HCI – CONCEPTUAL DESIGN MEMO

Data Management in the EMS Work Environment

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Team Proposal: To better utilize existing technology to gather patient data during an EMS call.

ABSTRACT

This memo is a follow-up to Paramedic Geek Squad's requirement memo discussing how to better utilize technology to improve data acquisition and flow during an EMS run. The object of our team is to re-design how medics interact with their monitor/defibrillator[1] allowing them to electronically gather data and input that data automatically into the patient care report (PCR)[2].

For this memo we will review the concepts at the heart of our project and design as well as elaborate on concepts from the requirements memo. We will then present in detail how the project will work utilizing computer software tools to design diagrams and table, demonstrating how the system will function. Finally we will briefly touch on future plans for prototype implementation.

BACKGROUND

The flow of data on an EMS call is hectic at best with vital information often being lost as patient care is transferred from one entity to another. Often times a patient will pass through several levels of care on their way to definitive care (hospital ED or admission). At the points during which a patient's care is transferred there is often times error inserted into the system, either information is obtained and passed on erroneously, forgotten altogether, or assumed to be of a certain parameter when it is not. For the purposes of this memo we will focus on the interactions taking place from the view of the ambulance crew, specifically a medic and an EMT tasked with transporting the patient from an incident scene to the Emergency Department.

PIC 1 EMS AGENCIES ARE TASKED WITH PROVIDING QUICK RESPONSE AND PATIENT CARE, OFTEN TIMES INFORMATION IS LOST OR FORGOTTEN IN THE FAST PACED WORLD OF EMS

The objective of our team's proposal is to better utilize current technology to better facilitate Ambulance Crews in obtaining information, document patient procedures, and electronically document patient information and status during transport to the hospital. By incorporating electronic data gathering and utilizing a computerized system

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[1] Monitor/Defibrillator - A computerized device utilized in EMS to monitor patient vital signs and administer various forms of electric therapy, such as defibrillation.

[2] Patient Care Report (PCR) – A PCR is written for every EMS call and documents the patient's information, history, vital signs, assessment and treatment given. A PCR is kept as part of a patient's medical record.

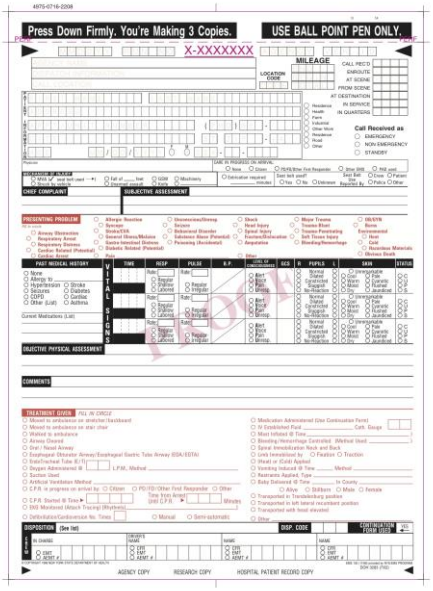
that is already brought to most EMS calls by ambulance crews (the monitor/defibrillator), our team feels that information will be better passed along to the next link in the EMS chain.

As discussed in our previous memo we feel that this system will provide many advantages to patients, EMS providers, and ED staff. Since the systems are already being developed to link ambulance crews to the ED it is not a far reach of the mind to envision a fully linked system that will allow information to be shared freely with a hospital even before the patient arrives at the ED. In this document we will demonstrate that our system is well underway to being a viable design.

CURRENT SCENARIO

Observations of current practices within EMS were made over a period of time and once the data from these observations was assessed our team agreed that changes could be made. One area in particular stood out for our team specifically during the observations, the flow of information from patient to EMS provider to the hospital. Our team spoke with several users of the current system who agree that problems exist and current systems seeking to solve these problems are falling short or creating more problems then the current system.

Currently EMS systems across the country are hitting a crossroads, as computer technology replaces the good old pen and paper many are finding the transition hard and cumbersome. Traditionally an EMS provider will collect information from a patient throughout an EMS call, writing it down on a scratchpad or a paper PCR. Enroute to the hospital the provider will call ahead on either a cell phone or radio and advise the hospital about the incoming patient and the patient's status. On arrival at the hospital the patient is transferred to a hospital bed and the provider gives a quick verbal report to a nurse about the patients condition and pertinent information. After this the provider then has to complete a PCR that gives a detailed report on the patients demographics, medical history, history of current problem, and treatments performed enroute to the hospital.



PIC 2 A SAMPLE PCR COPY, A LOT OF INFORMATION HAS TO BE CONTAINED ON THIS ONE PIECE OF PAPER.

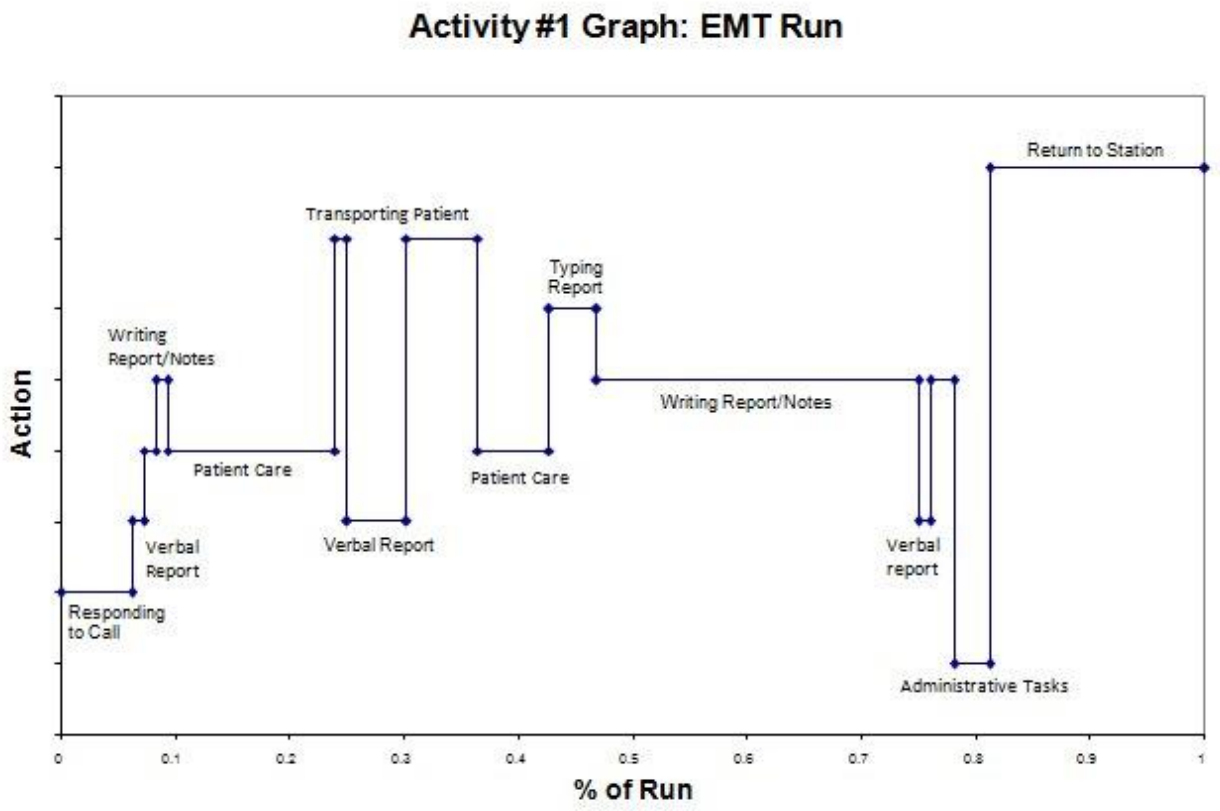
Throughout our teams observations and interviews with current EMS providers we determined there are some weaknesses in the current system, the biggest of which being that the provider handles too much information. Many times a provider is performing treatments or trying to multi-task while interviewing a patient and all to often information got lost, misplaced, or forgotten during the call. When a notepad was used it took too much time for the provider to write down all the necessary information or was illegible. The potential exists for a provider to forget important patient information and fail to pass it along to the hospital during the patient turnover.

