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Abstract

In 2009, the medical industry lost more than 750 billion dollars to unnecessary treatments, excessive administrative practices, prevention failure, and inefficient care-giving (Detmer, 2003). This waste puts a very large, unnecessary financial burden on patients and insurance companies. As the demand on the healthcare system continues to increase, this burden will become unbearable if nothing is done. Large corporations such as General Electric have coordinated initiatives to come up with solutions to many issues related to waste in the healthcare industry. The ultimate goal of these projects is to establish National Health Information Infrastructure (NHII). However, as we examine similarly distributed systems already in place, a common factor presents itself. None of these systems have been created by a single individual or organization. Instead, inventions such as radio, television, and the internet have all been the result of a combination of separate inventions brought about by a common economic need. Using these past developments as an example, the goal of the software outlined in this document is to be an integral part of the National Health Information Infrastructure as a whole. The intended use for the Arrow software is to allow hospitals to send data between one another in an efficient and standardized manner, while still maintaining their own database formats and medical data management software. This document contains background information, including regulatory policies and developments in healthcare data management up to the present, as well as an outline of both implementation procedures and constraints for the Arrow software and communications systems.

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Chapter 1: Motivation and Purpose

The motivation for creating a Health Information Management Administration (HIMA) system is the way in which the current system is handled. Our group believes, given the amount of instant sharing and security software available in today's market, the methods used to collect, access, store, and transmit health information can be drastically improved. Every time one walks into a place where health care is administered, they are generally handed a clipboard and asked to complete various forms. This information varies from place to place and we want to ask, why should it? Why is there no uniform method of collecting this data? Our group believes that by creating a HIMA system, we can reduce appointment times while improving the quality and effectiveness of patient care. We can make a system that increases accuracy of diagnosis, decreases human error, and reduce stress in patients and doctors.

When a patient goes to receive health care, they are asked various questions regarding their personal information and health status. Regardless of where one receives this health care, the information requested is generally the same. Countless hours of administrative time are spent organizing this sensitive healthcare data, and millions of dollars are spent paying these workers to pursue this task. Information is generally not shared between various health care centers; hospitals, physicians, etc., unless it is requested which costs the patient valuable, and possibly life threatening, time. The current personal health information system in place is not efficient, inclusive, nor available to health care professionals. In today's day and age, with the immense amount of advanced technology available, why does an efficient, seamless health information management administration not exist? A system of this caliber could not only change the way that health information is stored and maintained, but cut down on administrative tasks and refocus those funds towards medical research and other life saving sources.

This document outlines the proof of concept design of our software, Arrow, which will be the beginning of a National Healthcare Information Infrastructure. Simply put, we would like to create a means of information transfer between healthcare facilities. To achieve our final goal, we understand that many essential steps will have to be taken along the way. In order to understand the complex nature of this software, it is important to examine the current health information system. Instead of implementing an entire HIMA system, we intend on creating our individual patient information system around the current guidelines regarding the creation of an NHII. In order to do this, we will need to fully understand the current proposals of this system, as well as acknowledge its inefficiencies. Another major aspect of our project is to outline the legal requirements and limitations of HIMA. Based on the knowledge we have gathered, we have developed a proof of concept software to collect and transmit sensitive healthcare information while making it accessible to health care professionals. The information will be readily available for authorized users with proper credentials. Our final project is a detailed plan of exactly how our proof of concept software, Arrow, will work and what its impact on the entire healthcare industry will be.

Chapter 2: Background Information

This chapter outlines the pertinent background information used in the development of the final Arrow concept. This chapter focuses on the National Health Information Infrastructure (NHII). This includes obstacles facing the implementation of the NHII and technologies available for use. Additionally, this chapter will offer insight into the immense amount of waste that occurs in the healthcare industry, and most importantly, the privacy issues which are in place to help protect patient information.

2.1 National Health Information Infrastructure

The United States is currently undergoing a crisis in the entirety of the Healthcare industry. Everything from the quality of service to the amount of waste in healthcare is part of this current debacle (Stead, Kelly, & Kolodner, 2005). Among the debated topics are health care quality, information management, wasteful spending, and unnecessary procedures. A national system of patient healthcare information is essential in order to improve the quality of health care throughout the nation. The Department of Health and Human Services has named this endeavor the National Health Information Infrastructure. This initiative is designed to decrease spending, improve quality of care, and improve communication between health care providers. This section of the report provides background and insight into the benefits, obstacles, and requirements of the NHII.

The National Committee on Vital and Health Statistics defines the National Health Information Infrastructure as

> *"…the set of technologies, standards, applications, systems, values, and laws that support all facets of individual health, health care, and public health. The broad goal of the NHII is to deliver information to individuals – consumers, patients, and professionals – when and where they need it, so they*

can use this information to make informed decisions about health care" (Information for Health: A Strategy for Building the National Health Information Infrastructure, 2001).

The NHII is a redesign of the entire health care industry's use of information. In addition to the collection and organization of data, the NHII enables information delivery to health care professionals. This will increase the quality of health care and diagnosis accuracy for patients.

