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Examining the Impact of Health Information Systems on Healthcare Service Improvement: The Case of Reducing in Patient-flow Delays in a U.S. Hospital

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ABSTRACT

The impact of Health Information Systems (HIS) on healthcare service improvement is well known; however, there has been a limited amount of research regarding the HIS payoff and how this has influenced the quality of patient care. By focusing on Kaizen, this study investigates the possibility of reducing patient-flow delays of outpatients using the HIS. By using a six-step Kaizen method, the root causes of patient-flow delays in the outpatient surgery process can be identified, whilst the development of potential solutions and plans can be configured and the role HIS has on the outpatient surgery process and the consequences it can have on patient care in its quest for improving the efficiency of patient flow will be analyzed. The findings of this study indicate that the adoption of HIS has great potential to not only minimize the chaos and disorder in the outpatient surgery unit but also lead to a reduction of time and cost in relation to patient flow.

Keywords: Health Information Systems (HIS); Patient-flow Delays; Kaizen method; process improvement; Healthcare

1. Introduction

In response to the Patient Protection and Affordable Care Act (PPACA) which was brought into law by the U.S. Federal Government in 2010, healthcare organizations began to look for new opportunities which could help them reduce the cost of healthcare without sacrificing the quality of patient care. However, one of the main struggles that healthcare organizations faced when trying to control rising healthcare costs was hospitals inability to manage patient-flow (Alliance for Health Reform, 2012), especially in outpatient surgery (Cardoen et al., 2010; Lee and Yih, 2014). Papel's report (2011) breaks down the cost of healthcare services and illustrates that outpatient surgery accounts for a large proportion of healthcare service categories, and remains the most expensive outlay in the overall outpatient visit service. Amongst the surgery operations recorded, 65% were performed as outpatient procedures, with 35% being completed as inpatients procedures. According to the Health Care Cost Institute's report (HCCI, 2014), outpatient surgery per capita spending in U.S. hospitals accounts for 61.9% (\$526 per capita) of outpatient visits, with this figure rising at a considerable rate since 2010.

In outpatient surgery, patient-flow delay is often caused by issues with surgery scheduling, patient overcrowding, as well as the mass of patients queuing. A delay like this has such a significant impact as it is one of the most cost intensive areas in a hospital. These delays, in turn, result in an increase in patient dissatisfaction and lower the quality of care (Lee and Yih, 2014; Min and Yih, 2010). Health Information Systems (HIS) have in the past proven to be an effective tool to address these issues (Lucas et al. 2013; Kim et al. 2016; Mantzana et al. 2007). Many researchers recognize the benefits of incorporating HIS into clinical practices (e.g. Agarwal et al. 2010; Bhattacharjee et al. 2007); however, research has shown that healthcare organizations do not fully consider the finer details HIS payoff measurements and are unable to detect the effects of HIS (Jones et al. 2012). To date there

has been little attempt to improve hospitals understanding of how to deploy HIS within their healthcare organization in order to achieve an efficient patient-flow and how to evaluate its consequences: e.g. how much time or cost is saved? Does HIS work effectively? (Ammenwerth et al. 2003; Devaraj et al. 2013; Ker et al. 2014a; Yusof et al. 2008).

We seek to fill this gap by employing a six-step Kaizen framework developed by Kato and Smalley (2011), then take a step-by-step approach to improving patient-flow delays by implementing a HIS in an outpatient surgical unit at Louisiana State University Health Sciences Center (LSUHSC) at Shreveport, Louisiana. What will primarily be focused upon are the solutions to patient-flow delays at outpatient surgical suites and cancellations caused by pre-operative patient bottlenecks in the outpatient surgical unit.

In the next section the previous literature relating to the effects of HIS and Kaizen in healthcare will be analyzed. Section 3 details the cases used in this research along with the research methodology used. In Section 4, the application of the six steps of Kaizen to the case study will be discussed with the results of the process improvement being presented. The practical implications of this implementation and the final verdict of its success will be given in Section 5.

2. Literature Review

2.1. Impact of HIS on Patient-flow

HIS refers to “a computer system aimed at providing a paperless environment that covers all aspects of the hospital’s operation such as clinical, administrative, and financial systems” (Nilashi et al. 2016, p. 244). It can be observed that the adoption of HIS has certainly improved the quality of the healthcare service through a number of salient benefits, such as cost reduction in care delivery, medical error prevention and clinical outcome improvement, all of which have been identified in existing HIS literature (Agarwal et al. 2010;

Bhattacharjee et al. 2007; Bhattacharjee and Hikmet 2007; Goh et al. 2011; Ker et al. 2014a; Mantzana et al. 2007).

HIS has the potential to fill the growing need for healthcare managers to improve the efficiency of clinical workflow and patient flow (Devaraj et al. 2013; Ker et al. 2014a; Zheng et al. 2011). Patient flow is recognized as a key factor influencing hospital productivity and utilization (Devaraj et al., 2013). If patient flow is delayed by an inefficient stay and administrative operation process, the cost of healthcare will undoubtedly increase and the quality of care would diminish (Neil, 2003). Van Oranje-Nassau et al. (2009) suggest that the adoption of HIS with the use of RFID technology can eliminate human error in the healthcare sector. In recent studies, the effective use of an emerging HIS and the incorporation of big data analytics enabled hospitals to take prompt action in reducing delays in clinical workflow and patient flow (Wang and Hajli, 2017; Wang et al. 2016, 2017).

The existing literature provides substantial evidence that investing in HIS can offer the opportunity to redesign patient flow and as a result transform existing health service processes. Nevertheless, the approach healthcare organizations must take to deploy HIS and evaluate how HIS will actually payoff in the long run still remains unclear. In the following sections, we will discuss how to apply the kaizen method from an operations perspective in healthcare to justify the investment in HIS.

2.2. Kaizen in Health Care

Kaizen, a Japanese business philosophy, is a concept which underlines the core principles of obtaining continuous improvement which involves everyone in the organization. Kaizen is a series of policies that continually utilize incremental changes in an operation or business using the method: plan, do, check, and act (PDCA), in order to boost quality and efficiency (Kato and Smalley, 2011). The Kaizen method utilizes a specific set of technical

problem-solving tools, that have the potential to impact both production and employee performance (Ker et al. 2014b). This method mainly focuses on the activities that identify and quickly remove the unnecessary elements of a particular process in the value stream, making it an effective approach when companies need help in achieving lean manufacturing.

