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14. ABSTRACT
The purposes of this case study was to determine if the operating suites at Mayo Clinic Arizona have been utilized efficiently in the past and identify if there is additional capacity within the current number of the operating rooms. The operating suite consists of 18 operating rooms that support 11 surgical services, 57 surgeons, and a tertiary care practice. The variables examined were: OR capacity, utilized OR capacity, allocated block-time for each service, use of allocated block-time by each service, allocated block-time released by each service, and block time lost. The data used was from calendar years 2006 and 2007. In some instances only 2007 data was used due to the unavailability of 2006 data. Analysis showed raw utilization of 61% and adjusted utilization of 74%. The highest three users of block time were general surgery, gynecology, and urology. In 2007, 946 surgical hours were lost due to delays in the first case of the day. The results of this study suggested the ORs were under utilized in 2006 and 2007 and capacity exists to support more cases in the future. Mayo Clinic would benefit from additional studies on process and efficiency within the ORs. Additionally, the organization should allocate block time to individual surgeons, verses services, to facilitate better understanding of utilization as well as to control staffing costs.

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Graduate Management Project

Submitted to

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In partial fulfillment of the requirements for Degrees in Health and Business Administration

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Abstract

The purposes of this case study was to determine if the operating suites at Mayo Clinic Arizona have been utilized efficiently in the past and identify if there is additional capacity within the current number of the operating rooms. The operating suite consists of 18 operating rooms that support 11 surgical services, 57 surgeons, and a tertiary care practice. The variables examined were: OR capacity, utilized OR capacity, allocated block-time for each service, use of allocated block-time by each service, allocated block-time released by each service, and block time lost. The data used was from calendar years 2006 and 2007. In some instances only 2007 data was used due to the unavailability of 2006 data. Analysis showed raw utilization of 61% and adjusted utilization of 74%. The highest three users of block time were general surgery, gynecology, and urology. In 2007, 946 surgical hours were lost due to delays in the first case of the day. The results of this study suggested the ORs were under utilized in 2006 and 2007 and capacity exists to support more cases in the future. Mayo Clinic would benefit from additional studies on process and efficiency within the ORs. Additionally, the organization should allocate block time to individual surgeons, verses services, to facilitate better understanding of utilization as well as to control staffing costs.

Disclaimer

The opinions or assertions contained herein are the views of the author and do not reflect the official policy or position of the Mayo Clinic, Department of the Air Force, Department of Defense, U.S. Government or Baylor University. The study contains no patient identifying information.

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Introduction

Overview of the Mayo Clinic

The Mayo Clinic is a not-for-profit group practice dedicated to the diagnosis and treatment of simple and complex ailments and diseases. The organization has sites in Rochester, Minnesota, Jacksonville, Florida and Scottsdale/Phoenix, Arizona. These three sites have a combined staff of more than 2,500 physicians and scientists supported by 42,000 plus administrative and allied health professionals. On average the Mayo clinic treats more than a half a million people every year. (Mayo Clinic, 2007)

The Mayo Clinic in Scottsdale, Arizona opened in 1987. Since the opening of the original clinic in Scottsdale, the organization has evolved into a multi-campus system that includes the Mayo Clinic, Mayo Clinic Collaborative Research Building, and Samuel C. Johnson Research building in Scottsdale and the Mayo Clinic Hospital and Mayo Clinic Specialty Building in Northeast Phoenix. The Mayo Clinic Arizona (MCA) campus has 341 permanent physicians and scientists, 137 residents and fellows, and 3,679 administrators and allied health personal. On average the Scottsdale/Phoenix Mayo Clinic system diagnoses and treats over 100,000 patients with 26% of them originating from somewhere other than Arizona. (Mayo Clinic, 2007)

The Mayo Clinic Hospital opened in the fall of 1998 and was designed to provide state-of-the-art inpatient medical care. The organization promotes a team approach to delivering healthcare services and is known as a premier academic medical center in the Southwest. The hospital has 244 licensed beds, 18 operating rooms (OR), and a level II emergency room. The hospital provides inpatient care to support the 65 medical and surgical specialties and programs that the Mayo Clinic offers. The premier programs of the hospital are cancer treatment and solid organ/bone marrow transplant. (Mayo Clinic, 2007)

Problem Statement

In today's competitive healthcare market of capitated reimbursement and managed care, it is becoming increasingly important to contain cost and improve revenue streams (Overdyl, Harvey, Fishman, & Shippey, 1998). Organizations have seen reduced revenues from operating room care because of lower Diagnosis Related Group (DRG) payments, reduced fee-for-service rates, and capitated payment plans (Mazzei, 1999). With a tighter revenue stream OR utilization is increasingly important as unscheduled downtime within OR suites is costly (Basson, Butler, & Verma, 2006). MCA is no different and has made it a goal for all surgical departments in the organization to assess their current business practices.

MCA like other academic health centers face higher patient care cost than nonteaching hospitals, so it important they find efficiencies wherever possible (Koenig, et al., 2003). MCA is facing a perceived shortage of available prime operating time. Block-time or prime operating time is defined as the 9 hours (0730-1630) allocated daily (Monday through Friday) to each surgical service during which only that service can schedule surgery case(s) for the assigned operating room (OR). Currently the organization is adding surgeons and general medical education (GME) programs with no additional operating rooms scheduled to open in the next two years. Given the situation, it is paramount to understand how effectively the current prime operating time is being used.

The difficulty is in determining if there is actually a shortage of available block-time for the organization or if there are more efficient ways to allocate block-time and accommodate services in need of additional block-time. To address these issues the surgical leadership of the various surgical departments must determine if the 18 operating suites are being utilized efficiently and if the current method of allocating block-time is the best for the organization.

MCA, similar to most hospitals, assigns block-time to different surgical services with the expectation that those services will maximize utilization of the time (Ozcan, 2005). Block-time allocation to services does not always provide the results the surgical leadership is looking for in regard to management of the operating room (Mazzei, 1999). There are many different factors that can impact the utilization of operating room time. Some of these factors include: the surgeon's work schedule, the type of surgical procedure, the surgeon performing the operation, the presence of staff in training, and technology.

Historically Mayo Clinic has used a blue-orange (days of the week are labeled as blue or orange on a rotational basis) schedule for surgeons. The result of the blue-orange schedule is a surgeon will have a surgery day every other day, but is not guaranteed to have an OR at 0730. Previous studies have shown by having the same group of surgeons assigned to work on the same days of week for all practical purposes, the block-time is being allocated to individual surgeons instead of services (Dexter, Macario, Traub, & Lubrasky, 2003).

Literature Review

History

Few areas have a greater impact on the finances of the hospital than surgical services (Zelenock & Zambricki, 2001) Before managed care and capitated payments, hospitals were able to staff operating rooms for 8 to 12 hours a day and have little concern if they were fully utilized (Mazzei, 1999). During the 1990s, the healthcare market started to change as contracts demanded appropriate charges for services rendered (Morrisey, 2001). According to Zelenock and Zambricki "Cost Plus" financing of medical care is gone and will not return. The shift in the market has affected Academic health centers more than non-teaching hospitals due to the higher operating costs associated with teaching (Williams, Matthews, & Hassan, 2007). A study by Dobson, Sen, Koenig, Ho, and Gilani (2002) found that the relative change in operating margin in academic hospitals were 17.6% compared to 5% for non-teaching hospitals. With the reduced payments from payers it is paramount for organizations to become more efficient (Williams et al.).

There have traditionally been two types of OR scheduling systems used by hospitals (Ozcan, 2005). The first and easiest one to implement is allocation based on a first-come, first-serve basis (Ozcan). The second schedule is a block scheduling method where a service or surgeon is assigned a particular block of time either in half day or full day increments to schedule their cases in (Ozcan). Under the block method the surgeon is expected to efficiently fill the block of time with surgical cases (Tyler, et al., 2003). In this scenario surgeons or services with high utilization will be given more time in the operating room and those with lower utilization will lose operating room time (Tyler, et al.). The use of utilization as a reason to reallocate block-time from one surgical service to another is a source of contention with surgeons (Young, 2004).

Organizations typically set a utilization target, which the OR leadership will use to evaluate the efficiency of the organization's operating rooms and determine how much block-time a service or surgeon will receive (Archer & Macario, 2006). At MCA the goal has been set at 75% for each service. Many researchers believe the optimum utilization rate lies somewhere between 80% and 85% and that a 100% utilization rate is not realistic (Tyler, et al., 2003). A hospital has to have a flexible operating room schedule to deal with emergencies and variation in the duration of surgeries (Dexter, 2002). Variability in case durations can make it difficult for an OR manager to build a schedule that fully utilizes all available time (Tyler, et al).

In addition to setting utilization targets, healthcare organizations lack a standard for calculating utilization within the industry. Some institutions calculate raw utilization, which is the total hours of case performed during block-time divided by the available block-time (Marjamaa, Vakkuri, & Kirvela, 2008). Other organizations calculate and report an adjusted utilization number, which includes credit for turnover time of the operating room (Marjamaa et al.). The other critical piece involved using either method is determining how the organization accounts for the release and gaining of block-time from one service to another after the initial allocation (Dexter, Macario, Traub, & Lubrasky, 2003).

