Creation of a Standardized Data Collection Form: Aiding in Acute Abdominal Pain Examination and Diagnosis

Presented to
The Faculty of the
School of Engineering and Applied Science
at the
University of Virginia

In partial fulfillment of the requirements for the degree:
B.S. in Systems Engineering

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TCC 402
Section 10 (2:00 pm)
Professor Edmund P. Russell
March 26, 2001

On my honor as a University student, on this assignment I have neither given nor received unauthorized aid as defined by the Honor Guidelines for Papers in TCC Courses.

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ABSTRACT

In cooperation with the University of Virginia Hospital’s Emergency Room department, our Systems Engineering Capstone Group (Craig Donnelly, Kelsey LeBeau, Hannah McClellan, Matt Thompson) designed and tested a data collection form specifically designed for those patients complaining of acute abdominal pain (AAP). We hypothesized that incorporation of the AAP form would provide for a more complete means of data collection and analysis. Throughout the month of January, 2001, we performed our study, testing the AAP form for two of the four weeks. During this time, we recorded information on all AAP cases and entered them into a structured database, capable of maintaining and analyzing the inputted data. We assigned scores to each case based on the amount of data collected by the examining resident physician. Using these scores to compare the effectiveness of each form in data collection, we found that the use of the AAP form increased data collection by 59%. We also calculated the compliance rate of the residents, to determine the feasibility of use of the AAP form, which was 35%. Use of the form provided for a more complete means of data collection.
CHAPTER 1: BACKGROUND & INTRODUCTION

Acute abdominal pain (AAP) is one of the most common complaints presented by patients to the University of Virginia Hospital Emergency Room. Causes for the pain can range from harmless to potentially fatal conditions. Frequently it is difficult to ascertain the exact etiology of the abdominal pain (Cope, 1). Previous studies have shown the use of a structured form, tailored specifically for the examination of AAP patients, can increase diagnostic accuracy (de Dombal, et al, 287). We designed and created a standardized form for AAP patients and tested it over a two-week period in January. We hypothesized that the incorporation of this standardized form would provide for a more complete means of data collection, and for retrospective data analysis.

Dr. Syverud, of the University Hospital Emergency Medicine Department, has cited three faults with the current examination process: failure of the examiner to fully examine the patient history, failure to collect all relevant patient data, and failure to consider all potential sources of the pain. By failing to collect a complete data set on the patient, the examiner may make ill-advised diagnostic decisions. Misdiagnosis is an extreme example of poor decision making on the part of the physician, and may result in dire circumstances. A missed case of appendicitis, for example, could potentially end in death. Often times the physician will be unsure of the cause, and rather than risk a misdiagnosis, will offer a diagnosis of undifferentiated abdominal pain. The majority of these cases involve a benign condition, and often the patient is discharged (Lukens, 690). Physicians may overlook important factors, however, and this generic diagnosis could prove to be as harmful as a misdiagnosis if the condition is not treated properly. Often, before attempting to reach a diagnostic decision, physicians seek the advice of others. If
a complete data set is not available for the consultation, the physician has just wasted the
time of other doctors.

A major cause for these problems is the lack of a protocol for collecting a
patient’s historical and symptom data. A study conducted at the hospital in 1992 stated
that little was known in regards to the process of AAP diagnosis in the Emergency Room.
(Powers, et al, 303) Currently, the doctors use a standard form for all patients admitted
into the Emergency Room that has little space designated for AAP-related data.
Furthermore, these forms are usually filled out post-examination and the physicians only
record what data they felt was pertinent. If three different doctors examined the same
patient, it is not unlikely that there would be three different patient workups. Without a
standard set of guidelines for data collection, an examining physician may not know all
the information necessary to make diagnostic decisions. A separate 1992 study found
that the implementation of a standardized data collection form increased diagnostic
accuracy (de Dombal, Dallos, McAdam, 288).

This project attempted to solve the problems of the inefficient diagnostic
processes by developing a standardized form for use in AAP patient examination. We
created the form to aid in evaluating and recording patient symptoms and history, and
hypothesized that its use would assure that all patients were treated in the same manner
regardless of the examining physician. Furthermore, by defining and standardizing the
data set to be collected, the examiner would be required to perform a thorough and
complete examination, resulting in fewer premature, uninformed diagnostic decisions.

