Nursing SWAT Patient Transport Analysis
Regarding Workload and Tasks

Nursing Department
University of Michigan Health System

Final Report
Program and Operations Analysis Department

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November 27, 2006
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Executive Summary

The SWAT program at the University of Michigan Health System (UMHS) was developed to transport Intensive Care Unit (ICU) patients and perform conscious sedations. Since SWAT’s introduction into UMHS, the types of procedures and duties that SWAT is expected to perform have increased without any corresponding change to the staffing level. The SWAT program is currently fulfilling 82% of its requests. In an attempt to meet as much demand as possible in fiscal year (FY) 2006, the SWAT program was running well above (roughly 30% at times) the overtime trigger, set at 5%. Although this overtime allowed the SWAT program to fulfill almost all of its requests, the additional time incurred large overtime costs. In response to these costs, our client, the Critical Care Transportation Manager, was instructed to decrease the overtime to keep costs within her budget. Therefore, the overtime is now acceptable, but only 82% of requests are being fulfilled. Our team was tasked with studying the SWAT program in order to create patient triage criteria and charge nurse duties, determine an appropriate staffing level, and determine the future impact of the Cardiovascular Center (CVC) on SWAT.

Methodology

The SWAT team has been recording data associated with each request since 2000, including the origin, destination, duration, number of nurses required, and type of procedure. As a result of recent changes in hours of operation and staffing levels in FY 2005, our team focused our studies on FY 2006 data to recommend appropriate staffing levels. In addition, we surveyed the eleven nurses and interviewed and shadowed charge nurses to develop triage criteria and better understand the tasks that SWAT nurses perform. Finally, we analyzed blueprints of the new CVC to estimate the impact to the duration and quantity of transports resulting from the opening of the CVC. Update.

Triage Criteria and Charge Nurse Recommendations

Due to the lack of set criteria as to which UMHS patients SWAT services, the SWAT nurses perform many tasks that are outside of the original intention of the program. With no formal criteria, the acceptance and scheduling of requests are at the discretion of the charge nurse. A formal set of triage criteria is important to ensure that requests that meet the criteria are fulfilled and requests that do not meet the criteria are given lower priority. The percentage of the demand fulfilled that meets the criteria will determine the appropriate staffing level of the SWAT program. Our team recommends that request only be accepted for conscious sedation, ICU, 6CV and 4A South patients. This recommendation is based on findings from the charge nurse interviews and SWAT nurse surveys, in which the nurses indicated priority of units and procedural areas. The results of our survey suggested that SWAT nurses believed that a charge nurse’s job should consist only of answering and organizing requests. This survey conclusion agrees with the conclusions that a highly trained RN is needed in order to determine the severity of the patient’s health, thus the priority of the patient transport. We recommend the charge nurse’s responsibility only be to answer and organize requests during the peak request and scheduling times, from 7am to 11am.

Appropriate Staffing Level Recommendations
To determine appropriate staffing levels, we analyzed FY 2006 data provided by the Critical Care Transportation Manager. This data, in the form of a Microsoft Access database, contained information on every request SWAT received during FY 2006. We determined that the suggested staffing levels of the SWAT nurses vary throughout the day, peaking at 9am and 3pm. To maintain the 82% fulfillment of requests, we calculated the number of nurses needed using the mean duration time of the transports. SWAT currently has 9.4 Full Time Equivalents (FTE’s). To meet 82% of the demand, SWAT should have 8.825 FTE’s. These 8.825 FTE’s do not take into account sick days, charge nurses who are attending to scheduling, or non-work hours. Our client informed us that on average 1.5 FTE’s per day are unavailable (sick days, paid vacation, etc.). From shadowing observations and interviews, we noticed that the charge nurse spends roughly 50% of his or her time performing SWAT nurse duties, while spending the remaining time accepting and scheduling requests. For our analysis, we will assume that the charge nurse accounts for approximately 0.5 FTE. Thus, SWAT’s actual FTE would be equivalent to 7.4 FTE’s (9.4 FTE minus the 1.5 FTE’s from the unavailable nurses and the 0.5 FTE from the charge nurse). We also found that if the SWAT team were to account for the mean plus one standard deviation, they would be able to fulfill nearly all of the requests. To account for the additional standard deviation, SWAT would need to have 12.725 FTE’s. Therefore, we recommend either hiring 1.5 additional FTE’s or 5.5 additional FTE’s, depending on the desired percentage of completed requests.