Call for Change

There are increasing concerns with using utilization as the sole criteria to award operating room time (Dexter, Macario, & et al., 2003). Utilization can be easily manipulated and does not always provide the details needed to make sound business decisions (Tyler, et al., 2003). Detxer et al. found that utilization used as a sole source on who should receive more block-time will not account for bed issues, contribution margin, or variable costs the hospital might incur by assigning more block-time to a surgeon with high utilization.

Additionally the traditional definition of utilization does not account for the occurrence of over utilization, which happens when cases are finished outside of block-time (Strum, Vargas, & May, 1999). When cases are performed outside of normal scheduled operating hours additional costs are incurred for the organization (Strum, et al.) Furthermore Archer and Macario (2006) point out high utilization does not mean the OR has been used efficiently.

There are many different variables that can impact operating room efficiency and utilization. Some of the variables that impact utilization in the operating room are methods used for scheduling, type of surgical cases, order of these cases, variable turnover time, and staff expertise and availability

(Dexter, Macario, & et al., 2003). With so many different forces impacting utilization, it is critical to look at a toolbox of metrics. One metric found useful to understand throughput in the OR is measuring turnover time and other non-operative time (Harders, Malangoni, Weight, and Sidhu, 2006). By measuring and accounting for non-operative time the manager can find opportunities to improve efficiency (Marjamaa, Vakkuri, & Kirvela, 2008). Some other recommended measurements by Marjamma et al. are measuring OR start times, case volumes, case length, under- and over-utilization, costs, cancellation rate, and complications.

Opportunities in Processes Improvements

To increase efficiency and utilization within the surgical department alterations have been made to the first-come, first-serve and block scheduling methods (Ozcan, 2005). One method is to schedule the shortest case first, because the estimated time is usually more accurate and will not create a delay for the next case (Lebowitz, 2003). Another alternative to the first-come, first-serve is top-down, bottom-up (Ozcan). In this schedule the day is broken in half with the morning being set aside for the longer case and the afternoon for the shorter cases (Ozcan).

In regards to block-time scheduling one of the recommended change is to use a computer system to help build the surgical day by placing the surgical cases into the room and time where they make the most sense (Dexter & Traub, 2002). When using a computer system to fit the cases into a schedule as policy needs to be developed (Van Houdenhoven, Van Oostrum, Hans, Wullink, & Kazemier, 2007). The reason for a policy is that for a computer system to improve utilization the surgical schedule needs to be set two weeks in advance (Van Houdenhoven, et al.) The goal of using a computer to place surgical case in a best-fit method is to eliminate the services that overbook their day knowing that they will finish out of block (Dexter & Traub). The key to any schedule is trying to get to accurate case length estimates (Dexter, Epstein, Traub, & Xiao, 2004).

In addition to the changes with scheduling, a recent study by Freidman, Sokal, Chang, and Berger (2006) found that a change in the patient processing on the day of surgery can increase efficiency within the OR. The recommended change involves moving the induction and prep of the patient out of the OR and into another room to save the time that is wasted between one patient leaving the OR and the next case starting (Freidman, et al.). Another study found that preoperative clinics run by an anesthesiologist, where the patient will be seen and evaluated the day before surgery will reduce operating room cancellations and delays (Ferschl, Tung, Sweitzer, Hou, & Glick, 2005). Additionally Parsa, Sweitzer, and Small (2004) found these clinics enhance patient safety and satisfaction.

Importance of Technology

To be able to properly monitor the performance of the operating room and the identified metrics, one needs a sophisticated information system (Marjamaa & Kirveka, 2007). According to De Deyne and Heylen (2004) the system should be able to allocate and manage the optimal amount of OR time for individual surgeons to minimize the cost of performing surgeries outside of normal allocated time. Ideally the OR information system should enable centralized schedule, daily management of OR activity, and provide posthoc evaluation reports (Junger, et al., 2002). Additionally De Deyne and Heylen found within their hospital that by having a large screen, similar to those found in airports, displaying real time information on OR activity improved efficiency.

Macario and Vasanawala (2002) found in a survey that the feature most OR managers wanted in an information management system was a way to track the patient. Outpatient clinics, emergency rooms, and even some ORs have been using computerized tracking systems for sometime (Borowitz, 1996). The tracking systems that have been used though are a bar coded based system, which similar to traditional keystroke entry systems, have a dependency on manual data input (Shaw, Coia, & Michie, 1999). The problem with data that has been manually inputted is the higher likelihood of errors in the data (Plaster, Seagull, Xiao, 2003). To remove some of the manual process involved in current tracking systems, Marjamma, Torkki, P., Torkki, M., and Kirvela (2006) tested the use of a wireless tracking system that incorporated infrared and radio frequency tags to capture the timestamp of the patient's movement throughout the clinic. What Marjamma et al. found was the data was more accurate than the same information that had been collected manually. An improvement in data collection would allow information to be available immediately and remove the chance of manipulation of the timestamp (Marjamma, et al).

Statement of Purpose

The purposes of this case study was to determine if the operating suites at Mayo Clinic Arizona have been utilized efficiently in the past and to identify additional capacity within the current number of operating rooms. The variables examined were: OR capacity, utilized OR capacity, allocated block-time for each service, use of allocated block-time by each service, allocated block-time released by each service, and block-time lost. The period of time studied was calendar years 2006 and 2007. In some instances only 2007 data was used due to the unavailability of 2006 data.

Methods and Procedures

This was a retrospective study utilizing calendar year 2006 and 2007 data for the following surgical **services**; cardiac (CT), plastics, neurological (Neuro), gynecology (GYN), orthopedics (Ortho), urology (Uro), ear-nose-throat (ENT), and general surgery (GS). General surgery is unique from the other surgical **services** as it is comprised of 4 distinct **services**; general surgery, transplant, vascular, and colon-rectal. In the case of MCA as most academic centers, each surgical service is a department of three or more surgeons (Dexter, Abouleish, Epstein, Whitten, & Lubarsky 2003).

The data was collected from Peri-operative logs and the financial department's surgical reporting packet (SAC packet). The data then was compiled for each service on a monthly and yearly basis using Microsoft Excel. Descriptive statistics were developed to help guide the qualitative analysis. This case study can serve as a baseline for future studies on the efficiency of the ORs and potentially as an impetus for change to current policies.

An analysis of percentage of allocated block-time used was performed to identify which services were over utilizing and which services were under utilizing the resources provided to them in assigned block-time. Over utilization was defined as using more than 85% of allocated block-time, while under utilization was defined as using less than 75% of allocated block-time. These benchmarks are based on historical literature, which show 75% to 85% OR utilization as the desired metric for acute care hospital perioperative suites (Patterson, 1997). Experts agree that this range is the optimal utilization an OR can reach before straining the system with possible overtime cost (Tyler, et al., 2003).

Operational Definitions

The following definitions were used for the analysis:

Original allocated block-time hours were the initial block-time assigned to each surgical service each month. The block-time available each day for individual services varies. The monthly block-time allocation used by MCA can be seen in Figure 1.

Reported allocated block-time hours were the available hours for each service based on services credited for release of block-time prior to 48 hours. Available hours do not change if a service gains block-time from another service. As an example, if gynecology has two rooms and releases one room and plastics, which does not have an assigned OR, picked up the free room; the reported available block-time would be 9 hours for gynecology and 0 hours for plastics.

Reallocated block-time hours were the actual available hours for each surgical service accounting for release and gain of block-time. As an example, if gynecology has two rooms and releases one room and plastics, which does not have an assigned

OR, picked up the free room; the reported available block-time would be 9 hours for gynecology and 0 hours for plastics.

Release of block-time is the original allocated block-time a surgical service gives back each month prior to 48 hours of assignment because of lack of cases.

Gained block-time is the total hours a service receives from the available block-time another service has released.

Hours used were the actual hours used from patient entry to patient exiting the operating room plus 30 minutes for turnover time for each surgical service per month.

In-to-cut time is the total minutes for the first phase of the surgical case. The period of time last from when the patient enters the room until the surgeon makes his or her incision. During in-to-cut time the team will position the patient and the anesthesiologist/CRNA will begin induction.

Cut-to-close time is the total minutes for the second phase of the surgical case. The period of time lasts from the surgeon's incision to the placement of dressing.

Close-to-out time is the total minutes for the last phase of the surgical case. The period of time is from the placement of the dressing or wound closure until the patient leaves the room.

Turnover time is the time used to clean up the operating room after one patient leaves and the next one enters. In the case of MCA this time is not captured or calculated. Instead a flat credit of 30 minutes is used for each surgical case.

On-time start is a surgical case where the patient was in the room within 5 minutes of scheduled surgery time.

Late start is a surgical case that begins 5 minutes after scheduled surgery time for any reason that was not approved prior to surgery day.

Unused start is an operating room that does not have a case scheduled to begin at the start (0730) of block-time.

Cancelled Case is a surgical case cancelled the day of surgery for any reason.

Original block allocation utilization is the percentage of total hours used compared to original allocated block-time for each service.

Reallocation utilization is the percentage of total hours used compared to reallocated block-time for each service.