The need for an information infrastructure is to be able to connect users to pertinent information. Within the healthcare industry, information is growing by the minute and patient specific information is growing by the second. Unfortunately though, much of this information is not shared beyond the confines of the health care facility where it was recorded. The NHII aims to eliminate the lack of sharing of information that occurs within the industry. The NHII is a means of data collaboration in order to create a more continuous healthcare information standard. The benefits of such a system are extremely widespread and important. In order to create such a system, many changes must take place which will present multiple challenges for medical professionals. However, the multitude of benefits that this system provides allow for the continued pursuit of the creation of the NHII.

The most enriching benefits due to the NHII will manifest during patient diagnosis, treatment, and research. Understanding patient specific information that would have otherwise not been shared with the clinician is essential towards eliminating waste in the healthcare industry. Within the NHII's framework, individual patient information will be accessible through various means. This information will include every encounter that the individual patient has had with a healthcare facility since they were born. Additionally, this information will be compiled, much like a health biography about the patient. All important health records from birth until the present will be available to clinicians. Regardless of where the individual received health care, information on where to access patient health information will be recorded within the patient's NHII profile in order to be available for the next health care provider to examine if necessary. Example 1 shows insight into the various scenarios in which the NHII will influence the healthcare experience.

> *"Example 1: After recently moving to Florida, Mr. A realizes it is time for his yearly physical. He contacts a new doctor that was recommended by friends and sets up an appointment. At the appointment, Dr. B is examining Mr. A and realizes that his blood pressure is a little high. Dr. B is unsure of whether this is due to a new problem that he is discovering or if it is due to a problem that was previously diagnosed at a different healthcare facility. Dr. B looks down at his tablet computer and types into the search field for Mr. A: "Blood Pressure". Within seconds, Dr. B is given an interactive chart that shows the minor fluctuations of Mr. A's blood pressure over his entire life. Dr. B then adds Mr. A's current blood pressure results to the chart and discovers that Mr. A's blood pressure has been stable at this level for a few years now. Dr. B can also see that Mr. A was prescribed a blood pressure medication a few years ago and currently has an active prescription. Everything checks out for Mr. A and no further action is needed."*

Example 1 examines a common interaction with the NHII and how this system can support healthcare facilitators in their diagnosis and decision-making. In this example, the NHII is used as a way to save time and stress for the patient and clinician. Instead of having a questionable situation, the doctor is easily able to understand all of the relevant details of the case. This type of interaction results in saved time, money, and more patients being treated; all due to the NHII. Similar to the previous example, the NHII could be life saving by alerting physicians about possible life threatening situations at hand such as mistakenly prescribing conflicting medications or medications that the patient is allergic to.

In addition to being able to search individual patient information through the NHII, a clinician could use the NHII to confirm or contest their decisions. Specifically, if a doctor prescribes a patient medication with ingredients that caused the patient problems in the past, a notification will be displayed. Within our current medical system, prescribing conflicting or incorrect medication occurs without any warnings. However, when prescribing this medication to a patient's NHII profile, the clinician would be immediately alerted that there is a problem with the current selection and be instructed to pick an alternative medicine. An assumedly frustrating part of a doctor's daily job is the process of prescribing medications to individual patients and hoping that they do not interact poorly with other medication currently in use by the patient. Within the NHII however, patient information will be instantly compared to research information and statistical patient information as well. If the majority of patients who mixed the medications that the doctor is currently prescribing had problems, another notification will appear recommending that the doctor reconsiders their decision based on these facts. The NHII will turn an educated 'guess and check' method into a comprehensive medical system based on statistics. This new system will reduce stress, save time, save money, and avoid potentially harmful side effects.

One of the most important facets of the NHII is its impact on research. With a comprehensive system of every person's health records, research could be exposed to new results and achievements based on the larger data pool available. It is impossible to realize at this time the exact horizon of possibilities achievable, but research discoveries will be accelerated due to the exposure achieved by the NHII.

It is important to note that the NHII does not currently exist. For several years this idea has been worked on and modified to properly fit the current healthcare system. Additionally, with the technology available to us today, it seems feasible for this program to be implemented. Regardless, this system will not be created by one person or even one company. Instead, the NHII will start to form slowly with the involvement of various technologies applicable to this very broad task. Because of this implementation, the NHII could culminate as a combination of different systems that may or may not be currently envisioned. The system could have the entire healthcare field become paperless or call for a modified approach to research for example. Regardless of how the NHII is structured, it will be a groundbreaking achievement in the healthcare field that will change the way that everybody in the United States interacts with their health issues and their clinician.

2.1.1 Obstacles within NHII Implementation

The idea for a National Health Information Infrastructure is not new. In fact, this novel idea emerged almost 30 years ago (Detmer, 2003). Obviously, the technology was simply not readily available at that time in order to create a system of this magnitude. As the technology has continued to improve over the years, the idea of exactly what an NHII involves has grown as well. However, there have been many factors holding back the implementation of such a system over the years. The main factors required in order to create the NHII is a sound privacy policy that conforms to HIPAA laws and the implementation of available technologies.