CVC Recommendations

Based on the analysis of the past data, our team has developed a table of transportation times to and from certain locations within the UMHS. This table of transportation times will assist in scheduling patient care. Additionally, by studying the blueprints of the CVC, our team was able to estimate the travel times between the CVC and the rest of UMHS. The CVC will host an additional 48 ICU beds, which is equivalent to a 20% increase in ICU patients. Need to update.
Introduction and Background

The current workload of the SWAT program at the University of Michigan Health System (UMHS) is overwhelming available nurses. According to the project client, the Critical Care Transportation Manager, employee satisfaction is low and interest in applying for positions within SWAT has recently decreased due to the workload of the position. An analysis of the current workload is needed to determine staffing needs, such as the optimal number of nurses available during given hours of the day or days of the week to meet current and projected work demand. In addition to the workload, analyses of the travel times, travel distances, and SWAT nurse tasks are needed. The Critical Care Transport Manager tasked our team with developing patient triage criteria for SWAT, as no criteria currently exists. The Critical Care Transport Manager asked our team to study the current scenario within the SWAT program to estimate the workload demands, availability of nurses, duties of the charge nurses, and structure of SWAT to determine the appropriate number of nurses per day to run the program effectively. Our team was also tasked with determining the impact of the Cardiovascular Center (CVC) on SWAT’s workload and travel times.

The purpose of this report is to present the team’s methods, key findings, conclusions and recommendations. We will also present areas of future study.

Background

Roughly ten years ago, the Nursing Administration identified a decrease in employee satisfaction. The University of Michigan Professional Nurse Council (UMPNC) thought that this decrease was due to the workload placed on nurses with respect to patient transportation in the Intensive Care Unit (ICU). During negotiations with the Nursing Union, a new program was created to handle transportation of ICU patients to and from departments and units within the UMHS as well as conscious sedation procedures. These transports will be referred to as “road trips” throughout this report. This new program, titled SWAT, was and still is managed by the Critical Care Transportation Manager. The program started with two nurses and serviced only adult ICU transportations and sedations.

The SWAT program was successful, based on feedback from nurses, departments, and SWAT nurse workloads. The SWAT nurses developed a positive relationship with other units. Within a year, demand for SWAT nurse transportation spread to Mott Children’s Hospital. Due to the increased demand, SWAT hired an additional nurse. Soon after, Holden (neonatal intensive care unit) requested use of the SWAT program.

Over the past seven years, SWAT’s staff level increased to six nurses and the program was expanded to all units, except the Post Anesthesia Care Unit (PACU), Women’s Birthing Center, Ambulatory Unit, Survival Flight, Emergency Department and Operating Room. The duties of the SWAT nurses also increased to include such tasks as organizing paperwork, helping to prepare patients for transportation, preparing Intravenous medications and monitoring surveillance. According to our client, the administration and monitoring of Sedation Analgesiaa are the most time consuming and requested tasks for SWAT.
Current Scenario

In March 2006, SWAT received three additional Full-Time Equivalents (FTEs). Along with this increase in staff, SWAT expanded their hours and days of operation. Currently, the SWAT program operates Monday through Friday, from 7 a.m. to 11 p.m. The program also operates on Saturday, from 7 a.m. until 7 p.m. Two nurses are assigned for the Saturday shifts. During the week, some nurses work ten to twelve hours per day, staggering shift times. The busy hours on any given day are from 10 a.m. to 4 p.m. Currently, the goal of SWAT is to have five nurses available per day, although feedback from the nurses suggests that six nurses per day would be an ideal number to meet customer requests.

With these hours, the program was initially operating at roughly 30% overtime per 4-week period. If the nurses work over 2% overtime, then the department must pay additional compensation in addition to the standard “time and a half.” However, the department goal is set at 5% overtime.

The new Cardiovascular Center (CVC) is planned to open in July 2007. The CVC will add 48 ICU beds to the hospital capacity, as well as house all cardiac related procedural areas and units. The opening of the CVC will impact SWAT with a currently unknown increase in demand and transportation times.

Triage Criteria, Charge Nurse Tasks, Appropriate Staffing Level Recommendations, CVC

Currently, gaps in knowledge exist in triage criteria, charge nurse tasks, appropriate staffing levels, and the CVC. SWAT cannot create patient triage criteria when the SWAT process definition is incomplete and undocumented. Each charge nurse decides to accept or reject a request based on his or her personal opinion on necessity of transportation. Likewise, charge nurse duties are neither defined nor documented. An appropriate staffing level cannot be determined until transportation and workload data have been thoroughly analyzed to identify areas of waste and standard procedures. Although data has been collected on the requests received and fulfilled by SWAT, it has not been studied in great detail to determine workload. Also, the impact that the CVC will have on SWAT travel times and demand is currently unknown.