Reported utilization is the percentage of total hours used compared to reported allocated block-time.

Calculations

The block-time assigned and hours used were determined for each surgical service to help establish the percentage consumed each month. The calculation was done by dividing the total hours used by total hours (block-time) allocated and then multiplied by 100 to get a percentage of OR utilization for each service.

For example general surgery on Friday's are allocated 5 ORs for 9 hours, for a total of 45 allocated hours. On this particular Friday they had 5 surgeons scheduled to work with a total of 10 cases scheduled, resulting in a total of 33.2 hours used. The formula for the day would be 45 (allocated Hours)/ 33.2 (hours used) = 73.77% OR utilization for general surgery.

To determine the average hours per case, the total number of cases performed by each surgical service was divided by the total number of hours used by each surgical service for 2007. All cases were included. Following the same example used previously general surgery the result would be, 33.2 (total Hours) / 10 (surgical cases) = 3.32 (average case length).

Additionally the actual time spent in the operating room was broken into three separate, sequential categories of in-to-cut, cut-to-close, and close-to-out to see how the time in the OR was spent by each service. All surgical cases were gathered by service and then sorted by start time. The cases that were started and finished completely within block-time were labeled as block cases and all others were labeled as non-block cases. Once the actual time for each case was broken down those cases with an in-to-cut time or close-to-out time over 60 minutes were removed as an outlier. A calculation then was done to identify the percentage of total case time used for each phase; in-to-cut, cut-to-close, and close-to-out. For example a surgical case with a total time of 210 minutes, would result in 17% of total case time (35 mins) used for in-to-cut, 78% (165 mins) of total case time used for cut-to-close, and 5% (10 mins) of total case time used for close-to-out.

To calculate the number of cases needed to reach 75% and 85% utilization, 2007 data on the number of ORs originally allocated and the average case length for each service was used. The calculation was done for a daily, weekly, monthly, and yearly total. For example orthopedics on Friday's are allocated 3 ORs for 9 hours, for a total of 27 allocated hours. To find the total number of cases need for 75% utilization the formula is 27 (allocated hours) x 75% (desired utilization) = 20.25 (needed surgery hours) and then 20.25 (needed surgery hours) / 2.57 (average case length) = 7.8 cases.

Assumptions

For the purpose of this case study a few assumptions were made. The first assumption was staffing will remain stable and the organization will be able to continue to run 18 ORs during normal business hours. Secondly the support areas; pre-operative services, post-operative services, inpatient units, pharmacy, lab, and radiology will continue to provide the same level of services needed for surgical patients and will not be affected by an increase in surgical volumes. Lastly MCA will continue to allocate block-time as they have in the past using the block schedule method verses an open schedule of first come, first served.

Results

The goal of the study was to understand past OR utilization at MCA and to help identify if additional capacity exists within the current 18 operating suites. The ORs are available to support emergency surgeries 24 hours a day, 7 days a week but the goal is to optimally staff and utilize the ORs 85% of the available time during the hours of 0730 to 1630, Monday through Friday.

Hours Allocated per Surgical Service

Tables 1 and 2 present the total hours of block-time each surgical service was assigned in 2006 and 2007. Based on different accounting methods described in the operational definitions there are three different totals. The original allocated hours represent the hours each surgical service was expected to need. The reported allocated hours accounted for hours a surgical service released, while the reallocated hours accounted for situations where surgical services released and/or gained block-time.

Based on the data in tables 1 and 2 the services had similar original allocated hours in 2006 and 2007 except for cardiac surgery. In 2007 cardiac surgery was allocated the hours that had previously been unassigned in the 2006 original allocation. When comparing the original allocated hours with the reported allocated hours for urology there is a 2% decrease from year to year. Neuro surgery and orthopedics also have a 1% decline in total reported allocated hours compared to original allocated hours. The opposite trend happened with general surgery, where the percentage of the total original allocated and reported allocated hours stayed the same at 24%. The difference in general surgery's total is identified when comparing the original allocated hours to the total of reallocated hours. General surgery in both years was allocated 24% of the total available block-time, but after reallocation general surgery had 28% of the total available block-time.

Table 1

Allocated Hours to Surgical Services 2006

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours	Reported Allocated Hours	% of Total Reported Hours	Reallocated Hours	% of Total Reallocated Hours
General Surgery	10,044	24.41	9,927	24.13	11,619	28.24
Cardiac Surgery	3,150	7.66	3,150	7.66	3,168	7.70
Plastics	2,979	7.24	2,682	6.52	3,096	7.52
Ear, Nose, Throat	4,572	11.11	4,347	10.56	4,401	10.70
Neuro Surgery	3,636	8.84	3,024	7.35	3,042	7.39
Gynecology	3,132	7.61	2,781	6.76	2,961	7.20
Orthopedics	7,578	18.42	7,092	17.24	7,380	17.94
Urology	5,526	13.43	4,572	11.11	4,635	11.26
Unassigned Hours	531	1.29	3,573	8.68	846	2.06
Total Hours 2006	41,148	100.00	41,148	100.00	41,148	100.00

Table 2

Allocated Hours to Surgical Services 2007

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours	Reported Allocated Hours	% of Total Reported Hours	Reallocated Hours	% of Total Reallocated Hours
General Surgery	10,098	24.44	10,044	24.31	11,385	27.56
Cardiac Surgery	3,690	8.93	3,681	8.91	3,690	8.93
Plastics	2,997	7.25	2,754	6.67	2,988	7.23
Ear, Nose, Throat	4,590	11.11	4,500	10.89	4,545	11.00
Neuro Surgery	3,654	8.85	3,051	7.39	3,051	7.39
Gynecology	3,159	7.65	2,943	7.12	3,150	7.63
Orthopedics	7,596	18.39	7,074	17.12	7,326	17.73
Urology	5,526	13.38	4,500	10.89	4,626	11.20
Unassigned Hours	0	0.00	2,763	6.69	549	1.33
Total Hours 2007	41,310	100.00	41,310	100.00	41,310	100.00

Number of ORs Assigned per Surgical Service

Tables 3 and 4 present the total number of operating rooms allocated to each surgical service in 2006 and 2007. These tables further illustrate the process of original allocation and then the process of reallocation between surgical services. In 2006 general surgery picked up 50% of the total ORs released by other services and 60% in 2007. Plastics picked up over 11% of the total rooms available both years. Nuero surgery and urology kept under 90% of their assigned ORs. The other trend identified in tables 3 and 4 is that more than 22% of the rooms that are available to be used by another service ended up unclaimed.

Table 3

Total Allocated and Reallocated ORs 2006

Surgical Service	# of Assigned Ors	Assigned ORs Kept	% of Total Assigned ORs Kept	# of ORs Picked up	% of ORs picked up
General Surgery	1116	1102	98.75	189	49.48
Cardiac Surgery	350	350	100.00	2	0.52
Plastics	331	300	90.63	44	11.52
Ear, Nose, Throat	508	485	95.47	4	1.05
Neuro Surgery	404	336	83.17	2	0.52
Gynecology	348	314	90.23	15	3.93
Orthopedics	842	788	93.59	32	8.38
Urology	614	507	82.57	8	2.09
Unassigned ORs	59	8	13.56	86	22.51
Total ORs 2006	4572	4190	91.64	382	100.00

Note: The number of ORs picked up monthly is not accounted for in MCA's reported block hours.

Table 4

Total Allocated and Reallocated ORs in 2007

Surgical Service	# of Assigned ORs	Assigned ORs Kept	% of Total Assigned ORs Kept	# of ORs Picked up	% of ORs picked up
General Surgery	1122	1116	99.47	149	60.08
Cardiac Surgery	410	410	100.00	0	0.00
Plastics	333	303	90.99	29	11.69
Ear, Nose, Throat	510	501	98.24	4	1.61
Neuro Surgery	406	338	83.25	1	0.40
Gynecology	351	328	93.45	22	8.87
Orthopedics	844	785	93.01	29	11.69
Urology	614	500	81.43	14	5.65
Unassigned ORs	0	0	0.00	61	24.60
Total ORs 2007	4590	4281	93.27	248	100.00

Note: The number of ORs picked up monthly is not accounted for in MCA's reported block hours.

Utilization by Surgical Service

Tables 5 and 6 present represent the percentage of utilized hours in comparison to original allocated hours, reallocated hours, and the reported allocated hours. The total hours used for each service is the number of surgical hours used during block-time (Monday through Friday 0730-1630).

The utilization percentage varies based on the accounting measure used. No service, if they kept their assigned block-time, met 85% utilization during 2006 or 2007. Only urology, general surgery, and gynecology had utilization over 75%. When calculated based on the reported allocated hours, which is the current accounting method used at MCA only general surgery, gynecology, and urology had between 75% and 85% utilization for both 2006 and 2007. On the other end of the spectrum cardiac surgery, ENT, and neurosurgery failed to achieve 75% either year. Plastics and orthopedics also fell below 75% in 2007.

When accounting for the release and/or pick up of block-time only gynecology, orthopedics, and urology had utilization greater than 75%. Urology actually had utilization of more than 90%, which is classified as over utilization for the purpose of this study.