Kaizen methods have been widely applied to numerous operations and production processes in the manufacturing industry (e.g. García et al. 2013, 2014; Glover et al. 2014; James et al. 2014; Ker et al. 2014b). For instance in the healthcare system, the introduction of lean manufacturing methods become the latest trend (Essen et al. 2012; Ker et al. 2014a; Lee and Yih, 2014), with Kaizen, one of the most effective lean manufacturing methods around, has become a method of considerable interest to the healthcare operation field (e.g. Comtois et al. 2013; Gene et al. 2012; Iannettoni et al. 2011; Jacobson et al. 2009). With the intention of improving healthcare quality, some healthcare organizations have adopted the Kaizen approach to accelerate patient-flow and efficiently manage the healthcare service. One of the advantages of using Kaizen is that it lays the foundations for using the specific steps when conducting Kaizen policies in practice (Kato and Smalley, 2011).

Two of the best practices which used the Kaizen method to help improve healthcare performance will be now discussed, revealing not only the potential benefits but the impact this method could have on the entire healthcare system. First reported by The New York Times in 2010, the Seattle Children's Hospital introduced the Kaizen approach to improve patient via a series of continuous small changes to the supply systems (Weed, 2010). Seattle Children's Hospital started to use the continuous performance improvement (CPI) to examine every aspect of a patient's stay, from the moment they arrived until they were discharged. By using this improvement the average waiting time regarding various surgeries reduced from 25 days to around 1 to 2 days; whilst addressing inefficient drug distribution systems helped to

save \$3.5 million in expenses in relation to the expansion of the hospital’s surgical suites thanks to an increase in the number of surgeries they could perform.

Another institution that used a Kaizen method to help improve its healthcare performance was the Department of Emergency Medicine in the Vanderbilt University Medical Center (Jacobson et al. 2009). Here they created a continuous quality improvement (CQI) program, focusing on a suggestion-based model by means of a Kaizen cycle. CQI allowed Vanderbilt University Medical Center to empower all members of staff and departments to submit their “kaizen initiatives (KIs)” through a web-based Kaizen tracker application. This program resulted in over 400 changes occurring within their emergency department system, driving improvements concerning operational change and information dissemination regarding current standard operation procedure (SOP).

Furthermore, previous research has primarily focused on the adoption of the Kaizen methods in healthcare services (see Table 1 below). The organizational and operational benefits of adopting the Kaizen method are evident from these studies; for example, one recent study indicated that healthcare delivery system could be dramatically improved through the use of Kaizen events, which in turn would boost the efficiency of day-to-day operations, the staff scheduling and time utilization. For that reason, the incorporation of Kaizen into various sectors of the healthcare system has proven to be an effective approach in establishing low-cost high-quality healthcare services.

Table 1. Studies Related to Using Kaizen in Healthcare

Studies	Healthcare domain	Kaizen approaches	Key benefits gained from Kaizen
Dickson et al. (2009)	Emergency Department	5-day Kaizen events based on lean principles and techniques.	<ul style="list-style-type: none"> • The percentage of patients who ranked the overall ED care as “very good” from 54% to 59%. • An improvement in patient flow with a reduction in patient’s average length of stay, from 161 mins to 148 mins.

Iannettoni et al. (2011)	Esophagectomy surgery	Multidisciplinary Kaizen analysis (Intraoperative assessment of variability, cost analysis and quality improvement measures).	<ul style="list-style-type: none"> • 43% reduction in cost per esophagectomy case. • Patient's length of stay reduced from 14 days to 5. • The leak rate of intraoperatives and postoperatives dropped from 12% to 0%.
Jacobson et al. (2009)	Emergency Department	Creating CQI program based on Kaizen philosophy (Web-based Kaizen Tracker Application).	<ul style="list-style-type: none"> • 76% of suggestions submitted have identified process problems. • 53% of suggestions submitted have led to operational changes.
Natale et al. (2014)	Healthcare delivery system	Kaizen events	<ul style="list-style-type: none"> • The benefits of day-to-day operations, staff scheduling, and time utilization were recognized. • Improved the patient-centered process.
Toussaint (2009)	General healthcare	Toyota's Kaizen approaches	<ul style="list-style-type: none"> • Reduced time wastage and the wastage of resources by 40-50%. • Improved two specific care processes: heart attack care and newborn delivery care. • Changed physician culture. • Medicare pays \$2,000 less per patient in collaborative care in comparison to the traditional medical wing.
Tetteh (2012)	Perioperative Nursing	Using a Five-step Kaizen framework (teamwork, personal discipline, improved morale, quality circles and suggestions for improvement) to achieve process improvement.	<ul style="list-style-type: none"> • Created surgical checklists and on-time procedure starts to improve OR staff communications. • Developed continued nursing education to improve personal skills and knowledge. • Enthusiasm for challenges and opportunities. • Focused on knowledge transfer amongst staff members for improved patient healthcare, quality and safety. • Developed a perioperative process improvement measurement on behalf of patients.
Venkateswaran	Acute	<ul style="list-style-type: none"> • Pre-work 	<ul style="list-style-type: none"> • 6% increase in value added

et al. (2011)	rehabilitation service department	observations (a 3-day Kaizen event). <ul style="list-style-type: none"> • Post-lean implementation analysis. 	activities by creating a patient discharge list, telephone number cards and calling ahead prior to traveling to patient rooms.
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3. Methods

3.1. Case setting

The purpose of this case study was to examine the impact of the Kaizen method in relation to healthcare service improvements at an outpatient surgical unit in the case hospital. The LSUHSC is a public healthcare center pertaining to one of the largest hospital systems in the United States, and is set to expand in the near future. In 2013, LSUHSC had more than 450 licensed inpatient beds, treating around 450,000 outpatients and 20,000 inpatients, whilst also dealing with about 2,500 deliveries, approximately 1000 major surgeries and 600 minor surgical procedures. LSUHSC serves a large proportion of Louisiana’s underinsured, uninsured and low-income populations: this strain on the States healthcare system highlights the urgent need for cost-effective healthcare services as well as the enhancement of effective and efficient healthcare operations.

3.2. Research Design and Approach

The epistemological foundation of this study is based upon the interpretivist paradigm; with the case study method being used here being highly appropriate for interpretivist research. As Darke et al. (1998) and Walsham (1993) suggest this method is well suited for understanding how IT-related innovations interact with organizational contexts. As the purpose of this study is to understand how HIS has the ability to improve patient-flow delays, it is ideal that this type of case study has been chosen.