The issue of privacy in healthcare is very sensitive to many Americans. Various opinions of exactly what should be done with patient specific health information are worrisome to the general population. Without a change in public opinion due to education about the NHII, these thoughts will likely not change. The public does have a point though; health information is very sensitive and this information being seen by the wrong set of eyes could be very costly to individuals. Recently, the United States government redesigned the laws associated with healthcare privacy. These have become known as HIPAA: the Health Insurance Portability and Accountability Act of 1996. Since these new standards for health information privacy were released, improvements in public opinion regarding this issue have been evident. However, a change to the Standards for Privacy of Individually Identifiable Health Information included in HIPAA has failed to end the discussion on how to properly balance legitimate use of individual health information with privacy protection (Detmer, 2003).

In order to further develop positive opinion of a National Health Information Infrastructure, privacy issues must be addressed. The exact path of how to address these issues will likely depend on the available technology at the time of implementation. Wireless security would be a significant factor of development today. However, there is always a chance that this information could be stolen. Likewise, there is always a chance that current health information could be leaked. If the public understands the reality of information security, popular opinion could potentially point in favor of an NHII. Dispelling myths regarding the NHII will also help to change public opinion, specifically regarding the idea that all information would be stored in some sort of centralized location. This in fact is far from the current plan.

> *Recent events underscore that an effective NHII is not a luxury but a necessity; it is not a threat to our privacy but a vital set of resources for preventing and addressing personal and collective health threats. Better safeguards for privacy, confidentiality, and security are hallmarks of the NHII. The NHII is not intended to create a Federal database of personal health records or a centralized healthcare system. Instead, it will give users access—when it is appropriate, authorized by law or patient approval, and protected by security policies and mechanisms—to a diverse array of information, stored in locations that include providers' offices, organizational and governmental Web sites, and population health databases"* (Information for Health: A Strategy for Building the National Health Information Infrastructure, 2001).

The NHII will be a map for health care facilitators and patients alike to access pertinent health information. Instead of being able to access one central database that will hold all information, there will be an electronic exchange of information between healthcare facilities in order to acquire the desired information. Sophisticated software could potentially facilitate the information exchange seamlessly delivering information to the user who has the proper credentials and the legitimate need to access the data. An honest public opinion campaign aimed at exposing the truth behind current health information security and security associated with the NHII would lead to a shift in support for the NHII. The benefits associated with an NHII implementation would far outweigh the negative privacy concerns that could potentially result because of it. However, health information, for some individuals is an extremely sensitive issue. This view on health information must be highly respected.

Another obstacle that stands in the way of an NHII implementation is funding. A system to change the way that every person receives health care would be expensive. As previously stated though, the NHII has not yet been implemented. The funding party behind the creation of the NHII will control the final structure of the system. The national government would have to play some part in defining roles and integration tactics between medical facilities. However, it seems as though private companies would naturally take on the design of the software and technology required for such a system. Although this is a very large task, with a detailed explanation of exactly what the National Health Information Infrastructure entails, such as the publication by the National Committee on Vital and Health Statistics, various private companies will be able to devote themselves to individual pieces of this integrated puzzle. Upon completion, the resulting program would be colossal. Additionally, companies would gain back their initial investment while benefiting from the NHII in many different ways. Research companies would be willing to pay staggering sums of money to receive large scale health information that the NHII could potentially derive. For example, a research company could potentially run a study on the effects of a certain prescription drug when combined with a common pain reliever in males from the ages of 60-65 with an active lifestyle. Instead of spending money attempting to find potential individuals that may fit into these very specific parameters, the limiting factors involved in this experiment (age, medication history, lifestyle, and sex) could be inserted into the NHII database, and instantly receive anonymous statistics regarding health among the individuals fitting to this study. These potential advances in information gathering would forever change the routine of large scale medical research. Instead of investigating a volunteer sample audience, researchers could potentially access anonymous group health information from all NHII records. Funding for the NHII would be conceivable due to the lucrative profits possible for the entire research industry.

A final obstacle that must be considered is the requirement of digitized records for the NHII. In order to transmit information efficiently and to have patient data available precisely when it is needed, digital access is essential. One cannot assume that in this day and age all health facilities are currently digitizing their records. While it is most likely the norm of the industry to store health information within their own database, there are no industry data storage standards. In order to have a complete database of patient health information, all health facilities would be required to digitize their patient records.

The NHII could revolutionize the entire healthcare system. Through this concept, one could expect less wait time, fewer visits to the doctor's office, and no repeating information requests. Additionally, clinicians will be able to make more informed decisions based on each individual patient's past health scenarios. The fate of the NHII lies within the Federal

Government's ability to bring awareness to this cause and designate key individuals as leaders in the NHII movement. Additionally, private companies will be the main source of input for the ideas and software of this new system. It remains to be seen if the technology and resources needed to create the NHII will be able to come together for the betterment of the healthcare system.