Table 5

Utilization of Allocated Hours 2006

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours Used	Reported Allocated Hours	% of Total Reported Hours Used	Reallocated Hours	% of Total Reallocated Hours Used	Hours Used
General Surgery	10,044	81.21	9,927	82.16	11,619	70.20	8156.49
Cardiac Surgery	3,150	72.76	3,150	72.76	3,168	72.34	2291.81
Plastics	2,979	67.93	2,682	75.45	3,096	65.36	2023.69
Ear, Nose, Throat	4,572	68.90	4,347	72.47	4,401	71.58	3150.19
Neuro Surgery	3,636	56.57	3,024	68.02	3,042	67.62	2056.96
Gynecology	3,132	74.98	2,781	84.45	2,961	79.32	2348.52
Orthopedics	7,578	74.06	7,092	79.13	7,380	76.05	5612.15
Urology	5,526	76.59	4,572	92.57	4,635	91.31	4232.31
Unassigned Hours	531	27.80	3,573	4.13	846	17.45	147.61
Total Hours 2006	41,148	72.96	41,148	72.96	41,148	72.96	30019.73

Table 6

Utilization of Allocated Hours 2007

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours Used	Reported Allocated Hours	% of Total Reported Hours Used	Reallocated Hours	% of Total Reallocated Hours Used	Hours Used
General Surgery	10,098	80.92	10,044	81.35	11,385	71.77	8170.88
Cardiac Surgery	3,690	71.83	3,681	72.01	3,690	71.83	2650.68
Plastics	2,997	68.53	2,754	74.57	2,988	68.73	2053.75
Ear, Nose, Throat	4,590	72.89	4,500	74.34	4,545	73.61	3345.47
Neuro Surgery	3,654	52.80	3,051	63.23	3,051	63.23	1929.16
Gynecology	3,159	82.66	2,943	88.73	3,150	82.90	2611.3
Orthopedics	7,596	67.61	7,074	72.59	7,326	70.10	5135.36
Urology	5,526	79.03	4,500	97.05	4,626	94.41	4367.33
Unassigned Hours	0	0	2,763	4.63	549	23.31	127.96
Total Hours 2007	41,310	73.57	41,310	73.57	41,310	73.57	30391.89

Average Surgical Hours per case

Table 7 reflects the average case length for each service. The average case length increased in 2007 from 2006 for every service except neurosurgery and orthopedics. Nuero surgery and orthopedics both had a decline of 0.04 hours (2.4 mins). Overall the organization used 377 more hours in 2007, while doing 149 less cases. The result was an overall increase of average case length of 0.07 hours (4.2 mins) per case in 2007.

Table 7

Average Case Length per Service per Case

	Calendar Year 2006			Calendar Year 2007		
Surgical Service	Cases	Hours Used	Avg. Hours/Case	Cases	Hours Used	Avg. Hours/Case
General Surgery	3,125	10,075	3.22	3,103	10,295	3.32
Cardiac Surgery	642	2,719	4.24	719	3,091	4.30
Plastics	864	2,258	2.61	820	2,287	2.79
Ear, Nose, Throat	1,146	3,607	3.15	1,133	3,775	3.33
Neuro Surgery	851	2,273	2.67	803	2,112	2.63
Gynecology	952	2,542	2.67	1,040	2,830	2.72
Orthopedics	2,382	6,221	2.61	2,154	5,537	2.57
Urology	1,824	4,839	2.65	1,865	4,985	2.67
Totals	11,786	34,534	2.93	11,637	34,911	3.00

Cases per Surgical Service

In table 8 descriptive statistics are presented for the number of surgical cases per month per service for 2006 and 2007. Only cardiac surgery and gynecology had a significant increase in their case volumes in 2007. Gynecology had an additional 7.34 surgical cases a month for a total increase of 88 and cardiac surgery performed 6.42 additional cases per month for total increase of 77.

Two of the top three services experienced a decline in volumes during calendar year 2007 from 2006. Orthopedics had a decline of 19 cases a month for a total of 228 less cases and general surgery had a minimal decline of 22 cases for the year. In total MCA experienced on average twelve less cases per month in 2007.

Table 8

Descriptive Statistics on Cases per Surgical Service

	Calendar Year 2006		Calendar Year 2007	
Surgical Service[a]	Mean	SD	Mean	SD
General Surgery	260.40	47.18	258.58	47.51
Cardiac Surgery	53.50	7.80	59.92	12.64
Plastics	72	11.82	68.33	10.98
Ear, Nose, Throat	95.50	8.99	94.42	11.91
Neuro Surgery	70.92	9.93	66.92	10.58
Gynecology	79.33	10.35	86.67	9.60
Orthopedics	198.50	11.51	179.50	26.17
Urology	152	30.76	155.42	21.90
Totals 2006	982.20	95.48	969.75	91.51

[a]n = 12 for each surgical service

Hours Used per Surgical Service

Table 9 presents descriptive statistics on the number of block and non-block hours each surgical service used per month during 2006 and 2007. Non-block hours include all hours spent operating on the weekend, holidays, or between the hours of 1630 and 0730 Monday through Friday. As reflected in the table 9 there was a decrease in used block hours and an increase of used non-block hours in 2007 compared to 2006. Only two services cardiac surgery and gynecology experienced an increase in the use of both block hours and non-block hours.

Table 9

Descriptive Statistics on Used Block/Non-Block Hours

	Calendar Year 2006				Calendar Year 2007			
	Block Hours		Non-Block Hours		Block Hours		Non-Block Hours	
Surgical Service[a]	Mean	SD	Mean	SD	Mean	SD	Mean	SD
General Surgery	717	91.45	119.68	29.59	680.91	70.33	177.28	39.25
Cardiac Surgery	200.30	33.89	26.30	11.01	220.89	39.53	40.47	14.28
Plastics	174.40	33.43	13.69	6.59	171.15	24.90	19.39	9.30
Ear, Nose, Throat	277.60	28.81	25.32	11.77	278.79	29.13	36.04	16.57
Neuro Surgery	176.90	27.70	12.58	6.16	160.76	26.20	15.15	9.03
Gynecology	203.60	28.68	8.22	5.04	217.61	29.05	18.11	6.53
Orthopedics	482.70	35.74	35.58	10.89	427.95	56.92	33.34	9.64
Urology	375.10	64.88	28.26	10.93	363.94	47.25	51.45	11.66
Totals 2006	2620.00	237.53	270.13	33.06	2532.66	219.1	393.1	61.77

[a]n = 12 for each surgical service

Use of Surgical Hours

As presented in tables 10 and 11, the average minutes spent for in-to-cut for the majority of the services is higher in out of block cases than those cases done within block-time. Gynecology is the exception to the trend. They have an average of 35.62 minutes spent once the patient comes in the room before the incision during block-time while cases starting or finishing after block-time average 29.50 minutes. Furthermore, as represented in table 12, 28.57% of gynecology's total minutes used during block-time were during the initial phase of in-to-cut. The average for non-block-time found in table 13 was similar at 28.38%.

The service with the highest average of minutes spent on in-to-cut time was cardiac surgery at 38.25 during block-time and 40.83 out of block-time. The minutes only represented 17.94% in block-time and 15.44% out of block-time, of their total surgical minutes.

The average cut-to-close time was also higher for every service for cases done in non-block-time with the exception of gynecology. The average cut-to-close time for gynecology decreased from 80.22 minutes during block-time to 65.53 minutes during non-block-time. Plastics and ENT both use more surgical minutes in the cut-to-close phase as a percentage of total surgical minutes during non-block-time compared to block-time.

Table 10

Descriptive Statistics on Surgical Minutes Used During Block Time 2007

		In to Cut		Cut to Close		Close to Out	
Surgical Service	n	Mean	SD	Mean	SD	Mean	SD
General Surgery	2096	31.89	10.27	110.07	75.38	8.27	5.07
Cardiac Surgery	517	38.25	11.59	160.65	110.54	14.29	8.75
Plastics	675	25.52	8.28	82.47	71.26	6.27	4.90
Ear, Nose, Throat	855	29.09	10.63	100.26	87.31	11.84	8.10
Neuro Surgery	597	35.68	16.52	84.59	65.46	8.38	6.51
Gynecology	927	35.62	12.32	80.22	66.86	8.85	5.87
Orthopedics	1787	30.41	10.45	83.13	56.72	7.11	4.68
Urology	1408	28.34	12.57	82.74	70.59	8.21	5.58

Table 11

Descriptive Statistics on Surgical Minutes Used During Non-Block Time 2007

		In to Cut		Cut to Close		Close to Out	
Surgical Service	n	Mean	SD	Mean	SD	Mean	SD
General Surgery	552	35.50	12.62	155.48	102.86	9.27	7.02
Cardiac Surgery	132	40.83	12.86	209.09	140.42	14.52	8.33
Plastics	110	30.08	11.86	179.14	192.70	7.40	5.74
Ear, Nose, Throat	146	30.59	12.13	231.76	213.60	11.10	7.51
Neuro Surgery	58	38.36	14.01	116.50	97.45	10.29	6.52
Gynecology	35	29.50	9.45	65.53	61.60	8.91	4.42
Orthopedics	215	31.19	11.19	91.95	80.21	7.73	5.28
Urology	326	29.29	13.02	100.71	84.92	8.37	6.58