Key Issues

The following key issues were the motivation for this project:

- An increase in the need for SWAT nurses at the University of Michigan Health System
- An increase in the number of patients within the hospital system, as well as patient transportations, due to the new CVC
- The need for staff to meet current demand, causing the SWAT program to operate above the 5% overtime trigger
- The perception of high employee dissatisfaction rates due to overworked nurses
- The unmet demand of SWAT patient transportation requests (83.9% request completion rate, according to SWAT transportation database)
Goals and Objectives

To determine the ideal staff ratio and SWAT program structure, the student team achieved the following tasks:

- Studied SWAT transportation tasks, communication methods, process flow and structure
- Interviewed SWAT charge nurses to determine the criteria that charge nurses use to triage their requests
- Gathered data on travel times to and increase in demand due to CVC
- Identified areas of the process that contain wasted time or lack of efficiency
- Analyzed database provided by SWAT to determine appropriate staff level

With this information, we developed recommendations to:

- Design efficient structure for the SWAT program
- Develop criteria for SWAT transportation
- Increase SWAT nurses’ satisfaction with their workload
- Provide appropriate staffing levels to meet department objectives and keep overtime under 5% trigger

Project Scope

This project included every task that is performed within the SWAT process. The SWAT process begins when a unit calls the Communication Center and dispatch records key patient transportation request information. The process ends with either the completion of the patient transportation by SWAT or the refusal to transport a patient. SWAT would refuse to transport a patient if the request does not meet SWAT criteria or if staff is not available to complete the request.

The study did not include patient transportations that do not include SWAT nurses. As stated before, all departments are included in the SWAT program, with the exclusion of PACU, Women’s Birthing Center, Ambulatory Unit, Survival Flight, Emergency Department and Operating Room. An estimated demand is included in the project for the new Cardiovascular Center since actual data cannot be gathered until after the center is completed in July of 2007. We provided recommendations for the process and structure of the SWAT program, but did not implement new technology or equipment.

Methods

The primary hospital entities involved in this project were the SWAT nurses, program leader, administrative assistants and secretaries, dispatchers and patients. All departments were involved in this study, excluding PACU, Women’s Birthing Center, Emergency Department, Ambulatory Unit, Survival Flight and Operating Room.

Database

The SWAT team has been recording data on every request since 2000 in an Access database. We received this database on October 6, 2006. We analyzed data from FY 2006 (July 1, 2005 – June 30, 2006) since before this fiscal year the SWAT program operated different hours, served
different units, and had fewer staff. We received additional data regarding the Saturday workloads from August 5, 2006 though September 23, 2006. Also, our client provided data for the extended hours (7 pm – 11 pm) for September 5, 2006 through September 23, 2006. The data studied in this project amounted to 3,985 road trips.

We stratified the data by units and procedural areas to determine if one of these variables had a greater effect on the duration of the road trip. We also stratified the data by several other variables (day, time of day, etc.) to identify trends within the data. This data was used to determine the appropriate staffing levels.

**Shadowing and Recording Task Time**

On the 16\textsuperscript{th} of October, 2006, we shadowed one of the SWAT charge nurses from 11:00 am until 5:52 pm, in which we recorded the charge nurse’s actions, the length of time required to complete these actions, and the time the actions occurred. The team used a stop watch to accurately record the length of time required to complete the charge nurses actions. We analyzed the data collected during the 7-hour study in two manners: one overall analysis, and another in half-hour increments. The team used this data to determine how much time the charge nurses spend performing SWAT nurse duties as opposed to administrative duties.

**Surveys**

Currently eleven nurses comprise the SWAT team; each of these nurses completed a written survey created by our team. A copy of this written survey is attached as Appendix B. From these surveys, the team identified the SWAT nurses’ overall work satisfaction, opinions on having the charge nurse sole duties be to receive and organize request, and patient triage criteria.

**Interviews**

Four nurses on the SWAT team have had the most experience as charge nurses of the unit. The team interviewed these four SWAT nurses to determine the criteria and processes that charge nurses follow when accepting requests for road trips. From these interviews, we developed triage criteria to be used in determining whether to accept a request. The nurses were also interviewed to determine detailed information on the SWAT process to create process flowcharts of the SWAT process.