Additionally problems also were observed in the PCR system currently in place. Many EMS systems still rely on paper PCRs as the primary way of documenting the patient interactions and treatment during a call. However the current system is reliant on the memory of the provider, their knowledge of the PCR format, their handwriting skills. Many times these PCRs are turned in incomplete or too illegible to be

useful to the hospital, which can ultimately affect patient care. Current computer based systems also have shortcomings, taking too long to boot up, relying on an internet connection, or are cumbersome in their interface design.

Through our teams observations we discovered that the information flow during an EMS call could be greatly improved if some of the load could be taken off the provider and automated. With this in mind our team sought a solution to the problem utilizing tools already available to the provider.

Activity Analysis of EMS Run:



TRANSFORMED SCENARIO

For the transformed scenario our team analyzed the data obtained during our observation phase and identified key areas that could be improved upon. The foremost of these was to implement a better way for information to be captured and stored that did not rely on memory or rapidly scribbled notes. Additionally our group sought to integrate this transformation into a tool already utilized by EMS providers.

Integration and communication would also play a huge role in the transformed scenario, by networking EMS units in the field with hospitals and agency bases; information can be shared rapidly and in real time. A hospital will be able to have a patient pre-registered, know their vitals signs, and cross-reference that information against previous

records all before a patient arrives at the ER door. Additionally doctors will be able to weigh in on decisions in the field and make more informed decisions on further treatment being performed by the EMS provider. Information will be able to flow rapidly from point to point requiring less transcribing of digital to analog and analog to digital.

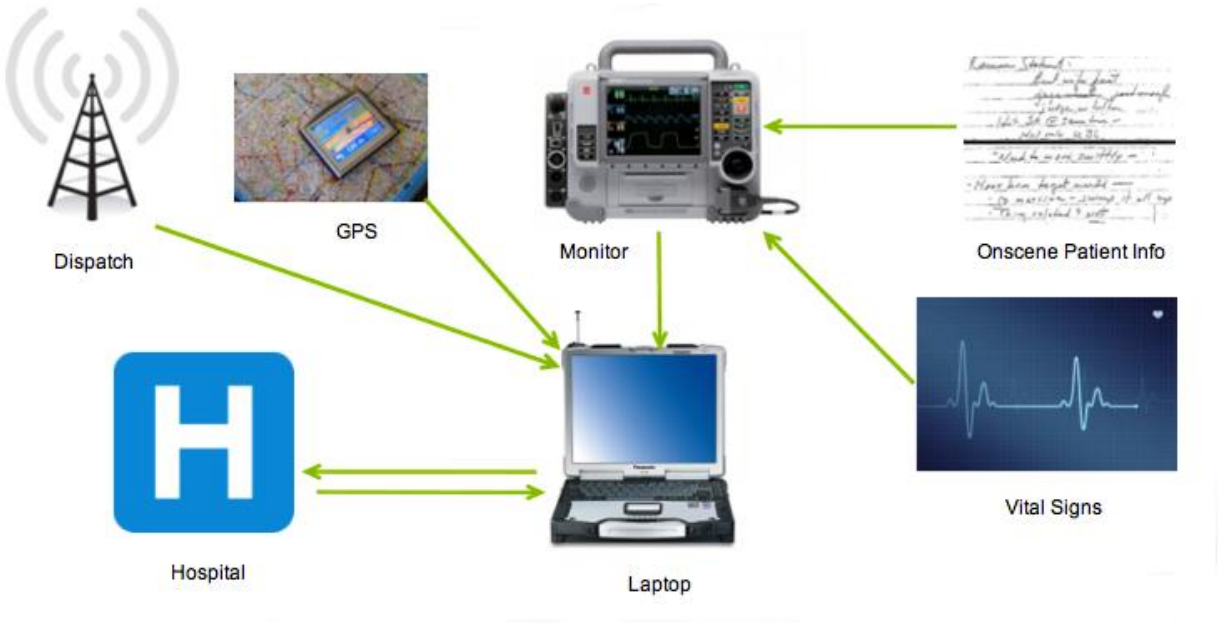


FIGURE 1 INTEGRATING DIFFERENT INFORMATION CENTERS ALLOWS INFORMATION TO FLOW RAPIDLY FROM ONE SOURCE TO THE NEXT, RELIEVING THE STRAIN ON THE EMS PROVIDER

The centerpiece of our transformed scenario will be transforming the monitor/defibrillator interface that allows it to be utilized as a data input device. It was decided to use the monitor in the manner because it is already utilized on nearly every EMS call and is already used by EMS providers on a widespread scale. The monitor is already capable of capturing patient data including vital signs, EKG[3] data, and is able to transmit small amounts of data to the hospital.

By transforming the monitor and giving it more capabilities that are easily accessible to the EMS provider our team foresees better data flow with improved data retention and decreased chances for error. The current plan involves implementing a new interface into the monitor requiring changes to both software and hardware contained within the monitor. This change will be made easier given the modular design of current EMS monitors allowing them to be easily field upgradeable. One of the biggest physical changes involves replacing the current LCD screen with a tough, crack resistant touch screen usable with either a stylus or ones fingertips. This will allow easy data input with a simple GUI that will include drop down menus and large easy to select parameters.

[3] EKG – Electrocardiogram is the visual representation that is displayed on a monitor of the electrical impulses that are travelling through the heart. They can tall an EMS provider a lot about how the heart is functioning and are to be included with the PCR.

A monitor is a key tool to any EMS provider and must be able to perform many functions both with and apart from the data input interface:

- Ability to have all the normal existing functions of the monitor easily available and rapidly accessible, the monitor is a life critical device and must be ready to use as a defibrillator at a moments notice.
- Ability to notify the user if patient's vital signs change significantly or display signs of patient degradation.
- Must be able to quickly switch back and forth between data entry and monitor view.
- Cannot rely on information in data entry to perform life critical tasks.
- Monitor must be able to provide information to PCR laptop and hospital.
- Must continually retain information to prevent data loss in the event the monitor is inadvertently turned off.

PIC 3 THE PHILIPS HEARSTART MRX IS ANOTHER MONITOR COMMONLY USED BY EMS AGENCIES

A new additional user interface will have to be conscious of the life critical functions that make up a monitor and can have no effect on how these functions perform in the field. The new data gathering function will have to integrate behind the existing functions on the monitor.

The new interface will be utilized during by the EMS provider to input information about the patient during several periods throughout the patient care process. Functions that will be required in the new interface design will have to work with existing functions on the monitor: including the clock[4], vitals signs, electrical therapies, and changes in patient status. Additionally the provider will at times enter information into a new interface that will have to several specific abilities:

- Able to rapidly input current patient status (stable/unstable) (pediatric/adult)[5]
- Ability to accept data from other functions on the monitor i.e. clock, vital signs, etc.
- Ability to input data automatically as the monitor performs treatments, example: "shock delivered at…"
- Allow the user to have a touch menu where they can select between patient data or treatments
- Inputting patient data should be similar to inputting data into a PCR with smart data entry techniques
- Interface should ask user for essential information first that will help the hospital ID the patient and allow the hospital to obtain previous hospital records from its database
- User should be able to do a primary assessment based on whether the call is trauma or medical based during which the monitor can be a guide to assist the assessment

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[4] Clock – Time stamping is critical to a monitor and the care provided, by utilizing a clock function on the monitor the medic has to worry less about figuring out what time specific treatments were provided or when certain assessments were performed.

[5] Patient Status – An unstable patient will require more in depth monitoring and less emphasis on obtaining patient information, additionally treatments for a pediatric vs. and adult vary and selecting one from the other will change how both the defibrillator functions and the options available when inputting patient information.