Furthermore, this patient data collected (from the AAP form) can be stored in a
structured database, allowing for retrospective data analysis. By analyzing the patient
information, the results of the tests, and the final outcomes, the doctors can better
determine which tests and data are necessary, and iteratively improve upon the process of
patient data collection. This could lead to a much more efficient examination process,
and ultimately more accurate diagnoses.

Thus, our group’s objectives for this study were:

- To develop a standardized data collection form for use in examining patients
  complaining of AAP
- To analyze the effectiveness of said form in collecting AAP-related patient
  information
- To provide the means for retrospective analysis on the information collected

The remainder of the report explains the relevant literature and its relation to the
project; describes the materials used and methods employed to design, create, and test the
form and to analyze the results; discusses the results of the test; and offers conclusions
and next steps to take.
CHAPTER 2: LITERATURE REVIEW

Numerous medical texts, journal articles and research papers have been devoted to the study of diagnosis of AAP. In particular, many of these have focused on the difficulty to collect all the pertinent information and how to make well-informed diagnostic decisions.

In 1921, Sir Zachary Cope published a book entitled “Early Diagnosis of the Acute Abdomen,” which is viewed by many as the benchmark for AAP. The book explains the difficulties of performing examinations on patients complaining of abdominal pain. Cope states, “It is common knowledge…that when confronted with a patient suffering great abdominal pain it is often very difficult to be certain as to the exact intra-abdominal lesion which has given rise to the symptoms.” (Cope, 1) Furthermore, he seeks to relate the importance of a proper, quick, and accurate diagnosis.

To this day, diagnosing AAP remains one of the most daunting challenges facing examining physicians. According to Roy T. Bergman, a general practice surgeon, the “definitive diagnosis of abdominal pain presents a formidable challenge even in the best of circumstances” (Bergman, 1). He further goes on to describe the large diversity of the etiology of abdominal pain. Thomas Lukens and Charles Emerman performed a study in 1993 on the diagnosis of AAP. They found that the diagnostic process was extremely difficult, and often resulted in diagnoses of undifferentiated abdominal pain (Lukens, et al, 696).

F. T. de Dombal, a doctor at the University of Leeds, has researched methods of improving the diagnostic process for many years. His primary interest lied in the use of computer-based tools to support and standardize decision-making. In 1972, he found that
the use of a computer-based aid improved diagnostic results (de Dombal, Leaper, Horrocks, McCann, 75). A 1990 study by S. Paterson-Brown and M.N. Vipond focused on the results of the findings on this de Dombal study. Their results suggested that the improvements in diagnostic accuracy might have been a result of the standardized process rather than the actual computer tool (Paterson, et al, 16).

In 1992 de Domball published the study, “Can Computer Aided Teaching Packages Improve Clinical Care in Patients with Acute Abdominal Pain?” Specifically, this study compared three methods of support to aid hospital staff in the diagnosis and management of patients complaining of abdominal pain. These methods were: the use of structured data collection forms, a real time computer aided decision support system, and the use of computer based teaching packages. The results of the study showed that all three methods increased diagnostic accuracy, and decreased the number of non-surgical admissions (de Dombal, Dallos, McAdam, 288). Another independent study on the use of computer-aided tools performed in 1986 found that their use could prove beneficial for hospitals (Adams, et al, 804).

Not all studies suggest the use of a computer-aided tool, however. In 1993, the American College of Emergency Physicians compiled a form for use in examining patients complaining of abdominal pain. This form was the result of a collaboration of many physicians and experts, and marked a significant step towards the standardization of patient data. In their paper, they state, “Careful collection of a uniform data set appears to be the most important factor in attaining the greatest diagnostic accuracy.” (American College of Emergency Physicians, 907)
Va. has already implemented the use of a standardized form to collect data on patients (Bon Secours St. Mary’s Hospital).

