaders challenge the group to take greater ownership for their work, “[align] followers with tasks that optimize their performance” and make joint and collaborative decisions.\textsuperscript{244,252} Thus, the “social commitment to one another is greater and… increases their commitment to the
decision. This approach also overlaps participative leadership theories which suggest that the ideal leadership style is one that takes the input of others into account. For example, Coch and French (1953) found better participation by employees in planning change led to less disagreement with managers, better acceptance of the change, and improved production after implementation. Morse and Reimer (1956) showed that broader participation in decision making yielded “higher morale and job satisfaction.” We found that adding these topics to quarterly nursing education, adding them to orientation education for new nurses, measuring performance in a transparent and inclusive manner, and rewarding high performers (coming soon) achieved these aims. One such example is this unsolicited email from a Main ED nurse (not associated with our study) in which she points out a nursing activity that is not documentable in Allscripts so that nursing can receive “credit” (effort capture in study parlance) for the work:

On Jun 7, 2013 4:45 AM, "M Whalen" <mwhalen8@jhu.edu> wrote:

Thank you for the update regarding PIV attempts! I think that it would be beneficial to have a place to chart that an RN or tech looked for a place to place an IV but were unable to locate a vein they thought they were able to access (but did not actually stick). I know that I and other staff have spent a lot of time looking for a vein to access but have decided it is best to seek help, but want credit for this work. Please let me know what you think about adding this component!

Best,

M Whalen
POLICY IMPLICATIONS

THE FINE LINE BETWEEN PATIENT NEEDS, STAFF WORKLOAD AND REGULATORY COMPLIANCE

While it is fairly obvious that a hospital’s profit orientation is somewhat at odds with the patient’s desire for fairly priced healthcare, this study highlighted a much more nuanced aspect of this relationship. This effort demonstrated that fairness to the patient, maximizing nursing output, managing staff workload, billing practices, regulatory compliance, and information system structure are in many instances directly in conflict with one another. First, hospital and ED leaders must have a strong ethical framework from which to work and to guide their management of these factors. Second, organizational teams that deal with these factors (for example, our own Facility Billing Committee) must have in place robust systems of checks and balances to assure balanced outcomes that can withstand external scrutiny from an ethical and regulatory perspective. In all this, the patient holds the least power – particularly in the emergency medicine setting. The ED patient, for example, has no mechanism to audit the minutes of care provided to them since the nursing interventions provided are not enumerated on the patient bill; rather, they are shown as a collective “triage charge” and “visit charge.” The patient is left to trust Newbold (2008), who states “Nursing is a bundle of services, all of value to the end user.”  

IMPLICATIONS FOR ED STAFFING MODELS

Numerous nursing staffing models have been described in the literature. While most of these models attempt to strike a balance between maximizing nursing output (almost exclusively through better process efficiency) and minimizing costs, since most of these (in the last 20 years) models were developed in response to fiscal challenges, the focus tends to be skewed towards economic efficiency i.e., cost reduction. The purpose of this initiative was not to explore new staffing models for nursing, but how to maximize the output of the existing one. The efforts of this study, however, also serve
to inform development of new models. Viewing nurses from the perspective of production theory is beneficial when exploring their utility (to the patient and to the organization). Production theory examines the input-output relations of goods or services constituting the manufacturing or production process. Nurses are an input or factor in the production process that creates and delivers medical care in the ED (as well as any clinical setting). According to Newbold (2008), production theory may be helpful for leaders seeking to maximize outcome from their nursing workforce (as was the goal of this study). He goes on to point out that little such evidence “currently exists in mainstream nursing workforce research.”

The production process for nursing care in the ED requires multiple factors – not just nursing labor. Adding more of one input factor usually results in a less-than-proportionate increase in output (nursing care). Therefore when we add to the nursing labor pool in an ED, we very quickly arrive at a point of diminishing returns as constraints in other inputs to the production process govern the output. This is despite the fact that (from a hospital perspective) the nursing staff is “by far the most productive labor input”. For example, adding additional nurses brings about little value without additional beds in which to provide clinical care. In simple terms, the marginal product of nursing declines as the number of nurses in the ED increases. Staffing mix (i.e., ratio of registered professional nurses (RNs) to allied health professionals like LPNs or Clinical Techs), as a variable in production, also demonstrates a point of diminishing returns. Since the focus of our study was only one input in the production equation of a functioning ED, then the most appropriate approach is to examine this from a short term production theory approach. Here, all input variables are held constant, while one input variable – or factor – is modulated. Our study after all, was designed to take the nursing workforce variable and to modulate it upwards. Said differently, this project’s framework was designed to maximize output from the nursing workforce without increasing its size.

The operational implication therefore is that before evaluating a change in either nursing workforce size, or contemplating a change in nursing workforce mix, an emergency department (or hospital) should evaluate maximizing output from existing resources. This study provides one possible template for achieving this. Certainly there
is opportunity to “mix and match” from among the programmatic activities presented in our study to build a programmatic intervention that is tailored to an individual ED’s operational and regulatory setting and its internal idiosyncrasies. This is a preferred approach in a restrictive fiscal or labor constrained environment. Costs are manageable, ROI is documented, and the potential for peripheral workforce enhancements is present. Such an approach is in the best interest of ED leadership, since accomplishing such optimization is often a relatively simple matter.

Staffing mix levels are debated in the clinical literature. According to Zimmermann (2000) “One ED manager found that the most productivity occurred in her emergency department, even at peak times, when the registered nurse staffing level was at least 71% to 72%.” Some states have legislated staffing ratios. Before any policy decisions are made about how many nurses are “ideal” in a given clinical setting, an exploration of nursing productivity should be undertaken. While every class of labor has inherent inefficiencies, understanding them and how they relate to operational structure, can help ED leadership understand fully what policy decisions are appropriate and which are based on conjecture. For the purposes of this discussion, we maintain a short term production theory orientation, and define inefficiency as that time classified by nurses as clinical care, but which does not yield any output (RVUs in our context). This discussion is not intended to look at the proportion of nurses' time conducting non-clinical activities versus clinical ones. We are looking at what constitutes the clinical time.

Some inefficiency in the nursing workforce is inherent and should be accepted. Regulatory requirements prevent billing for certain activities that nurses perform (sometimes due to organizational inefficiency). Färe, et al. (1985) called this “regulatory effects.” Occasionally, our ethical framework also prevents us from billing for certain aspects of care that take longer among certain segments of the patient population, even when we are able do so by law. We are most concerned with the inefficiency tied to the structure of our nursing and physician documentation system, the degree to which staff are consistent in documentig (which relates to their level of understanding of the relationship of documentation to billing and to their own interests), and the efficacy of
our billing system in converting nursing output to billable charges. Färe, et al. (1985) refer to this concept as “productive inefficiency.”

Figure 28 shows the distribution of clinical time among ED nurses in our hospital. This chart represents only what the Work Force Management division of Central Nursing classified as “productive clinical hours” (i.e., “non-clinical time” is presumably excluded). Our analysis showed that, because of our status as a Magnet hospital, 10% of clinical time is devoted to a required “lunch break”. Thus, on average, 48 minutes of each 8-hour shift are lost to productive inefficiency. An additional 34 minutes (7%) per nurse, per 8-hour shift are lost due to administrative tasks associated with roles such as shift coordinators, charge nurses, nursing supervisor, etc. (the 34 minutes are lost for all nurses, not just those in supervisory roles). Thus, the starting point for production efficiency is six hours and 38 minutes of each 8-hour shift. Our program focused on maximizing production during that 83% of productive clinical hours. Before entering into a policy or operational discussion about staffing mix or nursing ratio in the ED, effective leaders must be informed and knowledgeable about the productive capability of their own workforce in order to competently engage in such issues.

**Factor substitution in the current ED production model.** A production economics perspective can inform organizational policy regarding optimal deployment of nursing resources, and their activities, particularly labor substitution. In the current ED care model, where we expend labor resources on substitutable care (i.e. we use a nurse to do what a clinical tech could, with no improvement in quality); we are closer to the labor saturation point within the production process. This pushes the production process to substitute materials-intensive care for labor-intensive care. In other words, when task saturated, nurses may substitute input factors (in the production of nursing care) by selecting materials-intensive care methods in lieu of labor-intensive, and more personal care. For example, a psychiatric or violent ED patient may receive care through staff...
attention and interaction (labor-intensive) or via use of physical restraints or psychoactive drugs (materials-intensive).\textsuperscript{274} Material-intensive care in the ED setting may rely on increased use of catheterization (substitute for toileting or bladder care), medications (substitute for pain management), and restraints. Materials-intensive provision of emergency care is of interest to ED leadership because such methods – in other settings – have been shown to be associated with greater risks of morbidity and mortality.\textsuperscript{163,275} Detailed examinations of the composition of clinical effort among nurses, helps to identify what dynamics influence nurses to move away from labor-intensive care. Of greater importance, efforts such as ours, can suggest what changes are needed to reverse such trends. As Berwick (1989) concludes, “to understand the complex production processes used in health care”; we must recognize the relationships among the organizational variables and their influence on workforce dynamics.\textsuperscript{238}
SECTION VI

~~ APPENDICES ~~

OUTLINE

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   B. Annex B: Hybrid Audit Scope Document
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      2) Determining Sample Size for Time Studies
      3) Stratification, Randomization, and Scaling
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         ii. Randomization
         iii. Scaling
         iv. Outcomes
   B. Annex B: Observer Selection and Training
      1) Observer Selection Criteria
      2) Observer Training
3. Appendix C: Observational Audits
4. Appendix D: Facility Billing Definitions – Methodology, Implementation and Outcomes
   A. Methodology and Implementation
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5. Appendix E: Elements of the Programmatic Intervention
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7. Appendix G: Analysis of Revenue Implications of 0.1 RVU/pt Increase

8. Appendix H: Economic Evaluation
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VI. APPENDICES

Following are the Appendices and associated annexes cited in the text above:
APPENDIX A: Hybrid Audit

ANNEX A: Nursing Documentation Audit Tool and Results

Shown below is the complete nursing documentation audit’s most recent few months. This report is prepared manually and therefore runs behind, sometimes by several months.

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APPENDIX A: Hybrid Audit

ANNEX B: Hybrid Audit Scope Document

The Johns Hopkins Hospital
Department of Emergency Medicine

Scope Document
Facility Billing/Nursing Documentation Audit Database
“Hybrid Audit”
Version History

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<td>3/2012</td>
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SCOPE STATEMENT

SCOPE STATEMENT PURPOSE

The purpose of this document is to define the project scope for a web based nursing chart audit and facility billing/audit tool. Streamlining workflow and creating a paperless process; will enhance data capture, record storage, data entry, data reporting and provide quick access to old records.

The solution will be developed and tested in the JHH environment and finalized once approved by the stakeholders.

PROJECT STAKEHOLDERS

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Phone Number</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gai Cole</td>
<td>Asst Admin of Operations</td>
<td>410.614.5231</td>
<td><a href="mailto:gcole4@jhmi.edu">gcole4@jhmi.edu</a></td>
</tr>
<tr>
<td>Kathy DeRuggiero</td>
<td>Director of Nursing</td>
<td>410.502.4480</td>
<td><a href="mailto:kderuggi@jhmi.edu">kderuggi@jhmi.edu</a></td>
</tr>
<tr>
<td>Heather Gardner</td>
<td>Adult System Manager</td>
<td>410.955.2188</td>
<td><a href="mailto:hmacpher@jhmi.edu">hmacpher@jhmi.edu</a></td>
</tr>
<tr>
<td>Cathleen Lindauer</td>
<td>Clinical Nurse Specialist</td>
<td>410-955-4622</td>
<td><a href="mailto:ccarlen1@jhmi.edu">ccarlen1@jhmi.edu</a></td>
</tr>
<tr>
<td>Tammi Miller</td>
<td>Senior Project Administrator</td>
<td>410.599.7298</td>
<td><a href="mailto:tmille11@jhmi.edu">tmille11@jhmi.edu</a></td>
</tr>
<tr>
<td>Lynette Graham-Reed</td>
<td>Billing Coordinator</td>
<td>410.955.2280</td>
<td><a href="mailto:lgraham3@jhmi.edu">lgraham3@jhmi.edu</a></td>
</tr>
<tr>
<td>Gregory Fuller</td>
<td>Programmer Analyst</td>
<td>410.955.2280</td>
<td><a href="mailto:gfuller2@jhmi.edu">gfuller2@jhmi.edu</a></td>
</tr>
<tr>
<td>Tiffany Bryant</td>
<td>Operations Manager</td>
<td>410.955.2280</td>
<td><a href="mailto:tbryant4@jhmi.edu">tbryant4@jhmi.edu</a></td>
</tr>
<tr>
<td>Mary Ellen Wilson</td>
<td>Informatics Coordinator</td>
<td>410.591.5255</td>
<td><a href="mailto:mewilson@jhmi.edu">mewilson@jhmi.edu</a></td>
</tr>
<tr>
<td>Michael Tamberino</td>
<td>Pediatric Emergency Medicine Manager</td>
<td>410.502.9886</td>
<td><a href="mailto:mtamber1@jhmi.edu">mtamber1@jhmi.edu</a></td>
</tr>
</tbody>
</table>
BACKGROUND

Johns Hopkins Hospital recognizes the importance of monitoring compliance through auditing. The Clinical and Non-clinical groups have recognized opportunities in automating processes to reduce time required to manually input data and improve reporting. A committee has been formulated to examine these opportunities. Below is a review of the current workflow.

The following action steps are taken to complete the manual processes:

Billing Workflow
1. Print Daily Census report from Allscripts ED (Cognos report posted to SharePoint daily).
2. Alphabetically collate billing sheets to match Daily Census report.
3. Evenly distribute daily census report between Billing Coordinators and corresponding facility billing sheets.
4. Confirm the billing levels and enter manually supplies as appropriate.
5. File daily and store census report and facility billing documentation by Biller.

Billing Audit
1. Obtain a census report for previous month, and randomly choose 30 charts to review the Facility Billing (these are HMED audits for automated billed charts).
2. Department Auditor manually bills each chart to compare their results with the Allscripts ED systematic results.
3. Department Auditor manually inputs data into MS Excel sheet and analyzes the results.
4. Department Auditor provides a monthly report of results to Adult ED Audit meeting.
Nursing Audit

1. Obtain a census report for previous month, and randomly choose 30 charts to review.
2. Distribute the 30 chosen medical record numbers with DOS, to the ED SOP (Standards of Practice) committee to review charts.
3. Each SOP member is responsible for 4 chart reviews, and to complete the audit tool (see attached) for each chart reviewed.
4. Return the each completed audit tool to Cathy Lindauer.
5. Cathy Lindauer manually inputs data into a MS Excel sheet and analyzes the results.
6. Cathy Lindauer provides a monthly report of results to Nursing Operations and to ED nursing staff.

PROJECT DEFINITION

Problem Statement:
The manual process of chart abstraction and subsequent data entry is extremely time consuming. It only allows a small number of charts to be audited each month. Also, the current process largely restricts the ability of nursing team leaders to conduct meaningful chart reviews due to the time requirements associated with the current process. Thus nursing team leaders rarely review their team’s documentation practice with any detail or regularity.

PROJECT GOALS & OBJECTIVES

The goals & objectives for this project

1. Automate and streamline as much of the data entry process as possible. Automation will allow for faster data entry and analysis of results/discrepancies.
2. Increased fulfillment of nursing chart audit quotas, identifying opportunities for re-education and/or system enhancements.
3. Improved access to audit tools and database of patients, thereby decreasing time to perform audits.
4. Develop mechanisms that allow the billing staff to support the efforts of the nursing auditors so that more charts can be reviewed and a more detailed review of each chart is accomplished (with biller support). This may be accomplished by nursing and billers working together, possibly simultaneously, on a single chart audit or through other means.

**In Scope**

1. Initial focus is to automate the functions of the facility billing/billing audit, nursing audit and aid in the reporting processes.