- Ability to perform a head to toe assessment utilizing pertinent negatives[6] and patient history
- Ability to perform a secondary assessment during care that will note any changes in patient condition
- Once initial information is obtained with assessment, vital signs, and destination hospital the monitor should automatically send initial information to destination hospital so the patient can be pre-registered prior to arrival at ED.
- Another section of the new interface will involve treatments provided to patient
    - During critical calls provider may not be able to utilize this function, treatments can still be entered and time stamped manually utilizing a laptop interface
- Treatments can be split into trauma, medical, generic
- Trauma treatments to include an in depth trauma assessment with treatments provided (i.e. limb immobilized, ice pack applied, back boarded and collared, time stamps can be changed after call)
- Generic treatments (i.e. IV start with size of catheter, fluid administered and how much, # of attempts)
- Medical treatments to include medicine administered, dosages can be computed on monitor once patient's weight has been entered
- Prior to arrival at hospital, if needed an MD can be consulted for additional medical orders[7] MD can view information obtained by monitor remotely allowing the MD to have a bigger picture of the patients condition and allowing for the MD to make a more informed decision of patient treatment.
- On arrival at hospital monitor can transmit a preliminary outline of care as obtained up to this point by the monitor for initial care in the ER.
- After patient is turned over to ER monitor can then transmit the data to a laptop to be reviewed by the EMS provider who can edit information, add a descriptive narrative, and complete any missing information.
- Once complete the PCR is then transmitted wirelessly to the hospital and the EMS agency.

The design of the new interface will meet the needs set forth in our requirements memo (see appendix) and will obviously perform better then current practices. It will streamline the data flow of information during a call, reducing the times data is transcribed, transferred manually, or requires mental retention on the part of the EMS provider. This will result in faster more improved patient care with less room for error.

Problems will still be encountered in implementing just such a system into the current EMS system and range from the obvious to the human factor. One of the biggest factors that will have to govern design of the new interface (and has already been discussed in the outline above) is the need to ensure that the key monitor functions are still accessible and usable at a moments notice. Additionally, as a result for the need to be reliable and ready the monitor's programming is in a very basic language and prototyping on a monitor will be incredibly complicated initially. Nevertheless our team feels that once people become familiar with the new interface it will help improve efficiency, care, and the flow of data throughout an EMS system.

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[6] Pertinent Negatives – Certain assessment criteria that should be checked on every call, even if they are usually normal, i.e. most of the time a patient will not have chest pain, yet every call the provider should ask the patient and mark down (-/+) Chest Pain on the PCR.

[7] Medical Orders – Treatments that can be requested by a medic via a doctor that goes beyond standing orders (treatments that don't require a doctors approval). Require a medic give the doctor a brief overview of the patient and pertinent information.

CLASS DIAGRAM

The class diagram that is presented below is the result of careful analysis of the requirements and issues presented in the Requirements Memo.

1. The class diagram demonstrates that there are at least 4 systems that will interact with the new interface but there is only one truly identified user that will perform the majority of the interaction. The major differences between these users are defined in the following
   - EMS provider – does the actual data entry during a call and will be required to do most of the hands-on manipulation of the interface. The interface will also link to a laptop that will also be utilized by the EMS provider after a call to complete call information.
   - Hospital – talks with the interface prior to arrival at hospital and utilizes the information to pre-register a patient. Also can be used by an MD when an EMS provider is calling for medical orders. Hospital also requires a final copy of the PCR to retain with the patients medical records.
   - Agency – retains information for billing and legal purposes, only requires the final copy of PCR and can be uploaded after the call is complete via a wireless network.
   - State – receives a copy of the PCR to use for research purposes and data gathering
2. As defined above the EMS Provider is the primary user and the source of primary data entry into the monitor. The monitor can retain data and send incomplete data sets to the hospital and MD, once the call is completed the data is then uploaded to the laptop for completion and erased from the monitor to comply with HIPPA[8] policies.
3. Besides the EMS provider none of the other parties involved are required to manipulate the information on the monitor or laptop and are just receivers of the completed information to fulfill different services with the obtained information.
4. Additionally supervisors can access PCR records from the agency database with specific identifying patient information redacted to use for training and review of calls to ensure quality improvement (QI).

The system will have to utilize two separate modes:

Data Entry/Acquisition Mode (CALL MODE):

This mode will be used to define the time during the actual call when information is being gathered and treatments are being performed. Information on the monitor may not be complete or accurate in this mode however the “rough” data is still useful to the hospital that will be receiving the patient. However because this data is incomplete it is not usable for patient records or for the EMS agency. In this mode the EMS provider will have full access while all other users will have limited (hospital) or no access to the information obtained (EMS agency/State).

Final PCR Mode (COMPLETE MODE):

Once the EMS Provider has completely reviewed the PCR to ensure accuracy and acquired all the additional data necessary they are then able to submit the PCR. By submitting the PCR the provider ends their ability to input data

[8] HIPPA – Policies that define patient information rights and how such information may be disseminated

and sends the data digitally to the hospital for the patients record and to the EMS agency and state. This also ends the need for any data to be retained on either the monitor or the laptop as the call has been deemed completed.

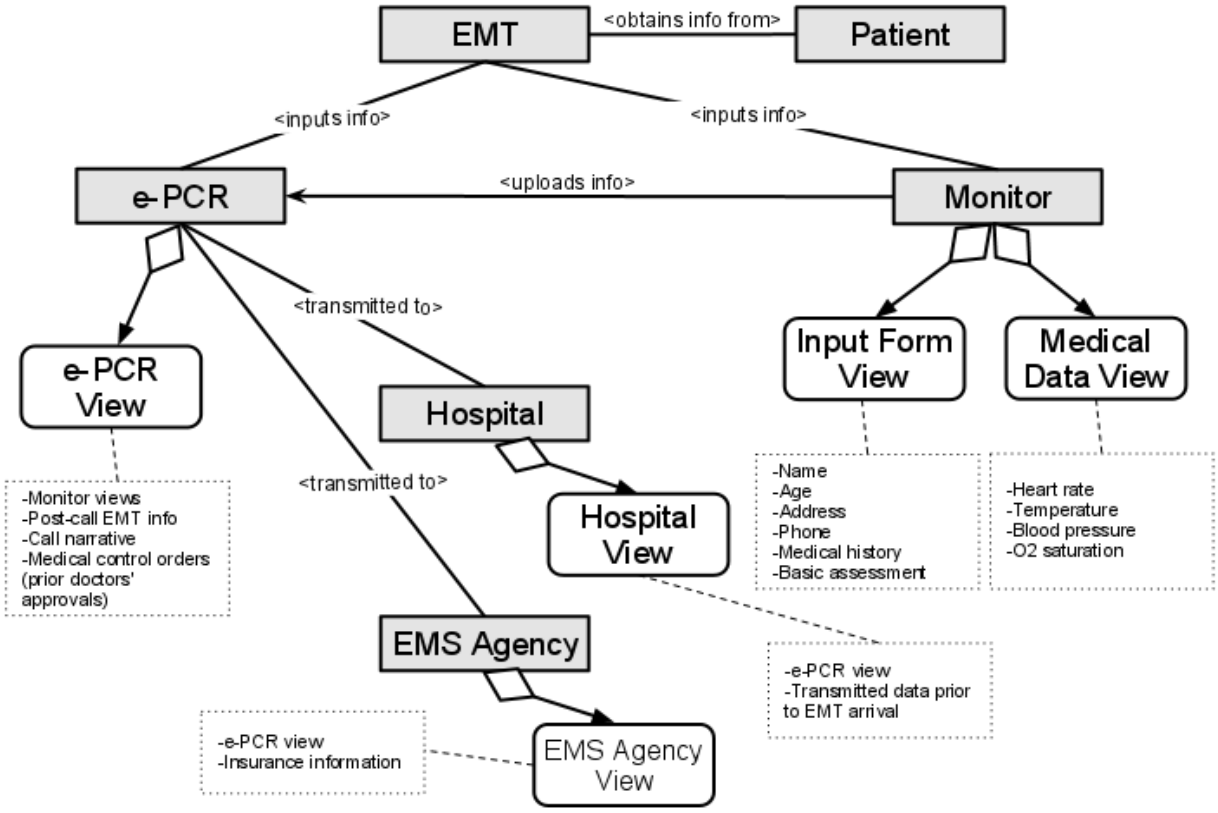


FIGURE 2 A VIEW OF OUR CLASS DIAGRAM HIGHLIGHTING SEVERAL OF THE END USERS AND HOW THEY WILL UTILIZE THE INFORMATION

INTERACTION DIAGRAMS

The following figures outline our interaction diagrams and out key views on which the interaction diagrams are based around. They show the individual entities that will be required to interact with the transformed scenario as described above. The diagrams also help to show how the system will function and replace the existing paper PCR system with a much more networked and flexible computer based system.