Two studies have been performed at the University of Virginia Hospital related to abdominal pain. They sought to learn more about distributions of diseases, what populations are most likely to require surgery, and what factors are best to identify patients with high risk and need for surgery. The 1992 study further mentioned the lack of a standard protocol, stating, “…little is known about the clinical epidemiology of [abdominal pain] in the emergency department.” (Powers, et al, 301)

This project looks to draw from the past work of de Dombal, the American College of Emergency Physicians, and the St. Mary’s Hospital to aid the University of Virginia Hospital in understanding the epidemiology of acute abdominal pain and attempting to improve the diagnostic process. Our group sought to accomplish these efforts by effectively providing a standardized data collection process for the University Hospital.
CHAPTER 3: METHODS

We divided the work of the project into five main sections, which follow in chronological order. They were: Development of the AAP Form, Definition of Criteria to Evaluate Effectiveness of Form, Creation of the Database and Analytical Tools, Data Collection, and Data Analysis.

1. Development of the AAP Form

The first major step in the process was to develop the AAP form to be used in the study period. We gathered two previously existing AAP-related forms, from St. Mary's Hospital in Richmond and the American College of Emergency Physicians, to use as guidelines during design. Emergency Room resident physicians filled out surveys that compared the two forms, focusing on issues of content, readability, usability, and layout. Expert physician reviewers provided feedback for iterative development of the AAP form. Data on the AAP form was divided into five main categories: History of Present Illness, Patient History, Review of Systems, Physical Examination, and Diagnostic Studies. These groupings correspond with the current groupings on the generic forms employed by the UVA Emergency room and elsewhere. In an effort to further increase familiarity, our group modeled the flow of information on the AAP form to be similar in nature to the hospital's generic form.

2. Definition of Criteria to Evaluate Effectiveness of Form

Before implementation of the study, we defined criteria by which to evaluate the AAP form. Throughout the study period, we gave each AAP case a score based on the data recorded by the examining physician. We obtained this data from the data collected by the resident physician during the examination, either on the hospital's generic or the
group's AAP specific form. In total, our AAP form had 165 possible data points. Of these 165, 68 data points were selected as being of high importance when forming diagnostic decisions. Objective, weighted scoring of these data points resulted in a score of 1, 2 or 4, depending on the subjective importance of each individual point. These points were later summed, resulting in a cumulative total score for the case. Our group only gave score credit for data points that were actually recorded by the examining physician. For example, noting of the presence or absence of diabetes, or the exact nature of the pain, would be scored. If the physician failed to make any mention of a selected data point such as these a score of 0 was given.

We calculated compliance rates of the physicians in the study to determine the success of the method used to introduce the AAP form, and to infer the physicians’ satisfaction with the AAP form. The compliance rate is the percent of the time in which the physician used the AAP form to examine a patient complaining of abdominal pain during the study period. To calculate this, we simply divided the number of cases with form use by the total number of cases in the study period for each physician, and the study group as a whole.

3. Creation of Database and Analytical Tools

We created a database to store the data collected on all patient examinations, and created the tool to maintain and analyze the collected data. The database provides the capability to enter, update and delete patient records, all via the internet. It also has the functionality to perform analysis of the data. Users can query the database to view such information as resident compliance, the number of patients seen per day, population
demographics, and the average scores, by resident and total. A screen capture of the data entry portion of the application can be seen below in Figure 1.

![Figure 1 – Screen capture of data entry (HPI Section)](image)

4. Data Collection

The study began January 3rd, 2001 and ended on January 30th, 2001. Emergency Medicine Residents utilized the AAP forms during examinations from January 10th to the 23rd. The group excluded all trauma-related AAP cases from the study, and patient workups performed by residents from other services that were on temporary rotations through the Emergency Department. At the end of each day, we collected hospital records for all AAP cases from that day and photocopied them. The group used these photocopies to record relevant patient and study information, score, and perform database entry.

5. Data Analysis

After all of the data was collected and entered, and the scores and compliance rates had been calculated, we divided the calculated scores into two subsets, those with the AAP form and those without, and performed statistical analysis upon the numbers.
We further divided the data into subsets by resident, to determine what effect the resident had on data collection.

**Subject Matter Experts**

Our group could not have accomplished what we did without the contributions of the following people:

**Dr. J. Forrest Calland** – Dr. Calland is a resident and research fellow in the University of Virginia Department of Surgery. He met with our group weekly, and was intimately involved in all aspects of the project, especially the design, creation and analysis of the AAP form.