Table 12

Utilization of Total Used Surgical Minutes during Block-Time 2007

Surgical Service	In-to-Cut Mins	% of Total Surgical Mins Used For In-to-Cut	Cut-to-Close Mins Used	% of Total Surgical Mins Used For Cut-to-Close	Close-to-Out Mins Used	% of Total Surgical Mins Used For Close-to-Out	Total Surgical Mins
General Surgery	66,840	21.23	230,702	73.27	17,327	5.50	314,869
Cardiac Surgery	19,776	17.94	83,056	75.36	7,387	6.70	110,219
Plastics	17,228	22.34	55,667	72.18	4,231	5.48	77,126
Ear, Nose, Throat	24,855	20.59	85,722	71.02	10,125	8.39	120,702
Neuro Surgery	21,298	27.73	50,499	65.75	5,005	6.52	76,802
Gynecology	33,024	28.57	74,360	64.33	8,207	7.10	115,591
Orthopedics	54,339	25.20	148,562	68.90	12,706	5.90	215,607
Urology	39,897	23.75	116,501	69.36	11,562	6.89	167,960

Table 13

Utilization of Total Used Surgical Minutes during Non-Block-Time 2007

Surgical Service	In-to-Cut Mins Used	% of Total Surgical Mins Used For In-to-Cut	Cut-to-Close Mins Used	% of Total Surgical Mins Used For Cut-to - Close	Close-to-Out Mins Used	% of Total Surgical Mins Used For Close-to-Out	Total Surgical Mins
General Surgery	19,596	17.73	85,825	77.64	5,115	4.63	110,536
Cardiac Surgery	5,390	15.44	27,600	79.07	1,916	5.49	34,906
Plastics	3,309	13.89	19,705	82.70	814	3.41	23,828
Ear, Nose, Throat	4,466	11.19	33,837	84.75	1,621	4.06	39,924
Neuro Surgery	1,533	22.15	5,002	72.26	387	5.59	6,922
Gynecology	1,003	28.38	2,228	63.04	303	8.58	3,534
Orthopedics	6,705	23.83	19,769	70.26	1,662	5.91	28,136
Urology	9,549	21.17	32,832	72.78	2,730	6.05	45,111

Block Time Lost/Unused

Table 14 presents data on how effectively each operating room began the working day during block-time in 2007. Based on 255 working days and 18 operating rooms, there were 4,590 possible first morning starts, but only 60.65% of them started on-time. The cancellation rate on the day of surgery was only 1.20%.

Table 14

Start of ORs in 2007

Type	# of Starts	% of Total Starts
On-Time Start	2,784	60.65
Late Start	1,489	32.44
Unused Start	260	5.66
Cancelled Cases	55	1.20
Total Starts 2007	4,590	100.00

Table 15 further, details the reason that 1,489 ORs started late during 2007. The late starts were attributed to one of the following categories; surgeon, anesthesia, patient, outside operating room resource, room set-up, bed shortage, requested delay, or other. The number one reason for a late start was attributed to the surgeon, which accounted for 347 (23.30%) late starts during the year. Requested Delay, which is when the surgeon asks for a later start time but does not release the room, was the number reason with 219 delays. Inpatient bed shortage only accounted for 61 delayed starts.

Table 15

Percentage of Delayed Starts by Reason

Delay Type	Number of Delays	% of Total Delays
Surgeon	347	23.30
Requested Delay	219	14.71
Anesthesia	208	13.97
Patient	183	12.29
Lab/X-Ray/Pharmacy	95	6.38
Room Set-Up	91	6.11
Bed Shortage	61	4.10
Other	285	19.14
Total Delays 2007	1489	100.00

Table 16 reflects the amount of time lost due to delays to the first OR case of the day by reason. The requested delay on average was 143 minutes (2.4 hours) and was responsible for 55.54% of the time lost to delays. The delays directly attributed to the surgeon accounted for 10.11% of the total time lost to delays and on average caused a 16.5 minute delay to the start of the surgical case. The operating room time lost to delays in 2007 is equivalent to having access to 105 operating rooms for a 9-hour day.

Table 16

Percentage of Total Time Lost to Delay by Reason

Delay Type	Number of Delays	Total Delay Time (Mins)	% of Total Delay Time	Mean	SD
Surgeon	347	5,741	10.11	16.54	17.24
Requested Delay	219	31,530	55.54	143.97	92.83
Anesthesia	208	3,090	5.44	14.86	12.09
Patient	183	3,131	5.52	17.11	23.23
Lab/X-Ray/Pharmacy	95	2,007	3.54	21.13	15.70
Room Set-Up	91	1,136	2.00	12.48	6.86
Bed Shortage	61	3,488	6.14	57.18	35.92
Other	285	6,649	11.71	23.33	21.28
Totals:	1489	56,772	100.00	N/A	N/A

Surgical Cases Required per Service with Turnover Time

In order for each surgical service to operate at 75% or 85% utilization of allocated block-time, a minimum number of cases need to be performed. Tables A1 and A2 in appendix A reflects the number of surgical cases each service would need to perform to reach 75% utilization and 85% utilization with 30 minutes of turnover time given to each case.

Surgical Cases Required per Service without Turnover Time

In tables B1 and B2 in appendix B, the number of surgical cases required to achieve optimal operating room utilization is presented without 30 minutes assigned per case for turnover. Without including turnover time the hospital would need to perform an additional 8 surgical cases per day to reach 75% utilization. An additional 9 cases per day could be performed before over utilization would become a concern.

Discussion

Hours and Operating Rooms Allocated per Surgical Service

The hours and number of operating rooms allocated to each surgical service fluctuates monthly, based on the working days in each month. Unlike most institutions, MCA does not routinely review and assign block allocation monthly, quarterly, or yearly based on prior utilization (Viapiano & Ward, 2000). Instead, MCA uses the same allocation template until another OR is opened or a service comes forward to request additional time.

Since the organization does not change block allocation on a regular basis, the service's surgical schedulers meet 4 weeks before the start of the next month to do a hybrid adjustment to the block allocation. During the meeting schedulers will release block time they know their service will be unable to utilize based on staff absences. Other services will then request to pick up the released block-time to add a surgery day for a surgeon or move up a delayed surgeon (surgeon who does not have a room assigned, but is expected to operate). If no service requests the day vacated by some other service it becomes open time, which is classified as unassigned hours.

In addition to schedulers meeting, a service can release time up to 48 hours prior to the day of surgery and receive credit to their allocated block-time. Some have questioned if the release of un-booked ORs should happen 5 days prior or 24 hours prior to day of surgery. Dexter and Macario (2003) found that ultimately the decision should be made on which ever fits within the local politics of the organization. The concern for the surgical leadership is what to do with the rooms that are released at the last minute. The two options are too close the OR and not bring in the staff or allow another service that had a delayed surgeon the opportunity to have the unused OR. When making that decision the chances are that the delayed surgeon only had one case booked for the day and so the expected case length should be accounted for. When opening an OR for a two-hour case it can be costly when the alternative would have been for the staff to stay home (Dexter, Macario, Traub, Hopwood, &

Lubarsky, 1999).

Overall this process of reallocation works, but it impacts the utilization calculation. Under the current system, services are able to manipulate the amount of time that will be reported as available time for them to operate, which can lead to inflation of their reported utilization. An example of the impact is seen in general surgery data for 2007. General Surgery released only 6 ORs but picked up 149 ORs, which equated to them having an additional 1,341 hours available to operate in for a total of 11,385 hours. Based on the current process of only crediting the service that released the time and not accounting for the service that gained the time, it was reported that general surgery had 10,044 available hours to operate in.

The problem in not accounting for the hours general surgery gained was their total reported used hours included cases that happened during the gained time. What is reported is a general surgery utilization rate of 81%, consuming 24% of the organizations total block-time, which looks positive. In reality when accounting for the additional time they gained, general surgery's utilization was 72% and consumed 28% of the organizations total block-time. Further research should be done on this data to see if it would have been more appropriate not to reallocate and open the 149 ORs for general surgery, but instead close them.

Utilization by Surgical Service

As previously discussed MCA has not reassigned block allocation on a routine basis based on low or high utilization of block-time by each surgical service. So the method of calculation and inputs into the metric has not been important. Within the last year the definition and method used to calculate utilization has been brought to the forefront of discussions. MCA has a policy of allowing services the opportunity to come forward to request additional block-time based on relatively higher utilization. The expectation is that a service should have utilization greater than 75% to make such a request. In the past no request has occurred, but recently this changed as a service submitted a request to the Surgical Operations Subcommittee (SOS) for additional block allocation. Under current guidelines and reporting metrics, 5 services in 2006 and 4 services in 2007 could make a request for more block-time. The issue then becomes one of fairness in accounting, including from where the additional time is taken.

The study revealed different utilization results based on what total was used for available hours for each service. As mentioned earlier, services have routinely changed their reported block-time by adding and/or dropping block-time. Based on current MCA definition and policy the reported utilization for each service was higher than the reallocated utilization and the original allocated utilization.

