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A case study

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in
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Introduction

The emergency room is one of the fastest-paced, intense places a person can find. Because many of the cases in the ER involve life-or-death decisions, accurate data in a useful format is critical for immediate access of necessary information. Over the last several years, this simple fact has sparked major interest in emergency room information resource management. While traditional paper methods are still widely used, the electronic capabilities provided by information technology are revolutionizing the way emergency rooms and trauma centers function.

An ideal state-of-the-art emergency department is integrated with the rest of the healthcare enterprise for access to all patient information via electronic media. This means doctors offices, remote clinics, and hospitals will all be linked by fiber optics or some other means of communication technology, eliminating “islands of automation” in which information is unable to be shared. Instead, all authorized medical personnel can access and share patient information at any wired location. This shared information includes all information gathered at the primary care physician’s office as well as all information gathered at all treatment facilities. Additionally, all software and hardware used in the ER will be fully integrated and designed to support the medical decisions made by the ER staff. This integration will allow medical information to be available to medical staff at the touch of a button. As a result, the quality of patient treatment is increasing as is the probability of patient survival.

A case study of Covenant Medical Center (CMC) will allow an assessment of one hospital’s ER compared to a state-of-the-art ER facility. Covenant Medical Center is a 366-bed health facility, employing approximately 270 physicians and 608 nurses, as well as 28 information technology professionals. Located in Waterloo, Iowa, CMC offers many services including a
Cancer Treatment Center, Dialysis Center, Sports Injury Center, Rehabilitation Center, Mental Health Services, and the 24-hour Emergency Trauma and Treatment Center (ETTC). Each year, this healthcare organization has approximately 12,000 inpatient hospitalizations and performs about 400,000 outpatient procedures.¹

CMC’s Emergency Trauma and Treatment Center is classified as a Level 2 trauma center, meaning all types of emergency cases are handled, with a few exceptions. CMC’s ETTC does not treat patients for open-heart procedures, limb reattachments, or major burns. However, all other types of medical emergencies are treated at this facility. The emergency department is staffed with 7 full-time and 4 part-time physicians, 30-35 nurses, and 6 technicians. Physicians work 12-hour shifts, with 2 working the noon to midnight shift and 1 working from midnight to noon. Nurses work either 8- or 12-hour shifts, depending on individual circumstances and schedules. CMC’s Emergency Trauma and Treatment Center sees 30,000 patients annually. Over 50% of hospitalized patients come from the emergency room (ER), and 24% of patients seen in the ER are admitted directly to the hospital.

A comparison will be made between the latest modern technology available and the technology used by Covenant in its emergency department. Specific comparisons will be made in the following areas: strategic management, technical equipment, electronic medical records, and patient tracking (tracking and logging, vital signs, pharmacy, clinical documentation, discharge, planning, and scheduling). Within each of these major areas, two elements will be addressed. First, some of the latest technological information systems and processes and their uses in an emergency department are explained. Then, I discuss how Covenant Medical Center’s Emergency Trauma and Treatment Center is progressing in the modernization of its ER department and utilizing some of these latest technological innovations to improve patient
treatment. The need for information anytime and anywhere in critical situations has prompted researchers to examine how medical information is being used in emergency rooms.

Strategic Management

An emergency room is an extremely important department and should be considered as such in a health enterprise's strategic management practice. Unfortunately, the emergency department is often overlooked or not well considered in this major planning process, especially when information technology is being discussed. Good planning for implementing and controlling a critical system is required. When there is a lack of strategic planning and needs assessments, implementation of processes and technologies can be severely delayed. This is a serious problem because emergency rooms are major centers of operation, where approximately 25-40% of all admissions originate, and there is a high need for the benefits that information technology can provide. These benefits include greater efficiencies in providing care and fewer occurrences of lost charges, which ultimately lead to better profits.