**Out of Scope**

None identified at this time.

**PROJECT REQUIREMENTS**

<table>
<thead>
<tr>
<th>#</th>
<th>Requirement</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nursing</td>
<td>Facility Billing/Facility Audit</td>
</tr>
<tr>
<td>1</td>
<td>The website will pull in the daily census.</td>
<td>The website will pull in the daily census.</td>
</tr>
<tr>
<td></td>
<td>• Daily Census Count</td>
<td>• Daily Census Count</td>
</tr>
<tr>
<td></td>
<td>• Name (Last, First)</td>
<td>• Name (Last, First)</td>
</tr>
<tr>
<td></td>
<td>• Date/Time of Service</td>
<td>• Date/Time of Service</td>
</tr>
<tr>
<td></td>
<td>• MRN</td>
<td>• MRN</td>
</tr>
<tr>
<td></td>
<td>• PATCOM</td>
<td>• PATCOM</td>
</tr>
<tr>
<td></td>
<td>• Chief Complaint</td>
<td>• Chief Complaint</td>
</tr>
<tr>
<td></td>
<td>• Primary Diagnosis</td>
<td>• Primary Diagnosis</td>
</tr>
<tr>
<td></td>
<td>• Disposition</td>
<td>• Disposition</td>
</tr>
<tr>
<td></td>
<td>• Nurse Name</td>
<td>• Nurse Name</td>
</tr>
<tr>
<td>2</td>
<td>• Electronic census allows the following:</td>
<td>• Electronic census allows the following:</td>
</tr>
<tr>
<td></td>
<td>• Ability to assign Nurse to chart.</td>
<td>• Ability to assign biller to chart.</td>
</tr>
<tr>
<td>Ability to filter by Nurse and work queue according to Nurse assigned.</td>
<td>Ability to filter by biller and work queue according to Biller assigned.</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Identify the status of the patient regarding facility billing, billing audit and nursing audit (check box options: Not done, In progress, complete).</td>
<td>Identify the status of the patient regarding facility billing, billing audit and nursing audit (check box options: Not done, In progress, complete).</td>
<td></td>
</tr>
<tr>
<td>Ability to check a box that says discrepancy (meaning discrepancy between billed and nursing documentation).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Automate nursing audit sheet available for each patient (providing logic as appropriate):
- Patient identifier (Name [Last name, first name], MRN, Date of Service, and Patcom), Chief Complaint, Primary Diagnosis and nurses name
- Auditor to input data into audit tool
- Audit tool will calculate total % of compliance for each audit element
- System to color code final % for each month (green, yellow, and red based on compliance- # from Cathy Lindauer)
- System generated graphs based on final monthly % of compliance for each element

Automate facility billing sheet available for each patient (providing logic as appropriate):
- Patient identifier (Name [Last name, first name], MRN, Date of Service, and Patcom)
- Add field for each billing element and nursing minutes associated (see attached).
- Ability to input occurrences of each billing element.
- System calculates total minutes per billing element (nursing minutes x occurrences).
- Calculate total minutes.
- Time/date fields to enter Obs Start time and End time and calculate total (calculate hours and round down to nearest hour).
• System filter by individual nurses compliance with individual elements

• Add field to enter Admission date/time.
• Logic to auto-populate billing level based off of total nursing time (if admission field is completed, choose admit billing level associated).
• Biller will review for accuracy and choose level in Allscripts

| Viewing mechanism, add logic of automated checkmark when: |
| Billed by Biller |
| Audited by Biller |
| Audited by Nursing |

Viewing mechanism, add logic of automated checkmark when:
• Billed by Biller
• Audited by Biller
• Audited by Nursing

5. Eye patients and Trauma patients identified (color, bold?) by chief complaint

Observation patients color coded in red (from field in billing sheet where Obs Start time and End time are inputted).

SCHEDULED MILESTONES

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestone</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scope Approved</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Requirements finalized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quote submitted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development completed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>JHH Testing complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Go Live</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Dates are tentative and subject to change.*
ASSUMPTIONS & DEPENDENCIES

1. The user is following the procedure as defined in this document.
2. Multiple users can access system at one.
3. A biller and a nurse can access the system and view the same chart audit simultaneously.

CHANGE MANAGEMENT

1. Education of appropriate staff in utilization of the product prior to implementation

PROJECT SCOPE APPROVAL

_____________________________________________  ____________________
Date

_____________________________________________  ____________________
Date
<table>
<thead>
<tr>
<th>Definition of Documentation Element</th>
<th>Documentation Element</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
<th>If answer is No, please comment on who should have completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full set of VS includes:</td>
<td>1. Initial Full set of Vital Signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature, Pulse, Respiration, BP, O2 saturation, and Pain Score</td>
<td>2. Repeat Vital Signs minimum of 4 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All elements must be present to get a YES.</td>
<td>3. Vital Signs within 1 hr of D/C, Transfer from the ED (Exception: Level 4 and 5 patients)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilize N/A when the patient does not stop at primary triage (Critical care patients).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Nurse Scolarship (FNG):</td>
<td>1. Verbal Order Signoffs is ordered within FNG Order Sheet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Every Patient is to have the Verbal Order for Initiating Triage and for any FNG Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Pain Assessment Located in ROS or in the CC Focused Assessment</td>
<td>1. Initial Pain Score Obtained with First Set of Vital Signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Assessment includes all of the following:</td>
<td>2. Initial Pain Assessment (ROS or CC Focused Assessment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Scale/Pain Score</td>
<td>3. Pain Score completed a minimum of 4 hours for all patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset of Symptoms, Duration of Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of Pain and Body Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reassessment of Pain for all Patients Q 4 hours Located in the PBC/PhD Tab includes the following:</td>
<td>4. Pain is reassessed within 1 hour of receiving pain medication and/or intervention to reduce pain (Ice/Elevation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location and Body Region of Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of the Pain Pattern to Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modifying Factors: Pain Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History Information Located in CC Focus Tab</td>
<td>1. Social History</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Medication List:</td>
<td>1. Name of Drug or Unknown is listed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To be considered a Yes it must include the following information or unknown is listed</td>
<td>2. Dose of Drug or Unknown is listed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Name of Drug</td>
<td>3. Route of Drug or Unknown is listed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Dose of Drug</td>
<td>4. Not on Medication or Does Not Remember Names Located in CC Focus Tab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Route of Drug</td>
<td>4. Not Currently on Medication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Not on Medication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation Element</td>
<td>YES</td>
<td>NO</td>
<td>N/A</td>
<td>If answer is NO, please comment on who should have completed</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------</td>
<td>-----</td>
<td>----</td>
<td>-----</td>
<td>----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Located in Prior/Prog Tab</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POCT (RESULT, GLUCOMETER, PROVIDER)</strong></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IV insertion</strong></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IV insertion-time, catheter size, site, site preparation, and number of attempt</strong></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blood results include time of collection and initials of individual collecting specimen</strong></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Patients placed on a monitor should have a rhythm interpretation</strong></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CC Focused Assessment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients should have an initial focused assessment (specific to patient chief complaint) and focused reassessment minimum of 0-4 hrs</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete ROS: Level I, II, and Level III patients who will be admitted and reassessment for all patients as appropriate</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Located on CC Focused Tab/ROS Tab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Screening</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients: Fall assessment and domestic violence screening</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted patients: social work, pastoral care, discharge, and nutrition screening</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medication Administration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to medication is documented for pain medications, vasodative drugs and any drug you expect to see a response. Located on MAR</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discharge/Admission</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Located on Disposition Tab</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discharge instructions signed by patient</strong></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discharge instructions signed by staff member</strong></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Care items discontinued</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Revised 3/6/12 CL
APPENDIX B: Time Studies

ANNEX A: Time Study Design, Methodology and Implementation

TIME STUDY DESIGN AND METHODOLOGY

At the onset of this study, documented times for billable nursing procedures at The Johns Hopkins Hospital ED were based on the procedure times at another facility, Doctors Hospital (a community hospital in Maryland). Given the lack of data specific to clinical time required by our own ED nurses to conduct procedures, a full set of time studies was conducted on all billable nursing procedures. The purpose of the time studies was to establish new mean times for each billable procedure for purposes of facility billing charge calculation. The proposed time studies would thus serve as descriptive studies, which are intended to generate descriptive information, e.g. means or proportions, about a single group or population. The time studies would not serve as comparative studies, which could, for example, be undertaken to compare the new mean procedure times against times at another facility or in the prior ED space, or to compare procedure times amongst varying types of patients.

Observational time studies of common RN and clinical tech procedures were conducted in the Main and Pediatric Emergency Departments at Johns Hopkins Hospital. The same procedures were used to study interventions in both locations. Since both EDs utilize the same documentation system, separate time standards were not possible. Both EDs had to use the same mean time for each billable intervention. Time study results were therefore combined in a weighted average. The weights used were the frequency each nursing intervention was performed in either ED. For example, the length of clinical care time associated with ‘Nebulizer Treatment Set Up’ was 3.8 minutes in the Main ED and 4.3 minutes in the Pediatric ED. This intervention is conducted 3,030 and 2,802 times per year in those EDs respectively. To calculate the weighted average of clinical care time we used the format:

\[ CCT = \frac{(3.8 \times 3030)+(4.3 \times 2802)}{3030+2802} = 4.0, \text{ and arrived at a weighted mean for each nursing intervention we examined. This weighted mean is what we then used to update the clinical care time in Allscripts.} \]
Time studies were based on newly created definitions for each nursing intervention as discussed elsewhere in this paper. The definitions listed each step and element of the intervention, but not every element was assessed as billable by the institution’s Compliance Department. For example, some interventions listed hand washing/cleaning as a subordinate element, but this was deemed outside the scope of billable time. Furthermore, interruptions, which are commonplace in the ED clinical setting, were not appropriate to include within intervention time. Therefore, time studies had to allow for regular ‘starting’ and ‘stopping’ of the timing process. To accommodate for this we utilized an Apple iPad application (“app”) called TimeStudy (version 1.3 by nuVizz). Off the shelf, the application was robust and effective but not as intuitive as we had hoped for observers working in a dynamic clinical setting. In the hopes of reducing user error, we worked collaboratively with the developer to customize the app for our needs. In this manner, we had at our disposal a tool that allowed observers to effortlessly select the intervention they were going to observe (Figure 29, left) and easily pause the clinical care time at the push of a button whenever the nurse being observed was interrupted or performed an activity outside the scope of clinical care time (Figure 29, right). Time was started and stopped by touching the appropriate blue or green button on the iPad’s screen. The application permitted observers to time

Figure 29: nuVizz TimeStudy Application on Apple iPad
clinical care separately from documentation time and facilitated categorizing the nature, length and frequency of interruptions for further examination in a future study. As noted in Figure 30, procedure, interruption and documentation times were all collected, but only procedure and documentation time contributed to billable clinical care time. Of note, this level of flexibility also contributed to a lengthier timeframe for data collection and analysis.

Figure 30: Time Study Conceptual Model
Sample sizes for descriptive studies can be estimated based on the level of confidence and precision desired in the calculated sample statistic. In order to estimate an appropriate sample size, one must determine the confidence interval (CI), which is “a range of values which we can be confident includes the true value”\(^{253}\). The equation for sample size calculation to estimate the statistical mean at a desired confidence interval is as follows:

\[
N = \frac{4\sigma^2(z_{(crit)})^2}{D^2}
\]

where \(N\) = the estimated sample size; \(\sigma\) = the estimated standard deviation for the population; \(z_{(crit)}\) = the z-score corresponding to the expected CI (e.g. 95%); and \(D\) = the width of the expected CI.\(^{252}\)

Since \(D\) is equal to the full width of the confidence interval, half of which will be lower than the sample mean and half of which will be higher than the sample mean, the formula can be simplified/rewritten as follows:

\[
N = \left(\frac{\sigma(z_{(crit)})}{E}\right)^2
\]

where \(D/2 = E\), and \(E\) represents the estimated margin of error.

During planning for our time studies, challenges arose in determining an appropriate sample size because the standard deviation of the population was unknown. Initially we planned to overcome this by conducting sample size calculations in tandem with the collection of time study data. Using the initial times collected for each intervention, we planned to determine an estimated standard deviation of sampled intervention times. A sample size calculator was developed to facilitate rapid calculation of the estimated sample size needed to generate results at specified confidence levels and margins of error.

In those calculations, \(\sigma\) (the standard deviation of the population) was replaced with ‘s’, the estimated standard deviation of the sample, which would have been derived from initial time study data. Additionally, the z-score for the desired level of confidence
was replaced by the t-score, as recommended when the standard deviation of the population is unknown.

Our calculations to determine sample size would therefore become:

\[ n = \left( \frac{s(t_{crit})}{E} \right)^2 \]

In determining the appropriate sample time for each procedure, we expected that the variance in times to completion for different procedures would vary significantly. Therefore, the allowable margin of error would differ among procedures.

We initiated the time study collection process by piloting our methodology using actual observers with real patients in both EDs. We quickly discovered a few factors that caused us to question the feasibility of the above methodology. First, nurses collected data at a much slower pace than anticipated. This meant that we would have less overall time to accomplish the main study. Second, as data was submitted and sample sizes were estimated this information was provided to the nurses. Because they collected a variety of interventions during each observation session, the 'n' for each intervention was low at the end of each collection period. This meant that the sample size was constantly being updated as we would get one or two observations (per intervention) after each collection period. The frequency with which the sample size was updated caused confusion, and worse, frustration, among the observers. Additionally, because margin of error varied among procedures based on assumptions we made about variability, the data calculation process was cumbersome. For these reasons we abandoned the margin of error approach and sought a simpler, less variable approach. This would reduce the precision of our investigation, but would allow us to optimize usage of time-restricted resources.

To maximize utilization of limited, and expensive, time study resources (i.e. nurses conducting the observations), we applied a stopping rule to our data collection process instead of using the variable margin of error approach. This kept us from expending effort collecting sample observations of procedures with minimal variance, while allowing us to sample more robustly those procedures that were inherently variable. According to Ray (1957) the general problem of sequential estimation is to “postulate a sampling rule which will ensure that the unknown parameter is estimated
with given accuracy and with minimum expected sample size. The form of the given accuracy may be width of confidence interval, standard error or coefficient of variation of the estimate.” For this study, we decided to utilize a fixed coefficient of variation ($C_v$). $C_v$ is the standard deviation over the mean. As Hidiroglou (1986) indicated, for a fixed coefficient of variation, the overall sample size will “invariably be lower” which was precisely our goal. Use of coefficient of variation as a stopping rule has been described elsewhere. We decided a priori to use the stopping rule of $C_v \leq 50\%$ described by Köbrich (2003). Variables with a high $C_v$ were subjected to additional sampling until the $C_v$ approached 50%. Initially we decided 50% was a definitive goal, but resource limitations forced us to accept variables with higher $C_v$ such as 55.8% for medications given (n=28) since continuing to sample was not feasible. For practical reasons we were unable to exclude variables that failed to meet the threshold. In three instances, we observed excessively high $C_v$. These were Allergies ($C_v = 65\%$, n=16); Patient History ($C_v = 110.7\%$, n=13); and Home Medications ($C_v = 11.7\%$, n=16). Understanding operationally what factors influence this level of variation helps explain why we accepted such high $C_v$. In all three interventions, information is collected from the patient. In instances of new patients, it may take as long as several minutes (e.g., 7 minutes for Home Medications) to collect new information and document it in Allscripts. For returning patients, these interventions may take mere seconds (e.g., 11 seconds for Home Medications) because of our ability to pull electronic information from previous visits. Since 66% of our patients in FY13 were seen more than once in the ED, a high volume of pulling information forward electronically, induces variability in certain interventions.
STRATIFICATION

The purpose of the study is to determine a single average time for each procedure, regardless of where it is performed in the ED, by whom, and on what type of patient. While the time to complete the same procedure times may vary between adult and pediatric EDs, for example, which are physically separate structures and maintain separate electronic health information systems, the mean must be representative of the procedure across these locations. Given the separation of the adult and pediatric EDs, along with the nature of the patient population (whereby patients arrive unannounced at any time of day or night), simple random sampling by presenting patient is not a feasible methodology. Therefore, a stratified sampling method was employed to improve the overall representativeness of the sample to the “population” of procedures performed by RNs and clinical technicians between the Main and Pediatric EDs (henceforth referred to simply as the EDs).