Table 6 showed the differences that can be found based on the method of inputs used in the calculation. Utilization based on the original hours allocated to each service resulted in the top three as gynecology (82%), general surgery (80%) and urology (79%). But, when the utilization is based on the actual number of ORs the services had available to them the top three were urology (94%), gynecology (82%), and ENT (73%). However, MCA reported utilization as urology (97%), gynecology (87%), and general surgery (81%). The same difference happened with the bottom three. The implication being that reallocated block-time would come from services with lower rates. Similar fluctuations in utilization can be seen in 2006 data.

The reason for the higher reported utilization is that it only accounted for the block-time a service released and not the additional time they gained from another service. By not accounting for both the released and gained block-time the utilization results are skewed on which services best used their actual available block-time. Furthermore, if the goal is the best use of block-time allocated, the original allocated block-time should be used as the available number of hours for each service. Under the current system of trying to determine who should have block-time taken away from it would be ideal to use the original allocated utilization percentage. The original allocated utilization reveals how much of the allotted block-time each service is given is actually used. The other two utilization methods accounted for an adjustment to the block-time allocation and cannot help in determining if the current allocation template is correct.

The releasing of block-time should not be considered a negative action as long as the organization is able to reassign the block-time and the overall utilization of block-time increases. The problem rests with not counting both the gained and released time by each service. Based on the current utilization metric individual service utilization based on reallocation is lower than the reported utilization. The challenge then becomes how to respond to requests for additional block-time and how to reassign time from one service to another, especially when it has not be done in the past.

At this time actual turnover time is unknown at MCA as it has not been measured or collected. Previous studies on OR utilization have questioned the validity of including turnover time in utilization metrics unless it has been collected (Abouleish, Hensley, Zarnow, & Prough, 2003). Overall MCA utilization dropped 10% when the exclusion of turnover time was excluded, as seen in Appendix A Tables A1 and A2. With the flat credit of 30 minutes of turnover time assigned to every case the services that perform a high volume of short cases will benefit more, especially if the actual turnover is less than 30 minutes (Abouleish, et al.). A service could perform 4 cases with actual turnover of 15 minutes and be out of the OR by 1430, but within the metrics would receive credit for operating until 1530.

Organizations need to use caution when using utilization as a sole factor in determining block-time allocation, because in reality utilization is just a measurement of occupancy of the OR suite. By rewarding services with more block-time for their high utilization rate, an organization can end up with higher cost with little or no return in positive revenue (Viapiano & Ward, 2002). The reason for possible higher cost is the occurrence of cases going past block-time. To be able to deal with scheduled cases finishing after block management will have to pay overtime or higher extra staff (Dexter & Traub, 2000). Macario (2006) suggests that organizations use a dashboard of metrics to evaluate operating room efficiency and utilization. Some of these metrics include excess staffing cost, start-time tardiness, case cancellation rate, contribution margin per OR hours, turnover times, prediction basis, and prolonged turnovers (Macario, 2006).

Cases and Average Surgical Hours per service

As mentioned previously, the total case volume for the organization was down, while the number of hours used was up. There are numerous factors that contribute to the increase of overall hours used by the surgical services. MCA is a teaching institution and during the majority of cases there will be a nurse, surgical residents/fellows, or CRNA in training. The training of staff and the use of advanced technology, such as the Davinci Surgical Robot, may lead to an increase in time required to complete a surgical case. A previous study by Babineau et al. (2004) found a significant time cost associated with the operative training of surgical residents. Additionally, the complexity of the cases increased from a case mix index of 1.78 in 2006 to 1.80 in 2007. The case mix index accounts for the severity of patient's ailments and the complexity of their medical needs.

A majority of the services experienced a decline in total cases from 2006 to 2007. Some of the decline can be attributed to the current strategy of the organization to change payer mix. In the past, Medicare patients have composed a majority of the MCA patient population, approximately 62%. The institution's goal is to become more balanced between patients with a commercial payer and patients with a government payer. The new initiative has reduced the number of patients seen. Additionally a couple of the services had surgeons that resigned during the year.

Use of Surgical Hours

To further evaluate the make up of case length in data for calendar year 2007, each case was broken down into three different sequential segments; in-to-cut, cut-to-close, and close-to-out. The reason to evaluate the data by different phases is to understand how the time of each case is used and to see if there are differences in cases completely done within block hours and those that are completed outside of block-time. There have been sentiments from the surgeons that the surgical staff in the operating rooms after 1530 is not as skilled as the staff that starts the day.

As presented in tables 10 and 11, the average minutes spent for in-to-cut for the majority of the services is higher in out of block cases than those cases done within block-time. Gynecology is the exception to the trend. They have an average of 35.62 minutes spent on in-to-cut during block-time, while cases starting and/or finishing after block-time average 29.50 minutes. One explanation for the longer in-to-cut time during block-time is a majority of the cases gynecology performed during block-time will involve the use of the Davinci robot. When using the robot for a case, the set-up and prep-time before incision is longer. Overall, there is a range of 25.52 to 38.25 minutes between the services during block-time, which increases to 29.29 to 40.83 minutes after block-time. With a range of 12 minutes between the high and low services, the question for further study involves the current process of in-to-cut for each service and the opportunity to make it more efficient.

The second phase of surgery, cut-to-close, represents the majority of surgery time and is the time of which the surgeon is most aware. The average cut-to-close time differs for each service, which can be attributed to the specialties and type of case mix. Once again the cases that start and finish completely within block-time are shorter than those that do not except for gynecology. A common explanation for cases accomplished outside of block-time being longer is emergent or urgent cases, or cases otherwise not considered routine are done outside of block-time. In the situation for gynecology, they will do less teaching and use the robot less outside of block-time. In the case of cut-to-close further research could be done on case type and surgeon to identify possible best practices.

The last phase of the surgical case is close-to-out, which is the time from the closure of the wound until the patient leaves the room. As a percentage of the total case time this phase represents less than 10% for each service. The difference between in-block and out-of-block cases is minimal with the majority of services having less than one-minute difference. The range of difference from lowest to highest in 2007 was 6.27 to 14.29 minutes during block-time and 7.40 to 14.52 out of block-time. The difference between the services for length of time could be attributed to case mix or the skill level of the staff in the room. Similar to the first phase of the case it might be beneficial to further study the process of close-to-out for each service to see if there is room for improvement. A recent study by Sokal, Craft, Chang, and Sandberg (2006) found that changing the patient flow in and out of the OR increased OR efficiency and shortened time attributed the first and last phase of a case.

Block-Time Lost/Unused

"The single largest cost to a hospital delivering surgical care is incurred in the operating room (OR). Salaries of OR staff account for most of OR cost, particularly at hospitals with salaried nurse anesthetists and/or anesthesiologist" (Dexter, et al., 1999). It is because of the cost of surgical staff that block-time lost to delays is concerning.

MCA implemented block-time because it provides a tool for the OR manager to control labor costs and to accommodate the surgeon's schedule. He or she can staff the ORs to run efficiently and effectively from 0730 to 1630 on normal workdays. When the first surgical case in an OR starts late it pushes the whole schedule behind for the day and increases the risk of cases finishing after block-time. In 2007, 11% of total cases started during block-time were completed after 1630. Once this happens MCA absorbs increased labor cost for the organization as more staff is needed or overtime is paid. During

2007, 56,772, minutes or 946 hours were lost at the beginning of the OR schedule because of delays to the first surgical case. The reasons ranged from paperwork not being completed to more complex issues like as shortage of inpatient beds. To try and minimize the impact of the first case delays, Lebowitz (2003) found that the first case of the day in each OR should be a short procedure.

Currently the service's scheduler and surgeon determine the order of the surgeon's cases. Because the OR manager does not have control, or a say in the ordering of cases, it is difficult to ensure the surgeons shortest case for the day is scheduled first. Additionally MCA has a robust committee structure with heavy physician involvement. Most of these meetings start at 0630 or 0700. When these meetings run late they can keeps the surgeon from being available at the start of the OR day.

Over 55% of the OR time lost was attributed to a requested delay, which on average was 2.4 hours. A requested delay happens when the surgeon scheduled for a room asks for a later start time, because he does not want to lose his or her room to another surgeon. This can be detrimental, because it could have been possible for another case to start in the room. If the OR manager had additional control of the schedule he or she could have scheduled a short case in that block of time instead of the OR sitting idle.

Cases Required for 75% and 85% Utilization

The surgical suites are allocated to each surgical service in a block-time format, which results in all 18 operating rooms being assigned to a particular service every day of the working week. Some services will have one room a day, while others will be assigned multiple rooms.

Based on the number of ORs assigned and average case length previously calculated for each service for calendar year 2007, projections were made on the number of cases to reach different utilization goals. The goal should be to schedule enough cases every day that the result will be 75% to 85% utilization of available block-time. The reason the goal is not 100% is because in surgery there is a level of uncertainty with how long an actual case will last. In addition by assigning all rooms to a service the organization loses flexibility in the daily schedule to allow for emergent or urgent cases to be performed.