**CVC**

Our team reviewed blueprints for the CVC to determine the distances from the CVC to the rest of the UMHS units and procedural areas. With these distances, our team determined the walking times needed to transport patients to and from CVC to other areas. The team used these times to determine the impact on travel time for SWAT. We also determined the expected impact on SWAT’s workload due to the increase in patient capacity afforded by the new patient beds of the CVC. update

**Key Findings**
Key findings were drawn from each of these methods. The team used these key findings to develop recommendations for patient triage criteria, appropriate staffing levels, charge nurse duties, and impact of the CVC.

**Patient Triage Criteria**

Our team determined that SWAT needs to define criteria for triaging requests. As mentioned previously, acceptance and scheduling of requests is done at the discretion of the SWAT charge nurse. However, it is impossible to determine which requests SWAT should fulfill if there are no formal criteria. Our team conducted a survey of the nurses and several interviews in order to define a mutually agreeable set of criteria. On the surveys, 5 out of 6 nurses indicated that conscious sedations should receive highest priority. Based on our interviews, the nurses felt that SWAT must be responsible for road trips required by ICU patients. Additionally, the nurses indicated that SWAT care is needed for patients in 6CV and 4A South because the nurses in these units are responsible for multiple patients.

These patient criteria (conscious sedation, ICU, 6CV and 4A South patients) accounts for 88.98% of the SWAT nurse workload. The remaining 11.02% of the workload is comprised of patients who do not fall under any of these categories but are deemed appropriate by the charge nurse for SWAT transport. Accepting these patients is left to the professional discretion of the charge nurse due to the inherent variability of patient conditions and required care within the hospital.

**Appropriate Staffing Levels**

In order to determine appropriate staffing levels, our team analyzed the SWAT FY 2006 database. This analysis allowed our team to understand trends in requests based on time of day, day of week, and type of request. It was found that the staffing needs vary throughout the day, as well as from weekdays to weekends.

**Initial Analysis of Database**

The database provided by SWAT gave the dates and days that requests were received. Figure 1 shows the total number of requests by day of the week.

*Figure 1: Number of Requests per Day of the Week Approximately Equal*
Figure 1 shows the number of requests per day is highest on Mondays and lowest on Wednesdays. However, only an 8% difference exists between Monday and Wednesday; a larger number of requests are made on Mondays due to the lack of SWAT services on Sunday. Therefore, we conclude that the requests per day are approximately equal.

Most Common Origins and Destinations
To understand the workload of the SWAT nurses we need to know the unit from which their patients are coming and to where they are going. In the database, the origins are identified as the Nursing Units and the destinations are identified as the Procedural Areas. Figure 2 below shows the Nursing Units from which the patients are coming.

Figure 2: 4DS and 6D are the Most Common Patient Origins
Figure 2 shows a wide range of units that SWAT consistently serves, although 4DS and 6D are the most common Nursing Units that use SWAT. All of the individual “Others” units have less than 100 total road trips.

Figure 3 shows the number of road trips by procedural area.

Figure 3: CT Most Common Patient Destination
Figure 3 shows that CT accounts for a large portion of the procedural areas to which SWAT transports patients. In fact, 36% of the road trips performed in the past fiscal year were for CT scans. The number of road trips for any particular procedural area significantly decrease from that point with Radiology, Angioplasty, and MRI having 668, 573 and 448 road trips, respectively. Based on the data, the SWAT team serviced 110 procedural areas 5 times or fewer throughout the whole year.

Calculating Staffing Levels
One of the main goals of this project was to determine the number of nurses needed to staff throughout the day. To determine this number, we analyzed the workload of the SWAT team. In FY 2006, the SWAT nurses worked a total of 246 days. The analysis found below is based on the data from the database we received. The data was broken down to total of number of requests per hour from 6 am until 7 pm for Monday through Friday. Therefore, to transform the data into number of requests per hour per day, the total number of requests per hour was divided by 246 days. The results can be seen in Figure 4.

Figure 4: Average Number of Jobs per Hour Peak at 9 am and 3 pm Every Day
In Figure 4, adding “Other requests” to “sedations” provides the “total” requests. The number of requests at the beginning (7 am) and end (7 pm) of the SWAT schedule are fewer than those between the two times. The requests tend to peak at 9 am and 3 pm and decrease between 10 am and 1 pm. A reasonable explanation for the decrease is that the requests slow down due to lunch breaks throughout the hospital.