2.1.2 Available Technologies for NHII

It is of little surprise that in today's world, the most effective tool for maintaining information and data is a computer. More recently, various forms of computers have made their way into the market as well. These different computers include tablets, laptops, desktops, and cell phones. Within these devices, extremely important technological advances exist which enable the spread and maintenance of information to occur. These technologies include the Internet, databases, and software. This section will define each available technology and explain their relationship with the National Health Information Infrastructure as opposed to the current system illustrated below in Figure 1 - Current Health System.

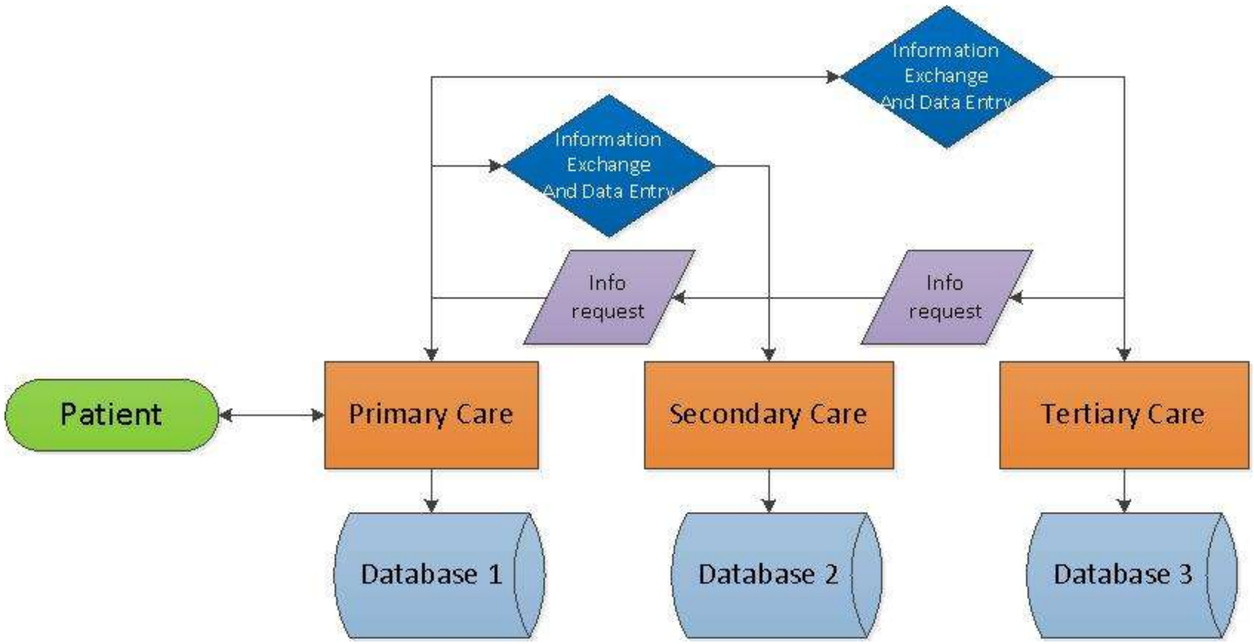


Figure 1 - Current Health System

A computer is defined as "a programmable electronic device that can process, store and retrieve data" (O'Reagan, 2012). This could range from a simple pager to an extremely sophisticated super computer. All computers are made up of two parts; hardware and software. Hardware is defined as the physical part of the device; usually including memory, Central Processing Unit, and a unit which controls input and output commands. Software is the set of instructions that control what the computer does with its hardware. Computers will be the most integral part of the NHII system.

Without computers, creating a system of on demand information in a secure setting would simply not be possible. However, due to recent advances in technology, the NHII is much more feasible than when the idea was first presented in 1991 (Detmer, 2003). Over the years, many improvements have been made towards the computer industry. These include, but are not limited to, Internet, databases, and variable software.

The Internet is one of the most important inventions in human history. With the introduction of the Internet for the common person, the world immediately shrunk from an expansive space to a small online community. With the Internet, one is able to immediately share information with anybody across the globe that has an available Internet connection. The spread of information across the world has never been faster due to the Internet's capabilities. The NHII would rely on the availability of the Internet to become operational. In order to instantly receive information from a healthcare facility anywhere in the nation, the Internet must be used. This would require an Internet connection within every healthcare facility in the United States. However, it can be assumed that relatively all health care facilities currently have an Internet connection, or are capable of acquiring one.

Although the Internet makes it possible for the NHII to exist, it also creates an opportunity for sensitive information to be stolen. In order for the NHII to exist in a safe and secure Internet environment, various online security measures must be taken. Whether through firewalls, encryption, or complicated passwords, security will have to be one of the main focuses of the NHII committee. Also, compliance with HIPAA laws will be a significant factor in the development of the NHII security standard.