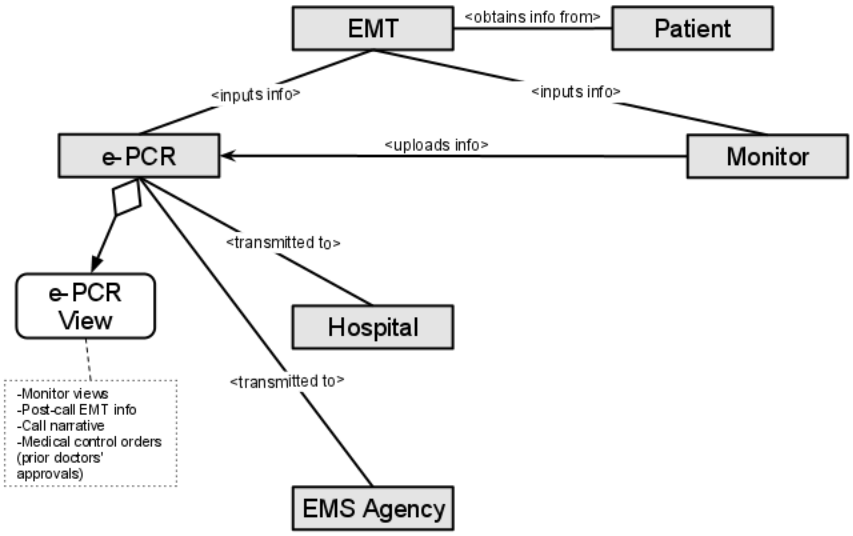


FIGURE 3 KEY VIEWS: E-PCR

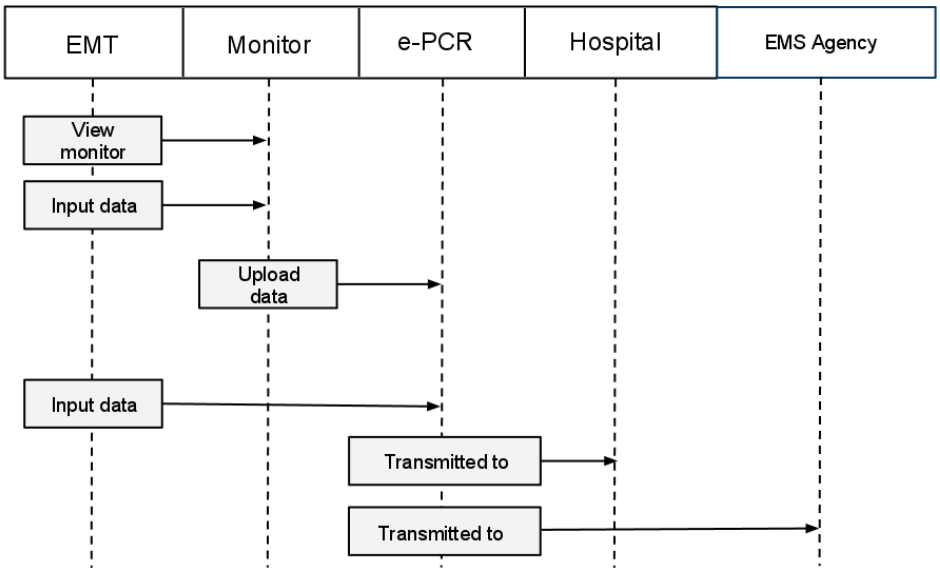


FIGURE 4 INTERACTION DIAGRAM FOR THE E-PCR VIEW, GENERATED USING FIGURE 3

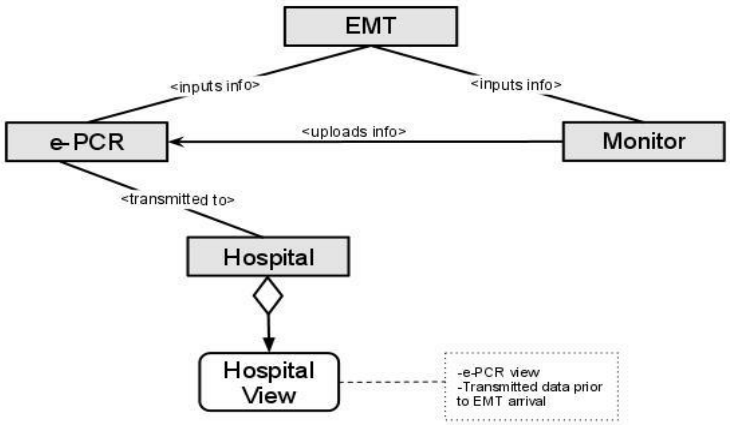


FIGURE 5 KEY VIEWS: HOSPITAL

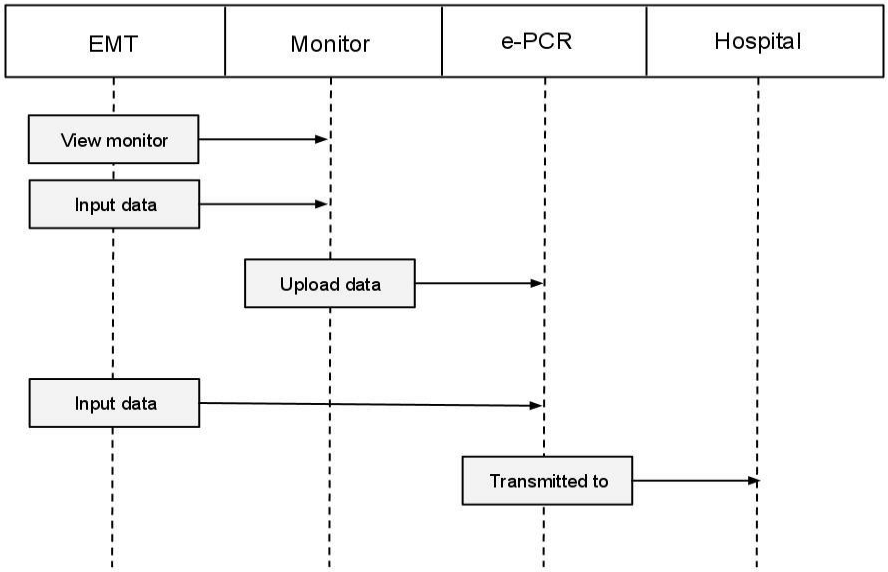


FIGURE 6 HOSPITAL VIEW INTERACTION DIAGRAM GENERATED USING HOSPITAL KEY VIEWS DIAGRAM IN FIGURE 4

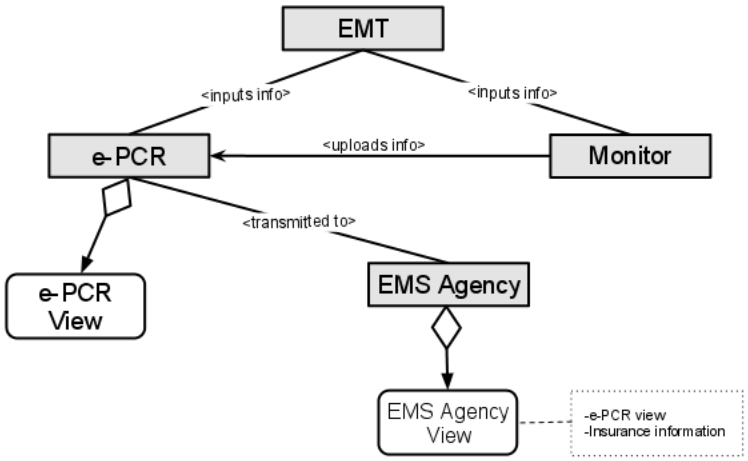


FIGURE 7 KEY VIEWS: EMS AGENCY

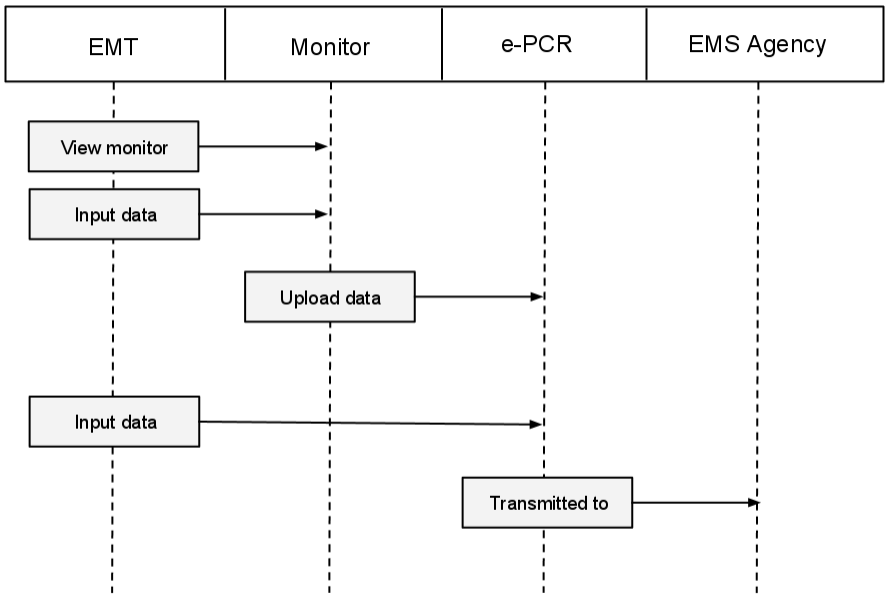
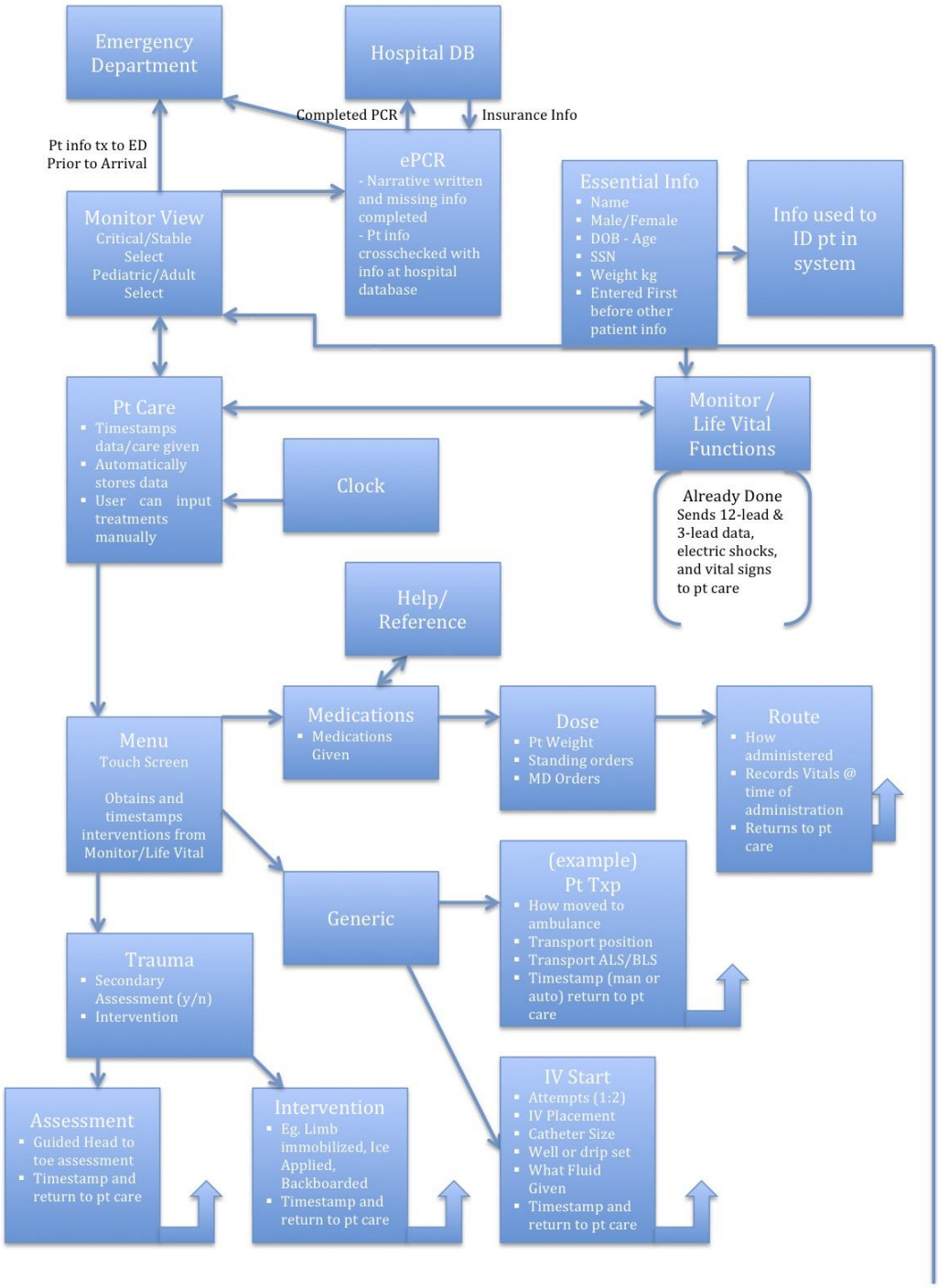