The emergency department is one of Covenant's Centers of Excellence. It therefore receives great consideration in strategic management. This area is promoted and marketed in the community, so the medical center focuses on keeping it fully staffed and its equipment current. Dr. Singer, President of Emergency Medical Associates, is included in strategic management meetings. He stated that a second reason the ER is one of the departments given significant attention in these planning sessions is the majority of patients arrive through this area. Dr. Singer estimated that $4.3 million is spent on the ETTC annually, appearing to signal that the medical center does in fact take this department seriously.
The lack of access to financial and strategic data prohibits the evaluation of Covenant's real commitment to information technology. However, even though a comparison cannot be made of the technology budget in relation to the overall budget for the organization, $4.3 million is a significant amount of money. In addition, though specific details regarding Covenant's strategy are unavailable, the organization does place an emphasis on strategic management. Covenant should ensure it has a fully developed information systems strategic plan in place to define the direction of information technology in the ETTC.

**Technical Equipment**

Technology is developing rapidly. Every day, technological ideas and concepts are becoming reality. From registration to discharge, technology is impacting the way emergency rooms function. The computers found in emergency rooms are smaller, faster, and have more processing capabilities due to advances in computing power, program memory, and data storage capacity. An investment of $2000, decreasing daily, can provide a workstation with immense power, enough to process computerized radiology images. It is important for the emergency room to be equipped with such a system because anatomical images, such as x-rays, can be immediately processed and viewed by physicians. This helps improve patient treatment and satisfaction.

A new type of technology being used in the medical field is "Point-of-care technology" (POC). POC technology, including pen-based portable computers, hand-held devices, and touchscreen monitors, allows the physician and medical staff to bring technology closer to the patient. This is very beneficial for documentation. Physicians can take a hand-held computer into the exam room to visit a patient and take notes on-line instead of writing them down on paper or
trying to remember them. The POC devices allow physicians to access a patient’s electronic medical record immediately while with the patient, saving time and ensuring the information is accurate and up-to-date. Some of these technical devices can send notes to personal computers or printers, store drug lists and billing codes, and provide the interface to medical equipment. “Point-of-care” technology, including wireless capabilities, is definitely providing benefits in the emergency room.

Covenant realizes the importance of information technology. Mike Hemmer, Director of Information Technology (IT) at Covenant, estimates that $3.7 million is spent annually on IT for the entire organization. Although this is a large expense, it is reducing costs by increasing the speed of job performance. There is also less paper waste, which saves on the cost to obtain and discard the paper.

CMC uses an Ethernet local area network (LAN) for its network. Twelve Novell servers, 3 Windows NT servers, and a small AS/400 make up the backbone for this LAN. The 250 terminals connected to the AS/400 are used for legacy and time-sharing programs while the Novell and NT servers are being used for new client-server applications. Specifically, the emergency department houses 6 computers, 6 printers, a touchscreen monitor, a copier and a fax machine. Because the ETTC is not fully electronic, this is enough to meet its needs at this time, but as the organization progresses toward state-of-the-art technology and functionality, more technology resources will be needed for the ETTC, especially with respect to POC technology.

POCs, especially laptops and hand-held computers, are being considered by Covenant. At this time, budgetary constraints have forced this luxury onto the back shelf, but medical personnel hope these systems will soon be implemented. One way the system would be used in the ETTC is in patient registration. At the present time, all patients who are not in immediate life-threatening
conditions begin their journey in the ER at the registration clerk’s desk. All patients in need of immediate life-sustaining treatment begin their journey in an exam room where they are treated by the medical staff without delay. With the use of POCs, instead of the patient going to a registration clerk, the registration clerk would go to the patient. This would cut down on the wait time required before a non-critical patient receives medical care and improve patient treatment and satisfaction.

**CPR/EMR**

In the information technology area, CPR does not refer to resuscitative breathing. In this case, CPR stands for computer-based patient record. Many people also use the term electronic medical record, EMR, to refer to the same concept. An EMR is a patient record stored electronically. It includes information from a variety of medical sources (systems) that are integrated to produce an understandable record. These records can contain various types of data—medication administration, specimen collection, and test results and interpretations.