Computer software will be essential to day-to-day operations within the NHII. Software in its simplest form is a set of instructions that tells the computer how to operate. Within the NHII software, many computer functions will take place. This software will be the control hub of each individual healthcare facility. In addition to maintaining patient records, this software must be able to schedule appointments and clinician's work shifts, assign rooms to patients, input real time health information into patient's files, prescribe medications, and offer financial resources. Currently, different software packages are used to accomplish the tasks listed above. It is conceivable that a framework which brings these elements together could be constructed.

The NHII will utilize a database in order to store information. A database is simply software that is capable of storing information. Databases will be an essential tool within the NHII in order to store information about patients who have visited an individual healthcare facility. Although this would require a large amount of computer memory, feasibility would not be threatened. In digital form, annual collected data from a single hospital encompasses about 5 terabytes (Haux, 2006). Although this is an extremely large amount of information, it can be stored electronically within a hard drive the size of a small textbook. As technology progresses, the physical space required by such a storage device will continue to shrink. Databases will also be used to maintain medical stock within the facility and organize non-patient specific health records such as medical dictionaries. The use of databases will be essential for the development and applications of the NHII.

The NHII software would be capable of running on various different interfaces including, but not limited to, desktop computers, laptops, and tablets. The most commonplace and practical of these devices for this endeavor is the tablet. With a tablet, one is able to do most processes that they can otherwise do on a computer. The only difference is that tablets are generally touch screens that give the user much more control and accuracy during tasks. Additionally, tablets are extremely portable. Although there are touch-screen laptops available that are equally portable, laptops generally are more bulky and require a surface to be rested upon in order to facilitate operations. Most tablets today are designed to be held with one hand and manipulated with the other. Because of this, clinicians would be able to carry a tablet around with them in place of their old clipboards. Additionally, depending on the software configured for the NHII, this tablet could exclusively be used for NHII processes. This would add increased security for NHII records because of the inability to install other possible harmful software onto the tablet which could compromise sensitive information. Additionally, the tablet could be used to administer tasks to various clinicians around a health care facility seamlessly. A clinician could simply log into their tablet under their specific name and view exactly what they need to be doing at that moment as defined by a manager. If that happens to be something related to a patient, such as surgery or an injury diagnosis, the software installed on the tablet would also begin pulling any pertinent information related to the task at hand for use by the clinician. If one clinician 'flags' a piece of information within the file, all other clinicians working on that patient currently would be able to view this purposeful alert. The possibilities for current technology in the health care field are endless.

The use of desktop computers would coincide with the use of tablets effectively. Desktop computers, unlike laptops would not be a portable computing device. However, by utilizing tablets, portability would only be necessary for the clinicians themselves. Behind the scenes, many workers would be busy scheduling, maintaining inventory, and assigning tasks to doctors. In order to facilitate these tasks, powerful computers with large amounts of storage, and extremely fast Internet speeds would be essential. All of these features could be found in a desktop computer. Although portability would be compromised, these workers would optimally not be moving around to complete their tasks. Instead, they would stay at an individual work site where they could focus on management operations.

In order to maintain adequate work efficiency while keeping patient data secure many other precautions must be considered. While at the work station, each worker would be isolated from each other. This would ensure that the spread of patient information verbally is not occurring. Additionally, the room where these computers are located would be password protected and monitored at all times. Once inside the room, the use of cell phones, paper, and pens or pencils would be prohibited. This would help to ensure that information is not being written down and stored manually. Each computer would only be able to be accessed by sensitive passwords that are given to each worker individually. While working, all processes of the computer would be monitored externally to ensure that no privacy infractions are taking place. Finally, these computers would be outfitted with the NHII software. These precautions against health information privacy begin to ensure that patient health information is not compromised within this endeavor. However, the exact specifications and scenarios that will play out within the NHII system are only speculated at this time.

2.2 Health Information Background

Within this section, the history and background of health information will be examined. The identification of developments concerning the use of health information over the last several decades paints a picture of why the healthcare system operates the way it does today. Examining the major changes over the past 50 years allows for a greater understanding of the reasons for the current state of health information management. The present situation is impossible to understand without at least superficial knowledge of the series of developments that took place in the medical field since the 1950s.

2.2.1 Health Information System History

The health care information system has in fact been developing for decades, making use of different technology and practices as they became available and applicable to the world of healthcare. The data within that system however, has been different depending on the era and the purpose of recording specific data. Information systems may be broken down into subsections (administrative and clinical) depending on whether the information is related to patient care, or the operations side of healthcare. For NHII purposes, the clinical system is of more importance.