RANDOMIZATION

Attempts were made to randomize samples among the adult and pediatric strata, as feasible within the daily operations of the facilities. Stratified randomization was used “to achieve approximate balance of important characteristics without sacrificing the advantages of randomization”.

Additional elements we considered when randomizing, or ensuring a representative sample when randomization was not possible, included:

1) The physical location that the procedure is performed within the ED (e.g., triage, trauma, patient room)
2) The type of patient receiving treatment in the ED (trauma patients, acute vs. low-acuity patients, etc.)
3) The time periods in which procedures are observed (shift, busy vs. routine occupancy hours)
4) The clinician conducting the intervention (nurses and clinical technicians)
Below are the randomization graphs associated with a few example nursing interventions that were time studies. These graphs demonstrate the randomized characteristics within each ED (Main and Peds) by intervention. First is the summary data for the Admission Process nursing intervention. The admission process is only conducted by nurses (and not by clinical techs); therefore, the “Employee Type” graph only shows one type of staff. For IV insertion the data seems less random with a majority of the observations being of clinical techs. This is by virtue of the fact that this intervention, to minimize the likelihood of infection, is conducted largely by clinical techs. Finally, we observe no randomization in location for some pediatric interventions. This is due to the fact that such interventions are only conducted in the patient’s room.
Admission Process (Main ED)
n=12
Distribution of variables for Admission Process observations:

**Observer**
- MK: 3
- GS: 2
- NB: 7

**Shift**
- 7am - 3 pm: 5
- 3 pm - 11 pm: 6

**Employee Type**
- Nurse: 12

**Location**
- Main ED: 3
- Eacu: 8
- Psych: 1

**Dates of observation**
- 1/8/2013: 2
- 1/13/2013: 1
- 1/15/2013: 2
- 1/10/2013: 1
- 1/14/2013: 1
- 1/18/2013: 2
- 1/9/2013: 2
- 1/22/2013: 1
**Blood Glucose – POCT** (Main ED)
n=10

Distribution of variables for Blood Glucose - POCT observations:

- **Observer**
  - MK: 5
  - NB: 3
  - LB: 2

- **Shift**
  - 7am - 3 pm: 6
  - 3 pm - 11 pm: 2
  - 11 pm - 7 am: 2

- **Employee Type**
  - Nurse: 7
  - Clin Tech: 3

- **Location**
  - Main ED: 5
  - EACU: 1
  - RAP: 1
  - Trauma: 1
  - Triage: 1

- **Day**
  - Monday: 5
  - Tuesday: 3
  - Wednesday: 1
  - Thursday: 1
  - Friday: 1
**IV Insertion – Successful (Main ED)**

n=14

Distribution of variables for IV Insertion – Successful observations:

- **Observer**
  - MK: 7
  - NB: 3
  - GS: 4

- **Shift**
  - 7am - 3 pm: 8
  - 3 pm - 11 pm: 3
  - 11 pm - 7 am: 3

- **Employee Type**
  - Nurse: 10
  - Clin Tech: 4

- **Location**
  - Main ED: 6
  - EACU: 5
  - Psych: 1
  - Triage: 1
  - RAP: 1

- **Day**
  - Monday: 2
  - Tuesday: 3
  - Wednesday: 2
  - Thursday: 4
  - Friday: 3
**Medication Given** (Pediatric ED)  
\( n=15 \)

Distribution of variables for Medication Given (PEDS) observations:

- **Observer**
  - LM: 8
  - MK: 7

- **Shift**
  - 7am - 3 pm: 8
  - 3 pm - 11 pm: 7

- **Employee Type**
  - Nurse: 15
  - Clin Tech: 0

- **Location**
  - Pt Room: 15
  - Triage: 0

- **Day**
  - Monday: 7
  - Tuesday: 2
  - Wednesday: 4
  - Thursday: 1
  - Friday: 1

- **Patient Age Group**
  - Infant: 3
  - Toddler: 2
  - Preschool: 1
  - School-age: 2
  - Adolescent: 7
**Vital Signs** (Pediatric ED)
n=17
Distribution of variables for Vital Signs (PEDS) observations:
IV Tubing Set Up (Pediatric ED)
n=10
Distribution of variables IV Tubing Set Up (PEDS) observations:

- **Observer**
  - LM: 6
  - MK: 4

- **Shift**
  - 7am - 3 pm: 1
  - 3 pm - 11 pm: 1
  - 11 pm - 7 am: 8

- **Employee Type**
  - Nurse: 10
  - Clin Tech: 0

- **Location**
  - Pt Room: 10
  - Triage: 0

- **Day**
  - Thursday: 4
  - Friday: 0

- **Patient Age Group**
  - Infant: 4
  - Toddler: 1
  - Preschool: 1
  - School-age: 1
  - Adolescent: 3
SCALING

Initially, discussion suggested samples should be scaled to the proportion of procedures occurring in the two EDs such that the mean time reflects a weighted average time. This seemed intuitive given that some procedures are performed predominantly in one ED and only occasionally in the other. Upon further examination, however, we decided that this may lead to a smaller sample size than desired in the Pediatric ED. Given the range of ages in that ED, we were concerned about the likelihood of higher variance in a group of samples for procedures performed across multiple ages. Feedback from pediatric nursing staff suggested that for some procedures, the younger the patient, the longer the mean time to completion (for example IV insertion or medication administration require more time with toddlers than with adolescents, and more time with adolescents than with teens). To avoid error induced by too small a sample size, we decided that sampling would occur in the same manner, using the same criteria, for each of the two EDs.

OUTCOMES

Table 20 below contains the results of the time study for the items not in the “top 19” most productive interventions. Interventions starting with ‘Arrival Patient Info’ and below are individual components of patient triage. These were time studied at a point when we had planned to separate triage into its individual components (in terms of billing, these items are already documented individually). However, with ongoing practice and process changes in triage associated with operational redesign in the Main ED, our study team decided to delay implementation of any triage billing changes until a later time.
Table 20: Results and Summary Statistics from the Time Studies in the Main and Pediatric EDs at The Johns Hopkins Hospital (Other Interventions)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Mean Intervention Time</th>
<th>Mean Documentation Time</th>
<th>Mean Total Time</th>
<th>Std Deviation</th>
<th>Coefficient of Variation</th>
<th>Min</th>
<th>Max</th>
<th>Documentation as % of total time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blood Glucose - POCT</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Adult</td>
<td>3.8</td>
<td>0.7</td>
<td>4.5</td>
<td>1.6</td>
<td>36.1%</td>
<td>1.8</td>
<td>6.8</td>
<td>15.0%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>1.4</td>
<td>0.6</td>
<td>1.9</td>
<td>0.2</td>
<td>13.0%</td>
<td>1.7</td>
<td>2.2</td>
<td>27.8%</td>
</tr>
<tr>
<td><strong>Blood Kiosk</strong></td>
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</tr>
<tr>
<td>Simulation</td>
<td>1.7</td>
<td>0.7</td>
<td>2.4</td>
<td>0.2</td>
<td>9.8%</td>
<td>2.1</td>
<td>2.9</td>
<td>29.8%</td>
</tr>
<tr>
<td><strong>Central Line Dressing Change</strong></td>
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</tr>
<tr>
<td>Simulation</td>
<td>7.0</td>
<td>1.1</td>
<td>8.1</td>
<td>1.0</td>
<td>12.3%</td>
<td>7.3</td>
<td>9.8</td>
<td>14.0%</td>
</tr>
<tr>
<td><strong>C-Spine Immobilization</strong></td>
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<td></td>
</tr>
<tr>
<td>Simulation</td>
<td>2.8</td>
<td>1.6</td>
<td>4.4</td>
<td>1.4</td>
<td>30.9%</td>
<td>2.3</td>
<td>6.2</td>
<td>36.0%</td>
</tr>
<tr>
<td><strong>IV D/C</strong></td>
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<tr>
<td>Adult</td>
<td>1.9</td>
<td>0.6</td>
<td>2.5</td>
<td>0.8</td>
<td>34.3%</td>
<td>1.0</td>
<td>4.2</td>
<td>24.1%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>4.6</td>
<td>0.6</td>
<td>5.2</td>
<td>0.6</td>
<td>11.5%</td>
<td>4.5</td>
<td>5.9</td>
<td>12.3%</td>
</tr>
<tr>
<td><strong>IV Tubing Set Up</strong></td>
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<tr>
<td>Adult</td>
<td>2.3</td>
<td>0.5</td>
<td>2.8</td>
<td>1.4</td>
<td>49.1%</td>
<td>1.1</td>
<td>5.9</td>
<td>17.3%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>4.2</td>
<td>1.1</td>
<td>5.2</td>
<td>2.1</td>
<td>40.3%</td>
<td>0.9</td>
<td>9.1</td>
<td>20.7%</td>
</tr>
<tr>
<td><strong>Medication Prep (Mixing)</strong></td>
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</tr>
<tr>
<td>Adult</td>
<td>3.3</td>
<td>1.3</td>
<td>4.7</td>
<td>1.9</td>
<td>40.0%</td>
<td>1.1</td>
<td>7.1</td>
<td>28.4%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>4.9</td>
<td>0.3</td>
<td>5.2</td>
<td>2.0</td>
<td>37.9%</td>
<td>2.1</td>
<td>7.5</td>
<td>5.2%</td>
</tr>
<tr>
<td><strong>Neb Treatment Set Up</strong></td>
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<td>Adult</td>
<td>3.1</td>
<td>0.7</td>
<td>3.8</td>
<td>1.7</td>
<td>44.5%</td>
<td>1.3</td>
<td>6.7</td>
<td>18.5%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>3.3</td>
<td>1.0</td>
<td>4.3</td>
<td>1.9</td>
<td>44.1%</td>
<td>2.8</td>
<td>8.0</td>
<td>22.5%</td>
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<td><strong>Implantable Port Accessed</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Adult</td>
<td>13.8</td>
<td>1.1</td>
<td>14.9</td>
<td>3.4</td>
<td>22.7%</td>
<td>12.5</td>
<td>17.3</td>
<td>7.1%</td>
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<tr>
<td>Pediatric</td>
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<td>14.1</td>
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<td>12.1</td>
<td>16.1</td>
<td>8.7%</td>
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<tr>
<td>Simulation</td>
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<td>0.8</td>
<td>3.0</td>
<td>0.8</td>
<td>28.3%</td>
<td>2.1</td>
<td>4.3</td>
<td>26.3%</td>
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<td><strong>Pulse Ox (Applied)</strong></td>
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<td>0.7</td>
<td>1.4</td>
<td>0.8</td>
<td>52.5%</td>
<td>0.1</td>
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<td>45.3%</td>
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<td>2.1</td>
<td>0.9</td>
<td>44.2%</td>
<td>0.6</td>
<td>3.5</td>
<td>29.1%</td>
</tr>
<tr>
<td><strong>Suture/Staple Removal</strong></td>
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<td>Simulation</td>
<td>3.2</td>
<td>0.8</td>
<td>3.9</td>
<td>0.9</td>
<td>24.0%</td>
<td>2.8</td>
<td>5.4</td>
<td>19.1%</td>
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<td><strong>Urinary Catheter Removal</strong></td>
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<tr>
<td>Simulation</td>
<td>2.4</td>
<td>2.2</td>
<td>4.6</td>
<td>1.0</td>
<td>21.8%</td>
<td>3.0</td>
<td>5.8</td>
<td>47.3%</td>
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<td>0.5</td>
<td>0.8</td>
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<td>38.2%</td>
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<td>71.2%</td>
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<td>Adult</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td>0.1</td>
<td>25.6%</td>
<td>0.3</td>
<td>0.7</td>
<td>61.3%</td>
</tr>
<tr>
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<tr>
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<td>0.9</td>
<td>2.3</td>
<td>1.2</td>
<td>49.9%</td>
<td>1.0</td>
<td>4.5</td>
<td>36.8%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>1.1</td>
<td>0.4</td>
<td>1.5</td>
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<td>38.2%</td>
<td>0.6</td>
<td>2.9</td>
<td>28.7%</td>
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<td><strong>FNGs</strong></td>
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<tr>
<td>Adult</td>
<td>0.6</td>
<td>0.6</td>
<td>1.2</td>
<td>0.4</td>
<td>34.3%</td>
<td>0.3</td>
<td>1.7</td>
<td>51.0%</td>
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<tr>
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<td>0.5</td>
<td>0.2</td>
<td>33.5%</td>
<td>0.2</td>
<td>1.0</td>
<td>50.2%</td>
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<tr>
<td><strong>ILI</strong></td>
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<tr>
<td>Adult</td>
<td>0.3</td>
<td>0.2</td>
<td>0.5</td>
<td>0.1</td>
<td>30.0%</td>
<td>0.3</td>
<td>0.8</td>
<td>47.9%</td>
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<tr>
<td>Pediatric</td>
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<td>0.4</td>
<td>0.3</td>
<td>60.6%</td>
<td>0.2</td>
<td>1.3</td>
<td>49.8%</td>
</tr>
<tr>
<td><strong>SAT</strong></td>
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<tr>
<td>Adult</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
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<td>26.2%</td>
<td>0.2</td>
<td>0.4</td>
<td>60.6%</td>
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<td><strong>Visit Overview Screen</strong></td>
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<td>0.3</td>
<td>0.5</td>
<td>0.1</td>
<td>15.6%</td>
<td>0.2</td>
<td>0.4</td>
<td>50.1%</td>
</tr>
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<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.6</td>
<td>94.5%</td>
<td>0.2</td>
<td>2.4</td>
<td>43.7%</td>
</tr>
<tr>
<td><strong>Allergies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>65.0%</td>
<td>0.1</td>
<td>0.7</td>
<td>52.5%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.1</td>
<td>34.3%</td>
<td>0.1</td>
<td>0.5</td>
<td>51.4%</td>
</tr>
<tr>
<td><strong>Home Meds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>1.0</td>
<td>0.5</td>
<td>1.5</td>
<td>1.7</td>
<td>111.7%</td>
<td>0.2</td>
<td>7.0</td>
<td>33.1%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>0.1</td>
<td>0.6</td>
<td>0.7</td>
<td>1.0</td>
<td>148.2%</td>
<td>0.3</td>
<td>3.4</td>
<td>53.7%</td>
</tr>
</tbody>
</table>
Observer selection and training criteria were based on methods used by Morey et al, (2002) in selecting and training emergency department physicians and nurses acting as raters in an ED-based MedTeams study. Unlike that study, however, training followed written protocols for both students and instructors; and we retained instructor consistency (same instructors every training session). Additionally, in contrast to the Morey study, our study leadership was present in every training session to ensure protocols were adhered to, to take notes on what to improve at future sessions, to answer questions when necessary, and to demonstrate organizational commitment for this effort to the students. Such steps were taken to ensure consistency and mitigate poor reliability of treatment implementation in a critical component of the study. Training was also known to increase inter-rater reliability.

Observers collecting time data for procedures were JHH-employed registered nurses (RNs) with a minimum of 8 years of experience working in the ED (Mean 19 years, median 13 years, range 8-36). Four of five observers volunteered for this study. Participants being observed were RNs and clinical technicians with at least 12 months of work experience in our ED. Participation in the time studies by RNs and clinical techs was voluntary.

Prior to initiating the time studies, observers received training from one of the department’s Clinical Nurse Specialists, Cathy Lindauer, RN, MSN, CEN. Training was conducted in 90-minute training sessions all of which were taught by nurse Lindauer. Instruction covered the manner of the time studies, how to approach clinicians and
patients, exclusion criteria, a review of intervention definitions, the electronic application, and role playing scenarios.