The data collected in the form of in-depth discussions with a panel of LSUHSC's surgeons and interviews with various staff members who are involved in each patient-flow process will be analyzed. Having in-depth discussions and interviews allows the participants to share their ideas with the interviewers, providing a deeper insight into the current patient-flow system and gives them ample opportunity to make useful suggestions. The LSUHSC's Institutional Review Board approved the collection of this data within the surgical unit, with all confidential staff and patient information being removed from the data collection sheet prior to analysis.

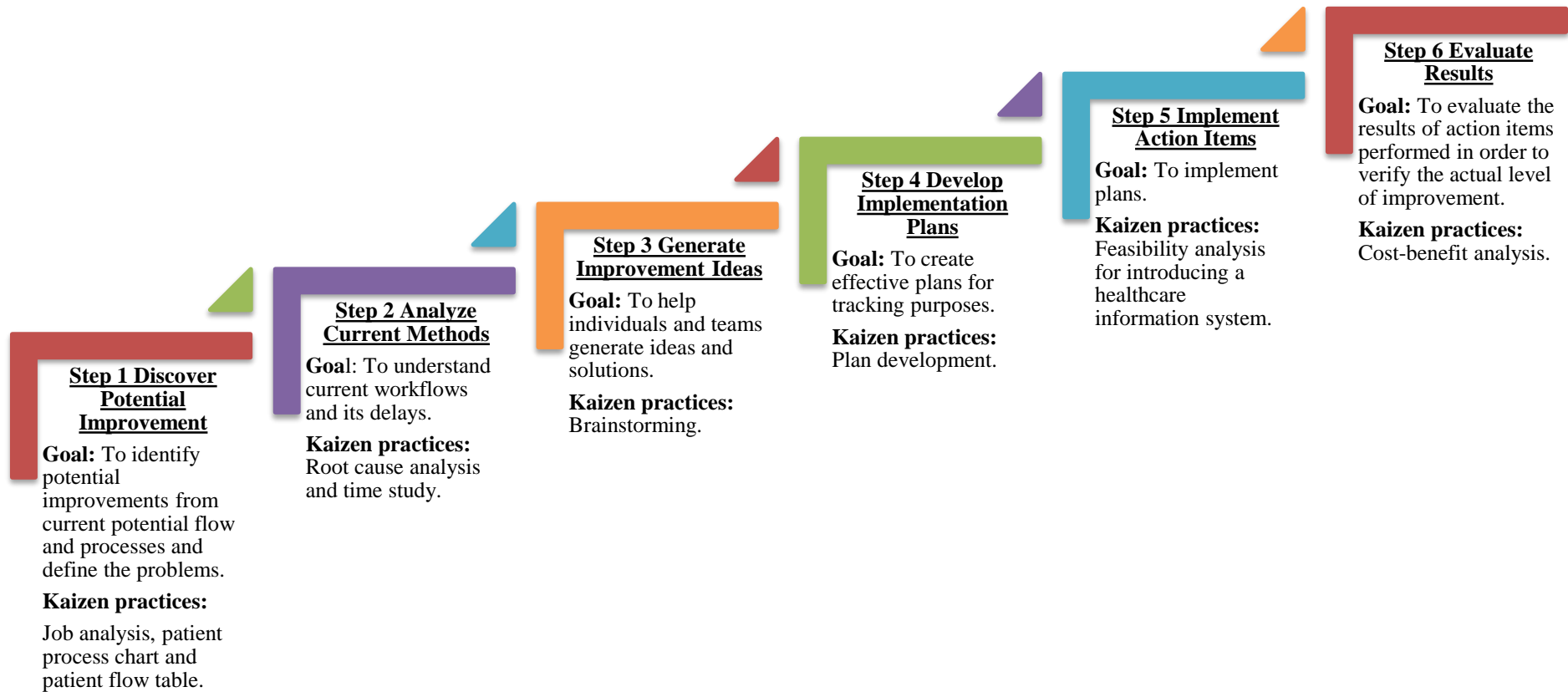
To clarify which solutions were best for LSUHSC, face-to-face meetings with project manager and surgeons were arranged. Possible solutions (e.g., Six-Sigma and process mapping) included cost efficiency, feasibility as well as patient satisfaction were taken into account. This is why the Kaizen method was chosen because the Kaizen employs a step-by-step approach allowing continuous improvement to be made in all areas of an organization. The most prominent example is the six-step Kaizen framework used by the Toyota Motor Corporation (Kato and Smalley 2011) as an improvement methodology. A similar Kaizen framework would incorporate a set of technical problem-solving tools with the aim of improving the daily surgery process at LSUHSC through six steps: 1) identify potential problems, 2) analyze current methods, 3) generate improvement ideas, 4) develop implementation plans, 5) implement action items and 6) evaluate results.

The Kaizen framework not only has the potential to directly save costs that can be easily measured and quantified, but also provides a clear executive guide to any improvement strategies. Furthermore, the Kaizen method adopts a staff-driven improvement approach which could possibly raise an awareness of staff conflicts inherent in the hospital's various departments. The Kaizen framework should potentially address these concerns by emphasizing a dual-channel approach (top down and bottom up), whereby the potential

problems can be determined, with possible solutions being established. These changes may reduce the conflict of each department's specific and singularly focused goals, whilst helping to bring to the forefront staff members ideas.

This type of Kaizen framework has been adopted to develop a Six-Step Kaizen Ladder which should improve patient-flow delays at LSUHSC. The Kaizen practice and main goal for each step is summarized in Figure 1. The steps and results of implementing a Six-Step Kaizen framework within the outpatient surgical unit at LSUHSC are presented in the next section.

Figure 1. Six-Step Kaizen Ladder to Improve Patient-flow Delays in Healthcare



4. Results

4.1. Step 1: Discovering improvement potential

To identify the potential problems in the case study, the patient-flow in the day surgeries and operating rooms has to be analyzed, whereby potential delays can be identified from the interviews conducted with the admittance workers, registered nurses and perioperative coordinator of the operating room. Each participant was asked the following questions:

- ◆ What does your job entail on a daily basis?
- ◆ On average how long does it take to complete a major task and a minor one?
- ◆ What are some of the major problems you have noticed?
- ◆ How would you solve those problems?