For these types of records to be used, an emergency room/trauma center must be automated. Physicians can use electronic records to review and sign transcriptions and enter text. They can also access lab and radiology data, history and physicals, operative reports, discharge summaries, consultations, demographics, and internal medicine reports. Nurses use these records for charting details of the illness or injury, lab test results, vital signs, height, and weight. This information is then immediately available to the physician for analysis and patient treatment. Efforts are currently underway to use electronic records for order entry as well.

Covenant does use the EMR technology (electronic medical record), although on a small scale. The information regarding each patient is stored electronically and authorized personnel
can assess specific information as needed. This allows employees to perform their jobs much faster than when relying on paper because online information can be accessed immediately. However, there is a gap between EMR use in a state-of-the-art facility and EMR use at Covenant. At the current time, EMRs are accessible by few CMC locations, meaning patient information cannot be readily shared or accessed by multiple people. However, Covenant is attempting to achieve the state-of-the-art EMR functionality. Efforts are underway to expand this accessibility to all clinics and physician offices for improved patient treatment. Soon, patient information will be accessible to authorized personnel from all areas of the healthcare organization. This will require additional equipment and software as CMC’s fiber optic network is expanded.

**Tracking a Patient**

*Tracking & Logging*

Tracking and logging systems trace an emergency patient from entry into the ER to hospital admittance or discharge. At the time of arrival, the patient is logged into the system, registered, and triaged to see how critical the injuries are. For those required to wait in waiting rooms, the system improves service by noting how long the patient has waited. Hospitals are using this information to assist in reducing the wait time experienced by patients. These systems also track procedures to completion, allowing physicians to see new, modified, or cancelled procedures on-line. This not only speeds up the process, it also improves efficiency and accuracy.

When a patient arrives in the emergency room, certain information such as demographics, insurance, and the complaint must be gathered. At CMC’s ETTC, an electronic logging sheet is used to document the time of the patient’s arrival, lab test information, x-rays, and the diagnosis.
This information is obtained from various sources, including the patient, the family, EMTs, insurance cards, and the computer system. A person who has been a previous patient at CMC will already have the demographic information recorded in the system. The emergency room personnel will retrieve and confirm the information, making any necessary changes.

Patient tracking at CMC’s ETTC is done via a physical white board next to the nurses’ station. Its visibility here makes this the prime location. Currently, when a patient arrives and is ready to be taken to an exam room, the nurse records the room, patient’s name, nurse, physician, and ailment on the white board and the patient is moved. This resource provides immediate information to nurses and medical staff, which is very beneficial (especially during shift changes). At one point, Covenant investigated an electronic white board. With an electronic board, all patient tracking would be done through a computer and viewed through a computer screen. The screen and keyboard would replace the physical board and the markers currently used. However, because the current physical board is very accessible and easy to use, these benefits, coupled with the expense of the electronic board, influenced management to decide against purchasing an electronic white board. I do not see Covenant investing in an electronic white board in the near future because of the high level of comfort with the current manual system and the cost of an electronic system. This means the ETTC will remain a step behind the description of a state-of-the-art ER, but Covenant is operating well with this current manual system.

**Vital Sign Readings**

In a state-of-the-art ER, technology is available to assist in taking and storing vital sign information. These vital sign readings are being taken and monitored constantly in the emergency room. As technology improves, medical equipment is increasingly playing a role in monitoring a
patient's vital signs. A large proportion of medical equipment is being interfaced through computer systems using touchscreen monitors. Touchscreen technology is important in the emergency room because touching the screen is usually much faster than typing on the keyboard. The benefits of these interfaces include streamlined and more efficient processes, improved turnaround times because information is automatically entered into the system, and improved accuracy of information. Blood gas machines, ventilators, EKG machines, and other pieces of medical equipment are utilizing this capability.