The training curriculum, designed to be delivered in a single 90-minute training session, included multiple elements depicted below. Following is the program of instruction actually used during training (verbatim):

1) Background
   a. ED patients are billed for both provider services and nursing services (on top of things like supplies and labs). Unlike the inpatient side, where nurses are considered to be part of “Room & Board” costs, the ED is actually compensated for the time our nurses and clinical techs spend providing care to our patients. This is called Clinical Care Time. The more Clinical Care Time provided, the higher the billing level of that patient and the more the ED is reimbursed for our nursing care.
   b. Clinical Care Time is calculated based on the nursing interventions (also called procedures) that techs and nurses document in HMED. Each intervention adds to the total Clinical Care Time. Because reimbursement is based on time spent by techs and nurses providing care, it’s important to accurately measure the time associated with each intervention or procedure. If the intervention time in HMED is less than in reality, then we are not being fully compensated for our work. If the time in HMED is longer than it really takes to do something, then the patient will be overbilled.
   c. The way we know how much time HMED captures for each nursing intervention is to observe the interventions and measure how long they take on average. We do this through time studies.

2) Our purpose here today is to prepare each of you to conduct time studies which are being done in both the Main ED and the Peds ED. These time studies will:
   a. Accurately measure length of time for nursing interventions in the ED. Our old times were borrowed from Doctor’s Hospital a small community hospital in Maryland.
b. Accurately assess impact of larger NCB space on nursing interventions.

3) In the next 45 minutes or so we will introduce you to our time study methodology and the tools we are going to use.
   a. Each of you will spend time in the clinical area observing our nurses and techs conducting procedures on regular patients. You will record these times and we will average your data to come up with accurate average times for each intervention. Those times will then be updated in HMED, which will ensure we are accurately reflecting the workload of the nurses and techs.
   b. One shortcoming in the time HMED has today is that they do not include documentation time. We are allowed to bill for the time you spend documenting, so we want to make sure that documentation is also part of the intervention/procedure time.
   c. Next we will talk about the time study procedures, the paper and electronic tools you will use to collect intervention times, and some criteria for throwing away specific data. After that we are going to go through the definitions of each of the interventions you are going to time study and provide those definitions to you in writing. After that we are going to discuss how you, the “observers” in the time study, are going to interact with the nurses, techs and patients you will observe. Lastly, we will give each of you an opportunity to practice with the observation tools before starting the pilot. We will give you a chance to ask questions during each section of this education session.

4) Methodology and data collection tools
   a. General Methodology
      1. The time studies are going to start by observing the 26 most common procedures. That list is included in your book.
      2. Each of you is an “observer”. You will collect 5 observations for each intervention and the other observer will also collect 5. Since there are two of you, this will give us 10 observations for each of the 26 procedures.
3. We will take the 10 observations and average them to come up with the average time for that nursing intervention.

4. Interventions that are done in both the Peds ED and Main ED will use the observations from each ED to come up with a single average time that will be used in both EDs since we share the same HMED system and can only have one time for each intervention.

5. Time study data will be collected utilizing an iPad/iPhone-based electronic tool in conjunction with a paper “time study sheet”.

6. The electronic tool is a standalone application developed by a company called NuVizz that provides a simple interface for recording start and stop times and exporting time data in a spreadsheet format.

7. This app is also going to allow you account for interruptions in the middle of an intervention.

8. The paper time study sheet allows you to record demographic information related to each observation. Each sheet can be used for multiple different interventions and observation.

9. Each observation will be numbered by the observer on the paper time sheet. The demographic information for each numbered observation on your sheet, will later be matched to the electronic data from app by research staff.

10. At the end of data collections, the observer will email the electronic data to the research staff and turn in their time study sheet to the study coordinator – Ms. Hope Leach.

11. Before we move on to discuss the time study sheet and app, are there any questions so far?

b. Paper Time Study Sheet
1. The time study sheet, in front of you, is used to identify – for each observation – the observer, the shift, location in the ED, type of intervention, and type of employee (nurse versus tech).
2. As part of the pilot we are not telling you where to get the observations, but try and mix up the shifts and locations as much as you can.
3. Notes about the observation are added – in the notes section – whenever you need to or whenever you are discarding or throwing away an observation.
4. Observers also use the time study sheet to identify patients who are physically and/or verbally abusive to staff. It may be unpleasant for you to be present with a abusive patient but this is required. These conditions are defined as follows:
   a) **Physically/verbally abusive Patient**: A patient who is behaving in an abusive or disruptive manner that requires de-escalation or additional time or resources to manage.
   b) **Intoxicated Patient**: A patient whose intoxication causes behavior that requires additional time or resources to manage. This should not be utilized to report patients that are simply “drunk” but those whose intoxication slows or disrupts their clinical management.
5. Before we move on to discuss the time study app, are there any questions so far?

c. **Electronic Tool**
   1. Time study data will be collected utilizing an iPad/iPhone-based electronic app developed by a company called NuVizz that provides a simple interface for recording start and stop times and exporting time data in a spreadsheet format. The time study app is used in conjunction with the paper time study sheet which records the demographics of each observation.
2. The app allows us to capture the following information about each nursing intervention:
   
a) The time the procedure takes with the patient
b) The time it takes to document the procedure
c) The number of times a nurse or tech get interrupted and how long those interruptions take.
d) The total procedure and documentation time without the interruptions.

3. Hope Leach is going to teach us how to use the app. in conjunction with the time study sheet next. Before she starts I am going to discuss some interruptions we are going to look at.

4. As part of the time study we will time the length of common interruptions nurses and techs face every day. These interruptions are going to be divided into 4 categories:
   
a) **Family/patient interruption**: Defined as, when a patient or family member needs assistance or when their personal needs prevent or temporarily stop the nurse or tech from doing their intervention. Examples are bathroom break, patient must get undressed without nursing assistance, or a cell phone call the patient takes.

   b) **Staff interruption**: Defined as, when the nurse or tech performing the intervention must temporarily stop the intervention because of another staff member actively interrupts that nurse. Examples are another nurse or tech asking where a supply is or asking the nurse or tech to help them with another patient. If the interruption doesn’t stop the procedure then do not stop the time for that interruption.

   c) **Phone/pager interruption**: Defined as, when the nurse or tech performing the intervention must temporarily stop the intervention because they need to answer their ASCOM or personal phone or pager.
d) **Another procedure interruption**: An interruption of one intervention in order to prep, start or complete another – unrelated intervention.

e) **Other**: Defined as, when the nurse or tech performing the intervention must temporarily stop the intervention because of an interruption caused by something other than the interruptions above. For example a security issue outside the patient’s room which interrupts the nurse from doing her intervention.

5. *Hope conducts class.*

6. Thank you Hope.

7. A few more points on recording intervention or procedure times:
   a) Do not avoid or throw away observations with times that are much longer than you expect or longer than all your other observations. Outliers like this are important in showing us that some individuals under some circumstances take much longer to do an intervention than is expected. For example, if you have 4 observations for vital signs all between 4 and 5 minutes and your fifth observation is 10 minutes long, do not throw away that fifth observation since it tells us that sometimes things take much longer than the average and we need to account for this.

8. Before we move on to discuss data exclusion criteria are there any questions so far?

d. Criteria for excluding observations from the study. Next we are going to discuss situations that would cause us to not include a nurse or tech, a specific intervention, or to throw away (or “exclude”) an observation we already made or already started.
1. Excluding nurses or techs: The nurses and clinical techs eligible for being observed must meet the following criteria for inclusion in time studies:
   a) Must be an ED/Peds ED employee
   b) Are not a temp/agency worker
   c) Are not a student

2. Excluding Interventions: Interventions meeting the following criteria should be excluded from the time study. Do not conduct an observation under the following conditions:
   a) During a declared mini-disaster
   b) Involving patients requiring Communications Assistance
   c) Involving patients 18 year or older in the Pediatric ED
   d) Involving patients under airborne or special or droplet isolation precautions
   e) Involving any Joint Commission sentinel event

3. Excluding an observation:
   a) Data is excluded or “thrown out” at the discretion of the observer
   b) When excluding an observation include a note for the particular observation you want to throw out on the time study sheet indicating why that observation is no longer valid. This lets us know which data in the electronic app to discard.
   c) Some examples of reasons an observation could be excluded are:
      i. You hit the wrong button on time study app
      ii. You lost track of what the nurse or tech you are observing is doing
      iii. You are interrupted by another staff member or phone call
iv. You have to help the nurse/tech with the patient or the intervention

4. Before we move on to discuss procedure definitions, are there any questions about anything we covered so far?

5) Review of Definitions - Review of detailed definitions for each nursing intervention to be time studied, as developed by nursing leadership and approved by the Standards of Practice (SOP) Committee, and Pediatric Senior Nursing Committee. The definitions will include a detailed breakdown of all activities entailed within each procedure, and clearly define when the procedure starts and ends.

a. Since we don’t want to take the time to go through each of the 25 intervention definitions, we would like to highlight the following 6

1. Admission Prep.
2. Discharge/AMA
3. EKG bedside monitor and EKG cart
4. IV insertion
5. Medication mixing and administration
6. Nursing assessment / Reassessment

b. Procedure modifiers: Procedure modifiers are situations that affect the conduct of the nursing intervention. Here are a few and how to handle them:

1. **Hand hygiene**: Hand hygiene is not part of procedure time and should not be included in procedure time. If hand hygiene is done during an intervention and causes the intervention to stop temporarily, treat it as an interruption (“other interruption” category).
2. **Log in to computer**: Logging or tapping into a computer in order to document the procedure, look up that patient’s info, or look at a reference is considered part of clinical care time. Make sure you include it in the time of the procedure.
3. **Patient or Family push back:** If the patient or family resists the intervention but the nurse or tech convinces them to move forward and do the intervention, then that time is counted as part of the procedure. If the family resists, time is paused if the nurse or tech has to go and get the provider to explain the intervention or why it is needed.

4. **Family questions:** Family or patient questions about the intervention being conducted and the time the nurse or tech take to respond are considered part of the intervention being timed.

5. **Gathering supplies:** The time a nurse or tech takes to gather supplies needed for a procedure (whether the supplies are outside or inside the room) is considered part of the procedure time.

6. **Supplies not available:** If a nurse has to search for supplies that are not where they should be, or if a nurse has to get supplies normally in the room from a Pyxis in the hallway or another room, this time is not included in the intervention and is considered an interruption (“other” category).

**c. Before we move on are there any questions about the intervention definitions, the procedure modifiers or anything else we covered so far?**

6) **Description of the observers’ role and guidelines for interactions when conducting time studies**

   a. The role of the observer is to objectively observe and accurately document length of time of specified nursing interventions in the ED.

   b. **Guidelines for observer interactions:**

      1. **Interaction with nurses/techs:**

         a) Approach nurse or tech. Ask if you may follow them to do some time studies. Feel free to specify which interventions you are observing that day.
b) During the observation, position yourself so that you are not influencing the performance of the intervention in any way.

c) Limit/minimize communication with the nurse/tech being observed during the intervention.

d) If an observed intervention is interrupted, the nurse may communicate to you when she re-starts the intervention you are timing.

e) If you think that your presence is influencing the nurse’s behavior, at the completion of that intervention you may remind the nurse that the goal of your observations is to determine how long it takes for common nursing tasks to be completed under average conditions, not to determine how quickly they can be done.

2. Interaction with patients

a) Ask nurse or tech you are observing to introduce you to the patient (this time should be timed as an “interruption” to the intervention). A good way to have her introduce me is “This is (Heather Gardner), she is one of the nurses here. She is observing me today.”

b) If nurse or tech forgets to introduce you, introduce yourself to the patient. Try saying something like “I am (Heather Gardner), I’m one of the nurses here. I’m observing (name of patient’s nurse) today.”

c) Try to avoid any interaction other than the introduction with the patient and patient’s family.

d) If the patient expresses concern about your presence or role, discontinue the observation and discard the time data for that intervention by annotating the paper time study sheet as directed in the time study sheet protocol.

7) Question and answer session
8) Scenario Review — outline 2-3 scenarios (e.g. patient/family does not want intervention, tasks for intervention done out of sequence - get list from Heather)

a. Scenario 1 – Patient / family question: A nurse is in the process of inserting an IV and the patient’s mother asks “why are you sticking the IV into my son’s thumb and not the crook of his elbow?” The nurse pauses, looks at the mom, and explains that she couldn’t find a vein large enough in her son’s arm so she went to the thumb instead. This is the best vascular access on this arm she could find, the nurse explains. The nurse then returns to inserting the IV in the son’s thumb. Is this an interruption or part of procedure time?

b. A nurse is in the process of inserting an IV and the patient indicates they don’t want an IV because they don’t see the need for it. The nurse tries to convince the patient of the necessity for the IV but is unsuccessful. The nurse then tells the patient she will discuss the matter with the provider and steps out of the room to find him.

Part a: The provider is sitting at a workstation across the pts room and the nurse approaches him to discuss the matter. They have a conversation and the nurse asks the provider to step into the patient room. The provider sees the patient and explains the necessity for the IV. The patient agrees and the IV is then inserted. When do you start and stop the times for this procedure?

Part b: The provider is not visible outside the patient’s room so the nurse calls him and speaks with him on the phone. They have a conversation and the nurse asks the provider to step into the patient room when he is done with his current patient. The provider later sees the patient and explains the necessity for the IV. The patient agrees and the IV is then inserted when the nurse gets back to dealing with that patient. When do you start and stop the times for this procedure?
APPENDIX C: Observational Audits

METHODOLOGY

To obtain thorough results, we employed clinical and non-clinical staff to perform observational audits in the ED. Our methodology was inspired by Carayon, Wetterneck, et al. (2005) who described the use of observational methods to examine the interaction of nurses and technology for medication administration.\textsuperscript{114} In researching clinical nursing practice in the US and UK, Roe and Webb (2008) explained three parameters of structured observations: The behavior of interest should be recorded in a systematic manner; observations should be recorded accurately and reliably; and subjectivity should be avoided.\textsuperscript{285} To the extent possible, given limited resources, these guidelines were included in the development of our methodology.

Performing our observations were four billers from the billing division of the Department of Emergency Medicine, two nurses from the Pediatric ED, and two nurses from the Main ED. As daily users of Allscripts, all seven individuals are trained in, and experienced with our clinical documentation system; and intimately familiar with the nursing documentation structure. Variation in these observers’ backgrounds was intended to counterbalance any observations of activities that might normally be overlooked by staff more accustomed to ED nursing duties. Utilizing observational methodologies in research can present various biases related to human perception. We worked to reduce the chance of bias by obtaining samples from different individuals, both familiar and unfamiliar with Main ED nursing tasks. In employing staff members from the billing department and the Pediatric ED, we hoped to uncover behaviors or routines that Main ED nursing staff might be unaware of.\textsuperscript{274} Individuals may be more likely to not acknowledge certain tasks when they are used to and, more importantly, have pre-formed conceptions of the tasks. On the other hand, Main ED nurses were also viewed as beneficial and included in the observations as they bring an inside perspective and understanding of the daily duties of nursing in the Main ED.

With the goal of identifying un-captured nursing effort, “observation sheets” were created to allow observers to record their findings. The sheets included the following
information: Name of observer, date, shift start time, shift end time, area of observation within the ED, undocumented action performed, whether a nurse or tech performed the action, and additional notes. A sample sheet is shown in Figure 32 at the end of this appendix. Observers used the sheet to record any actions performed by nursing staff that were not documented at that time in Allscripts. To further avoid the introduction of bias into the observations, observers were instructed to record anything that was not documented by the nurse or tech whether it was known to be documentable/billable or not. Names of nurses being observed or patients involved were never recorded. The assigned observer shadowed multiple nurses across the ED’s 36,277 square feet of space.