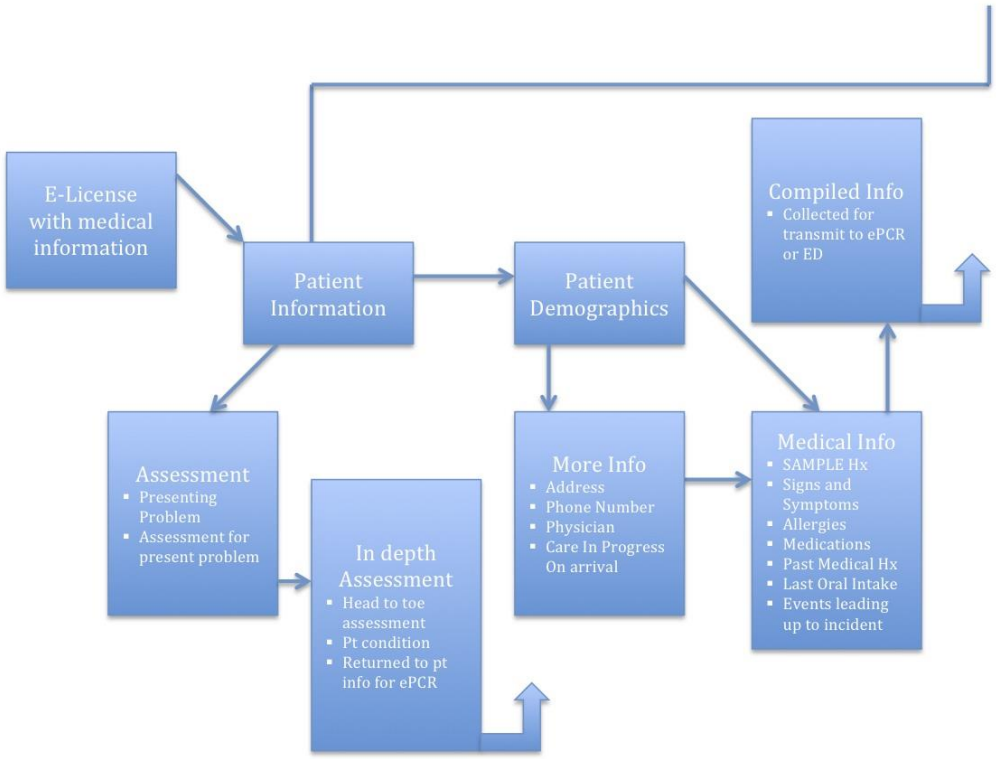


FIGURE 8 INTERACTION DIAGRAM FOR THE EMS AGENCIES GENERATED USING INFORMATION IN FIGURE 7

Besides the views and interactions shown above our group also wanted to show the interactions that would be taking place within the newly designed monitor software. This was a complicated task however it will help lay out a groundwork for a future prototype. Additionally this is just a mockup of the interactions and several of the simulated actions are examples of many interactions that could be implemented in the monitor software.