Fortunately, systems today are using the vital sign results to actively keep the medical staff informed. For example, some systems provide stoplight coding. When vital signs are in the proper range, a green light will be displayed. When the readings are approaching the range limits, the light will turn to yellow, signaling that the physician may want to examine the patient to determine the reason for the readings. If the vital sign readings are outside the normal range, the light will turn red. This indicates a problem exists with the patient that must be investigated promptly. Vital sign readings can also interact with pharmacy systems to make medication suggestions and corresponding dosage recommendations. This type of system, automatically monitoring vital signs readings and interacting with other systems, benefits the hospital and the patient.

With vital sign technology, Covenant is at both ends of the spectrum. The ETTC has a long way to go before it becomes state-of-the-art in recording vital sign readings as vital signs are mostly taken manually and recorded on the paper charts. An extra step is then needed to enter this information into the computer system. On the other end of the spectrum, Covenant is using advanced touchscreen monitor technology. A touchscreen monitor is used to interact with EKG machines. This monitor, located at the nurses' station, can display the heartbeats of several
different patients simultaneously, allowing the nurses to see these without switching windows on the screen. The EKG results are printed and the paper copies examined by the physician. The touchscreen monitor allows a patient to be monitored without a medical staff member physically present in the room.

**Pharmacy**

Drugs and medications are used in almost all emergency cases. The management of these drugs is crucial because giving the wrong medication to the wrong patient can be a fatal mistake. The most advanced systems today are very sophisticated in their management of drugs and are designed to aid physicians in pharmaceutical decisions. It is difficult for medical personnel to stay current on their knowledge of prescription drugs and drug effects because new drugs are always being introduced. It has been estimated that physicians must read 270 articles per day to keep up-to-date.17

Pharmacy systems with drug knowledge bases are used frequently in the emergency room. Such systems can identify dosage problems and alert the medical staff of conflicts. When a medication is ordered, the system checks the patient’s age, weight, diagnosis, gender, height, race, and any test results to assist the physician in prescribing the correct dose of the medication.18 Systems today can also allow for defined clinical triggers. When a certain event occurs (such as a received test result) that may be in contradiction to the medication ordered, the system will flag the medical staff to address the issue.

These “smart” systems are helping to decrease the number of adverse drug events, or ADEs. There are fewer instances of the wrong medication or wrong dosage being administered, which decreases costs while improving the quality of care. It is surprising how many problems
occur because of these ADEs: 18-30% of hospitalized patients and 14% of hospital days were attributed to ADEs. Of these errors, 28% were dosage errors and 29% came from the physician’s lack of knowledge due to being unable to keep up with medications and their effects.\textsuperscript{19}

Covenant’s Emergency Trauma and Treatment Center uses PYXIS, a fairly advanced prescription drug system. This system consists of a cart with several different drawers and each drawer contains different medications. To retrieve a medication, the nurse enters his/her identification number, the patient number, and the medication identification code. Once the system has validated this information (almost instantaneously), the appropriate drawer unlocks and opens, and the nurse may remove the medication. PYXIS is integrated with the hospital’s financial system, so charges for this medication are automatically assigned to the patient and the specified dosage is subtracted from inventory. Although advanced, the PYXIS system is not the smartest system available. For example, it does not log the medication being administered in the patient’s medical record. It also cannot interact with the medical record to determine whether any adverse drug reactions are likely to occur or make medication recommendations to the medical staff. Additionally, the system is unable to provide suggestive drug or dosage information based on patient symptoms. Therefore, while the system is providing some benefits to the ETTC, it is not as smart a system as is found in a state-of-the-art facility.

**Clinical Documentation**

The latest in clinical documentation software provides templates for charting and narrative notes. In this context, a template is an outline, or guide, informing the medical staff of the needed information by listing questions that must be diagnosed or asked of the patient, and the format that should be used when documenting the answers. These templates are usually available only
for the most common complaints, including chest pain and pediatric trauma. Complaint specificity is needed because some questions are necessary for one injury or illness, but not for another. These templates are easily accessible, and the complaint specificity is semi-generic: chest-pain, leg-pain, etc. While these are somewhat general, they do provide enough detail to eliminate certain questions from the template while retaining and including others. The templates are also gender specific and specific to different complaints. Gender specificity is necessary because some medical questions are appropriate for one gender but not the other.