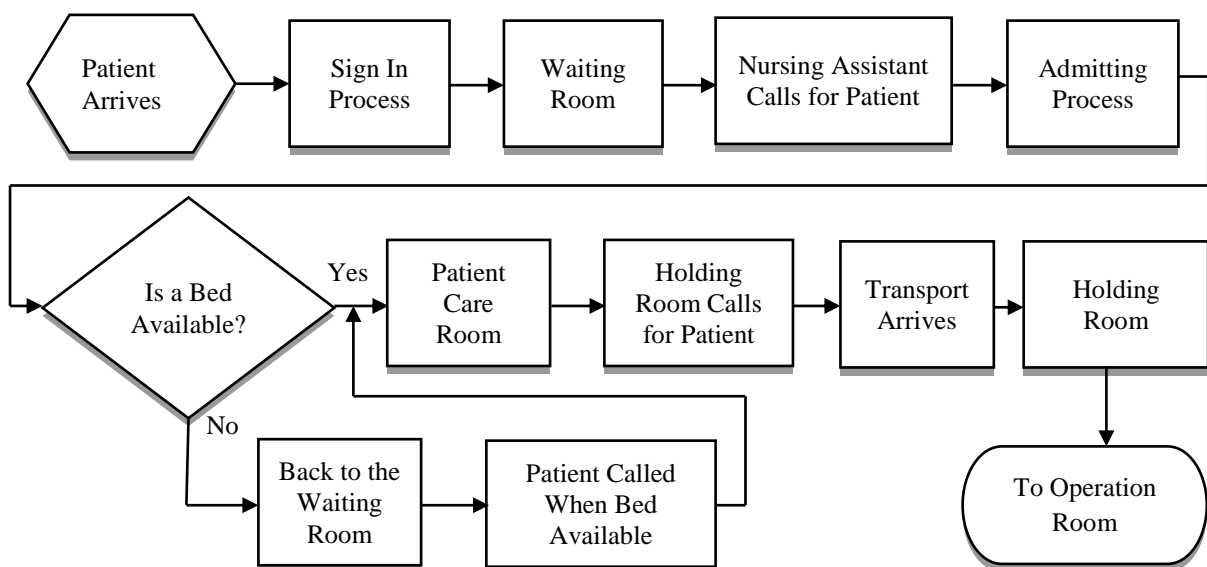
Answers to the above questions provided detailed view of the daily tasks that both patients and staff members experience. Based on these responses, a patient flow table (see Appendix 1) was created to help collect time data needed for the next step analysis. The admittance worker, day surgery nurses and nursing assistants, and the holding room nurses are responsible for completing this chart for each patient. This data helped identify exactly where the bottleneck was occurring.

The findings of the above questions and patient-flow table presented a detailed view of the daily tasks and workflow at LSUHSC' outpatient surgical unit. The work day process is clearly outlined in the patient process chart shown in Figure 2. The admittance worker, day surgery nurses, nursing assistants and the holding room nurses are all responsible for completing this process for every single patient who visits the outpatient surgical unit. The chart illustrates the various time periods in the patient process (i.e. the patient's arrival time, starting and finishing times for admittance and nursing assistant duties, time in and out of the patient care room, transport time, time in the holding room, and time to the operating room).

This chart together with the information collected enables potential patient-flow delays to be identified.

Furthermore, the data collected from the patient flow table helps identify exactly where the bottleneck is occurring by breaking down each station and deciphering the value added and non-value added times for each patient. Value added times are classified as any work directly associated with the patient, such as checking personal information or vital signs; non-value added times are classified as work which is performed that is deemed no value to the patient, such as the patient sitting in the waiting room. After observing and analyzing the patient process, it is evident that the outpatient surgical unit is experiencing operating room delays and cancellations caused by bottlenecks occurred in the pre-operative process.

Figure 2. Patient Process Chart



4.2. Step 2: Analyzing current methods

When a patient experiences a delay or cancellation, a nurse fills out the Delay and Cancellation Form. Day surgery and the operating room nurses fill out two different Delay and Cancellation Forms. These forms, which are shown in Appendix 2 and Appendix 3, respectively, were used to collect data in this study and were required to be attached to the

Patient Flow Table. The Delay and Cancellation Forms clarify exactly why the patient was off-schedule. These Delay and Cancellation Forms were entered into Microsoft Excel to help identify the most common type of delays, as well as the amount of time each patient spent in each process. After the data has been collected, a time study was performed which calculated the length of time each patient spent in the outpatient surgery process along with a root cause analysis.

Figure 3 depicts the average amount of time patients spent in each process: this information was calculated from the patient-flow table. The pre-operative process includes patient admittance, patient in the waiting room, nurses checking in with the patient, patient's being sent for, transportation of patient and holding room. The highest percentage of time (56%) is when patients are in the patient care room, with the second highest percentage of time (27%) consisting of patients being in the holding room.