Observations began on May 23, 2013 and ended on June 7, 2013. Thus, one limitation of the data is that no observations took place during winter. Thus no seasonal variation was captured. Between the eight staff members conducting the study, a total of 53 hours were spent observing nursing activity. Table 21 below shows the distribution of observation hours among the eight observers, while Table 22 shows the distribution of observation locations across the Main ED.

Table 21: Time Distribution of Observers

<table>
<thead>
<tr>
<th>Billing Total</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biller 1</td>
<td>7.5</td>
</tr>
<tr>
<td>Biller 2</td>
<td>5.92</td>
</tr>
<tr>
<td>Biller 3</td>
<td>2.5</td>
</tr>
<tr>
<td>Lead Biller</td>
<td>3</td>
</tr>
<tr>
<td>Nurse Total</td>
<td>34.08</td>
</tr>
<tr>
<td>Main ED RN 1</td>
<td>4</td>
</tr>
<tr>
<td>Main ED RN 2</td>
<td>18.25</td>
</tr>
<tr>
<td>Peds ED RN 1</td>
<td>7.83</td>
</tr>
<tr>
<td>Peds ED RN 2</td>
<td>4</td>
</tr>
<tr>
<td>Total Observation Time</td>
<td>53.00</td>
</tr>
</tbody>
</table>


Observers recorded a total of 266 observations. These were further divided into 399 individual nursing activities. Many of the recorded observations included multiple, differing nursing actions, which necessitated the simplification of the data to move forward with classification. Simplification involved translating observations into succinctly phrased activities that could then be more simply categorized. Each of the 399 activities was then assigned to one of the following ten categories:

1. Discussion with Clinician/Staff
2. Gather Equipment
3. Room Preparation
4. Patient Care
5. Documentation and/or Review
6. Patient / Family Education
7. Transportation
8. IT Related
9. Pharmacy Related
10. Miscellaneous

The categories were created based on recurring themes across all observed activities. Though some nursing activities could likely be considered appropriate in more than one category, each assignment was limited to the one most relevant category for simplicity and ease of evaluation.

The purpose of categorization was to gain a better understanding of the wide range of nursing duties within the ED and ease the process of evaluation. By separating the activities into categories, we hoped to identify specific, related duties that...
consume effort but have been previously overlooked. As nursing duties can vary between healthcare facilities, future studies using this method may choose to identify additional or alternative categories to better fit their facility’s operations and nursing practice standards. Further simplification or subdivision of larger categories, such as “Patient Care,” could make evaluating the nature of the data more precise. For example, making a “Comfort Measure”\textsuperscript{10} sub-category to parse more activities from the “Patient Care” category could ease subsequent review and provide further insight. For the purpose of this study, however, we did not feel it necessary to have more than 10 categories for our evaluation.

The categorized activities were then brought to a small committee comprised of three experienced ED nurses (experience range 20-36 years, mean 29). The Main ED’s Clinical Systems Development Manager, the Pediatric ED’s Nursing Informatics Coordinator, and one of the Main ED’s Clinical Nurse Specialists, reviewed all activities, category by category, assessed the activity’s appropriateness for documenting and/or billing, and placed each into one of three decision groups: 1) No, 2) Maybe, and 3) Yes. Figure 31 below illustrates the process of an observation as it flowed through the initial stages of review and categorization.

Figure 31: Review and Taxonomy Process (simple)

\textsuperscript{10} Many activities noted in our audit were associated with providing comfort measures (e.g. a drink, a blanket, a meal) to patients and their family members.
Activities were assigned to the “No” decision group if they were not selected to move forward for further review. An activity was placed into this group if it was:

1. Already documented and billable in the system
2. An administrative duty needed for normal management of the facility (thus not clinical care time)
3. A task that anybody could complete (not just a nurse or clinical tech) (thus not nursing clinical care time)
4. Not specifically related to patient care
5. Prompted by a failure in the Allscripts system (system was down)
6. Not billable due to regulatory compliance

After this evaluation, these activities were discarded from the review list to avoid duplication of effort via re-assessment of the same or similarly worded activity.

The “Yes” decision group was selected for activities that did not need further review. Such items were deemed appropriate for adding to clinical documentation, or for modifying existing clinical documentation where appropriate. Some of the activities were not previously documented. The expert panel agreed these consumed enough nursing clinical care effort that the added burden of documenting them was fully justified for accurate clinical effort capture. These items were found to be billable clinical care time in every instance. Some of the activities were documented but not billed. The expert panel agreed these merited billable CCT and set these on the path to be hooked to billing. Other items in this group were already documented, but determined to need a change of location within the Allscripts system. Moving the location of these items was anticipated to better capture clinical effort by simplifying or streamlining documentation.

Though the activities in this decision group did not need further review, their addition to Allscripts awaited the rebuilding of necessary elements within the system in order to accommodate the changes. Furthermore, changes were reviewed by the nursing Standards of Practice Committee and the Information Systems and Technology Oversight Committee. For items selected to be hooked to billing, appropriate time measurement was also needed for each activity, requiring either time studies or expert panel discussion. As with most items associated with this project, Compliance
Department review and approval was also solicited before changes were applied. After such requirements were complete, the items were either altered within Allscripts, or added de novo and hooked to billing. As of this writing, several items are still going through this process.

The “Maybe” decision group was chosen for activities that required further review and discussion. These items were not documented and/or not billed, but consumed enough nursing effort or occurred with sufficient frequency that they warranted further discussion with a larger committee. An activity was placed into this group if the expert panel was indecisive as to whether it should be added to the system and hooked to billing, altered within the system, or left unchanged. To limit the burden placed on nurses due to added documentation, the committee was extremely careful about recommending additions or alterations to the nursing documentation process without supplementary evaluation. These activities were subsequently moved to review and discussion at the Facility Billing Meeting (FBM) – a larger, multidisciplinary, action-oriented task-force.

Further evaluation at the FBM determined whether items previously in the “maybe” decision group justified change within, or addition to the system. Some of these activities that merited addition to Allscripts, were subsequently rejected (by the expert panel or by FBM based on the insufficient value they created as compared to the added burden of new documentation requirements on the nursing staff. Items later selected for addition followed the same requirements as the “Yes” decision group, and were either altered within the system or added and hooked to billing after a definition was written, a time was assigned, a Compliance Department review occurred, and system accommodations were made.
Figure 32: Sample Observation Sheet

<table>
<thead>
<tr>
<th>Area of ED (trauma, psych, EACU, hallway, etc)</th>
<th>Describe the clinical activity performed but not documented</th>
<th>Nurse or Tech (N or T)</th>
<th>Notes/comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triage</td>
<td>RN walked pt back to triage room</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Triage</td>
<td>Went into WR to assist pt to triage, retrieved wheelchair</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Triage</td>
<td>Wheeled pt to a room from triage</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Assisted pt from bed into home wheelchair, assembled chair legs</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Provided pt with blanket to cover during transport</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Took pt to waiting room after discharge</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>EACU</td>
<td>Weighed pt in room, brought scale into room</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Pt taken on stretcher up to floor with MD</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Nurse-tubed labs</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>Spoke with pt regarding comfort during U/S, helped preparation</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>
Definitions for each nursing intervention were developed by a small group of nurses from the Main and Pediatric EDs relying on Mosby's Dictionary of Medicine, Nursing & Health Professions, 9th Edition, Mosby's Pocket Guide to Nursing Skills and Procedures: 7th Edition, and relevant departmental and hospital policies. These new definitions were then provided to the Compliance Department for review and feedback. Edits were made based on their feedback, and the definitions were then taken for review by both the Main ED’s Nursing Standards of Practice Committee and the Pediatric ED’s Nursing Leadership Committee. At these committees, definitions were reviewed in detail and modified based on expert input. The updated definitions were then reviewed by the department’s billing staff prior to a final Compliance review and approval. At that point they were finalized and published as part of the department’s Billing Manual. This process is shown in Figure 33 (left). Part of the intent of reviewing definitions with senior nursing panels was to create focus among nurses that their practice was being reviewed. By involving nurses in the definition update/creation
process, we also expected to improved awareness of our efforts among the nursing staff – another programmatic short term goal.

OUTCOMES

Below is a sample of additional definitions as an illustration of the work completed during this programmatic activity. 73 definitions were updated or developed de novo. This list is over 25 pages long and therefore not included in its entirety.
<table>
<thead>
<tr>
<th>FACILITY BILLING DEFINITIONS FOR TIME STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitions are intended to describe all the elements of a nursing intervention. The definition is not intended to depict activities in a sequence. These elements are not sequential. Elements may occur simultaneously, sequentially or completely out of the order shown in the definitions.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>(1) * Assistive Device provided</td>
</tr>
<tr>
<td>(M) Bathroom Assist</td>
</tr>
<tr>
<td>Blood Culture</td>
</tr>
<tr>
<td>(1) Communication Assistance</td>
</tr>
<tr>
<td>(1) Capnography Monitoring Initial</td>
</tr>
<tr>
<td>Intervention</td>
</tr>
<tr>
<td>-------------</td>
</tr>
</tbody>
</table>
| IV Tubing Set Up | To report the time and effort that is required by ED nursing staff to setup/prepare the necessary supplies to administer intravenous fluids/medications to a patient (this does not include the time/effort for the administration of any medications, please refer to medications given). | 1. Review the order for IV Fluids  
2. Identify your patient  
3. Explain procedure to patient  
4. Gather supplies  
5. Open the IV tubing  
6. Connect IV tubing to the bag of IV Fluids or IV bag of medication and prime the tubing  
7. Label the tubing and IV bag per policy |
| Labs – blood specimen | Utilized to account for staff member resource consumption associated with the procedure for drawing blood from a patient, when performed by ED staff (this does not include the placing of the saline lock, see IV insertion definition). | 1. Review the orders  
2. Identify your patient  
3. Explain procedure to patient  
4. Gather supplies  
5. Log into workstation  
6. Open Care fusion application  
7. Log into Care Fusion  
8. Scan the patient's armband  
9. Access your labels  
10. Gather patients labels (they will auto print after accessioning)  
11. Obtain blood sample  
12. Transfer blood to appropriate blood tubes  
13. Label blood tubes  
14. Scan the labels on the blood tubes  
15. Clean up  
16. Bag and walk the samples to the pneumatic tube or to the lab if tube system is not operational  
17. Place the samples in the pneumatic tube and send to the lab  
18. Document the procedure in the patient's chart  
19. Log out of Care fusion, HMED and workstation – should documentation take place before sending labs |
| Labs – other specimen (Throat, Nasal, Urine, Vaginal) | Utilized to account for staff member resource consumption associated with the procedure for obtaining of sample specimens by the ED staff. These may include; sputum, stool, throat cultures, wound cultures, any swabbing, etc. If a patient is given a collection cup, and provides a urine sample on their own (the ED staff does not draw the urine from a catheter or physically assist in obtaining the specimen), then the ED staff should not account for this intervention per CMS guidelines. | 1. Review the orders  
2. Identify your patient  
3. Explain procedure to patient  
4. Gather supplies  
5. Log into Care Fusion  
6. Scan the patient's armband  
7. Access your labels  
8. Gather patients labels (they will auto print after accessioning)  
9. Obtain sample  
10. Label sample  
11. Scan the labels on the collected sample  
12. Clean up  
13. Bag and walk the samples to the pneumatic tube or to the lab if tube system is not operational  
14. Place the samples in the pneumatic tube and send to the lab  
15. Document the procedure in the patient's chart  
16. Log out of Care fusion, HMED and workstation – should documentation take place before sending labs |
| (M) Level 1 (rapid fluid infuser) | Utilized to account for staff member resource consumption associated with the procedure for obtaining of sample specimens by the ED staff. These may include; sputum, stool, throat cultures, wound cultures, any swabbing, etc. If a patient is given a collection cup, and provides a urine sample on their own (the ED staff does not draw the urine from a catheter or physically assist in obtaining the specimen), then the ED staff should not account for this intervention per CMS guidelines. | 1. Review the order(s)  
2. Identify your patient  
3. Explain procedure to patient/parent  
4. Gather supplies  
5. Follow procedure for inserting tubing into the rapid infuser  
6. Close all the tubing clamps above the heat exchanger  
7. Remove the air from the bag(s)  
8. Ensure that any pressure chambers above the main unit are unpressurized by sliding the lever to the right (to the "--" sign)  
9. Hang the spiked bag(s) in the pressure chamber(s) on an appropriate level tab  
10. Depending on the disposable set, open any clamps above the drip chamber  
11. Squeeze the drip chamber until it is one-half to three-quarters full  
12. Open any remaining clamps above the heat exchanger  
13. Prime the patient end of the tubing  
14. Tap the gas vent/filter assembly to dislodge any air bubbles from the unit  
15. Move control on pressure chamber to "+" to inflate pressure chamber  
16. Connect tubing to patient  
17. Document the procedure in the patient’s record |
| Gastrostomy/Nasogastic (NG/OG) Tube removal | To report time and effort that is required by ED nursing staff, to perform set-up, documentation of the procedure to remove a nasogastric tube | 1. Review the orders  
2. Identify your patient  
3. Explain procedure to patient/parent  
4. Gather supplies  
5. If applicable, turn off suction or continuous feeding  
6. Position the patient in the supine position. Elevate the head of the bed 30 to 45 degrees or higher, if tolerated  
7. Gently remove tape from under the lip, cheek or nose  
8. Occlude the tube by pinching it closed, bending it, and holding it with the thumb and index finger. Pull the tube out of the mouth or nose using a swift, consistent motion  
9. Clean patients face  
10. Document the procedure in the patient’s record |
APPENDIX E: Elements of the Programmatic Intervention

The diagram on the following page was developed to illustrate the primary activities in the Facility Billing Program intervention detailed in the Interventional Design and Methodology section above. The diagram, known as a mind map, is intended to demonstrate the linkages among the various activities, which often necessarily feed into one another. For example, benchmarking and observational audit activities are linked in that they both feed into the discovery of value-added clinical tasks which were previously undocumented and/or unbilled, and which then necessitated time studies (a distinct but related activity) and subsequent addition into Allscripts. The mind map was also useful as a planning tool in understanding decision pathways and dependencies among the various activities in the work plan.
### APPENDIX F: Implementation Plan

#### Facility Billing Program - Implementation Work Plan

<table>
<thead>
<tr>
<th>Category</th>
<th>FY13</th>
<th>FY14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monthly % Documented Reports</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Monthly % Documented Reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Review reports to monitor up/down trends in documentation behavior</td>
<td></td>
<td></td>
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<tr>
<td>1.2 Analyze results to identify problem areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Educate/retain nurses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Team leader (RGN) Chart Audits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Planning to implement team leader chart audit program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Quarterly chart audits conducted by team leaders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3 Review performance audits to identify high performers and underperformers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 Educate/retain nurses (underperformers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 Incentivize high performers through nursing incentive program</td>
<td></td>
<td></td>
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<tr>
<td>2.6 Analyze programmatic impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nursing Incentive Program</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Planning to implement nursing incentive program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Implement nursing incentive program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Ongoing implementation and refinement</td>
<td></td>
<td></td>
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<tr>
<td>3.4 Analyze results</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hybrid Audits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Planning to implement hybrid audits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2 Implement hybrid audits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3 Ongoing implementation and refinement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4 Educate/retain nurses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5 Program sustainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Observational Audits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1 Implement observational audits to identify undocumented tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2 Implement observational audits to identify underdocumented tasks</td>
<td></td>
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</tr>
<tr>
<td>5.3 Quantify items not worth documenting for charge capture/resource justification</td>
<td></td>
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<tr>
<td><strong>Benchmarking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 Review/reconcile items documented in HMED</td>
<td></td>
<td></td>
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<tr>
<td>6.1.1 Create list of documentable items not hooked to billing</td>
<td></td>
<td></td>
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<tr>
<td>6.1.2 Reconcile these items against billable procedures against EDs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.3 Reconcile billable items to billing after time studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.4 Analyze results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2 Review/reconcile items not documented in HMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.1 Reconcile HMED documentable items against provider orders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2 Reconcile HMED documentable items against knowledgeable clinicians</td>
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<td></td>
</tr>
<tr>
<td>6.2.3 Billable items not documented to HMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.4 Reconcile billable items to billing after time studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.5 Quantify items not worth documenting for charge capture/resource justification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3 Update billing definitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time Studies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1 Time studies of currently documentable interventions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1.1 Conduct time studies of currently documentable interventions in HMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1.2 Update billing sheet with accurate procedure times</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2 Time studies of interventions not currently documentable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2.1 Conduct time studies of billable interventions not currently documentable in HMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.3 Time studies of incremental documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.3.1 Conduct time studies of incremental documentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **FY13** and **FY14** indicate the timeframe for each plan item.
- **Jul-12** to **Dec-13** represent the months corresponding to each fiscal year.
### APPENDIX G: Analysis of Revenue Implications of 0.1 RVU/pt Increase

