TRIAR: The Triage Chair

Device Development

Project Report

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Emergency Room for the Future (HS 8803 A)

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The Triage Chair

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Executive Summary

The Emergency Department (ED) treats over 100 million patients a year and all will go through the triage process. With this magnitude of patients, it is important to make all the processes of the ED efficient and integrated. One of the problem areas in the ED is the space allotted for the Triage process.

The Triage space is not functionally designed to efficiently meet the needs of patient volume, acuity adaptability, clinician responsibility, and maintain regulatory requirements. These problems arise because the space was created and the process was forced into the space. The current space results in inefficient workflow, poor space utilization, inaccessible equipment, a lack of procedural integration, and a lengthy triage process.

The impact of these problems cause a bottleneck in the entire ED process which makes the patients unsatisfied and the staff inefficient. The solution to these problems is very simple. The TRIAR (tree-air) - the triage chair will solve these problems. **The TRIAR is a one-stop chair, which integrates all the needed equipment and performs the immediate measurements a nurse conducts during Triage.** The TRIAR weighs, takes blood pressure, pulse, measures temperature, allows for oxygen storage, reclines for EKG, holds IV bags, provides access for blood samples, is easily cleaned, and mobile. The TRIAR will allow the patient to sit in one area for the entire triage process.

There were several challenges creating the Triar. These challenges varied from equipment problems to construction issues. Despite the problems a working prototype has been developed. In the future, the Triar will be interoperable with the hospitals electronic medical record (EMR), operate wirelessly, continuously monitor the patient’s vitals, and travel with the patient through the entire ED visit.

The Triar will solve the problems of Triage. Triar will be a one-stop chair that will solve the inefficiency, poor workflow, lack of integration, and reduce the space need for Triage. The Triar accommodates the triage process and not the triage space.
Introduction

Motivation

Over 100 million patients enter the ED each year. All 100 million will undergo triage. As a result, the triage process must be taken into consideration when designing and running an ED. Triage is one of the only processes that affect every single patient in the ED. Triage is also the first step in an ED visit. If it is not done quickly and efficiently, it is impossible to have the most efficient and satisfying visit for the patient. We feel that many of the problems an ED faces cannot be corrected if the problems with triage are not solved. By correcting the problems with the space of triage, the rest of the ED visit for the patient will be quicker and more satisfying.

Current Problem

The triage space is not designed with the process of triage in mind. The first problem with triage is there is lack of equipment integration. Each step of the triage process requires its own piece of equipment. There are vital machines, scales, and thermometers but nothing does more than one function. Triage uses many pieces of equipment in order to be accurate. All the equipment forces triage to be done in a large space. The large space results in poor space utilization. Space in a hospital is very costly and needs to be used effectively. The large space also causes an inefficient workflow. The nurse must take the patient to each piece of equipment or bring the equipment over to the patient. There is inaccessible equipment because of the space and amount of equipment needed in the triage room. With the poorly designed triage room, the nurse has to concentrate on operating equipment and enter data and is unable to focus on the patient.

Related Work

Research and Evidence

Our team conducted research on the triage process and observed several local emergency room triage procedures. Studies show triage is typically performed by a nurse, nurse practitioner (NP), or combination of nurse, NP, and physician. Triage can be as simple as sorting urgent from non-urgent patients to as complex as a five level acuity based sorting process called Emergency Severity Index. Many hospitals are attempting to reduce wait time by treating low acuity patients in the triage space. Our research showed that there is a standard number of procedures performed and information collected during triage, regardless of the level, type, or style of triage.
There are seven essential elements to every triage process: Weight, Height, Temperature, Blood Pressure, Pulse, Symptoms, and Last Known Period (females). Hospitals are also required to conduct an electrocardiogram (ECG or EKG) within the first ten minutes of a patients visit if they have chest pain. The EKG ties up a triage room for an additional 10 to 15 minutes.

Observation

We observed triage processes at Emory Crawford Long Hospital, Egleston Children's Hospital, Emory John’s Creek Hospital, and DeKalb Medical Center. Each Emergency Room triage space differed but the process was similar. Emory Crawford Long used three rooms that varied in size and layout. Only one room had a bed required to perform an electrocardiogram (ECG or EKG). Egleston Children’s Hospital uses four triage rooms and conducts Treatment Assessment Pull Process (TAPP), or treat and discharge the patients at the triage space. The medical equipment in the triage rooms was congested and sometimes inaccessible. John’s Creek Hospital has a low volume of patients. There is only one triage room although it is very large and equipped with two chairs, a bed, two scales, and various medical and administrative equipment. The triage nurse and ER Director stated that the bed is never used and the space could be turned into two rooms to be more efficient.