**Suggested Number of Nurses on Weekdays.** The next step was to determine the number of nurses needed at any given time during the day. First, the number of nurses needed per sedation request was computed. According to SWAT nurses, sedations always require two SWAT nurses and average 3.5 hours in duration. Therefore, the number of nurses needed for sedations is:

\[ \text{Number of sedations} \times \frac{3.5 \text{ hours}}{\text{sedation}} \times \frac{2 \text{ nurses}}{\text{sedation}} \times \frac{1}{\text{# of sedations/hour}} \]

In addition, the number of nurses needed for the “other requests” was calculated using similar methodology. Most of the “other requests” only require one nurse, but approximately 3.5% of the “other requests” require a second SWAT nurse. For a more accurate formula, we separated the “other requests” into subgroups: coaxial tomography (CT), radiology, gastrointestinal (GI) radiology, nuclear medicine, angiography, medical procedures unit (MPU), magnetic resonance imaging (MRI), and remaining requests. Therefore, the number of nurses needed for other requests is:

\[ \frac{1.02 \text{ hours/CT request} \times 1.035 \text{ nurses/request} \times \text{# of CT requests/hour}}{1} + \frac{1.16 \text{ hours/radiology request} \times 1.035 \text{ nurses/request} \times \text{# of radiology requests/hour}}{1} + \frac{1.51 \text{ hours/GI radiology request} \times 1.035 \text{ nurses/request} \times \text{# of GI radiology requests/hour}}{1} + \frac{2.03 \text{ hours/nuclear medicine request} \times 1.035 \text{ nurses/request} \times \text{# of nuclear med. requests/hour}}{1} + \frac{2.06 \text{ hours/angiography request} \times 1.035 \text{ nurses/request} \times \text{# of angiography requests/hour}}{1} + \frac{2.07 \text{ hours/MPU request} \times 1.035 \text{ nurses/request} \times \text{# of MPU requests/hour}}{1} + \frac{2.35 \text{ hours/MRI request} \times 1.035 \text{ nurses/request} \times \text{# of MRI requests/hour}}{1} + \]
Once we obtained the number of nurses needed for sedations and “other requests” for each hour, we summed these to find the total number of nurses required. The results can be seen in Figure 5.

Figure 5 shows that the number of nurses follows a similar trend as the number of jobs per hour. In the next step, the data for the extended hours of operation is analyzed. Fifteen days of data is used to determine the number of nurses needed between 7 pm until 11 pm; 8 days of data is used to establish the number of nurses needed on Saturdays. Figure 6 shows the number of nurses compared to total requests during the extended hours. This data does not differentiate between sedations and other requests, so we assumed that 10% of the requests were sedations since roughly 10% of the total requests from previous data were sedations.
Figure 6 shows that the number of requests during extended hours peaks at about 9 pm and decreases thereafter. The number of nurses needed after 9 pm decreases to less than 1 nurse per hour.

All of the analysis preceding this point is based on the average length of time of each road trip. However, another important analysis of the data was performed. Our team determined the staffing levels needed throughout the day in order to meet certain percentages of request. Table 1 provides three suggested staffing levels: staffing levels for SWAT to meet 82% of all requests that meet criteria, staffing levels for SWAT to meet all requests using mean road trip times, and staffing levels for SWAT to meet all requests using mean road trip times plus one standard deviation. As mentioned previously, SWAT was originally intended to care for only ICU patients. Therefore, the second column in Table 1 provides the suggested number of nurses to care for only those ICU patients. SWAT could continue meeting 82% of the request demand by following the suggested staffing levels using means. If SWAT were to increase the number of nurses to account for the addition of one standard deviation, the team could complete much closer to 100% of the demand. The fourth column of the table shows the impact of adding one standard deviation.

Table 1. Suggested Number of Nurses for Monday through Friday Increases When Adding One Standard Deviation
<table>
<thead>
<tr>
<th>Time</th>
<th>Number of Nurses to Only Meet Criteria Using Means</th>
<th>Number of Nurses to Fulfill Requests Using Means</th>
<th>Number of Nurses to Fulfill Requests Using Means + 1 Standard Deviation</th>
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**Suggested Number of Nurses on Saturdays.** To determine the number of nurses suggested for Saturdays, we used the same calculations that we developed for weekdays and extended hours. Figure 7 shows the average number of requests per hour and the number of nurses suggested on Saturdays.

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Figure 7: Number of Nurses Suggested On Saturdays Follows Weekday Trend

Data from SWAT FY 2006 Database, Sample Size = 3985
Figure 7 shows that the requests on Saturdays approximately follow the weekday trends. The requests peak at 9 am and 2 pm with a lull in the middle.

Similar to our previous analysis, we also considered other possible staffing changes and the results are shown in Table 2.