Effectively outlining the development of the health care information system we currently utilize requires a decade by decade analysis focusing on the health care environment and information technology of the era. The federal climate and legal implications that impacted the system may also be pertinent to understanding the history of health information. One of the first reforms which created the initial need for information systems in healthcare came in the mid-1960s, when Medicare and Medicaid were signed into law. Never before had healthcare been guaranteed on a large scale, and federal money was now available to reimburse hospitals for care given to those who qualified for Medicare and Medicaid. Any hospital that treated patients who were covered by either of these two organizations would then have to apply for the amount of money they used during the treatment, based on billing records. At the time, the billing and patient record process was not dependent on any other systems, and they were typically inaccurate and untimely. The need for automated patient billing and cost recording became apparent, as it was now directly related to the revenue that the hospital generated at any given time, and there was great potential for loss if underreporting of resource consumption took place. The early systems which emerged as solutions to this problem were aiming to capture patient demographic data, insurance information, and cost data and combine the three records to create a patient bill. By utilizing a streamlined bill, cost reporting was improved greatly, decreasing "the amounts of lost charges and unbilled services" (Wager, Lee, & Glaser, 2009). The development of these systems most often took place in large hospitals, and university hospitals, as they stood to lose the most if cost reporting was improperly taken care of, and because they had sufficient staff diversity to share the burden of adapting to a new system.

The applications used in support of these early information systems had to be run on mainframe computers, which were large and expensive, and thus limited to large hospitals. The cost of computing of the era indicates why the processing power was focused on administrative needs like the billing and reimbursement agenda, rather than clinical needs such as recording individual patient data. An example of an attempt at getting around the mainframe roadblock was made by vendors offering “shared systems” that linked small hospitals to the mainframe of a vendor. The hospitals paid based on the amount of data used and utilized a service from these vendors for the processing of their billing data (Wager, Lee, & Glaser, 2009).

The development of the information system needed for billing and administrative functions paved the way for future expansion to clinical applications. As the computing power developed and the financial need increased evolution within this field began to occur. The next decade- the 70s – saw out of control increases of health care costs “due to Medicare and Medicaid expenditure” and “rapid inflation in the economy, expansion of hospital expenses and profits, and changes in medical care.” The increased use of technology and medicine of this era led to a change in hospital structure through departmentalization. The ability of a department to separately manage and treat patients suffering from different classifications of illnesses allowed for an increase in productivity, and a rise in revenues. “The development of departmental systems coincided with the availability of minicomputers.” The technological development of the minicomputer allowed individual departments to manage their own data, without the dependence on a mainframe computer. The result was a series of “turnkey programs” being released to manage the clinical information of a specific department or pharmacy (Wager, Lee, &

Glaser, 2009). By utilizing the new technology, processes were accelerated and fine-tuned leading to an increase in the quality of healthcare provided and minimizing the costs associated with doing so. This is one of the first instances where it is clear that better patient information management led directly to decreased costs and wasted resources.

In the 1980s, the trend of increased health care costs continued, and the need to manage information became even greater. The methods of Medicare and Medicaid payment to hospitals changed completely, and rather than reimbursement based on billing, they now received a fixed amount per patient based on their "diagnosis related group" (DRG) or the classification of their illness and expected treatments. It now became of the utmost importance for reimbursement to accurately record the diagnosis of individual patients, as the hospital would only be paid a fixed amount regardless of the cost of treating that patient. This era saw the transition "toward privatization and corporatization of health care." The great change of this era was brought on by the release of microcomputers. Also known as the personal computer (PC) this tool allowed departments and overall organizations "real computing power" at individual workstations. Although PCs existed at this time, it was rare to find an organization which had combined its administrative requirements such as patient demographics and insurance information with its clinical requirements. This led to an inability to accurately calculate the costs of administering care to individual patients, and posed a great challenge to hospital financial executives. This lack of communication between key nodes of the overall process can be attributed to the way that the vendor community provided systems. Each different section within the hospital system such as the pharmacy, the lab, and the finances, all purchased their own system, and stored their data in a unique way. This led to major roadblocks for communication and lack of cooperation between departments that were sorely needed. The microcomputer's release triggered an extremely important health care environment development: it allowed computing power to be attainable to more than just the large hospitals. This meant that many more healthcare providers were coming into contact with information systems and that they were much more conscious of their performance. Another significant development of the era was the ability to share information among computers with a local area network. This meant that “a group of computers and associated devices [were] controlled by a single organization” (Wager, Lee, & Glaser, 2009). The dawn of the connectivity era was beginning to break with the use of LAN, but major change was around the corner.

In the 1990s, another major change in the Medicare structure once again altered the way the physicians were paid for treatment of those on Medicare. The new system dubbed the “RBRVS” or “resource-based relative value scale” was based on the success that the earlier DRG system displayed. Doctors under this new system received reimbursement based on “provider time, effort, and degree of clinical decision making” that was not so heavily dependent upon the billed cost of the patient’s treatment. This meant that primary care physicians who spent more time with their patients and educated them stood to be reimbursed at a greater rate than before, and encouraged quality treatment for patients. Aside from this change in practice, preventative medicine grew in popularity “with the goal of promoting health and well-being and preventing disease” (Wager, Lee, & Glaser, 2009). These changes in healthcare led to a change in the way that healthcare providers utilized their information systems. The increase in the pursuit of preventative medicine led to a greater need for patient information such as treatments rendered and progress made. This is when some physicians began to recognize the importance of accurate clinical information, not only with respect to their reimbursement, but also the implications for the treatment of their patients. The accuracy and availability of clinical information was not of nearly as much value to physicians before this change, and the pursuit of better records was driven by preventative medicine practices.