Based on 2007 data, including turnover time, MCA needs to schedule 40 to 46 cases every block day to have utilization of 75% to 85%. If turnover is excluded, the capacity increases to 49 to 55 cases daily. Overall MCA has, within the 18 operating suites, the capacity to perform 11,705 to 14,045 surgical cases annually during block hours. General surgery, orthopedics, and urology should schedule 58% of those cases, as they are continually allocated a majority of the available block-time.

Study Limitations

There are a number of shortcomings of this study, which, if overcome, could improve the analysis and conclusions available. First, this study only looked at service line utilization as a whole and not at the individual surgeon level, which would have provided more detail. Second, the study did not review the types of cases started in block-time that were finished outside of the block in order to understand if the surgical case could have been done in block if it was properly scheduled. Finally, the data used for this study was reported annually instead of on a monthly basis, which would have helped determine if there were trends based on day of week or time of year.

Conclusion and Recommendations

Conclusions

The purpose of this study was to determine if MCA's operating rooms have capacity within block-time and if the current use is efficient. Data collected and analyzed for 2006 and 2007 indicted that extra capacity exists. Utilization of block-time for the whole organization is between 62% and 74% depending on the inclusion of turnover time for each case. In 2007 the organization would have had to perform an additional 4,721 hours of surgery to reach 85% utilization for available block-time. This calculation is based on the available block hours multiplied by .85 and then subtracting the total hours used including turnover time. The result of 4,721 hours is equivalent to 2 additional ORs used for 9 hours everyday. This data does not support the current perception of a lack of OR time at MCA, nor does it support the need for more ORs or expanded block-time schedules. The real foundation in this researcher's opinion of the need for more ORs or block-time is surgeons don't want to be delayed and prefer to operate first thing in the morning based on the traditional Mayo Clinic schedule of operating every other day.

Another issue of concern is efficient use of the staff. Utilization should not be the only metric used when trying to determine how efficient the OR is used or which services should get additional block-time. In the current case study, an evaluation was done on time lost due to start-time tardiness for the first scheduled case of the day. During 2007, 28% of the cases started an average of at least 12 minutes late, resulting in 946 lost surgical hours.

The current system of allocation to services instead of individual surgeons makes it difficult to gauge and adjust block allocation easily based on utilization. With the constant change in provider availability based on clinical and professional needs, it is crucial to actively manage available OR time down to the individual surgeon. Additionally, the organization lacks a central database that can easily be accessed to help pinpoint the reason for a service's low utilization. For this reason some providers have questioned the validity of the utilization data presented.

Another challenge is that each service has their own surgical scheduler and no two surgical schedulers manage the block-time allocated to their service the same way. Some schedulers actively manage the time, while others leave it solely to the surgeon's discretion. When this happens holes are created within the OR schedule, which are often noticed too late to schedule additional cases. If block allocations are made directly to surgeons, this could be fixed. Ideally the organization would have centralized surgical schedulers working together as a team to create a daily surgical schedule outside of the silo service aspect currently used. This would result in a schedule that is not only beneficial to the surgeon and patient, but also the institution as a whole.

Recommendations

In this researcher's opinion the OR suites at MCA have available capacity and the goal should be providing the tools and support to the OR management team to improve processes in order to maximize efficiency. There are a number of information systems on the market that can help in scheduling cases and tracking data that would be of benefit. I recommend the organization acquire a wireless radio frequency system that will help in the capture of the needed data accurately. Once the correct tools are in place, MCA needs to evaluate historical data in regard to individual surgeon volume, case length, and turnover to help establish block-time allocations directly to individual surgeons verses surgical services. Additionally the organization needs to centralize the surgical schedulers or implement rules on how to effectively schedule cases that will help in the efficiency in the OR on the day of surgery. Finally, the OR suites are an ideal place for Lean/Six Sigma projects to help understand where processes in the pre and post-surgery might be reduced to save not only time but also to improve patient safety.

References

Abouleish, A.E., Hensley, S.L., Zornow, M.H., Prough, D.S. (2003). Inclusion of turnover time does not influence identification of surgical services that over- and underutilize allocated block time. *Anesthesia and Analgesia, 96,* 813-818.

Archer, T., Macario, A. (2006). The drive for operating room efficiency will increase quality of patient care. *Anesthesiology, 19,* 171-176.

Babineau, T.J., Becker, J., Gibbons, G., Sentovich, S., Hess, D., Robertson, S., et al. (2004). The "Cost" of operative training for surgical residents. *Archives of Surgery, 139,* 366-370.

Basson, M.D., Butler, T.W., & Verma, H. (2006). Predicting patient nonappearance for surgery as a scheduling strategy to optimize operating room utilization in a Veterans' Administration hospital. *Anesthesiology, 104(4),* 826-834.

Borrowitz, S.M. (1996). Impact of a computerized patient tracking system in a pediatric clinic. *AMIA Annual Fall Symposium,* 508-511. Retrieved December 11, 2007, from the Ovid database.

De Deyne, C., Heylen, R. (2004). Introduction of an operating room information management system improved overall operating room efficiency. In F.H. Roger (Ed.), *Health*

Continuum and Data Exchange in Belgium and in the Netherlands (61-67). France: IOS Press.

Dexter, F. (2002). Cost implications of various operating room scheduling strategies. *The American Society of Anesthesiologists, Inc., 30,* 87-95

Dexter, F., Abouleish, A.E., Epstein, R.H., Whitten, C.W., & Lubarsky, D.A. (2003). Use of operating room information system data to predict the impact of reducing turnover times on staffing costs. *Anesthesia and Analgesia, 97, 1119-1126.*

Dexter, F., Epstein, R.D., Traub, R.D., & Xiao, Y. (2004). Making management decisions on the day of surgery based on operating room efficiency and patient waiting times: Review of scientific studies. *Anesthesiology, 101,* 1444-1453.

Dexter, F. & Macario, A. (2004). When to release allocated operating room time to increase operating room efficiency. *Anesthesia and Analgesia, 98, 758-762.*

Dexter, F. Macario, A., Traub, R.D. & Lubarsky, D.A. (2003). Operating room utilization is not an accurate metric for the allocation of operating room block time to individual surgeons with low caseloads. *Anesthesiology, 98,* 1243-1249.

Dexter, F., Marcario, A., Traub, R.D., Hopwood, M., & Lubarsky, D.A. (1999). An operating room scheduling strategy to maximize the use of operating room block time: Computer simulation of patient scheduling and survey of patients' preferences for surgical waiting time. *Anesthesia and Analgesia, 89,* 7-20.

Dexter, F., & Traub, A. (2002). How to schedule elective surgical cases into specific operating rooms to maximize the efficiency of use of operating room time. *Anesthesia and Analgesia, 94,* 933-942.

Dobson, S., Koenig, L., Sen, H., Ho, S., & Gilani, J. (2002). Financial performance of academic health center hospitals, 1994-2000. Chicago: The Commonwealth Fund Task Force on Academic Health Centers. Retrieved January 12, 2008, from the Medical Ovid database.

Ferchl, M.B., Tung, A., Sweitzer, B.J., Hou, D., & Glick, D.B. (2005). Preoperative clinic visits reduce operating room cancellations and delays. *Anesthesiology, 103,* 855-859.

Friedman, D.M., Sokal, S.M., Chang, Y., & Berger, D.L. (2006). Increasing operating room efficiency through parallel processing. *Annals of Surgery, 243 (1),* 10-14.

Harders, M., Malangoni, M.A., Weight, S., & Sidhu, T. (2006). Improving operating room efficiency through process design. *Surgery, October,* 509-516.

Junger, A., Benson, M., Quinzio, L., Michel, A., Sciuk, G., Brammen, D., & et al. (2002). An anesthesia information management system as a tool for controlling resource management of operating rooms. *Methods of Information in Medicine, 41,* 81-85.

Koenig, L., Dobson, A., Ho, S., Siegel, J.M., Blumenthal, & Weissman, J.S. (2003). Estimating the mission-related costs of teaching hospitals. *Health Affairs, 22(6)*, 112-122.

Lebowitz, P. (2003). Schedule the short procedure first to improve OR efficiency. *AORN Journal, 78(4)*, 651-659.

Macario, A. (2006). Are your hospital operating rooms "efficient"? A scoring system with eight performance indicators. *Anesthesiologist, 105(2)*, 237-240.

Morrisey, M. (2001). Competition in hospital and health insurance markets: A review and research agenda. *Health Services Research, 13(1pt2)*, 191-221.

Mayo Clinic. (2007). Retrieved on August 31, 2007, from http://www.mayoclinic.org/about/

Mazzei, W.J. (1999). Maximizing operating room utilization: a landmark study. *Anesthesia and Analgesia, 89,* 1-2.

Macario, A., & Vasanawala, M. (2002). Technology and computing in the surgical suite: Key features of an OR management information system and opportunities for the future. *Anesthesia and Analgesia, 95,* 1120-1121.

Marjamaa, R.A., & Kirvela, O.A. (2007). Who is responsible for operating room management and how well do we measure how well we do it?. *ACTA Anaesthesiologica Scandinavica, 51,* 809-814.

Marjamaa, R.A, Vakkuri, A., & Kirvela, O.A. (2008). Operating room management: Why, how and by whom?. *ACTA Anaesthesiologica Scandinavica, 52,* 596-600.