Monitor Model Steps

1. Turn on monitor, determine patient status, critical vs. stable then pediatric vs. adult. If critical, monitor directs to Monitor/Life Vital Functions
2. If stable, monitor asks for Essential Pt info. This info used for other functions, including ID of patient at ED
3. Monitor then goes into monitor mode so 1st set of vitals can be obtained
4. Select either pt info to add more patient information or pt care to log care provided to patient
5. Some care is already logged by monitor, including 12-leads, any form of electric therapy (pacing, defibrillation, synchronized cardio-version), and vital signs
6. Manually entering pt care opens window with three options, medication administration, generic care, and trauma
7. Selecting generic care will allow the user to select items like IV Start Menu > user then enters attempts, where IV started, what was connected to IV, fluid administered, with a timestamp given by the clock
8. User can also enter in a manual timestamp if IV was started earlier
9. User is returned to monitor page and can then select patient info to add to information
10. Patient Demographics completes the information on the patient, also allows the user to enter medical hx information about the patient
11. Assessment is an in depth assessment performed with pertinent negatives that are checked on every call
12. User also has the option of using an e-license to get information from an unconscious or unwilling patient
13. User has the ability to step out of patient info view at anytime and return to monitor view. This will occur automatically if patient vitals change or patient is in an unstable condition that the user needs to be alerted to
14. User can transmit information to hospital prior to arrival for a doctor to review and assess
15. Once at hospital information is transmitted from monitor to laptop with ePCR software and the user then completes all information on the PCR prior to transmitting a final copy to the hospital, hospital also transmits patient insurance info

FORECAST

Our team's plan is to continue developing the networked system and begin to work specifically on the monitor interface, which we plan on spending the majority of our time. The next step will be prototyping our monitor interface and attempt to create a digital prototype that a user will be able to interact with. Due to the amount of money and cost of developing a prototype featuring a fully functioning monitor, our team is planning on using an iPad or similar touch screen device to do the initial prototyping and testing. We will use the data collected from testing to refine our prototype and gain information that may be useful in a final design.

To complete a final design we will need to partner with a larger company that produces the monitor/defibrillator. Many of these companies are already beginning to develop software-based systems that aim to network many EMS functions into one overall system. One such company is Zoll, which has designed a variety of software solutions from data capture to crew scheduling and advanced billing. If our team can develop a high definition prototype it may be usable as a marketing device to gain the support of a company such as Zoll.

CONCLUSION

Research has been performed on the current market pertaining to EMS market solutions and the forecast has so far been promising. From what our team has been able to gather no such software currently exists that allows the user to effectively and easily input data utilizing an interface on the monitor/defibrillator. We feel that this will be a breakthrough for current EMS systems which are struggling to become more efficient and streamlined and will reduce the workload on current EMS providers by allowing them to input information into a simple and central location throughout a call. This will translate into much better care as information is transmitted accurately and quickly to a hospital via a digital format designed to take human error out of the equation. In conclusion we find that our concept answers a need and provides a solution that will improve EMS care nationwide if implemented.

APPENDIX

Requirements Memo:

Introduction

Team Paramedic Geek Squad (PGS) consists of Jennifer Brown, Brent Campbell, Dave Mezaros and Kristin Shumway. Our group proposes a project titled, Digitizing EMS Documentation, which involves developing a solution that will "work smarter" with current EMS systems and replace traditional patient care reports (PCRs). Current paper copies of the PCRs require information to be entered manually, contain no error checking, can be lost or damaged and require users to write legibly. Our electronic PCR system will minimize these problems by streamlining data flow, reducing errors and improving emergency patient care[1]. The end-users of the system include EMTs, doctors, nurses, hospital personnel and police and firefighters who respond to 911 calls.

Our group believes we are well suited to complete this project. Brent is an EMT at Empire Ambulance Service in Troy, NY and has extensive experience working with PCRs and medical equipment. His familiarity with the current paper forms, medical terminology and the processes involved in patient care will be invaluable to the success of this project. In addition, Jennifer, Dave and Kristin have backgrounds in computer science, information technology and human-computer interaction; skills in these areas will be necessary to develop a technically feasible system which meets the needs of its users.

The Activity Analysis

Three slightly different activities were observed to obtain an understanding of the various users and situations in which the Digital EMS Documentation system will be used. The three activities observed and analyzed were: an advanced life support emergency medical call, a basic life support transport, and a typical day for a dispatcher[2]. Participants in these observations included patients, EMTs, medics, dispatchers, fire fighters and other medical personnel.

From the observations, our group realized that only a small amount of medical information is written down or entered into a computer at any given time. Medical information is generally recorded piece-meal throughout the duration of an EMT run as well as in the hospital after the run has been completed. In addition, the activities performed during an EMT run change frequently and are very faced paced. Lastly, medical information is often exchanged verbally between people and sometimes the same information is asked of or taken from the patient multiple times.

Graphs of the activity observations are displayed in the appendix[5]. The observations were divided into eight main categories: administrative tasks, responding to call, verbal report, patient care, written report/notes, typed report, transport patient, and return to station. The frequency and duration of each category varied widely between the three observations.

Throughout our activity analysis we were sure to keep a lookout for activities/processes that could be improved upon. One of the largest dissatisfactions among EMS workers was the amount of manual paperwork that EMT's had to complete after each call. Often times information has to be "re-entered" into a Patient Care Report(PCR), the current PCR is completed using an outdated paper form, from information that was rapidly scribbled down on scraps of paper during the chaos of a call. Other times information is obtained in a hard copy (such as a hospital face sheet) and then has to be transcribed onto the PCR or insurance form. Within the current system a lot of information is rapidly obtained and passed on, often times with error due to human interaction.

Our group feels that the flow of information could be considerably improved by reviewing and revising how information is obtained during an EMS call. By reducing areas where information is repeated or using information that is already available via health care records could greatly improve the flow of information and reduce the workload on an EMS crew. Additionally, networking different tools and databases together could greatly improve communication of information between the different patient care providers and reduce the amount of human error inherent in the current system.

Design Scenarios

Current Scenario

The current scenario of a paramedic filling out a patient care report (PCR) consists of sporadic scrawling on a paper form whenever the paramedic gets a chance. This leaves the form a mess of usually incomplete, illegible and sometimes incorrect information.

Information can be filled in at anytime during an EMT run, so if it's an easy/slow run then the form can be filled in without a problem. However if it's a chaotic scene like a huge MVA (motor vehicular accident), then the filling out the PCR usually (and rightfully so) takes a backseat to treating the patient. When the EMT finally has the time to complete the form, he or she will have to do it from memory, therefore leading to incorrect information being filed.

Transformed Scenario

The biggest key behind our design is improving the flow of information over the course of an EMS call by utilizing technology to reduce workload and streamline the transmission of information.

Our design is going to start with the monitor/defibrillator, a tool that is already in use by almost any EMS agency and is easily upgradeable via replaceable modules. The Lifepack 15 (see picture) is a well designed monitor/defibrillator often used in the field to take vital signs, monitor EKG's, provide electrical defibrillation, and transmit EKG data to the hospital. Additionally patient information can be entered into the current model, however many tend to shy away because of how cumbersome the interface can be. One medic summed it up well, "it's like trying to write a term paper with an xBox 360 controller and an onscreen keyboard."

Our group feels that redesigning the monitor to provide an intuitive and easy to use interface would encourage electronic entry. The most obvious physical change that could help improve information input would be the inclusion of a touch screen interface. Utilizing this touchscreen interface the monitor can take on new functions during an EMS call, including a primary input device for patient information, replacing the current practice of scribbling notes on scraps of paper.

Often times in the chaos of an EMS call treatment is quickly given and only logged after a call, sometimes with estimates of when the treatment was administered and how it affected the patient (changes in vital signs). However by having a quick, easy to use interface readily available a medic can quickly log a treatment on the monitor with a time stamp and associated changes in vital signs. If warranted a medic can transmit the data mid call to a hospital and connect with a doctor to discuss the patients condition and continuing care beyond typical protocols. By having more information at his fingertips a doctor can make a more informed decision on how to treat a particular patient.