Table 2. The Number of Nurses Suggested for Saturdays Increases When Adding One Standard Deviation

<table>
<thead>
<tr>
<th>Time</th>
<th>Number of Nurses to Only Meeting Criteria Using Means</th>
<th>Number of Nurses to Fulfill Requests Using Means</th>
<th>Number of Nurses to Fulfill Requests Using Means + 1 Standard Deviation</th>
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<tr>
<td>18:00</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Charge Nurse Duties**
The purpose of this analysis was to determine the proportions of time spent on certain charge nurse actions. Figure 8 shows the proportions of the total study time that the charge nurse spent performing certain tasks. The charge nurse’s tasks were:

- Talking on the phone or the SWAT radio
- Confirming the SWAT schedule with other SWAT nurses or units throughout the hospital (not on the phone or radio)
- Experiencing downtime; monitoring a patient, whether during transportation or procedure
- Walking to or from SWAT office or departments, not with a patient
- Completing SWAT paperwork.

Figure 8. SWAT Charge Nurse Spends the Most Time Monitoring Patients and on Phone

As seen in Figure 8, the majority of the charge nurse’s time, 47%, is spent monitoring a patient. Roughly 25% of the charge nurse’s time is spent on the phone or the radio, and an additional 6% is spent confirming the schedule of transportations with SWAT nurses or units in person. The charge nurse spends 7% of his or her time completing SWAT paperwork and 8% walking to or from the SWAT office without a patient. The charge nurse has 7% downtime throughout his or her day.
The team grouped the time divisions of Figure 8 into three categories: charge nurse duties, regular SWAT nurse duties, and other. These three groups were created to distinguish the proportions of time that a charge nurse would spend performing strictly charge nurse duties in comparison to SWAT nurse duties or other duties. Charge nurse duties include confirming or scheduling transportations via telephone or SWAT radio and in person. The regular SWAT nurse duties include: monitoring a patient, transporting a patient, and completing SWAT paperwork. The remaining percentages of time fall into the other category, which consists of time spent walking to or from the SWAT office (without a patient) and downtime. The division of the charge nurse’s time into these three categories can be seen in Figure 9.

As seen in Figure 9, roughly 30% of the charge nurse’s time is spent performing charge nurse duties, whereas 55% of the charge nurse’s time is spent performing regular SWAT nurse duties.

Analysis by Half-Hour Increments
In the half-hour increment analysis, the team studied the data collected during shadowing to identify trends of time spent on tasks. An important note for this analysis is the trends are based off of working time within the half-hour increment. The amount of working time is defined as the total time in the increment (30 minutes) minus the downtime in the increment.

The specific trends that we focused on were:

- Percent of working time that the charge nurse spends monitoring patients
- Percent of working time that the charge nurse spends on the phone, radio or schedule
• Percent of time the charge nurse spends on the phone or radio while monitoring a patient.

Figure 10 shows the percent of working time that the charge nurse spends monitoring patients for every half-hour increment.

Figure 10. Percent of Time Charge Nurse Spends Monitoring Patients Varies Throughout the Day

Figure 10 shows that the time varies throughout the day in no specific trend, with lows of 0% at three separate increments. However, for the half-hour increments after 3:30 pm, the percent of time spent monitoring patients remains over 50%, with increments at 100%.

Figure 11 shows the percent of time the charge nurse spends confirming or scheduling transportations with the SWAT nurses or health system units. These confirmations or patient scheduling occur either on the phone, radio, or in person.
Figure 11 does not show a solid trend, although the percentages after 3:30pm are noticeably lower than those before 3:30pm. An exception in this trend is the data point showing 98.3% in the 3:00-3:29 pm time increment. A conclusion cannot be made from this figure on whether the charge nurse spends more or less time on phone calls or the SWAT schedule at certain times in the day due to the figure’s lack of a solid trend.

Figure 12 shows the percent of time that the charge nurse spends on the phone or radio while monitoring a patient.
As seen in Figure 12, the percent of time that the charge nurse spends on the phone or radio while monitoring a patient varies throughout the day with no specific trend. However, for times after 2:30pm, the percentage drops to 0.0% almost continuously, except for one low data point of 3.3% at 4 pm. The percent of time the charge nurse spends on the phone or radio while monitoring a patient could be far lower in the later part of the day (after 2:30) due to a combination of the following: the charge nurse spends less time on the phone in the later part of the day (as seen in Figure 11) and the charge nurse spends more time monitoring patients in the later part of the day (as seen in Figure 10).