Figure 3. Average Time Patients Spent in Each Process

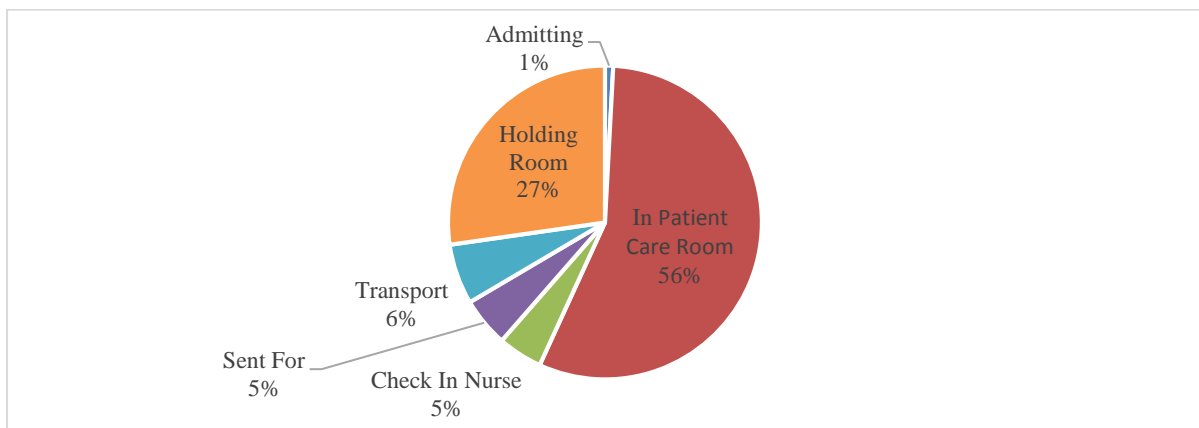
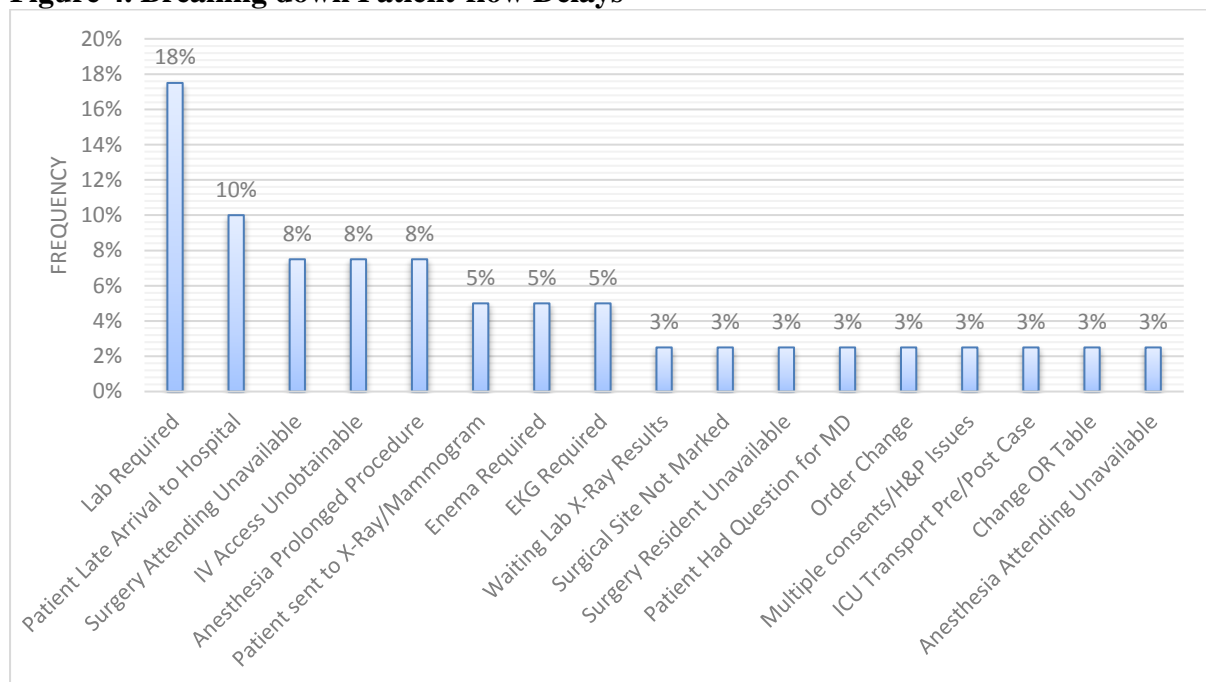


Figure 4 illustrates the numerous types of patient-flow delays that were categorized using the results from the Delay and Cancellation Forms. There were a total of 96 patients who experienced delays during a one-month period. The most common delay turned out to be

not having the appropriate lab paperwork available (18%). The second most common delay was due to patient's late arrival to the hospital (10%). The next most common delay was caused by three separate actions: surgery attending unavailable (8%), IV access unobtainable (8%) and anesthesia prolonging the procedure (8%). The fact that patient's either arrived late or not at all account for a significant proportion of delays (10%), whilst patients' preoperative paperwork being incomplete or not promptly available (31%) is due to four linked factors: lab required (18%), enema required (5%), EKG required (5%), and waiting lab X-Ray results (3%).

Figure 4. Breaking down Patient-flow Delays



4.3. Step 3: Generating improvement ideas

Based on the results of the first two steps, it is perceived that patient-flow delays were mainly caused by individual departments' operations (e.g. surgery attending unavailable, IV access unobtainable, and anesthesia prolonging the procedure). However, it is unlikely that these delays can be improved, because any changes regarding time saving and cost reduction

to surgical operations and procedures may jeopardize the quality of patient care. Therefore, this study focuses on eliminating time wastage created by patients who arrive late to outpatient surgical unit, reduce the time it takes to admit patients, and rectify the issue of incomplete or non-existent paperwork, elements which should make patient-flow more feasible once implemented. The causation of these delays, why they happened and how these issues could be dealt were analyzed and described in the next section.

4.3.1. Patient's late arrival

Patients must report to the outpatient surgery at 5:30 a.m. to begin the surgical process. Late arrivals have the potential to delay or cancel surgeries. The reasons for patients not being punctual are because they are either from out-of-town, got stuck in traffic or didn't remember they had an appointment. Late arrivals often defer hospital's schedules and thus substantially increase hospital's operating cost. Physicians may have to work overtime to complete the daily surgeries. Those patients who arrive on time but see their schedules being deferred to accommodate late arrivals feel dissatisfied due to excessive waiting times.

4.3.2. Admitting process delay

The current admitting process has been observed to have some flaws. In an ideal condition, a patient will be placed in the patient care room only after she/he is admitted. However, the current admitting process allows a patient to be placed in a patient care room before he/she is admitted. This means that a patient is allowed to be admitted before being seen by a nursing assistant. Admittance workers are usually running through the hospital halls searching for the correct patient to admit; the patient sometimes has to be admitted in the waiting room or in the patient care room, depending on where the patient is in the pre-operative process. If this is the case, the admittance personnel must be cautious when

admitting someone, because privacy laws are a major concern. Also, if a patient completes all of these pre-operative steps, there is still a chance that they may not even be admitted. This not only wastes time, but also increases hospital costs.

4.3.3. Paperwork delay

A major issue in the outpatient surgery unit is the loss of paperwork or paperwork arriving late. Currently, medical records such as a patient's history, electrocardiogram results, labs results and x-rays are required for each patient. However, the tardiness or unavailability of electrocardiograms and lab results is a major concern for LSUHSC's outpatient surgery: these files are late or not available at the appropriate time mainly because physicians are not completing the necessary paperwork before the patient arrives in outpatient surgery. Electrocardiograms and lab results are supposed to be completed before the preoperative clinic appointment time. When done in time, there should be a copy of electrocardiogram and test result placed in the patient's file. These documents can then be reviewed by the physicians who would approve the patient for surgery. Some lab results and x-rays are currently stored on the existing computer at LSUHSC for the purpose of easy access, but at present, LSUHSC does not take full advantage of this resource.