**Dr. Stephanie Guerlain** – Dr. Guerlain is a professor in the Systems Engineering department at the University of Virginia. She acted as our group’s technical advisor, participating in all aspects and meeting weekly (if not more often) with us.

**Dr. Scott Syverud** – Dr. Syverud works as an Associate Professor of Emergency Medicine department the University of Virginia Department of Emergency Medicine. He aided in the design of the form and assisted greatly in the organization and implementation of the study.
CHAPTER 4: RESULTS

Cumulative Average Scores

Average scores rose significantly by more than 59% when the residents employed the AAP-form for examination (p < .05). The mean for all cases without form use was 27.4, whereas the mean for all cases with form use was 43.7. Figure 2, seen below, is a box-plot that graphically demonstrates the difference between the two subset’s scores.

Figure 2 – Average cumulative score of data collected by form use. The top and bottom lines for each box represent the range of scores that were presented.
**Average Scores for Individual Residents**

We also calculated the average scores individually by resident. Out of the 11 residents who participated in the study, 9 performed at least one examination using the form. For all physicians, average scores rose for encounters involving use of the AAP form. Resident 1 saw the most dramatic increase in score, of over 170%. Resident 4 and Resident 9 performed the most examinations using the form, and saw increases of 65% and 43%, respectively. The results for all residents can be seen in Figure 3.

![Comparisons of Scores](image)

Figure 3 - Average Score by Resident
Compliance Rates

For a majority of the cases in the testing period, the physicians did not utilize the template form. Out of 116 total cases seen in weeks 2 and 3 (the testing period), the physicians only utilized the template form 41 times, for a 35% overall compliance rate. There existed a large disparity among the compliance rates of the individual physicians. Some had rates as high as 72.22% (Resident 4), whereas others were as low as 8.70% (Resident 6). Residents 7 and 11 never used the form. These results can be seen below in Figure 4.

Figure 4 - Resident Compliance Rate
CHAPTER 5: CONCLUSION

Our group hypothesized that the use of a standardized AAP form would provide for a more complete means of data collection and analysis. After determining what data was crucial to diagnostic decision-making, we designed and created an AAP form to test this hypothesis. For a two week period in January, Emergency Room residents used this form as a substitute for the hospital's current generic form when performing examinations on patients complaining of AAP. We collected hospital records on all cases of AAP throughout the month of January, and recorded all documentation made by the residents. Our group assigned scores to certain data points, and totaled these to give a score to each case in the study. To determine the effect of the AAP form, we then compared the scores based on form use.

When residents utilized the form, the average score was 16.3 points, or 59% higher (p < .05) than when they did not. More data points were collected per case when the form was used, and thus the form provided for a more complete means of data collection.

After the study period, we surveyed the emergency residents to ascertain their satisfaction with the AAP forms. The majority of the residents were pleased with the form, and felt that it was valuable and useful. In addition, they said that our AAP form was more thorough than the current generic form employed by the hospital, and that it had potential for future use.

Unfortunately, the residents only used the forms 35% of the time. There could be many causes for the lack of conformity by the residents. In some cases, residents felt it was tedious to use the new form, especially if they were unfamiliar with it. Several
residents expressed a desire to have a longer learning period. The group did not make the inclusion criteria explicitly clear to the residents, and they may have overlooked cases that the group would consider an AAP case, such as flank pain. Furthermore, many patients that enter the emergency room present more than one complaint, whereas our form was only applicable to acute abdominal pain. If a patient had more than one chief complaint, our form may not have been used. For the full incorporation of a form to be successful, it would need to be utilized by all residents.

There still exist many necessary steps to be taken before a form such as the one created by our group can be fully implemented. First and foremost, the issue of compliance rate must be addressed. Fortunately, this problem is solvable. Surprisingly, many of the residents stated that they simply forgot to use the AAP form. With time, the residents will become more familiar with the process and will be more likely to remember to use the AAP form. Another problem cited by the residents was the inconvenience to acquire it. We placed the forms in two locations in the emergency room, but these may have been out of the way for the residents. If these forms were to become a part of the actual hospital records, they would already be with the residents when performing examinations. This would hopefully also alleviate the problem of forgetfulness, since the form would be in the hands of the resident.