The medical staff decides which template should be used for a patient based on the patient’s symptoms and diagnosis. The templates assist physicians by standardizing on-line notes, making the information easily accessible and formatting the medical information in a common recognizable format. They also ensure that all necessary information is recorded. In addition, some software programs allow for handwritten annotations on anatomical drawings, so pictures and explanatory text can be stored.

Currently, clinical documentation at Covenant’s ETTC is done much differently than at a state-of-the-art institution. The ETTC staff documents information manually, on paper. There are no guides to assist them as to what questions need to be asked when diagnosing ailments. Instead, the physicians rely on their expertise and experience and respond to the situation at hand. When documenting, physicians record the information in the standard format with which they are comfortable. This is much different than the state-of-the-art system, in which everything is standardized and online. While Covenant’s staff is getting by with their current documentation procedure, they would realize many benefits by implementing clinical documentation software.
Discharge, Planning, & Scheduling

The latest discharge systems interact with the tracking and logging systems to ensure all procedures for a patient are finished before the patient is discharged. These systems also provide discharge instructions, work release and workmen's compensation forms, and prescriptions based on the nature of the injuries or illness. When a patient is discharged, the hospital keeps the necessary information in the patient's computer-based record. There is also usually a piece of paper given to the patient with instructions and occasionally a prescription to be filled.

If follow-up procedures are needed for the patient, those can be scheduled through interaction with the scheduling system for the rest of the healthcare enterprise. Many systems can also communicate with the physician's office system, automatically accessing the physician's appointment schedule. The emergency room staff can then interact with the physician's system, making an appointment acceptable to the patient.

Covenant also falls far behind a state-of-the-art emergency department in this area. At the present time, prescriptions and specialized instructions must be written for discharged patients, or phone calls made to a pharmacy to order a medication. If an appointment is to be scheduled with a physician, either the emergency staff places the necessary phone call or this task is left up to the patient. Workmen's compensation forms are not automatically produced in any situation, and the scheduling of future procedures is done manually through phone calls. Thus, while Covenant is functioning properly, it could be functioning more efficiently.

The Future for CMC's ETTC

What is on the horizon for CMC and its ETTC? First, an online documentation and a discharge system are coming in the near future. There are also two other systems and functions...
that are soon to become reality, including electronic medical records available at multiple locations and a physician dial-in system.

**Online Documentation**

Covenant is seriously considering the purchase of a state-of-the-art online clinical documentation software program. This online documentation template will provide significant benefits to the Emergency Trauma and Treatment Center. Performance will be improved, especially in the areas of liability and Medicare reimbursements, as the correct questions will always be asked and the ordering of resulting tests validated. The template will also provide for a standard format of information representation. As the government cracks down on fraud and abuse in healthcare organizations, this standardization will help Covenant validate its procedures.

**Discharge System**

A new discharge system for Covenant will perform many functions including automatic production of patient instructions, workmen's compensation forms, and scheduling future procedures and patient appointments with other physicians. Computer-based patient instructions will ensure that all patients receive somewhat standard instructions for the same type of injury or illness. Many documents are needed when a patient leaves a hospital or emergency room. This discharge system would also automatically produce medical documentation for workmen's compensation claims in the appropriate situations, dramatically decreasing the time it currently takes to produce such forms.

By providing the ability to schedule future procedures and future appointments with other physicians, the patient is ensured that an appointment is made, and the best schedule can be found
for the patient. Currently, if an appointment with the patient’s general physician is needed, the emergency room staff must physically place a phone call setting up that appointment or instruct the patient to make the appointment. With the new system, the fact that these appointments will be scheduled automatically from the ER by the ER staff will improve patient satisfaction, as the patient will not have to worry about scheduling the appointment later. To achieve this, the ER staff will be able to see and add to the schedules of the physicians, so patients are scheduled at acceptable times.