Even if patient's medical records arrive on time, there are still other problems with regards to handling of records. In some cases nurses may overlook certain aspects of a patient's medical record, when they are preparing them for transport to the holding room. Once a patient has arrived at the holding room, it is the duty of a nurse to review the records and note the medical procedures that the patients requires; for example, blood work must be taken before the patient can go into surgery. These procedures in the holding room cause a delay in the surgical process because the nurse will have to complete the necessary procedures before the patient can have their surgery.

4.4. Step 4: Developing implementation plans

Due to the problems in the admitting process, including patients' not arriving on-time and incomplete paperwork, delays and cancellations are bound to occur. A Kaizen committee was assembled to develop implementation plans with the aim of solving these problems. This committee consisted of admittance workers, registered nurses from day surgery rooms and holding rooms, as well as the registered nurse unit manager and the perioperative coordinator of the operating rooms. During the kick-off meeting, tasks needed to be defined along with the actions which were going to be taken needed to be itemized. Task assignments regarding the outpatient surgical unit were done in accordance with unit members' daily schedules. After the third round of evaluation meetings, a timeline for completing the plan was established: the plan was to introduce an electronic medical office system to address the inherent issues, with a 6 week time frame for the completion of this plan.

4.5. Step 5: Implementing action items

LSUHSC's IT team researched two possible electronic medical office systems (VantagePoint Charts and VantagePoint EMO) both made by VantagePoint. Regarding system functionality, both systems not only can reformat the hospital's forms and documents, making them easy accessible in the database, but also permit medical staff to enter information into the system by either keyboard, voice, text or digital ink using a tablet or personal computer. Table 2 lists the technical features of both systems.

LSUHSC purchased VantagePoint Charts due to its highly competitive price: VantagePoint EMO cost \$4,999 per location, while VantagePoint Charts cost \$1,999 per location. VantagePoint Charts focuses on customizing patient's charts, chart scanning and document management, whereas VantagePoint EMO is a full electronic medical office

solution. When taken into account LSUHSC’s needs, VantagePoint Charts was a better choice, as it would allow the admittance process to take place online, making the process essentially paperless at a relatively low cost.

Table 2. VantagePoint EMO versus VantagePoint Charts

Features	VantagePoint EMO	VantagePoint Charts
Front Desk Paperless Sign-In	Yes	Yes
Patient Check In & Tracking	Yes	Yes
Patient Appointments	Yes	Yes
Patient Demographics	Yes	Yes
Use your own documents (digitally recreated)	Yes	Yes
Fax & Scanning Solution	Yes	Yes
Biometric Electronic Signatures	Yes	Yes
Interoffice Document Notification	Yes	Yes
Quick Patient Vitals	Yes	Yes
Patient At-A-Glance View	Yes	Yes
Document Annotation	Yes	Yes
Tablet PC support	Yes	Yes
Static Workflow	No	Yes
Dynamic Workflow	Yes	No
Prescription Writing Module	Yes	No
Pharmaceutical Dispensing & Inventory Control Module (optional)	Yes	No
Report Writing Wizard (Optional)	Yes	No
The Briefcase Model	Yes	No
Daily Sign-In History	Yes	No
Patient Speed Panel	Yes	No

4.5.1. Actions taken for addressing patient’s late arrival issues

VantagePoint Charts are able to solve the late arrival issue by using three components: Front Desk Paperless Sign-In, Patient Check In & Tracking and Patient Appointments. VantagePoint Charts were implemented into three different locations: the clinic, admittance/day surgery (these processes are in the same area) and the holding room. Charts created using the Patient Appointments function allowed LSUHSC to track patient’s right from the moment their appointment was made by medical staff through their arrival time at the hospital to their departure.

In addition, VantagePoint Charts offers a pre-registration online service which includes privacy and security protections. With this system, LSUHSC can receive all information online. This enables the hospital to assign patients more effectively with respect to their surgery times and the places. In addition, LSUHSC started requesting admittance workers to call or e-mail patients one to two days prior to their surgeries to remind them of the time and place of their surgeries. These workers can also answer any questions the patient may have regarding the admission process or their surgeries.

4.5.2. Actions taken for addressing admittance process delays

The Kaizen method was initially chosen with the aim of establishing a well-organized and effective admittance process, which starts with the admittance workers at the clinic. At the clinic, the admittance workers carry out the same duties on a daily basis of checking the patient's health insurance and demographics. The admittance workers also attempt to contact the patients by phone prior to their admission date to pre-register them in order to expedite room assignment, any testing required and admission. They also ensure that all documents needed to proceed with the surgery are completed and are placed in the patient's respective folder. To reduce unexpected insurance delays, LSUHSC decided to start the admittance process earlier to allow more time to handle such delays. This new admittance process occurs one to two weeks before the scheduled surgery of the patient, and it takes place around the time when the patient has his/her doctor's appointment at the clinic. On the day of the surgery, it is the job of the admittance worker to check the patient's identification and to verify that he/she is the correct person for that surgery.

4.5.3. Actions taken for addressing paperwork delays

LSUHSC decided to implement a punishment mechanism for physicians and/or surgery services in an attempt to improve incomplete paperwork issues. The system forces the physicians or their assistants to complete any necessary paperwork prior to the patient arriving at the outpatient surgical unit. Since completing patients' records at the clinic is a requirement, physicians and/or surgery services should be held accountable at committee meetings, with an adequate punishment being enforced if this issue should continue to rise. In addition, patient records are now created as digital originals in VantagePoint Charts which helps physicians manage the patient care service process and maintain patients' records such as electrocardiograms with ease.

4.6. Step 6: Evaluating results

To study how the proposed actions would benefit LSUHSC, a cost and benefit analysis was conducted using the data collected in one month period at the outpatient surgery department. There were a total of 96 patients who experienced delays over the one-month study period. The minimum time caused by these delays during this period amounted to 7.2 hours (433 minutes). The average delay time per patient is about 4.5 minutes. These delays were mainly caused by patients' not arriving on time, slow admittance process and patients' medical paperwork being either incomplete or not promptly available. Based on the assumption that each delay associated with the operating room costs LSUHSC \$2000 per hour, the operating room delay alone cost SUHCS a minimum of \$14,400. There are additional costs which needed to be taken into consideration as well: the cost of changing an operating room in between patients costs the hospital a minimum of \$1,500. Also, when a patient is altered from a first case patient to a second case patient or vice versa, this costs the hospital another \$1,500, minimum; on average, there were five patient order changes per month, this resulted in the hospital paying an extra \$7,500. The total delay cost to LSUHSC

amounted to \$21,900. Appendix 4 provides formulas for calculating various cost used for this cost and benefit analysis.