Upon completion of a call a medic simply has to upload the information to a laptop and complete any missing information and write out a narrative detailing the call (how patient was found, condition of patient, and what happened during the call). By networking with the hospital database the medic can quickly upload the completed PCR (for hospital records) and obtain the patient's face sheet (detailing patient and insurance information). All that's left to do is to have the patient sign a digital insurance form on the laptop and upload the PCR to the agency database when back at the station.

Requirements & Issues

Currently the process of entering and synchronizing information on EMS calls is inefficient and can lead to inaccuracies in information. To improve the current system for patient care reports on EMS calls, our group intends to increase efficiency and prevent human error through synchronization of data and easy to use design interfaces.

Most importantly, the system needs to be able to synchronize data between several locations, including the hospital, ambulance and dispatcher. Currently, when a dispatcher is issuing a call to an ambulance, the address is given verbally. If the dispatcher could digitally as well as verbally send the address, it would cut time spent verifying the location. A majority of pertinent information is given by the monitor/defibrillator, and thus is would be beneficial for this information to be relayed to the dispatcher and hospital. Receiving information on ALS calls prior to the ambulance's arrival would inevitably allow for better preparation in cases where time is a primary factor in saving a patient's life.

The Lifepack 15, as referenced above, has the ability to digitally enter information regarding patient care, however it has not been largely adopted by EMT's due to the amount of effort required to use the system. Typing on this system is slow and cumbersome, which does not pair well with the hectic patient care environment. Our system, therefore must be easy to navigate and enter information, as well as be familiar to current systems in place. By entering information digitally, events and patient reactions can be logged closer to the time of the occurrence while maintaining workflow.

Finally, information entered by both the EMT's and dispatch should be accessible. This would lead to less discrepancies in information, while still improving the current system. It may also be beneficial to provide information regarding other and upcoming calls, which EMT's could view during downtime.

Culturally, this system would have an impact both on patients and those directly using the system. Patients may be apprehensive about the security of sensitive medical information and cause difficulties if the patient refuses

to use such systems. As it would be required to submit all PCRs electronically, our easy to use system will help both patients and medical respondents with the transition of paper to digital medical records.

There are several technological factors that may limit us from providing the "perfect" electronic PCR system. These limitations deal with flow of data and the ability of each piece of the system to interact with each other. This networking of data between the hospital, ambulance, and dispatcher could cause difficulties, especially in areas with poor cell reception.

Other issues stem from confidentiality and compliance requirements. All electronic systems must be approved by the Department of Health for NY state [3], which raises further questions of how consistent these requirements are with laws of other states. Because of this, our system would only be immediately scalable to the New York area.

The Department of Health also states that submitting PCRs electronically must be a routine process, requiring EMTs to fully transition to the electronic system. Adaption of an electronic system also requires backup of information and "proof of contracts for technical support, maintenance, upgrading and troubleshooting." [3] This implies that an electronic system must be fully committed to, and change may be generally resisted by those using the system unless its advantages are directly related to its users.

The upgrade of this system could potentially affect millions of patients and thousands of emergency care respondents. According to the Department of Health for NY, as of January 2008 there are 1107 ambulance services in NY state, totalling 4775 registered ambulances. Over 1.6 million EMS calls were made in New York State as of 2005, approximately 21% of these calls being for Advanced Life Suppport (ALS) [4].

Improved productivity and consistency of data would benefit patients, EMT's, nurses, and doctors. This new and improved system will also encourage the transition from paper to digital medical records. The ability to access in depth data about a patient's health experiences would prove invaluable for assessing the best action to take on a patient.

Potential Impact

The potential impact of this project is tremendous! The health care system as a whole is moving towards functioning electronically. Electronic health, medical, and patient records are being created and the old paper systems are slowly being pushed out. This process is even going on here at RPI's Health Center. This electronic move is inevitable.

The impact of digitizing EMS documents will save space, time, and most importantly lives. For legal reasons, most EMS forms have to be saved for 7 years and in paper form, this takes up a lot of space and isn't really safe. By making these documents electronic, it will free up a lot of space that can be much more adequately used and backup copies can be made in case of an accident. Can you imagine if there was a fire? All of the paper forms would be lost forever.

Making EMS documents digital will also save a lot of time. As it is now, the paramedics spend a lot of time filling out these reports and trying to hunt down information they may have missed or forgotten during the time they were doing their actual job, taking care of the patient. This is time that could be spent helping others or studying to be able to provide even better care for their patients.

However, the most important impact that digitizing EMS documents will have is saving lives. Since these reports are written so hastily, they are usually not very legible, 100% correct, or even totally completed. A copy of this report is handed to the hospital staff who then places it with the patients medical chart. If the patient is unconscious, it's extremely important to know if he or she is allergic to anything, what their medical history is, and what their current situation is.

Since the paramedics picked the patient up, there is a strong chance that they were able to talk to someone about the patients medical history, allergies, etc. and the paramedics definitely know what the current situation is

with the patient. If the PCR is illegible, incorrect, or incomplete, it could cost a patients life. By digitizing these documents, it will make sure that they are legible and correct since it will be able to take the patients vitals from the machines the paramedics use, removing human error. Unfortunately, there will still be room for error in the medical history and allergies, but it will be legible and use a spell checker/drop down boxes, which will hopefully eliminate some typical errors.

Appendix

[1] The e-PCR will streamline the data flow by reducing repetition in data input. Data will be able to pass seamlessly between different computer systems and will not require users to re-input data from a paper form to an electronic form or between two systems which don't interact with each other. Automatic form checking will reduce input errors, ensure all required fields are completed and remove the need for users to write legibly.

The e-PCR will also improve emergency patient care. According to the article, "*Paper Records a 'Direct Factor' in Patient's Death"* by E-Health Insider Primary Care, using paper records instead of electronic ones can have fatal results. The article describes a patient who died due to inadequate information sharing between doctors at a clinic. Had the patient's information been easily accessible to the doctors through a computer system, the patient may not have died. The Digitized EMS Documentation system our group is proposing will make medical information readily available to all health care personnel who come in contact with the patient. For example, doctors in the emergency room will be able to view an incoming patient's medical information before the patient even arrives at the hospital. This will ensure the best possible care for patients.

Lastly, New York State is pushing for all paper forms to be digitized. Implementing the Digitized EMS Documentation system will meet the state's requirements while providing a easier-to-use interface than current systems which are cumbersome, time-consuming and do not integrate with other systems.

[2] The advanced life support emergency medical call involved treating a patient with severe chest pain. Firefighters and emergency medical personnel responded to the call, arrived at the patient's home to start medical care and then transported the patient to the hospital in an ambulance. Throughout the process, the patient was asked questions, treated, and had his medical information recorded. Medical information passed between several people verbally, through written forms, and through a computer application.