Further iterations of the form should also be tested. There exist many possibilities of layout and content designs which may better suit the needs of the hospital. For example, one resident suggested streamlining all the answers to be in the exact same format. Another resident noted the need for more room to document medical decision making. The hospital should also analyze the results of this study, including population
demographics, resource utilization, and case outcomes to redefine the data set as necessary.

Based on the significant increase in score demonstrated in Chapter 4, we feel a full-scale implementation of a standardized form in the future will significantly aid the Emergency Room residents in data collection, and ultimately, in diagnosis.
ANNOTATED BIBLIOGRAPHY


This study focused on the use of a computer-aided diagnostic tool. The results demonstrated that the tool could have benefits for various types of hospitals.


Diagnosing acute abdominal pain is one of the most challenging dilemmas facing a doctor in the ER. To increase diagnostic accuracy, doctors should carefully collect a thorough, uniform data set. The board created a standardized form as a template to be used when examining patients complaining of AAP.

Bergman, Roy T. “Assessing Acute Abdominal Pain: A Team Physician's Challenge”

[http://www.physsportsmed.com/issues/apr_96/bergman.htm](http://www.physsportsmed.com/issues/apr_96/bergman.htm)

Diagnosis of abdominal pain is always difficult, but it presents an exceptional challenge to a team physician, who often has only limited access to tests and specialists. The most important decision to make is whether or not surgical intervention is necessary.

This study focused on the work of a previous study performed at the University of Virginia hospital in 1972. It found that the majority of patients complaining of acute abdominal pain require neither surgery nor hospitalization, and the majority of those are discharged without a clear determination of the cause of the pain. In cases of high-risk patients that may require surgery, there exist several factors that help identification, including recent pain, tenderness, and advanced age.


The standardized paper form used by St. Mary’s Hospital, which was used as a template for designing the Capstone group’s form.


Diagnosis of acute abdominal pain must be made quickly and accurately. This book contains protocols for diagnosis, and descriptions of the main causes and solutions to acute abdominal pain.

This study demonstrated that the utilization of a computer-based aide improved diagnostic results.


This study focused on several different methods of attempting to utilize tools to support decision-making. The results showed improvements in diagnostic accuracy of 7% with a decision support tool, and 20% with a decision support tool and the use of a computer-based training tool.


Due to the extreme difficulty in accurately determining the cause for abdominal pain, patients are often diagnosed with undifferentiated abdominal pain and discharged. This is the most frequent diagnosis given to patients, and usually indicates a benign condition.


A comprehensive source containing descriptions and graphical depictions of the entire anatomy of the human body. Entire chapters are devoted to the abdominal
area, describing the location and function of each organ, and how they relate to each other. A thorough understanding of the abdomen is crucial when attempting to determine the source and cause of abdominal pain.


This study referred back to the studies performed by de Dombal in regard to the use of decision support tools. It suggested the results of the de Dombal study, which showed an increase in diagnostic accuracy, could have been a result of the standardized process rather than the actual computer decision-support program.


Over the past 20 years, the University of Virginia Hospital has experienced an increase in the specificity of diagnosis and a decrease in the frequency of hospital admission. This suggest improved accuracy, due to most likely an increase in available tests and experienced clinicians.

The majority of appendicitis misdiagnoses result from a careless physical examination and survey of patient historical data. Physicians should ensure to utilize quality assurance techniques when performing examinations.


Descriptions of the functions of the organs contained within the abdomen. A basic understanding of the anatomy of the abdomen is also offered.

http://www.stomachpain.com

A site devoted to abdominal pain, its symptoms and causes. It contains an on-line diagnostic tool to aid those experiencing pain in determining possible causes.

http://www.springnet.com/ce/j612a.htm

An article that reviews the anatomy of the abdomen, the types of abdominal pain, their possible causes, and methods of examination. Information is given in regards to methods of physical examination and patient history, and how to ascertain potential causes and their solutions.

http://webmd.lycos.com/content/asset/adam_symptoms_belly_ache

A site intended for those experiencing abdominal pain. It provides information on potential causes, what to do if experiencing pain, and what to expect when being examined and treated.