With VantagePoint Charts system, the 31% of patient-flow delays derived from incomplete or late paperwork (18% caused by lab results required; 5% an enema being required; 5% EKG required; 3% waiting on X-Ray results) could be resolved and would reduce the delay cost from \$21,900 to \$6,789. The total cost of the VantagePoint Charts system for three location was \$6000 per year (or \$500 per month). Assumed that the 10% patient-flow delays deriving from patient's late arrival or not showing up for appointments at all remained unchanged and amounted to \$2,190, the total cost after implementing the VantagePoint Charts system turned out to be \$9,479. Overall, LSUHSC could save \$12,421 (i.e., \$21,900-9,479) per month or 149,052 yearly.

5. Discussion and Conclusion

Researchers have paid special attention to healthcare, especially regarding quality of care and cost-effective issues. This study applied a Six-Step Kaizen Ladder framework to identify patient-flow delay problems in the outpatient surgery process, organized solutions plans to improve the process, provided several empirical measures to improve the efficiency of the surgery process, attempted to eliminate the mistakes made regarding the loss of patients records and delays in patients hospital process; subsequently introducing a healthcare information system which could solve the delays in the admittance process, patient lateness to the outpatient surgical units and incomplete paperwork.

With regard to the theoretical and practical implications, this case study provides a significant insight into the health information system and how it is run. By using the Kaizen methods, time wastage and unnecessary delays in patient-flow were identified, thanks to the use of a patient-flow table and patient process chart, both of which confirmed the most

significant patient-flow delays in the outpatient surgical process via Delay and Cancellation Forms and a thorough study of how much time each patient process took. This paper demonstrates a rigorous methodology and guide for patient process improvement both for research scholars and healthcare practitioners, and has outlined how this process can be applied practically to a specific healthcare unit.

Whilst, healthcare managers may want to adopt an alternative method which allocates organizational resources through HIS; the benefits of using a HIS have clearly been identified in this study, benefits that not only minimized the chaos and disorder in the outpatient surgery unit but also condensed the bottleneck of patient-flow and reduced patient-flow delays and the costs they incur. All of which led to an increased profit margin for healthcare services.

An appropriate assessment regarding the impact these healthcare service improvements have also been outlined, with this study evaluating the cost and benefit after the adoption of HIS by calculating time delays in the outpatient surgical process. Therefore, it can be noted that the Kaizen method is not only invaluable to the healthcare system but can also be easily applied; improving the quality of the healthcare service as well as reducing the cost of healthcare.

In conclusion, for two decades, healthcare providers have strived for improvements in all aspects of the healthcare system to help facilitate patient satisfaction and increase hospitals profit margins. As considerable transformations are expected in the future, healthcare industries have the choice to either evolve with this advancement or be overpowered by other hospitals. Using the Kaizen method in this case study, large amounts of savings have been achieved, as well as a significant improvement in patient-flow with the aid of HIS. This study has shown a healthcare practice which can provide staff members with appropriate HIS to help improve care efficiency, and one which directly involves them in the

identification of solutions, which will improve staff members productivity as well as patient satisfaction.

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Appendix 1. Patient Flow Table

Patient Flow Table					
<u>DATE:</u>			<u>PRIOR PREOP:</u>	Yes	No
<u>ARRIVAL TIME:</u>			<u>ITEMS MISSING:</u>		
<u>PATIENT TYPE:</u>	<input type="checkbox"/> 1 st Case <input type="checkbox"/> 2 nd Case <input type="checkbox"/> 3 rd Case <input type="checkbox"/> Other		<input type="checkbox"/> H&P <input type="checkbox"/> EKG <input type="checkbox"/> CXR <input type="checkbox"/> Lab <input type="checkbox"/> OR Consent		
<u>TIMES:</u>			<u>SERVICE:</u>		
	Time In/Start:	Time Out/Completion:	<input type="checkbox"/> General	<input type="checkbox"/> Ortho	<input type="checkbox"/> Neuro <input type="checkbox"/> Heart
Admitting (Vincent):			<input type="checkbox"/> Plastics	<input type="checkbox"/> Trauma	<input type="checkbox"/> Pedi <input type="checkbox"/> Tumor
In Room:			<input type="checkbox"/> Vascular	<input type="checkbox"/> ENT	<input type="checkbox"/> GYN <input type="checkbox"/> EYE
Check In Nurse:			<input type="checkbox"/> OMFS	<input type="checkbox"/> BU	<input type="checkbox"/> Oncology <input type="checkbox"/> GU
Chart & Patient Ready:			<u>REMARKS:</u>		
Sent For:			Nurse: <input type="checkbox"/> No NA	<input type="checkbox"/> No Bed	<input type="checkbox"/> No Room
Transport:			<input type="checkbox"/> Cancellation	<input type="checkbox"/> Enemas	
*Holding Room:			NA: <input type="checkbox"/> Patient Not Ready	<input type="checkbox"/> Patient No Show	
To OR:			<input type="checkbox"/> Desk Notified		
			<input type="checkbox"/> Call for Help w/Patient Bed		
<u>*HOLDING ROOM:</u>		<u>OR ROOM #:</u>	<u>CANCELLATION REASONS:</u>		
<input type="checkbox"/> IV in <input type="checkbox"/> Patient seen by Anesthesia					
<u>COMMENTS:</u>					
<i>** Please attach a copy of the Delay/Cancellation form</i>					

Appendix 2. Delay and Cancellation Forms for Day Surgery

LSUHSC – Day Surgery Delay / Cancellation Form

Date: _____

OPS Staff: _____

Time Signed In: _____

Time Signed Out: _____

Patient Information:

Circle Code for Delay

1. Patient arrived to hospital late
2. No chart/paperwork received on patient
3. Insurance verification
4. Interpreter needed
5. Lab required
6. Enema required
7. EKG required
8. UPT required
9. Lab pending
10. Patient sent to X-Ray/Mammogram
11. IV access unobtainable
12. MD with patient
13. MD using chart
14. Medical Therapy required – blood, respiratory tx.
15. Order change
16. Add on from clinic
17. Consent incomplete/not present
18. Patient request to talk to doctor
19. Patient in lock-up