#### D. INCREASE RVU BY AN AVERAGE OF 0.1 PER CASE: REVENUES INCREASE, COSTS ARE FIXED

<table>
<thead>
<tr>
<th>Type</th>
<th>OP</th>
<th>Volume</th>
<th>RVUs</th>
<th>Charge</th>
<th>NetRevenue</th>
<th>VIndCost</th>
<th>A</th>
<th>VarInd</th>
<th>VarNetMargin</th>
<th>FixDirect</th>
<th>FixInd</th>
<th>NetProfit</th>
</tr>
</thead>
</table>
| ED   | I  | 14,656 | 212,367 | 21,516,999 | 18,733,990 | 3,291,069 | 939,415 | 14,503,506 | 2,448,572 | 2,942,466 | 9,112,468 
| ED   | O  | 47,417 | 467,246 | 46,008,205 | 29,227,041 | 7,503,700 | 2,019,251 | 19,704,089 | 6,868,556 | 6,324,763 | 6,510,770 |
| ED   | TOTAL | 62,075 | 679,612 | 67,525,204 | 47,961,031 | 10,794,790 | 2,019,251 | 20,523,596 | 9,217,128 | 9,267,229 | 15,425,238 |

<table>
<thead>
<tr>
<th>Observation</th>
<th>Volume</th>
<th>RVUs</th>
<th>Charge</th>
<th>NetRevenue</th>
<th>VIndCost</th>
<th>A</th>
<th>VarInd</th>
<th>VarNetMargin</th>
<th>FixDirect</th>
<th>FixInd</th>
<th>NetProfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>501</td>
<td>8,356</td>
<td>1,266,862</td>
<td>1,033,080</td>
<td>227,574</td>
<td>57,894</td>
<td>747,613</td>
<td>105,361</td>
<td>181,337</td>
<td>460,915</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>3,521</td>
<td>51,696</td>
<td>9,371,008</td>
<td>6,570,219</td>
<td>1,793,894</td>
<td>440,824</td>
<td>4,335,801</td>
<td>670,845</td>
<td>1,380,136</td>
<td>2,285,320</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>4,022</td>
<td>60,052</td>
<td>10,637,867</td>
<td>7,603,399</td>
<td>2,021,468</td>
<td>498,518</td>
<td>5,083,414</td>
<td>775,706</td>
<td>1,561,473</td>
<td>2,746,235</td>
<td></td>
</tr>
</tbody>
</table>

**ALL CASES**: 68,095 | 739,665 | 78,183,071 | 55,584,430 | 12,816,257 | 3,457,184 | 39,291,009 | 10,092,835 | 10,828,701 | 18,169,473 |

**Increment**: - | 6,610 | 686,816 | 476,834 | - | - | - | 476,834 | - | - | 476,834

#### E. INCREASE RVU BY AN AVERAGE OF 0.1 PER CASE: REVENUES AND VARIABLE COSTS INCREASE

<table>
<thead>
<tr>
<th>Type</th>
<th>OP</th>
<th>Volume</th>
<th>RVUs</th>
<th>Charge</th>
<th>NetRevenue</th>
<th>VIndCost</th>
<th>A</th>
<th>VarInd</th>
<th>VarNetMargin</th>
<th>FixDirect</th>
<th>FixInd</th>
<th>NetProfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED</td>
<td>I</td>
<td>14,656</td>
<td>212,367</td>
<td>21,516,999</td>
<td>18,733,990</td>
<td>3,313,940</td>
<td>945,943</td>
<td>14,474,107</td>
<td>2,448,572</td>
<td>2,942,466</td>
<td>9,083,069</td>
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<tr>
<td>ED</td>
<td>O</td>
<td>47,417</td>
<td>467,246</td>
<td>46,008,205</td>
<td>29,227,041</td>
<td>7,503,700</td>
<td>2,019,251</td>
<td>19,704,089</td>
<td>6,868,556</td>
<td>6,324,763</td>
<td>6,413,139</td>
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<tr>
<td>ED</td>
<td>TOTAL</td>
<td>62,075</td>
<td>679,612</td>
<td>67,525,204</td>
<td>47,961,031</td>
<td>10,894,570</td>
<td>2,985,897</td>
<td>34,080,565</td>
<td>9,317,128</td>
<td>9,267,229</td>
<td>15,496,208</td>
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</table>

<table>
<thead>
<tr>
<th>Observation</th>
<th>Volume</th>
<th>RVUs</th>
<th>Charge</th>
<th>NetRevenue</th>
<th>VIndCost</th>
<th>A</th>
<th>VarInd</th>
<th>VarNetMargin</th>
<th>FixDirect</th>
<th>FixInd</th>
<th>NetProfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>501</td>
<td>8,356</td>
<td>1,266,862</td>
<td>1,033,080</td>
<td>228,946</td>
<td>58,243</td>
<td>745,891</td>
<td>105,361</td>
<td>181,337</td>
<td>459,193</td>
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</tr>
<tr>
<td>O</td>
<td>3,521</td>
<td>51,696</td>
<td>9,371,008</td>
<td>6,570,219</td>
<td>1,806,196</td>
<td>443,646</td>
<td>4,320,477</td>
<td>670,345</td>
<td>1,380,136</td>
<td>2,269,996</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>4,022</td>
<td>60,052</td>
<td>10,637,867</td>
<td>7,603,399</td>
<td>2,035,142</td>
<td>501,888</td>
<td>5,066,368</td>
<td>775,706</td>
<td>1,561,473</td>
<td>2,729,189</td>
<td></td>
</tr>
</tbody>
</table>

**ALL CASES**: 68,095 | 739,665 | 78,183,071 | 55,584,430 | 12,929,712 | 3,487,785 | 39,186,933 | 10,092,835 | 10,828,701 | 18,225,397 |

**Increment**: - | 6,610 | 686,816 | 476,834 | 113,475 | 30,601 | 332,759 | - | - | 332,759

Analysis conducted by Paul Intihar, Director, Johns Hopkins Medicine Financial Analysis Unit, 10/18/2013
In their book, *Methods for the Economic Evaluation of Health Care Programmes* [sic] (2005), the authors propose the model shown in Figure 34a as a simple way to construct an economic analysis of a health care improvement program. They propose various formulations of economic evaluation to conduct cost-benefit, cost-effectiveness, and cost-utility analyses some of which will be explored in depth as part of the workplace challenge. As a starting point, the elements to consider in the evaluation of the facility billing program are structured using the Drummond *et al.* model as a reference point. This is shown in Figure 34b below.
Figure 34b: Components of Joint Economic Analysis of Workplace Challenge
APPENDIX H: ECONOMIC EVALUATION
ANNEX B: SENSITIVITY ANALYSIS

Crystal Ball Report - Full
Simulation started on 8/13/2013 at 5:29 PM
Simulation stopped on 8/13/2013 at 5:29 PM

Run preferences:
- Number of trials run: 1,000
- Extreme speed
- Monte Carlo
- Random seed
- Precision control on confidence level: 95.00%

Run statistics:
- Total running time (sec): 0.07
- Trials/second (average): 13,565
- Random numbers per sec: 732,493

Crystal Ball data:
- Assumptions: 54
- Correlations: 0
- Correlation matrices: 0
- Decision variables: 0
- Forecasts: 1

Forecasts

[Histogram of net benefit for 1,000 trials, showing distribution with a peak at zero net benefit, and tails extending to both negative and positive values.]

Dissertation - Final: Gai Cole
Even if costs were not fully offset by benefits, the ED may still choose to continue with the initiative if the economic evaluation can demonstrate improved workforce and/or social outcomes that align with its organizational goals. The CCA supports the business case by identifying and measuring those outcomes that align with organizational goals at the operational, patient and societal levels. Another facet in the selection rationale for a CCA is its value to ED leaders. Cost consequence analysis has emerged as a pragmatic option for health and policy decision-makers in that it is transparent and provides comprehensive information to decision-makers, particularly when contrasted with traditional economic evaluation methods. Detsky in JAMA (2007) points out that “…the information used to generate… sophisticated but difficult to understand [incremental cost effectiveness] ratios can be made more useful to most clinicians and decision makers through… a cost-consequence analysis.” Others point to the gap between the aim and the use of economic evaluations in health care, and believe that the increasing methodological complexity of economic evaluations and the difficulty in interpreting their results have actually made them less useful to decision-makers. According to Brouselle and Lessard (2011), “Discussion around decision-makers’ use of economic evaluations indicates that, with regard to economic evaluation methods, a contextualized approach is needed that provides relevant and non-aggregated information on costs and effects, is transparent and simple, and presents assumptions or arbitrary choices clearly and as minimally as possible” in a way Detsky (2007) calls “…concrete and familiar to clinicians…” Mauskopf et al. (1998) state that the “cost-consequence format is more likely to be approachable, readily understandable, and applied by healthcare decision-makers…” and “…will enable decision-makers to select the components most relevant to their perspective and will also give them confidence that the data are credible to use as the basis for resource allocation decisions.”

Of importance, a CCA does not preclude conducting a more rigorous economic evaluation, and might even serve as an important building block for other
methodologies. In the CADTH publication *Guidelines for the Economic Evaluation of Health Technologies*, it is suggested that “…the transparency of other types of economic evaluations is improved when a [CCA] is used as an intermediate step in reporting the analysis, with the outcomes and costs presented in a disaggregate form before combining them in another type of evaluation.”

One downside of the CCA is that “it can be difficult for the decision maker to integrate the information... [in the presence of] multiple benefits and harms, and if the benefits and harms are so disparate that they cannot be directly compared.” Decisions based on CCAs are potentially biased by the individual perspective of the decision maker as they weight the relative importance of disaggregated costs and consequences presented in the CCA.

Lastly, such decisions might not always incorporate the values of the patient, community or society when information is open to subjective valuation.

While financial impact is clearly important from the ED perspective, the opportunity to better align the organization’s social objectives with its financial goals is critical to achieving what the Baldrige Framework refers to as “aligned approaches” in department operations. The Baldrige Health Care Criteria for Performance Excellence stress the ED’s societal responsibility and need for “Highly ethical conduct in both business and health care practices.” This economic evaluation captures not only the ROI of the program’s more direct and tangible financial and workforce measures, but also the more qualitative and “humanistic” outcomes (consequences) related to the fairness with which we treat patients (financially), to further strengthen the business case and its utility. In this manner, the CBA and CCA will provide comprehensive information to support ED decision making and resource allocation. Brousselle and Lessard (2011) assert that “At the moment, this kind of analysis is under-represented in the health economics literature.”
APPENDIX H: ECONOMIC EVALUATION

ANNEX D: PRODUCTION EFFICIENCY

DETAILS AND METHODOLOGY

Table 23, below, shows the median salary information used in our calculations of the variable factors of production used in the production efficiency calculations. Shown are FY13 rates. FY10 and FY11 rates were used for those timeframes and then inflation adjusted to keep the calculations comparable.

Table 23: Average and Median ED Salary Structure

<table>
<thead>
<tr>
<th>DSM Code</th>
<th>Position Title</th>
<th>Average BASE rate</th>
<th>Average PACE Rate</th>
<th>Average PACE diffs</th>
<th>Median BASE Rate</th>
<th>Median PACE Rate</th>
<th>Number of Employees</th>
<th>Number of FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10367600</td>
<td>CLINICAL TECH</td>
<td>$16.16</td>
<td>N/A</td>
<td>N/A</td>
<td>$15.32</td>
<td>N/A</td>
<td>36.0</td>
<td>30.3</td>
</tr>
<tr>
<td>10150300</td>
<td>NURSING ASST-CERTIFIED</td>
<td>$13.59</td>
<td>N/A</td>
<td>N/A</td>
<td>$13.48</td>
<td>N/A</td>
<td>9.0</td>
<td>8.4</td>
</tr>
<tr>
<td>50053752</td>
<td>CLINICAL NURSE EXTERN</td>
<td>$15.25</td>
<td>N/A</td>
<td>N/A</td>
<td>$15.25</td>
<td>N/A</td>
<td>12.0</td>
<td>5.4</td>
</tr>
<tr>
<td>10366400</td>
<td>NURSE CLINICIAN</td>
<td>$26.82</td>
<td>$29.92</td>
<td>$2.40</td>
<td>$26.60</td>
<td>$30.43</td>
<td>19.0</td>
<td>18.5</td>
</tr>
<tr>
<td>10366300</td>
<td>NURSE CLINICIAN IM-PACE</td>
<td>$28.25</td>
<td>$31.67</td>
<td>$3.42</td>
<td>$28.08</td>
<td>$29.94</td>
<td>29.0</td>
<td>27.0</td>
</tr>
<tr>
<td>10366500</td>
<td>NURSE CLINICIAN IM-PACE</td>
<td>$33.83</td>
<td>$36.93</td>
<td>$3.09</td>
<td>$32.60</td>
<td>$35.32</td>
<td>60.0</td>
<td>56.9</td>
</tr>
<tr>
<td>10368800</td>
<td>NURSE CLINICIAN IIE-PACE</td>
<td>$35.83</td>
<td>$38.37</td>
<td>$2.55</td>
<td>$35.35</td>
<td>$37.19</td>
<td>6.0</td>
<td>5.9</td>
</tr>
<tr>
<td>10366600</td>
<td>NURSE CLINICIAN III-PACE</td>
<td>$41.76</td>
<td>$44.51</td>
<td>$2.75</td>
<td>$43.26</td>
<td>$44.89</td>
<td>16.0</td>
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</tr>
<tr>
<td>10366800</td>
<td>NURSE CLINICIAN I-FP</td>
<td>$39.75</td>
<td>N/A</td>
<td>N/A</td>
<td>$32.00</td>
<td>N/A</td>
<td>4.0</td>
<td>1.0</td>
</tr>
<tr>
<td>10363800</td>
<td>NURSING COORDINATOR</td>
<td>$36.70</td>
<td>$40.51</td>
<td>$3.81</td>
<td>$38.03</td>
<td>$44.59</td>
<td>7.0</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Figure 35 below shows CCT by type of hour (regular, overtime, high needs, double overtime, etc) for each year since 2010, month by month (only May and June of 2013 are show). Having the type of hour, allowed us to apply the correct salary number, adjusted by the type of hour worked. For example, for hours indicated as double overtime (“DBLhours” in Figure 35) we applied 200% of the hourly rate. Figure 35 is the summary table. To ensure accuracy, we collected the data on a by-name basis. An example of that data is shown in Figure 36. This table was over 6500 lines long and allowed us to ensure only shifts we considered clinical were incorporated into the data.
Figure 35: Summary ED Clinical Hours by Position
Run on 07/26/2013

| 5   | 2013 | EACU LEAD | 696.00 | 0 | 48 | 0 | 12 |
| 5   | 2013 | EACU RN   | 1999.00 | 180 | 12 | 0 | 0 |
| 5   | 2013 | Nursing Coordinator | 744.00 | 0 | 0 | 0 | 0 |
| 5   | 2013 | Nursing Supervisor | 660.00 | 0 | 84 | 0 | 0 |
| 5   | 2013 | Orientation | 0.00 | 64 | 0 | 0 | 0 |
| 5   | 2013 | RAP LEAD | 422.00 | 0 | 40 | 0 | 0 |
| 5   | 2013 | RN       | 9862.58 | 506 | 693 | 0 | 6 |
| 5   | 2013 | TECH     | 4078.27 | 0 | 389 | 0 | 0 |
| 6   | 2013 | EACU LEAD | 684.00 | 0 | 60 | 0 | 0 |
| 6   | 2013 | EACU RN   | 1888.00 | 0 | 46 | 0 | 0 |
| 6   | 2013 | Nursing Coordinator | 704.00 | 0 | 16 | 0 | 0 |
| 6   | 2013 | Nursing Supervisor | 624.00 | 0 | 88 | 0 | 0 |
| 6   | 2013 | Orientation | 0.00 | 552 | 40 | 0 | 0 |
| 6   | 2013 | RAP LEAD | 454.00 | 0 | 2 | 0 | 0 |
| 6   | 2013 | RN       | 9107.50 | 328 | 787 | 0 | 180 |
| 6   | 2013 | TECH     | 3719.00 | 336 | 393 | 0 | 0 |