During our observations, the patients typically spent 10 to 15 minutes at triage. The space utilization was inefficient. Patients and nurses moved several times to measure weight, take vitals, or acquire information. All of the data must then be entered into a patient medical record. We observed that the lack of integration in medical equipment and the poor space utilization prolonged the process and took the focus off the patient. Nurses were too busy collecting and capturing data that they did not have time to focus on the patients symptoms.

Project Description

Design Formulation

We identified the need for a well integrated space to conduct triage. A common theme we observed was the need to reduce the triage area in order to create additional triage rooms and maximize treatment space in the rest of the Emergency Department. However, the process needed to remain the same. Initially our solution involved splitting the triage area into two categories, quick triage for low acuity patients and extended triage for higher acuity (mainly patients needing EKG or testing). The quick triage area would only require a chair and medical
equipment resulting in a reduction in space needed for treatment. The extended triage area would require slightly more room due to the need for a bed or stretcher.

During the process of evaluating our solution we realized that many Emergency Departments would not be able to alter the triage area or increase the number of rooms available to perform triage. So we went back to the drawing board and developed a plan to integrate the medical equipment into one space. The solution – Triar – The Triage Chair.

*Design Concept*

Triar began as a concept to reduce the space needed to conduct triage without eliminating any of the process. The common theme in all triage areas was a piece of furniture for the patient to sit or lay down. We began researching a way to replace the common piece of furniture with an integrated chair. First we reviewed the basic processes of triage to identify all of the constraints for our chair.

**Design Constraints**

- ✔ Furniture must be easy to sanitize.
- ✔ Furniture must be able to recline in order to conduct an EKG.
- ✔ Furniture and equipment should be integrated with the process.
- ✔ Furniture should be ergonomic.
- ✔ Equipment should reduce triage time.
- ✔ Furniture should be easily adaptable.

Next we researched vendors to find products that would meet the needs of our constraints and perform all of the triage tasks. Our team was more concerned with the concept of our solution and less on building an expensive product. We developed a budget and product list and purchased our supplies.

<table>
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<th>Item</th>
<th>Vendor</th>
<th>Cost</th>
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<tr>
<td><strong>Supplies</strong></td>
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<td>Weight Scale (digital multi-sensor)</td>
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<td>Chair base with casters</td>
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<td>Vinyl to cover chair</td>
<td>Hancock’s</td>
<td>$80.00</td>
</tr>
<tr>
<td>fitting materials (screws, nails etc)</td>
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Design Process

The first step in constructing the Triar was to turn an ordinary bathroom scale into a chair scale. We removed the four load cells and increased the length of the wires to fit the base of our chair. Through multiple testing processes we were able to mount the load cells on the chair base and still record an accurate weight.

We then fit the chair base with casters to the reclining chair. Our base was adjustable allowing us to alter the shape. The base also had a much needed brake feature. The rear casters can be flipped up to prevent the chair from rolling or flipped down making the chair mobile.

The chair needed to be able to store and transport oxygen. To accomplish this we formatted the base to carry an oxygen tank using a wooden platform. To simulate an oxygen tank we painted a 2-liter bottle and made a gas valve.

To make the chair mobile we added handles to the back of the chair. We used the top portion of two canes to provide a comfortable, ergonomic handle. The canes were cut, formed and attached using four bolts.

The next step was to make the chair easy to clean. We measured and cut vinyl to fit the front and back of the chair. We then sewed the top and bottom of the vinyl to make a slip cover. The rest of the cover had to be sewn by hand. First we attached a bungee cord to the upper portion of the chair and integrated the blood pressure cuff to the chair.

To simulate a future temperature capability we tested a temporal thermometer. We found that by placing the thermometer on the arm of the chair at the patient’s wrist we could obtain a fairly accurate temperature. In order to affix the thermometer we used zip ties and covered it in vinyl.

We finished the chair by adding an infusion stand to the base of the chair and designing flip-up armrests on either side of the chair to allow a nurse to take blood samples or emplace an IV.
Design Impacts

The Triar will greatly improve on the problems in the triage space. There are five main aspects that are affected by the Triar:

1. Reduces Triage Space
2. Maximizes Flow
3. Integrates Triage Equipment
4. Reduces Footprint
5. Acuity Adaptable

Triar reduces space by integrating all of the medical equipment into one space. The figure above shows triage was using the majority of a 20 by 25 foot room. When the Triar is in place, the space needed for triage was reduced by half. The next aspect improvement is that the flow is maximized when using the Triar. It does this by reducing the time needed for triage. The faster the triage process is the more patients can be seen. One of the most important impacts the Triar makes is that all the equipment needed for triage is integrated with one another. This makes the process easier for the nurse. With all the equipment in one central location, it allows the nurse to focus more on the patient and less on the data collection and entry. The integrated equipment also reduces the footprint for both the nurse and patient. When entering the triage room, the nurse and patient will only need to go to one location because of the Triar. Finally, the Triar is adaptable for acuity levels making only one type of space needed for triage.