**High-Level and Detailed Flowcharts of SWAT Process**

After analyzing the SWAT process through interviews with our client, coordinator, SWAT nurses and Dispatch, we created both a high-level flowchart of the SWAT process and two detailed flowcharts of the SWAT process. Figure 13 shows the high-level flowchart.
Figure 13 shows that the charge nurse first receives a request for a patient transportation. The charge nurse then decides whether to reject the request, place it on a waiting list of requests that are not urgent, or schedule the request. If the request is placed on the waiting list, it is fulfilled whenever a SWAT nurse and the procedural area can fulfill the request, or it is scheduled for a later date and time. If the request is scheduled, then a SWAT nurse fulfills the request by transporting the patient at the scheduled time.

The two more detailed flowcharts are attached as appendices. Appendix C is a flowchart of the overall SWAT process in detail. Appendix D is a flowchart which shows how a SWAT nurse fulfills a request.

**Results from CVC Data**

We will be meeting with Ruste Wilke, Lean Coach of the Michigan Quality System, on November 29, 2006, to discuss the impact of the complete of the CVC on our project. We will have this section complete for the final report.
Conclusions and Recommendations

Our team drew several conclusions from our key findings. Firstly, the SWAT program patient triage criteria are needed to ensure that the high priority patients are being serviced. This conclusion is drawn from our interviews and surveys, in which nurses had conflicting methods of determining patient priority. Secondly, the charge nurse should complete only scheduling and phone related activities during certain parts of the day. This conclusion was made from the charge nurse shadowing data, in which our team noticed several times in which the charge nurse was interrupted with scheduling or phone activities while monitoring a patient. Thirdly, three options exist for appropriate staffing levels: fulfilling the current 82% of requests that meet criteria, fulfilling requests based on mean road trip times, or fulfilling requests based on mean road trip times plus one standard deviation. Finally, conclusions on CVC.

Patient Triage Criteria Recommendations

We recommend that the SWAT nurses only accept requests for conscious sedation, ICU, 6CV and 4A South patients. If the process continues where the charge nurses discretion is the only determinant of request acceptance, then there can be no limit to the demand for SWAT services. Providing criteria is necessary to limit demand, analyze true performance, and determine staffing needs.

After the criteria is implemented, we suggest that SWAT continue analyzing their data and update staffing levels using the same mathematical equation that was used in the key findings section.

Charge Nurse Tasks Recommendations

There should be a charge nurse on weekdays from 7am until 11am whose sole responsibility is to accept and schedule requests and manage the other SWAT nurses. These times were chosen because they are the busiest times of the day for road trips and they represent the peak hours for scheduling requests.

We recommend a trial run of one month to understand the impact or necessity of this change. At the conclusion of this trial, we suggest that SWAT reassess this implementation. If the hours are too long or too short, SWAT should adjust the hours. However, the charge nurse should be dedicated to administrative times only during the peak hours as shown in Figure 5.

Appropriate Staffing Levels Recommendations

Based on our analysis, we recommend staffing levels that are equal to or greater than the minimum number of SWAT nurses suggested from our key findings. Shown below in Table 3 and Table 4 are our recommended staff schedules for weekdays and Saturdays.

Table 3. Recommended Weekday Schedule for SWAT Nurses
<table>
<thead>
<tr>
<th>Shift</th>
<th># of Nurses</th>
<th>Shift</th>
<th># of Nurses</th>
<th>Shift</th>
<th># of Nurses</th>
</tr>
</thead>
<tbody>
<tr>
<td>7am to 3pm</td>
<td>2</td>
<td>7am to 3pm</td>
<td>2</td>
<td>7am to 3pm</td>
<td>3</td>
</tr>
<tr>
<td>8am to 5pm</td>
<td>2</td>
<td>8am to 4pm</td>
<td>1</td>
<td>8am to 3pm</td>
<td>1</td>
</tr>
<tr>
<td>9am to 5pm</td>
<td>1</td>
<td>8am to 5pm</td>
<td>2</td>
<td>8am to 5pm</td>
<td>3</td>
</tr>
<tr>
<td>3pm to 9pm</td>
<td>1</td>
<td>9am to 6pm</td>
<td>1</td>
<td>9am to 5pm</td>
<td>1</td>
</tr>
<tr>
<td>5pm to 11pm</td>
<td>1</td>
<td>3pm to 9pm</td>
<td>1</td>
<td>3pm to 9pm</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5pm to 11pm</td>
<td>1</td>
<td>3pm to 10pm</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5pm to 11pm</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4. Recommended Saturday Schedule for SWAT Nurses