Perhaps the most influential advance of this decade was the beginning and proliferation of the Internet. Before this time, most information system development took place within hospitals on closed loop systems. As healthcare needs shifted however, private practices and primary care physicians began to realize a new need. To effectively treat their patient, physicians needed access to timely and accurate clinical data as might be found within hospitals. Vendor products made specifically for this healthcare environment were developed by vendors of the time. These tools included disease management programs which assisted doctors with managing care much more effectively and demonstrated the usefulness of electronic prompts and reminders. This represents the advent of the health plan, where a doctor has a set of practices and guidelines for treating a patient with a chronic disease, as well as educating the patient on how to become more involved in monitoring their own condition.

The Institute of Medicine released a report titled “The Computer-Based Patient Record: An Essential Technology for Health Care” in 1991. They called attention to the wasteful practices and inevitable difficulties with paper-based medical records. Also mentioned, was a plan that a “computer-based patient record” or “CPR” be developed and adopted by the year 2001 (Wager, Lee, & Glaser, 2009). The calls for change made many ripples in the world of healthcare providers as well as the vendors who developed information systems. Many believed that it represented the beginning of major change in the way that patient information would be managed, and the way that patient care would be delivered; they were partially right. CPR systems were indeed created by several vendors of this era, but a rate of less than 10% implementation was achieved within hospital and physician care environments.

Nearly a decade after the CPR system had been proposed by the Institute of Medicine (IOM); another report was published highlighting the frequency with which patients died due to medical errors. The Institute urged health organizations to update their technological systems in order to more accurately record and share "essential health information on patients and their care." These publications generated action by the federal government as well as major health care providers to advance the use of health care IT. Their goal in this endeavor is to realize a system where transparency is a priority, errors have been reduced, and patient care is improving. Seemingly in response, the Medicare Modernization Act of 2003 made a new round of changes to the standards on reimbursement. The new "pay for performance" or "P4P" method had a host of quality measures and standards "intended to promote and reward quality" (Wager, Lee, & Glaser, 2009). As a result of this development, an even greater emphasis was placed on clinical performance and recording of results. Information technology in healthcare was recognized as an essential tool, and efforts to further develop its application have been ongoing.

The final wave of change necessary to bring this system to today's standard was the advancement of technology overall. Handheld devices with greater computing power allow for electronic prescriptions to take place among a host of new systems for recording, storing, and transmitting information. The culmination of these advances has led to the possibility of true Electronic Health Records (EHR), defined as "an electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization" (Wager, Lee, & Glaser, 2009). The proactive expansion of these tools will lead to unprecedented changes in the healthcare industry within the near future.

2.2.2 Current Medical Forms

One of the problems with the current health industry is the usage of handwritten forms. These forms are not standardized across the medical industry which results in vast variations from medical center to medical center. Additionally, the efficiency of use of such forms is extremely low. Simply eliminating hand-written forms and switching over to computer software to handle these tasks would save time and money. The following figures will illustrate exactly why current medical forms are inefficient and wasteful.

It is imperative for one to understand the substantial amounts of waste which occur through the use of paper forms. Regardless of implementation of the NHII, a switch to electronic records is able to save medical facilities time and money in administrative tasks. By examining the following forms, Figure 2 – Figure 9, comprehension will be gained regarding the immense amounts of waste generated by non-paper. With the addition of the NHII, electronic forms will be able to generate patient information automatically without patient input.