Marjamaa, R.A., Torkki, P.M., Torkki, M.I., & Kirvela, O.I. (2006). Time accuracy of a radio frequency identification patient tracking system for recording operating room timestamps. *Anesthesia and Analgesia, 102,* 1183-1186.

Overdyk, F.J., Harvey, S.C., Fishman, R.L., & Shippey, F. (1998). Successful strategies for improving operating room efficiency as academic institutions. *Anesthesia and Analgesia, 86,* 896-906.

Ozcan, Y.A. (2005). Scheduling. In Jossey-Bass (Ed.1), *Quantitative Methods in Health Care Management,* (pp. 188-194). San Francisco: Jossey-Bass.

Plasters, C.L, Seagull, F.J., & Xiao, Y. (2003). Coordination challenges in operating-room management: An in-depth field study. *AMIA Annual Fall Symposium,* 508-511. Retrieved January, 13 2008, from the Medical Ovid database.

Parsa, P., Sweitzer, B., & Small, S.D. (2004). The contribution of a preoperative evaluation to patient safety in high-risk surgical patients: A pilot study. *Anesthesia and Analgesia, 100,* 145-147.

Patterson, P. (1997). Is an 80% to 85% utilization a realistic target for Ors? *OR Manger*. Retrieved October 10, 2007, from the Medical Ovid database.

Shaw, R. Coia, J.E., & Michie, J. (1999). Use of bar code readers and programmable keypads to improve the speed and accuracy of manual data entry in the clinical microbiology labatory: Experience of two laboratories. *Journal of Clinical Pathology, 52,* 54-60.

Sokal, S.M., Craft, D.L., Chang, Y., Sandberg, W.S., & Berger, D.L. (2006). Maximizing operating room and recovery room capacity in an era of constrained resources. *Archives of Surgery, 141,* 389-395.

Strum, D.P., Vargas, L.G., & May, J.H. (1999). Surgical subspecialty block utilization and capacity planning: A minimal cost analysis model. *Anesthesiology, 90(4),* 1176-1185.

Tyler, D.C., Pasquariello, C.A., & Chen, C. (2003). Determining optimum operating room utilization. *Anesthesia and Analgesia, 96,* 1114-1121.

Van Houdenhoven, M., Van Oostrum, J.M., Hans, E.W., Wullink, G., & Kazemier, G. (2007). Improving operating room efficiency by applying bin-packing and portfolio techniques to surgical case scheduling. *Anesthesia and Analgesia, 105 (3),* 707-714.

Viapiano, J. & Ward, D.S. (2000). Operating room utilization:

The need for data. *International Anesthesiology Clinics, 38(4)*, 124-140.

Williams, J.R., Matthews, M.C, & Hassan, M. (2007). Cost differences between academic and nonacademic hospitals: A case study of surgical procedures. *Hospital Topics, 85(1)*, 3-10.

Young, D.W. (2004, Aug). Improving operating room performance in a center of excellence. *Healthcare Financial Management*, 70- 74.

Zelenock, G.B., & Zamnricki, C.S. (2001). The health care crisis: Impact on surgery in the community hospital setting. *Archives of Surgery, 136(5)*, 585-591.

Appendix A

Current MCA Block Schedule Template

MCH BLUE DAY	GS	CVT	Plastics	ENT	Neuro	GYN	Ortho	Urology
MON	5	1	1	2	2	2	3	2
TUE	4	2	1	2	2	1	3	3
WED	4	2	2	2	1	1	4	2
THUR	4	1	1	2	2	1	4	3
FRI	5	2	1	2	1	2	3	2
MCH ORANGE DAY	GS	CVT	Plastics	ENT	Neuro	GYN	Ortho	Urology
MON	5	1	1	2	2	2	3	2
TUE	4	2	2	2	2	1	3	2
WED	4	2	1	2	1	1	4	3
THUR	4	1	1	2	2	2	3	3
FRI	5	2	2	2	1	1	3	2

Appendix B

Table B1

Average Number of Cases Need to Reach 75% Utilization Including Turnover Time

Surgical Service	Case/Day	Cases/Week	Cases/Month	Case/Year
General Surgery	8.95	44.73	190.10	2281.17
Cardiac Surgery	2.52	12.62	53.63	643.60
Plastics	3.16	15.80	67.14	805.65
Ear, Nose, Throat	4.05	20.27	86.15	1033.78
Neuro Surgery	4.09	20.43	86.83	1042.02
Gynecology	3.42	17.08	72.59	871.05
Orthopedics	8.69	43.47	184.73	2216.73
Urology	6.09	30.44	129.35	1552.25
Hospital Total	40.50	202.50	860.63	10327.50

Table B2

Average Number of Cases Need to Reach 85% Utilization Including Turnover Time

Surgical Service	Cases/Day	Cases/Week	Cases/Month	Case/Year
General Surgery	10.14	50.69	215.44	2585.33
Cardiac Surgery	2.86	14.30	60.78	729.42
Plastics	3.58	17.90	76.09	913.06
Ear, Nose, Throat	4.59	22.97	97.64	1171.62
Neuro Surgery	4.63	23.16	98.41	1180.95
Gynecology	3.87	19.36	82.27	987.19
Orthopedics	9.85	49.26	209.36	2512.30
Urology	6.90	34.49	146.60	1759.21
Hospital Total	45.90	229.50	975.38	11704.50

Appendix C

Table C1

Average Number of Cases Need to Reach 75% Utilization without Turnover Time

Surgical Service	Case/Day	Cases/Week	Cases/Month	Case/Year
General Surgery	10.53	52.66	223.80	2685.64
Cardiac Surgery	2.86	14.28	60.69	728.29
Plastics	3.85	19.25	81.80	981.55
Ear, Nose, Throat	4.77	23.85	101.37	1216.43
Neuro Surgery	5.05	25.23	107.22	1286.62
Gynecology	4.19	20.93	88.94	1067.23
Orthopedics	10.79	53.96	229.35	2752.17
Urology	7.49	37.45	159.16	1909.91
Hospital Total	48.60	243.00	1032.75	12393.00

Table C2

Average Number of Cases Need to Reach 85% Utilization without Turnover Time

Surgical Service	Case/Day	Cases/Week	Cases/Month	Case/Year
General Surgery	11.94	59.68	253.64	3043.72
Cardiac Surgery	3.24	16.18	68.78	825.39
Plastics	4.36	21.81	92.70	1112.42
Ear, Nose, Throat	5.41	27.03	114.89	1378.62
Neuro Surgery	5.72	28.59	121.51	1458.17
Gynecology	4.74	23.72	100.79	1209.53
Orthopedics	12.23	61.16	259.93	3119.13
Urology	8.49	42.44	180.38	2164.56
Hospital Total	55.08	275.40	1170.45	14045.40

Appendix D

Table D1

2006 OR Utilization of Allocated Hours by Surgical Service without Turnover Time

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours Used	Reallocated Hours	% of Total Reallocated Hours Used	Reported Allocated Hours	% of Total Reported Hours Used	Hours Used
General Surgery	10,044	69.50	11,619	60.08	9,927	70.32	6980.49
Cardiac Surgery	3,150	64.84	3,168	64.47	3,150	64.84	2042.31
Plastics	2,979	55.95	3,096	53.83	2,682	62.14	1666.69
Ear, Nose, Throat	4,572	59.39	4,401	61.69	4,347	62.46	2715.19
Neuro Surgery	3,636	47.39	3,042	56.64	3,024	56.98	1722.96
Gynecology	3,132	61.59	2,961	65.15	2,781	69.36	1929.02
Orthopedics	7,578	60.39	7,380	62.01	7,092	64.53	4576.65
Urology	5,526	63.29	4,635	75.45	4,572	76.49	3497.31
Unassigned Hours	531	20.93	846	13.13	3,573	3.11	111.12
Total Minutes 2006	41,148	61.34	41,148	61.34	41,148	61.34	25241.74

Table D2

2007 OR Utilization of Allocated Hours by Surgical Service without Turnover Time

Surgical Service	Orig Allocated Hours	% of Total Orig Allocated Hours Used	Reallocated Hours	% of Total Reallocated Hours Used	Reported Allocated Hours	% of Total Reported Hours Used	Hours Used
General Surgery	10,098	69.59	11,385	61.72	10,044	69.96	7026.88
Cardiac Surgery	3,690	64.42	3,690	64.42	3,681	64.58	2377.18
Plastics	2,997	56.36	2,988	56.53	2,754	61.34	1689.25
Ear, Nose, Throat	4,590	62.98	4,545	63.61	4,500	64.24	2890.97
Neuro Surgery	3,654	43.94	3,051	52.63	3,051	52.63	1605.66
Gynecology	3,159	68.12	3,150	68.31	2,943	73.12	2151.8
Orthopedics	7,596	54.85	7,326	56.87	7,074	58.90	4166.36
Urology	5,526	65.50	4,626	78.24	4,500	80.43	3619.33
Unassigned Hours	0		549	18.03	2,763	3.58	98.96
Total Minutes 2007	41,310	62.03	41,310	62.03	41,310	62.03	25626.39