**Wider Availability of EMRs**

Many of the clinics associated with Covenant Medical Center are being wired for fiber optics, which is part of the integrated healthcare enterprise discussed earlier. Once this is completed, these locations will be able to access CPRs for specific patients. This will increase the amount of information available to physicians as they will see all medical transactions for the patient and the on-line information will be accessible almost instantaneously. This will allow patients to seek medical attention at multiple locations with the knowledge that the physician will be able to see the patient’s medical records. Patient treatment will improve as well as patient satisfaction.

**Physician Dial-in Program**

Finally, it should be mentioned that Covenant is beginning implementation of a physician dial-in system. Using the program called Physician’s View, physicians can see Covenant’s EMRs and stored images. A few installations have already been completed, and 14 additional
installations are planned for the near future. Once the functionality of these systems is approved, hundreds of installations will begin to get all physicians on-line quickly.

Expectations and Recommendations

Covenant Medical Center’s Emergency Trauma and Treatment Center is one of the finest ERs in the area. While it has a few modern technological features, it still has a long way to go. Fortunately, CMC itself realizes this fact. The near future promises to show great technical advances for Covenant, bringing the organization up-to-date with medical technological advances.

I have several recommendations for Covenant’s ETTC. Though it is improving its technology infrastructure and technology inventory, there are still many issues that should be addressed and actions that need to be taken.

1. This organization should actively pursue completion of the infrastructure and implementation of integrated EMRs. The computerized records are an important source of immediate information that can drastically reduce the time it takes to treat a patient, and are the foundation of the rest of the recommendations. With this, the installation of the physician dial-in program, Physician’s View, needs to be completed quickly to enhance the ability of physicians to access electronic records. This technological capability is currently the most important to implement. Immediate access of a patient’s information will show benefits in the number of lives saved, the satisfaction of patients and medical staff, and the image of the medical center.

2. The clinical documentation software also needs to be installed and become routine for the medical staff. This standardized information will allow the physicians to access critical data faster. This is beneficial because there is not enough time in life-and-death
situations to search for data. The data should be in a common recognizable format so its contents can easily be found and utilized.

3. The new discharge system should be installed. The medical staff is constantly being inundated with more paperwork, which is either left unfinished or done hurriedly. A new discharge system would allow the medical staff to perform the functions for which they have been trained: to practice medicine.

4. At this time, I would recommend that Covenant stay with the current physical white board. The staff seems to be very comfortable and happy with this, and the funds needed to acquire an electronic white board are needed in other areas.

5. Covenant should seriously consider obtaining a “smarter” pharmacy system. A system that can aid physicians in catching potential adverse drug interactions before they occur would be very beneficial. This system would not only improve the quality of patient care, it could also save lives. In the emergency room, things sometimes move so quickly that not all potential problems are addressed. This system would assist the medical team by alerting them of drug and/or dosage problems.

6. More technology should be sought to assist with documenting vital sign readings. As mentioned, some vital sign equipment can be interfaced through computer systems. This technology should be investigated because the process of taking vital signs could be decreased. Instead of taking vital signs and entering those results into the computer at a later time, the automated vital sign equipment can take the readings and record them into the system automatically.

7. Finally, Covenant should look at increasing the number of computers located in the ETTC. Specifically, point-of-care (POC) computers should be investigated, and cost-
benefit analyses should be conducted to determine whether the acquisition of this advanced technology would be of benefit to the enterprise at this time.

By addressing these issues and considering these recommendations, Covenant can become aware of the information resource management issues facing them today and potential solutions for current problems. As the future approaches, Covenant faces two options: remaining stagnant with yesterday’s and today’s technology or progressing with tomorrow’s constantly advancing technology. It appears the organization committed to advancing and understands the importance of technological progress.

1 Covenant Brochure


7 [www.physix.com]


16 Open Management Foundation: Cerner’s Management Data Repository, Cerner Corporation, 1996, p. 4.


19 Ibid