Comments:

Appendix 3. Delay and Cancellation Forms for Operating Room

LSUHSC: OPERATING ROOM DELAY / CANCELLATION FORM

Date: _____ Room #: _____
Patient's Name: _____
OR Nurse: _____
Anesthesia Staff: _____
Anesthesia Resident/CRNA: _____
Total Delay Time: _____

Room Ready: _____
Time In: _____ Time Out: _____
Service: _____
Surgeon: _____
Resident: _____

CIRCLE CODE FOR DELAY

Floor Delays

1. Lab required
2. Prolonged regional block recover
3. Environmental Service
4. Insurance verification
5. PACU Re-intubated
6. Interpreter unavailable
7. Patient receiving blood
8. Respiratory distress
9. Medical therapy required

10. Waiting lab X-Ray etc. results
11. Unstable vital signs
12. No beds – Floor ICU
13. Patient arrived late
14. Resident/CRNA unavailable
15. Pending lab X-Rays/EKG results/UPT results
16. Transport delay
17. Previous patient a no show
18. Patient arrive to hospital late

Operating Room Delays

19. Waiting for elevator
20. Add on case to elective/emergency schedule
21. Delay in sending for patient
22. Bumped for emergency case
23. Change in case order
24. Field contaminated (room re-opened)
25. Complex case
26. Nursing staff unavailable
27. H/P not present
28. OR equipment unavailable
29. Multiple consents/H&P issues
30. Return to OR
31. MD time request
32. Room being cleaned

33. Outside equipment/implants unavailable
34. Waiting for transport
35. Previous case cancelled
36. Unavailable for transport
37. Procedure scheduled incorrectly
38. Prolonged nursing set up
39. Surgery attending unavailable
40. Case cart not set up
41. Surgery resident unavailable
42. Room change
43. Surgical consent not complete per policy
44. Terminal clean needed previous case
45. Surgical consent not present
46. Surgical site not marked

Anesthesia Delays

47. Anesthesia consent not complete per policy
48. Anesthesia attending unavailable
49. Anesthesia consent not presents
50. Anesthesia assessment not complete per policy
51. Anesthesia assessments not present
52. Anesthesia prolonged procedure
53. Anesthesia tech unavailable
54. IV access unobtainable
55. ICU transport Pre/Post case

PACU

56. PACU equipment delay
57. PACU floor not available for report/patient
58. PACU hemorrhage
59. PACU no bed available
60. PACU pain
61. PACU slow emergency anesthesia

Other Department Delays

62. X-Ray equipment/tech unavailable

Comments:

Appendix 4 Formulas and Assumptions for Cost-benefit Analysis

Transportation Time Formulas

$$\frac{t_{travel}}{pt.} = t_{down} + t_{up}$$

$$t_{down} = t_{(floor\ to\ OR)}$$

$$t_{up} = (1 - \% RR)(t_{(OR\ to\ floor)}) + [\% RR + \% back - (\% RR)(\% back)] t_{(RR\ to\ floor)}$$

$$t_{(6G\ travel)} = t_{(6G\ down)} + t_{(6G\ up)}$$

$$t_{(3G\ travel)} = t_{(3G\ down)} + t_{(3G\ up)}$$

$$t_{savings} = t_{(6G\ travel)} - t_{(3G\ travel)}$$

Transportation Cost Formula

$$\frac{C_{travel}}{pt.} = C_{down} + C_{up}$$

$$C_{down} = \left(\frac{pt.}{day}\right) \left(\frac{t_{(floor\ to\ OR)}}{60}\right) (N.A.sal. + E.O.sal.) \left(\frac{W.D.}{yr.}\right)$$

$$C_{up} = C_{(OR\ to\ floor)} + C_{(RR\ to\ floor)}$$

$$C_{(OR\ to\ floor)} = \left(\frac{pt.}{day}\right) \left(\frac{t_{(OR\ to\ floor)}}{60}\right) (N.A.sal. + E.O.sal.) \left(\frac{W.D.}{yr.}\right) (1 - \% RR)$$

$$C_{(RR\ to\ floor)} = \left(\frac{pt.}{day}\right) \left(\frac{t_{(RR\ to\ floor)}}{60}\right) (N.A.sal. + E.O.sal. + N.sal.) \left(\frac{W.D.}{yr.}\right) [\% RR + \% back - (\% RR)(\% back)]$$

$$C_{(6G\ travel)} = C_{(6G\ down)} + C_{(6G\ up)}$$

$$C_{(3G\ travel)} = C_{(3G\ down)} + C_{(3G\ up)}$$

$$C_{travel\ savings} = C_{(6G\ travel)} - C_{(3G\ travel)}$$

Operating Room Delay Cost Savings Formula

$$t_{savings} = t_{(6G\ travel)} - t_{(3G\ travel)}$$

$$C_{(OR\ delay\ savings)} = \left(\frac{pt.}{day}\right) (t_{savings}) \left(\frac{\$500}{15\ min}\right) \left(\frac{W.D.}{yr.}\right)$$

Notation

$t_{(floor\ to\ OR)}$ = Travel time from either 3rd floor or 6th floor to OR

$t_{(OR\ to\ floor)}$ = Travel time from OR to either 3rd floor or 6th floor

$t_{(RR\ to\ floor)}$ = Travel time from RR to either 3rd floor or 6th floor

% RR = Percentage of patients requiring general anesthesia therefore requiring recovery room

% back = Percentage of patient returning to day surgery for discharge

pt. = patient

N.A.sal. = Nursing assistant salary (per hour)

E.O.sal. = Elevator operator salary (per hour)

N.sal. = Nursing salary (per hour)

W.D. = Working day

OR = operation room

RR = recovery room

Assumptions

$$t_{(6G\ to\ OR)} = t_{(OR\ to\ 6G)} = t_{(RR\ to\ 6G)} = 6\ min$$

$$t_{(3G\ to\ OR)} = t_{(OR\ to\ 3G)} = t_{(RR\ to\ 3G)} = 2\ min$$

$$\% RR = 75\%$$

$$\% back = 75\%$$

$$Pt./day = 42$$

$$W.D./yr. = 260$$

$$N.A. = \$7/hour$$

$$E.O. = \$7/hour$$

$$N = \$19/hour$$