<table>
<thead>
<tr>
<th>Number of Nurses to Only Meet Criteria Using Means</th>
<th>Number of Nurses to Fulfill All Requests Using Means</th>
<th>Number of Nurses to Fulfill All Requests Using Means + 1 Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift</td>
<td># of Nurses</td>
<td>Shift</td>
</tr>
<tr>
<td>7am to 1pm</td>
<td>1</td>
<td>7am to 1pm</td>
</tr>
<tr>
<td>8am to 3pm</td>
<td>1</td>
<td>8am to 3pm</td>
</tr>
<tr>
<td>9am to 5pm</td>
<td>1</td>
<td>9am to 5pm</td>
</tr>
<tr>
<td>1pm to 7pm</td>
<td>1</td>
<td>1pm to 7pm</td>
</tr>
</tbody>
</table>

Cost of Staffing Levels

In order to compare these options financially, we have determined the annual cost associated with each staffing option. These annual costs assume that no overtime will be worked, that SWAT nurses spend 7% of their working time completing non-SWAT duties (such as training or attending meetings), that SWAT nurses’ benefits amount to 23% of their annual salary, and that an additional 1.5 FTE’s are required to backfill for SWAT nurses on vacation or sick leave and an additional 0.5 FTE is required for a charge nurse to be dedicated to administrative tasks (on top of the FTE’s needed to fulfill work hours). The equation to calculate cost of staff is:

\[
\text{Cost of Staff} = [1 + \% \text{ not working (such as training)}]*[# \text{ FTE's} + 1.5 \text{ for sick days/vacation} + 0.5 \text{ for charge nurse}]*[\text{average salary}]*[1 + \% \text{ benefits}]
\]

The average salary is found by the following equation:

\[
\text{Average salary} = [\$35.42/\text{hour}] \times [40 \text{ hours/week}] \times [49 \text{ weeks worked per year}]
\]

\[
= \$69,423 \text{ per nurse}
\]

Considering the fact that there are currently 11 FTE’s in the SWAT program, the current cost of staffing is equal to $1,005,044.

Depending on what goal of requests fulfilled SWAT wishes to achieve, the cost of staffing will vary. Table 5 displays the annual costs of the three staffing level options mentioned in Table 3 and Table 4.
Table 5. Cost of Staffing Levels for SWAT, Least Expensive Option is to Staff to Only Meet Criteria Using Means

<table>
<thead>
<tr>
<th>FTE’s Needed</th>
<th>Number of Nurses to Only Meet Criteria Using Means</th>
<th>Number of Nurses to Fulfill All Requests Using Means</th>
<th>Number of Nurses to Fulfill All Requests Using Means + 1 Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTE’s Needed</td>
<td>$7.3 + 1.5 + 0.5 = 9.3</td>
<td>$7.7 + 1.5 + 0.5 = 9.7</td>
<td>$12.6 + 1.5 + 0.5 = 14.6</td>
</tr>
<tr>
<td>Annual Cost</td>
<td>$911,893</td>
<td>$951,115</td>
<td>$1,431,574</td>
</tr>
</tbody>
</table>

CVC Predictions and Recommendations

We will be meeting with Ruste Wilke, Lean Coach of the Michigan Quality System, on November 29, 2006, to discuss the impact of the complete of the CVC on our project. We will have this section complete for the final report. Update.
Appendix A – SWAT Nurse Survey

Please circle one number for each question and feel free to provide additional information on the back of this survey.

1. How satisfied are you with your job as a whole?
   Not at all 1 2 3 4 5 6 7 8 9 10 Completely

2. How satisfied are you with the workload associated with your job?
   Not at all 1 2 3 4 5 6 7 8 9 10 Completely

3. How beneficial would it be to have the charge nurse’s job consist only of answering phone calls and organizing requests?
   Not at all 1 2 3 4 5 6 7 8 9 10 Very

4. Please rank the following from most important to least important in prioritizing or selecting road trips to complete.
   (1 being the most important and 11 being the least important)
   We know there are a lot of uncertainties so please feel free to explain your reasoning.

   ____ CT
   ____ Angio
   ____ MRI
   ____ Radiology
   ____ Sedations
   ____ GI Radiology
   ____ Nuclear Medicine
   ____ MPU
   ____ Ultra Sound
   ____ Pulmonary Function
   ____ Vascular Lab
   ____ Other (Please define)

Please use the available space to the right of each procedural unit or the space on the back to explain your reasoning or any “grey” areas. Thank you!