Notes:
- Names withheld in this paper
- Percentage column indicates CCT factors applied to hours and is displayed as rounded (i.e. 11%=10.83%)

Figure 36: Detail ED Clinical Hours by Position
Run on 07/26/2013

<table>
<thead>
<tr>
<th>M</th>
<th>Y</th>
<th>Name</th>
<th>Budget Type</th>
<th>Salary</th>
<th>Adjusted Salary</th>
<th>Percentage</th>
<th>ShiftType</th>
<th>RegHours</th>
<th>Orientation</th>
<th>OTHours</th>
<th>DBLHours</th>
<th>DBLHours</th>
<th>HNHours</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>Acting Clinical Exempt</td>
<td>$15.32</td>
<td>$15.02</td>
<td>100%</td>
<td>TECH</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>CLINICAL TECH</td>
<td>$15.32</td>
<td>$15.02</td>
<td>100%</td>
<td>TECH</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$30.43</td>
<td>$29.83</td>
<td>100%</td>
<td>RAP LEAD</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$37.23</td>
<td>$36.46</td>
<td>100%</td>
<td>RAP LEAD</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$37.23</td>
<td>$36.46</td>
<td>100%</td>
<td>RAP LEAD</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>Name Withdrawn</td>
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<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
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<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN F/PACE</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2009</td>
<td>Name Withdrawn</td>
<td>NURSE CLINICIAN</td>
<td>$44.69</td>
<td>$44.01</td>
<td>100%</td>
<td>RN</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Since orientation hours generate RVUs, we included them as CCT. Orientation nurses were divided into two scenarios - orientation for new nurses and orientation for experienced nurses. Both of them were compensated for didactic and clinical time, but we wanted to ascertain only the proportion spent in direct patient care. According to our survey, on average, new nurses in orientation spent 81% of their time taking care of patient for 20 weeks, while experienced nurses in orientation spent 94% of their time in direct patient care for 12 weeks. Calculations were adjusted based on these figures.

Besides defining the nursing productivity, another challenge was caused by lunch breaks, which were integrated into working hours by Work Force Management. Different shifts were associated with different lengths of lunch break. It was not possible to accurately trace and record the lunch break time in the Work Force Management system for each type of nurse.

So we analyzed the distribution of lunch breaks for each shift length:

```
<table>
<thead>
<tr>
<th>Shift Length</th>
<th>0min</th>
<th>30min</th>
<th>60min</th>
<th>90min</th>
</tr>
</thead>
<tbody>
<tr>
<td>6hr shift</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8hr shift</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12h shift</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16h shift</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Shifts that were less than six hours had no lunch break. Shifts of between six and eight hours had a 30 minute lunch break, and so forth. Since 92.2% of shifts in our analysis period were between eight and twelve hours, we applied a one hour lunch break to our entire series of calculations.
CALCULATIONS AND ANALYTIC DETAIL

Below are the general calculations we used to arrive at our production efficiency ratio of the product to the variable factor of production (labor cost). These ratios exclude observation RVUs. Calculations with observation RVUs included are shown in the body of the paper in the production efficiency section.

\[
\text{Baseline Production Efficiency} = \frac{639264 - 36430}{156350.47 \times $31.55 + 49477.08 \times $15.35} = 0.10589
\]

\[
\text{Interventional Period Production Efficiency} = \frac{754504 - 42150}{183442.36 \times $30.21 + 60608.86 \times $15.29} = 0.11015
\]

Tables 24 and 25 show the mean labor efficiency comparisons between baseline and intervention periods for both observation RVUs included (Table 24) and excluded (Table 25). For each month, they show the cost of labor (clinical hours X salary), the RVU output attained, the MPK, and the MPK value in dollars in both adjusted and unadjusted formats.
Table 24: Labor Efficiency – Output Due to Observation Included

<table>
<thead>
<tr>
<th>Date</th>
<th>SUM LABOR (Incl. Obs)</th>
<th>Total RVU (Incl. Obs)</th>
<th>MPK Baseline</th>
<th>Value Unadjusted</th>
<th>Value Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-10</td>
<td>494,618</td>
<td>55,509</td>
<td>0.11223</td>
<td>$9.00</td>
<td>$9.66</td>
</tr>
<tr>
<td>Feb-10</td>
<td>422,289</td>
<td>47,431</td>
<td>0.11232</td>
<td>$9.01</td>
<td>$9.66</td>
</tr>
<tr>
<td>Mar-10</td>
<td>477,446</td>
<td>59,354</td>
<td>0.12432</td>
<td>$9.97</td>
<td>$10.70</td>
</tr>
<tr>
<td>Apr-10</td>
<td>461,189</td>
<td>58,999</td>
<td>0.12793</td>
<td>$10.26</td>
<td>$11.01</td>
</tr>
<tr>
<td>May-10</td>
<td>488,662</td>
<td>57,163</td>
<td>0.11698</td>
<td>$9.38</td>
<td>$10.07</td>
</tr>
<tr>
<td>Jun-10</td>
<td>482,037</td>
<td>56,557</td>
<td>0.11733</td>
<td>$9.41</td>
<td>$10.10</td>
</tr>
<tr>
<td>Jul-10</td>
<td>477,213</td>
<td>53,251</td>
<td>0.11159</td>
<td>$8.95</td>
<td>$9.60</td>
</tr>
<tr>
<td>Aug-10</td>
<td>482,845</td>
<td>53,391</td>
<td>0.11058</td>
<td>$8.87</td>
<td>$9.51</td>
</tr>
<tr>
<td>Sep-10</td>
<td>471,235</td>
<td>50,184</td>
<td>0.10649</td>
<td>$8.54</td>
<td>$9.16</td>
</tr>
<tr>
<td>Oct-10</td>
<td>484,494</td>
<td>50,085</td>
<td>0.10338</td>
<td>$8.29</td>
<td>$8.89</td>
</tr>
<tr>
<td>Nov-10</td>
<td>467,337</td>
<td>48,581</td>
<td>0.10395</td>
<td>$8.34</td>
<td>$8.94</td>
</tr>
<tr>
<td>Dec-10</td>
<td>485,158</td>
<td>48,759</td>
<td>0.10050</td>
<td>$8.06</td>
<td>$8.65</td>
</tr>
<tr>
<td>Total</td>
<td>5,694,523</td>
<td>639,264</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.11230</td>
<td>$9.01</td>
<td>$9.66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>SUM LABOR (Incl. Obs)</th>
<th>Total RVU (Incl. Obs)</th>
<th>MPK Intervention</th>
<th>Value Unadjusted</th>
<th>Value Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-12</td>
<td>506,468</td>
<td>63,629</td>
<td>0.12563</td>
<td>$11.12</td>
<td>$11.22</td>
</tr>
<tr>
<td>Aug-12</td>
<td>495,917</td>
<td>62,204</td>
<td>0.12543</td>
<td>$11.10</td>
<td>$11.21</td>
</tr>
<tr>
<td>Sep-12</td>
<td>485,754</td>
<td>60,120</td>
<td>0.12377</td>
<td>$10.96</td>
<td>$11.06</td>
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<tr>
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<td>63,254</td>
<td>0.12045</td>
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<td>$10.76</td>
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<td>60,466</td>
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<td>63,259</td>
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<td>0.11252</td>
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<td>524,790</td>
<td>58,239</td>
<td>0.11098</td>
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</tr>
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<td>Mar-13</td>
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<td>67,520</td>
<td>0.11596</td>
<td>$10.26</td>
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</tr>
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<td>Apr-13</td>
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<td>0.11084</td>
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<td>May-13</td>
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<td>65,441</td>
<td>0.11485</td>
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</tr>
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<td>Jun-13</td>
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Table 25: Labor Efficiency – Output Due to Observation Excluded

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<th>Date</th>
<th>SUM LABOR</th>
<th>RVU Excl. Observation</th>
<th>Observation RVU</th>
<th>Total RVU (Incl. Obs)</th>
<th>MPK Baseline</th>
<th>Value Unadjusted</th>
<th>Value Adjusted</th>
</tr>
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<td>Jan-10</td>
<td>494,618</td>
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<td>422,269</td>
<td>44,395</td>
<td>3,036</td>
<td>47,431</td>
<td>0.10513</td>
<td>$8.43</td>
<td>$9.05</td>
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<td>477,446</td>
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<td>58,999</td>
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<td>468,662</td>
<td>54,127</td>
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<tr>
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<td>56,557</td>
<td>0.11103</td>
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<td>$9.55</td>
</tr>
<tr>
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<td>477,213</td>
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<td>0.10399</td>
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<td>$8.95</td>
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<td>3,130</td>
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<td>$8.59</td>
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<td>484,494</td>
<td>47,235</td>
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<td>467,337</td>
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<tr>
<th>Date</th>
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<th>RVU Excl. Observation</th>
<th>Observation RVU</th>
<th>Total RVU (Incl. Obs)</th>
<th>MPK Intervention</th>
<th>Value Unadjusted</th>
<th>Value Adjusted</th>
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<td>65,441</td>
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</table>
APPENDIX I: Statistics Output

Calculations use the University of California, Los Angeles, Statistics Online Computational Resource
Available at http://www.socr.ucla.edu/htmls/SOCR_Analyses.html

1. RVU Impact of Pilot: Comparison of Pre and Post-Pilot Periods

A. Comparison of 6 month period pre and post pilot. Not controlled for observation RVUs.

Result of Two Independent Sample T-Test:

Confidence interval:
The mean of Group One minus Group Two equals \(-0.876900\)
95% confidence interval of this difference: From \(-1.130702\) to \(-0.623098\)

Variable 1 = C1
Sample Size = 6
Sample Mean = 10.3140000000
Sample Variance = .0153521360
Sample SD = .1239037368

Variable 2 = C2
Sample Size = 6
Sample Mean = 11.1909000000
Sample Variance = .0624972360
Sample SD = .2499944719

Degrees of Freedom = 10
T-Statistics (Unpooled) = 7.6983586222
One-Sided P-Value (Unpooled) = .0000082306
Two-Sided P-Value (Unpooled) = .0000164612

B. Comparison of 6 month period pre and post pilot. Observation RVUs held constant.

Result of Two Independent Sample T-Test:

Confidence interval:
The mean of Group One minus Group Two equals \(-0.695900\)
95% confidence interval of this difference: From \(-0.915098\) to \(-0.476702\)

Variable 1 = C1
Sample Size = 6
Sample Mean = 10.3140000000
Sample Variance = .0153521360
Sample SD = .1239037368

Variable 2 = C2
Sample Size = 6
Sample Mean = 11.0099000000
Sample Variance = .0427164280
Sample SD = .2066795297

Degrees of Freedom = 10
T-Statistics (Unpooled) = 7.0737860221
One-Sided P-Value (Unpooled) = .0000170016
Two-Sided P-Value (Unpooled) = .0000340031
C. Comparison of 6 month period pre and 12 month post pilot. Not controlled for observation RVUs.

Result of Two Independent Sample T-Test:

Confidence interval:
The mean of Group One minus Group Two equals -0.905817
95% confidence interval of this difference: From -1.092016 to -0.719618

Variable 1 = C1
Sample Size = 6
Sample Mean = 10.3140000000
Sample Variance = .0153521360
Sample SD = .1239037368

Variable 2 = C2
Sample Size = 12
Sample Mean = 11.2198166667
Sample Variance = .0379076361
Sample SD = .1946988343

Degrees of Freedom = 16
T-Statistics (Unpooled) = 11.9792928454
One-Sided P-Value (Unpooled) = .0000000011
Two-Sided P-Value (Unpooled) = .0000000021

D. Comparison of 6 month period pre and 12 month post pilot. Observation RVUs held constant.

Result of Two Independent Sample T-Test:

Confidence interval:
The mean of Group One minus Group Two equals -0.779058
95% confidence interval of this difference: From -0.958262 to -0.599854

Variable 1 = C1
Sample Size = 6
Sample Mean = 10.3140000000
Sample Variance = .0153521360
Sample SD = .1239037368

Variable 2 = C2
Sample Size = 12
Sample Mean = 11.0930583333
Sample Variance = .0345984390
Sample SD = .1860065564

Degrees of Freedom = 16
T-Statistics (Unpooled) = 10.5607556653
One-Sided P-Value (Unpooled) = .0000000064
Two-Sided P-Value (Unpooled) = .0000000128

2. Proportion of Patients at Each Billing Level – Pre and Post-Pilot

A. Comparison of 6 month period pre and post pilot – Level 1 patients.

Result of Two Independent Sample T-Test:
Variable 1 = C1
Sample Size = 6
Sample Mean = .0970721667
Sample Variance = .0000396292
Sample SD = .0062951729

Variable 2 = C2
Sample Size = 6
Sample Mean = .0277288333
Sample Variance = .0005338842
Sample SD = .0231059353

Degrees of Freedom = 10
T-Statistics (Unpooled) = -7.0926501195
One-Sided P-Value (Unpooled) = .0000166222
Two-Sided P-Value (Unpooled) = .0000332444

B. Comparison of 6 month period pre and post pilot – Level 2 patients.

Result of Two Independent Sample T-Test:

Variable 1 = C1
Sample Size = 6
Sample Mean = .1056998667
Sample Variance = .0000314967
Sample SD = .0056121949

Variable 2 = C2
Sample Size = 6
Sample Mean = .0724798500
Sample Variance = .0001548938
Sample SD = .0124456354

Degrees of Freedom = 10
T-Statistics (Unpooled) = -5.9602366125
One-Sided P-Value (Unpooled) = .0000696590
Two-Sided P-Value (Unpooled) = .0001393179

C. Comparison of 6 month period pre and post pilot – Level 3 patients.

Result of Two Independent Sample T-Test:

Variable 1 = C1
Sample Size = 6
Sample Mean = .2195039500
Sample Variance = .0000388555
Sample SD = .0062334201

Variable 2 = C2
Sample Size = 6
Sample Mean = .2954433000
Sample Variance = .0007908604
Sample SD = .0281222394

Degrees of Freedom = 10
T-Statistics (Unpooled) = 6.4576990337
One-Sided P-Value (Unpooled) = .0000363807
Two-Sided P-Value (Unpooled) = .0000727615

D. Comparison of 6 month period pre and post pilot – Level 4 patients.

Result of Two Independent Sample T-Test:

Variable 1 = C1
Sample Size = 6
Sample Mean = .2841825667
Sample Variance = .0000454623
Sample SD = .0067425753

Variable 2 = C2
Sample Size = 6
Sample Mean = .2875558500
Sample Variance = .0001293947
Sample SD = .0113751784

Degrees of Freedom = 10
T-Statistics (Unpooled) = .6248660484
One-Sided P-Value (Unpooled) = .2730259115
Two-Sided P-Value (Unpooled) = .5460518230

E. Comparison of 6 month period pre and post pilot – Level 5 patients.

Result of Two Independent Sample T-Test:

Variable 1 = C1
Sample Size = 6
Sample Mean = .2843411000
Sample Variance = .0000787555
Sample SD = .0088744279

Variable 2 = C2
Sample Size = 6
Sample Mean = .3101737167
Sample Variance = .0000781638
Sample SD = .0088410304

Degrees of Freedom = 10
T-Statistics (Unpooled) = 5.0513313639
One-Sided P-Value (Unpooled) = .0002491366
Two-Sided P-Value (Unpooled) = .0004982732
We conducted multiple linear regression analysis using the time study variables and outcomes data to examine the association between our observers and reported intervention times. The Stata output for this analysis follows:

```
  13.0 Copyright 1985-2013 StataCorp LP
Statistics/Data Analysis  StataCorp
4905 Lakeway Drive
College Station, Texas 77845 USA
800-STATA-PC  http://www.stata.com
979-696-4600  stata@stata.com
979-696-4601 (fax)
Single-user Stata license expires 30 Mar 2014:
  Serial number:  301309225848
  Licensed to:  Gai Cole
    Johns Hopkins
Notes:

.*(1 variable, 583 observations pasted into data editor)

.*(1 variable, 583 observations pasted into data editor)

.*(1 variable, 583 observations pasted into data editor)

.*(1 variable, 583 observations pasted into data editor)

.*(1 variable, 583 observations pasted into data editor)

.*(1 variable, 583 observations pasted into data editor)

.rename nursinginterventionmained intervention
.rename interventiondocumentminutes time
.encode intervention, gen(action)
```
```
. regress time i.action i.shift i.location i.employeetype

Source |       SS       df       MS              Number of obs =     549
-------------+------------------------------           F( 49,   499) =   31.98
Model |  17850.0409    49  364.286548           Prob > F      =  0.0000
    Residual |  5683.49711   499  11.3897738           R-squared     =  0.7585
-------------+------------------------------           Adj R-squared =  0.7348
Total |   23533.538   548  42.9444124           Root MSE      =  3.3749

------------------------------------------------------------------------------
time |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  action |
   Allergies  |  -12.97822   1.530101    -8.48   0.000    -15.98445   -9.971982
 Arrival Patient Info  |  -12.56624   1.550295    -8.11   0.000    -15.61215   -9.520333
    Blood Culture  |   10.06007   1.564675     6.43   0.000     6.985909    13.13423
   Blood Glucose - POCt  |  -9.204303   1.66652   -5.52 0.000    -12.47856   -5.930042
   Blood Kiosk (Simulation)  |  -9.71144   1.803485    -6.50 0.000    -15.25776   -5.175036
   CAP  |  -12.9399   1.521683    -8.50   0.000    -15.9296   -9.950208
    Cardiac Monitor Lead Placement  |  -6.241225   1.462448    -4.25   0.000    -9.087539   -3.409111
   Central Line Dressing Change (Simulation)  |  -4.794904   1.588074    -3.02   0.003    -7.867503   -1.722303
    Chief Complaint Quote  |  -11.23865   1.550295    -7.25 0.000    -14.28456   -8.192741
   Discharge/AMA with Instructions  |  -5.743076   1.346631    -4.26   0.000    -8.387072   -3.105986
   EKG (bedside monitor)  |  -8.227731   1.511941    -5.44 0.000    -11.26963   -5.185832
   EKG (cart)  |  -1.808757   1.605111    -1.13 0.260    -4.962366    1.344851
   FNGs  |  -12.41926   1.550295    -8.01   0.000    -15.46517   -9.373345
    Home Meds  |  -12.12121   1.42953    -8.48 0.000    -14.92985   -9.31257
   ILI  |  -12.79663   1.664921    -7.69   0.000    -16.06775   -9.525513
   IV D/C  |  -11.79164   1.237079    -9.53   0.000    -14.22216   -9.361112
   IV Insertion - Attempt  |  4.373872   1.692201     2.58   0.010     1.049155    7.698589
   IV Insertion - Successful  |  0.103097   1.441092    0.07 0.939    -2.521046    3.124241
   IV Tubing Set Up  |  -12.16522   1.371519    -8.87 0.000    -14.85988   -9.470552
   Implantable Port Deces (Simulation)  |  -11.4422   1.801424    -6.35 0.000    -14.98151   -7.902886
    Labs - blood specimen  |  0.3151035   1.396882    0.23 0.822    -2.429391    3.059598
    Labs - other specimen  |  -8.376771   1.360743    -6.16 0.000   -11.05026   -5.703279
------------------------------------------------------------------------------
```
Lead Cardiac Rhythm Interpretation | -11.84771   1.480512   -8.00   0.000   -14.75651   -8.938902
Medication Prep (mixing) | -11.29744   1.391625   -8.12   0.000   -14.0316   -8.563274
Medications Given, IV, PO, IN and Fluids | -7.444828   1.194189   -6.23   0.000   -9.791087   -5.09857
Neb Treatment Set Up | -11.13996   1.403569   -7.94   0.000   -13.89759   -8.382327
Nursing Assessment / Reassessment (ROS) | -2.980663   1.365224   -2.18   0.029   -5.66296   -.2983671
Pain Eval/Assessment | -12.25584   1.455717   -8.42   0.000   -15.11593   -9.395745
Patient History (Med & Surge) | -12.42569   1.582882   -7.85   0.000   -15.53562   -9.315753
Patient Status | -12.80521   1.26013   -10.16   0.000   -15.28103   -10.3294
Port - a - Cath Accessed | -.0391879   2.590668   -0.02   0.988   -5.12915   5.050774
Pulse Ox (applied) | -13.04804   1.278952   -10.20   0.000   -15.56083   -10.53524
SA | -13.00327   1.550313   -8.39   0.000   -16.04921   -9.957325
Transport by RN/CT (External) | 6.3587   1.323034   4.81   0.000   3.759295   8.958105
Transport by RN/CT (Internal) | -5.666917   1.360531   -4.17   0.000   -8.339991   -2.993842
Urinary catheter removal (Simulation) | -9.330521   1.861364   -5.01   0.000   -12.9876   -5.673444
Visit Overview Screen | -12.91593   1.681533   -7.68   0.000   -16.21968   -9.61217
Vital Signs | -9.303443   1.207039   -7.71   0.000   -11.67495   -6.931938
c spine immobilization (Simulation) | -9.497664   1.861364   -5.10   0.000   -13.15474   -5.840587
suture/staple removal (Simulation) | -10.4726   1.701161   -6.16   0.000   -13.81492   -7.130277

shift |
2 | .1187853   .3654003   0.33   0.745   -.599127   .8366979
3 | -.7657569   .5461401  -1.40   0.161   -1.838774   .3072606

location |
1 | -.6169577   2.482756  -.025   0.804   -5.494901   4.260986
2 | 1.370312   2.401204   0.57   0.568   -3.347404   6.088029
3 | .8787019   2.425826   0.36   0.717   -3.88739   5.644794
4 | 3.594157   2.583718   1.39   0.165   -1.48215   8.670465
5 | .8657931   2.408401   0.36   0.719   -3.866063   5.597649
6 | .6070585   2.476224   0.25   0.806   -4.258052   5.472169

2.employeetype | -1.692437   .5351174   -3.16   0.002   -2.743798   -.6410758
_cons | 13.79742   2.581536   5.34   0.000   8.725398   18.86944
```
. estimates store Model1

. regress time i.action i.shift i.location i.employeetype i.observer

        Source |       SS       df       MS              Number of obs =     549
-----------------+------------------------------           F( 52,   496) =   30.98
Model |  17993.4279    52  346.027459           Prob > F      =  0.0000
Residual |  5540.11012   496  11.1695768           R-squared     =  0.7646
-----------------+------------------------------           Adj R-squared =  0.7399
Total |   23533.538   548  42.9444124           Root MSE      =  3.3421

        time |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+-------------------------------------------+----------------------------------------------------------------
      action |                                    
         Allergies  |  -12.60203   1.538542    -8.19   0.000    -15.62489   -9.579165
   Arrival Patient Info  |  -12.92162   1.585122    -8.15   0.000      -16.036   -9.807237
        Blood Culture  |   10.13239   1.552398     6.53   0.000     7.082306    13.18248
   Blood Glucose - POCT  |  -9.111869    1.66283    -5.48   0.000    -12.37893   -5.844809
    Blood Kiosk (Simulation)  |  -10.82409   1.814498    -5.97   0.000     -1.07239   -3.576005
        CAP  |  -13.29137   1.532364    -8.67   0.000     -15.3021   -11.28065
   Cardiac Monitor Lead Placement  |  -6.144625   1.452353    -4.23   0.000     -8.998148   -3.291101
Central Line Dressing Change (Simulation)  |  -4.92253   1.57601     -3.12   0.002    -7.997918   -1.847101
   Chief Complaint Quote  |  -11.06608   1.547387    -7.15   0.000    -14.10632   -7.225903
Discharge/AMA with Instructions  |  -5.384056   1.34602     -4.00   0.000    -8.028659   -2.739453
       EKG (bedside monitor)  |  -8.184521   1.498115    -5.46   0.000    -10.22878   -6.140257
        EKG (cart)  |  -1.553795   1.602717    -0.97   0.338     -4.702746    1.595157
         FNGs  |  -12.18069   1.548344    -7.87   0.000     -15.2228   -9.138576
       Home Meds  |  -11.86341   1.422408    -8.34   0.000    -14.65816   -9.068727
         ILI  |  -12.82496   1.662381    -7.71   0.000    -16.09114   -9.558783
       IV D/C  |  -11.78478   1.225365    -9.62   0.000    -14.19435   -9.379201
   IV Insertion - Attempt  |   4.322447   1.676184     2.58   0.010     1.029151    7.615744
   IV Insertion - Successful  |   .2443788   1.42901     0.17   0.864   -2.563281    3.052039
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4  |   .0024424 .6412005   0.00  0.997    -1.257362  1.262246  
| 
_cons       |    14.7009 2.604834 5.64  0.000     9.58303 19.81877

-------------------------------------------------------------------------------
 . estimates store Model2
 . lrtest Model1 Model2

Likelihood-ratio test  
LR chi2(3)  =   14.03
(Assumption: Model1 nested in Model2)  Prob > chi2  =  0.0029

. regress time i.action i.employeetype i.observer

| Source | SS       df      MS     Number of obs =  549  
|--------|----------|--------|------------------------|
|        | F(44,   504) =  35.48  
Model  |  17789.5248  44  404.307381  Prob > F  =  0.0000  
|  Residual  |  5744.01323  504  11.3968516  R-squared  =  0.7559  
|  Total  |   23533.538  548  42.9444124  Root MSE  =  3.3759  

------------------------------------------------------------------------------------------------------------
| time | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|------|-------|-----------|-------|------|------------------------|
| action |
| Allergies  |  -14.985  1.300088 -11.53  0.000    -17.53926  -12.43074  
| Arrival Patient Info  |  -14.75458  1.364671 -10.81  0.000    -17.43572  -12.07343  
| Blood Culture  |   10.32228  1.526953   6.76  0.000     7.3223  13.32225  
| Blood Glucose - POCT  |  -9.854767  1.463807  -6.73  0.000    -12.73068  -6.97885  
| Blood Kiosk (Simulation)  |  -12.11764  1.379335  -8.79  0.000    -14.82759  -9.407681  

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<td>-1.514917</td>
</tr>
<tr>
<td>4</td>
<td>-.1959967</td>
<td>.6110306</td>
<td>-0.32</td>
<td>0.749</td>
<td>-1.396477</td>
</tr>
<tr>
<td>_cons</td>
<td>15.26891</td>
<td>.9889008</td>
<td>15.44</td>
<td>0.000</td>
<td>13.32603</td>
</tr>
</tbody>
</table>

```
. estimates store Model3

. regress time i.employeetype i.observer

Source |       SS       df       MS              Number of obs =     549
-------------+------------------------------           F(  4,   544) =   11.65
Model |  1856.55452     4   464.13863           Prob > F      =  0.0000
Residual |  21676.9835   544  39.8473961           R-squared     =  0.0789
-------------+------------------------------           Adj R-squared =  0.0721
Total |   23533.538   548  42.9444124           Root MSE      =  6.3125

-----------------------------------------------------------------------------
time |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
2.employeetype |   3.352827   .6538919     5.13   0.000     2.068365    4.637289
| observer |  |  |  |  |  |  |
| 2 | -.1036174 | .8933359 | -1.16 | 0.247 | -2.790985 | .718636 |
| 3 | .4327592 | .6149397 | 0.70 | 0.482 | -.7751881 | 1.640706 |
| 4 | -.3244195 | .9489187 | -3.42 | 0.001 | -5.108189 | -1.380202 |
| _cons | 5.289726 | .4624877 | 11.44 | 0.000 | 4.381245 | 6.198206 |

-----------------------------------------------------------------------------
. estimates store Model4
```
To confirm the LR test between our Model 1 and Model 2, we also conducted an ANOVA. Since the LR test and ANOVA use different distributions, the p values are not exactly the same, however, they both indicate statistically significant differences between the two models. The LR test provides a p value of 0.003, while the ANOVA provides a p value of 0.005. The output of the ANOVA is shown immediately below.

```
anova time i.action i.shift i.location i.employeetype i.observer

Number of obs =     549     R-squared     =  0.7646
Root MSE      = 3.34209     Adj R-squared =  0.7399

Source |  Partial SS    df       MS           F     Prob > F
------------+----------------------------------------------------
Model |  17993.4279    52  346.027459      30.98     0.0000

| action |  12591.7281    40  314.793202      28.18     0.0000
shift |  37.2154061     2   18.607703       1.67     0.1901
location |  168.077311     6  28.0128852       2.51     0.0212
employeet-e |  115.600471     1  115.600471      10.35     0.0014
observer |  143.38699     3  47.7956634       4.28     0.0054

| Residual |  5540.11012   496  11.1695768
------------+----------------------------------------------------
Total |   23533.538   548  42.9444124

. lrtest Model1 Model2

Likelihood-ratio test       LR chi2(3) =  14.03
(Assumption: Model1 nested in Model2) Prob > chi2 =  0.0029
```
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94. The issue of co-creation of value has been relatively understudied (Kohli and Grover, 2008). Thus, causal relationships are not clearly understood. Our intent in this project was to do something new by creating this hybrid audit. Kogut & Zander (1992) propose that “firms learn new skills by recombining their current capabilities” which is
exactly what we wanted to do – create a new process by combining existing resources to create value that exceeded what either individual group (billers, nursing) could achieve alone.


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124. Patton MQ. *Qualitative research.* Wiley Online Library; 2005.


137. As was hypothesized for a different set of outcome constructs and outcome measures (related to team training in the operating room) in Gai Cole’s HPM qualifying exam (exam code #527).


144. Links J. Methodology developed with input from Jonathan Links, PhD, Professor and Dissertation Advisor, Bloomberg School Of Public Health, Johns Hopkins University. August 2012.


146. Leoutsakos J, Ph.D. Correspondence with Dr Leoutsakos, Assistant Professor, Bloomberg School of Public Health, Johns Hopkins University. September, 2013.


162. Dawson P. NDNQI methodology as described by Patricia Dawson, MSN, RN, Assistant Director, Central Nursing Programs, Nursing Administration, The Johns Hopkins Hospital via email. August 2013.


215. Makowski M. Conversation with, and input from Michael Makowski, PhD, Assistant Professor, Department of Emergency Medicine, Johns Hopkins University. Dr. Makowski holds a PhD in economics. June 10, 2013.


255. Regarding Morse and Reimer (1956) "the experimental change of a major organizational variable": This study was done with 1950s clerical staff and conclusions are being applied to modern nursing staff which function at a far more autonomous level. Other references in the literature, conducted with more proximate populations of employees (including nurses), suggest the conclusions drawn by Morse and Reimer can be appropriately extended to the ED nurses of today.