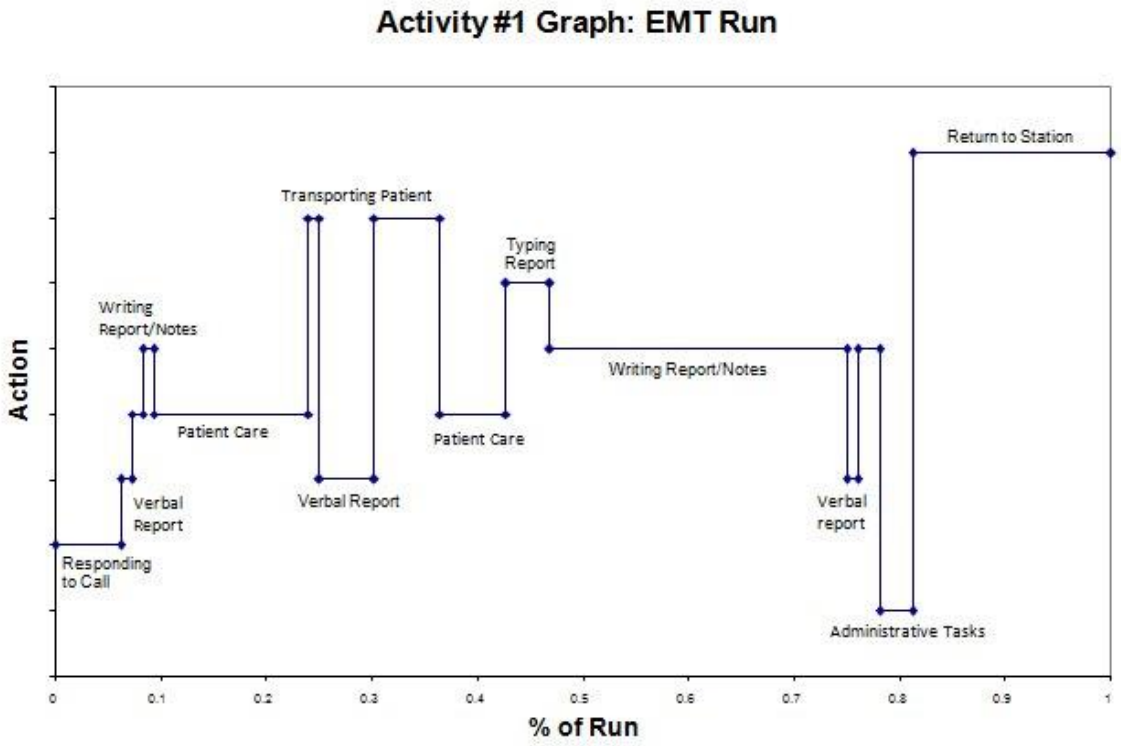
The basic life support transport involved an elderly patient at St. Mary's Hospital who needed to be transferred back to her nursing home. The patient was moved into the ambulance, monitored during transport, and helped into the nursing home. During the process, a PCR form was filled out with the help of hospital, nursing home and insurance company employees.

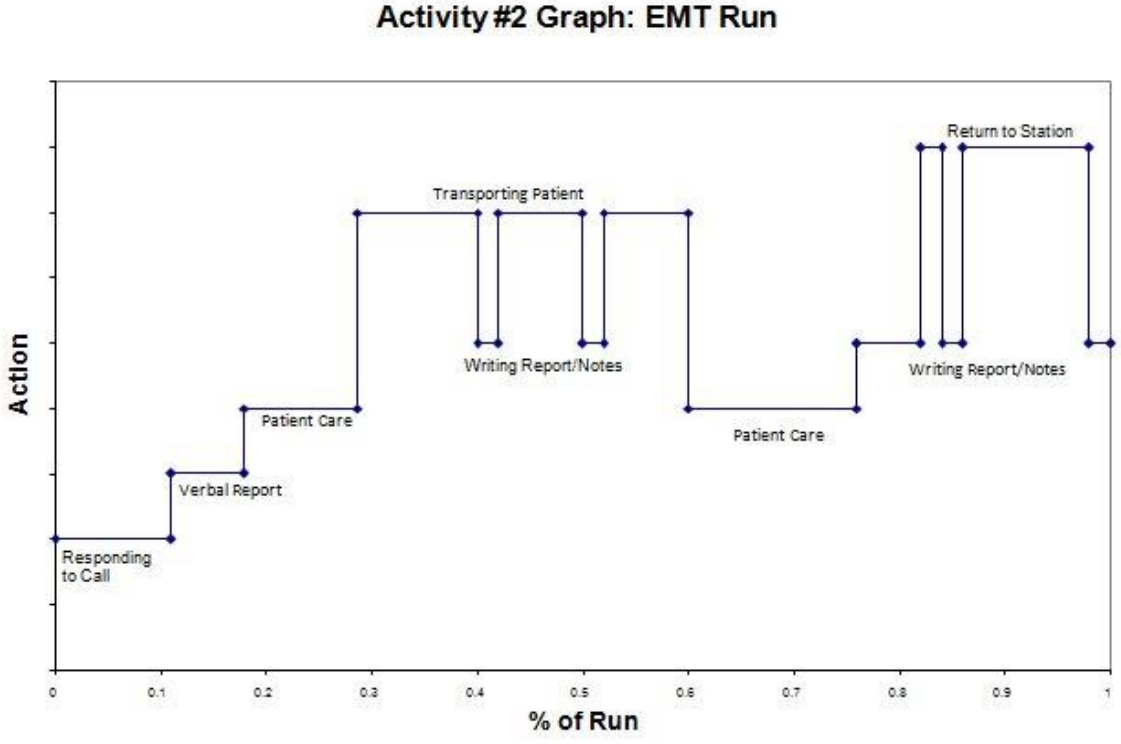
The dispatcher observation involved documenting the daily activities of a dispatcher. The employee dispatched scheduled transports, basic life support transports and emergency calls. Throughout the day the dispatcher recorded initial information for transports and calls, determined the closest ambulance to assign to a call, and updated information throughout the duration of a call/transport.

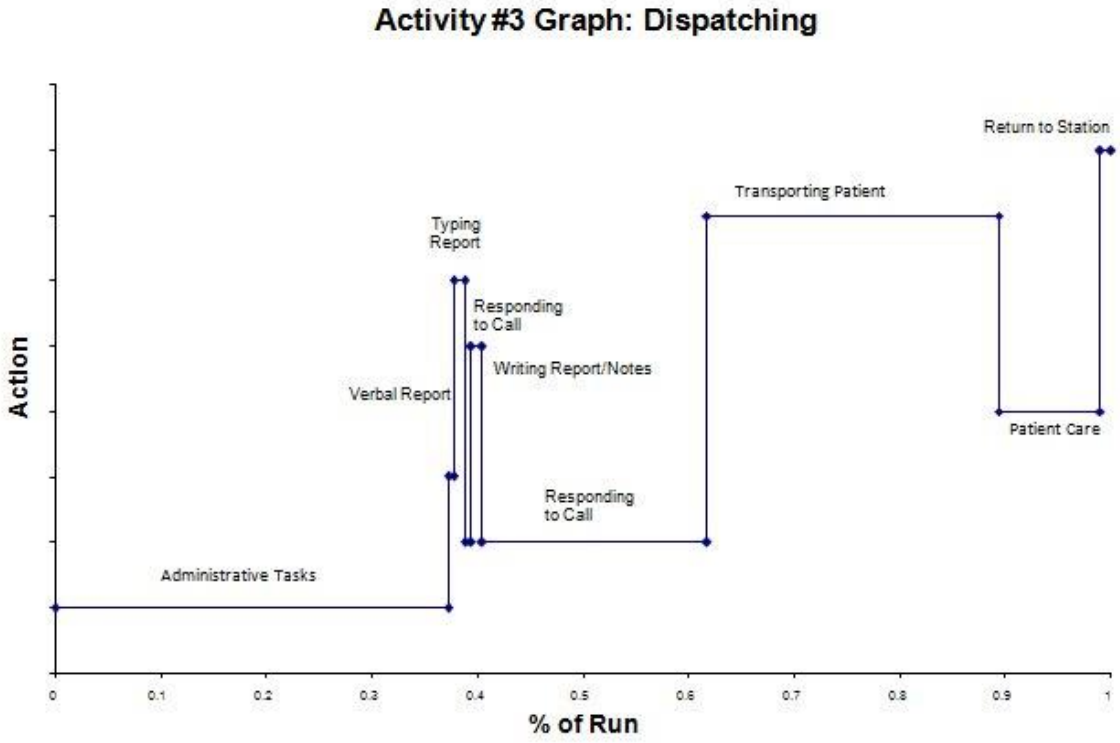
[3] New York State Dept. of Health - Electronic PCR Data Submission. (May 2004)
http://www.health.state.ny.us/nysdoh/ems/policy/04-05.htm

[4] NEW YORK STATE DEPT. OF HEALTH - EMERGENCY MEDICAL SERVICES STATISTICAL INFORMATION. (JAN. 2008)

http://www.health.state.ny.us/nysdoh/ems/stat.htm



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Return to Station
Transporting Patient
Typing Report
Responding to Call
Writing Report/Notes
Verbal Report
Patient Care
Responding to Call
Administrative Tasks
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