Design Challenges

During the initial phases of the project we were trying to build a triage area which can optimize workflow and accommodate all the necessary regulatory requirements. The greatest challenge was to isolate the design from the patient demographics. Each hospital has a patient demographic of its own. So we were not able to suggest a generic solution.

Another challenge we had with the space design was to implement parallel processing. It was impossible to have parallel processing with a one to one relationship with triage and the emergency room. To address this problem architecturally we will have to have multiple triage areas for one emergency room. This has a huge cost and space impact.

So when we integrated the triage equipments into a single movable area like our Triar we were able to solve the above problems. But building Triar from scratch presented its own challenges. It demanded a lot from us to select the right materials, equipment and proper craftsmanship.
The future challenges are how successfully we can implement an interface with the EMR systems and how well we can do infection control in Triar.

**Triar of the Future**

*Design Improvements*

The materials that were used to create the Triar will need to be evaluated in the future. The equipment on the prototype was chosen based on cost and not on accuracy. For the future, equipment for blood pressure, temperature, and weight need to be evaluated and rated on a scale measuring accuracy, cost, and time needed to perform the function. The material that the chair is made out of and covered needs to be taken into consideration. The Triar needs to be quickly and easily cleaned to guarantee a timely triage turnover between patients. Cost of the Triar will play a large role in the ability of the Triar being adopted into the ED. The materials which are chosen must be cost efficient otherwise hospitals will not opt to purchase the Triar.

Another future step for the Triar would be to adopt its use for outside of the ED. Some areas which should be considered are home care and nursing homes. Once the wireless adaptability is created then the Triar would be a great way for physicians to monitor their patients at home. The Triar could be used for patients to monitor their vitals at home and either the patient could report the numbers to the doctors or the Triar could report it remotely. The reason the Triar would be beneficial in this area is the ease of use of the Triar. The users would not need to learn how to use the chair because the patient would just need to sit down. The same is true for nursing homes. It is an easy way to monitor patients without a lot of hassle on the doctor or patient.
Future Concepts

The Triar of the future will continue to reduce triage time by wirelessly integrating the systems into a hospital's electronic medical records allowing continuous monitoring.

1. **Interoperability with EMR**— Triar will use HL7 standards and will talk to EMR and Registration systems in compliance with Health Insurance Portability and Accountability Act (HIPAA). The Triar will talk with the EMR and automatically fill in the patient's weight, temperature, and vitals.

2. **Continuous and Real time Patient Monitoring**— It will be able to monitor the patient's vitals continuously in the ED. It will monitor by using an RFID tag and computer communication using Bluetooth. Nurses would be able to monitor all patients sitting in one workstation. It will be able to send alerts to needed medical professionals if vitals change.

3. **Universal Chair for ED**— The Triar would be a one-stop chair from triage process to discharge. The patient would never have to change beds for their entire visit to the ED.

The future for Triar is wide open. The capabilities span from the hospital to home care. In addition, the Triar could be adapted to perform more functions if needed. Continuing research for the Triar will show new ideas and areas for it to be used in with one of the most promising areas being home care.
References

*Emergency Medical Services: At the Crossroads* (2007) Board on Health Care Services (HCS)


**Interviews and Observations**

Valorie Sweigart, RN, Emergency Room Director, Emory Crawford Long Hospital. Discussion and Observation September 19, 2008.

Mick White, MBA, BSN, RN. Director of Emergency Services, Emory John’s Creek Hospital. Interview and Observation September 24 and November 3, 2008.

Amanda Hardy, RN, BSN, Egleston Children’s Hospital. Discussion October 23, 2008.

**Advisors**

Jeremy Ackerman, MD, PhD. Emory Hospital Emergency Room Physician and Assistant Professor of Emergency Medicine, Emory University. Interview October 16, 2008.

David Cowan. Program Director and Executive in Residence of Health Systems Institute, Georgia Institute of Technology. Discussions 2, 9, 18, and 25 September, 2, 7, 16, and 23 October, 13 and 18 November 2008.

Ellen Yi-Luen Do, PhD, Associate Professor, Joint Appointments in College of Architecture and College of Computing, Georgia Institute of Technology. Discussions 9, 18, and 25 September, 7, 16, and 23 October, 18 November 2008.

Craig Zimring, PhD. Professor of Architecture and Psychology, Georgia Institute of Technology. Discussions 9, 18, and 25 September, 7, 9, and 23 October, 13, 18, and 20 November 2008.

Marvina Williams, RN. Former Emergency Room Director of Nursing, Perkins & Will consultant. Interview October 23, 2008.