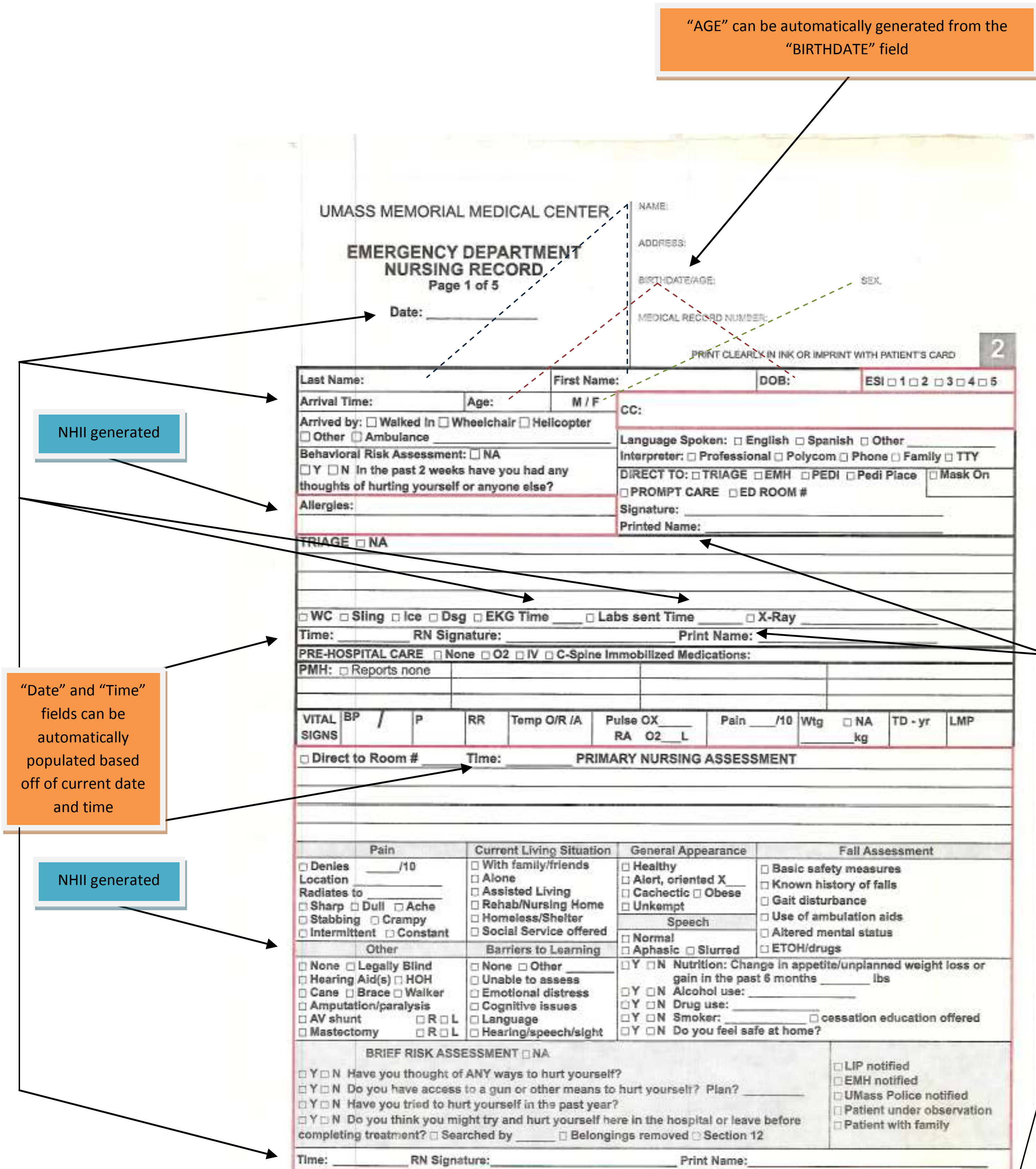
This section will focus solely on the current UMass Memorial Medical Center (UMass Medical) in Worcester, Massachusetts' Emergency Department Nursing Record. To begin, the form is a culmination of 5 sheets of paper, each of which has at least 40 information fields with the most having more than 150 fields. While it is important to understand that not all of these individual fields may currently be filled out for every patient, inefficiencies still take place regardless of the level of completeness of each form.

The first page of the UMass Medical Emergency Department Nursing Record can be found below (Figure 2 - UMass Memorial ER Nursing Record 1). Upon first examination, this form may seem overwhelming. In fact, it records an immense amount of information regarding the patient. Since this is the emergency department form, inefficiencies between communication regarding forms could be the difference between life and death during the most severe of situations. The following paragraphs will highlight the simple and obvious changes that could occur if this specific form was computerized. Additional insight will be given towards fields that would easily be affected by connecting the computerized form to the National Health Information Infrastructure which was previously explained.

On page 1 of the UMass Medical Emergency Department Nursing Record, there are 96 informational fields. Out of these 96 fields, 13 were previously known information requiring repeated work. Additionally, 19 fields were requiring information which could simply be generated by a computer such as date and time. On this particular sheet, over 33% of the requested information is considered to be wasted information because of its repetitiveness. To begin, as one can see at the top of the form, the date is requested. While the date would only take a few seconds to write down, a computer program could record the date without requiring any effort from the user. At the right of the form, the following information is requested: Name, Address, Birthdate/Age, Sex, and Medical Record Number. Since this form is used in the Emergency Department of the hospital, this information was considered to be unknown until the patient arrives. However, a repetitive field within this particular section is the request for the age of the patient next to the birth date. A simple computer program can input the birth date of an individual and output the current age. Again, a few seconds could be saved in this section of the form.

As one continues to complete this form, many more repeating information requests occur. The next field is a perfect example of the waste occurring within medical forms. Although the clinician recorded the patient's Last Name, First Name, DOB, Age, and M/F above, they are requested to do so again. Within inches of each other on the form, duplicate information exists.

As one continues down this page, the "Allergies" section is next in view. While this information cannot be generated by a simple computer program like the date and time, it could be known if the computer program is connected to the National Health Information Infrastructure. As previously stated, within this program, patient health information will be able to be requested by clinicians. Allergies will be a part of the standard information in the NHII system that all health care facilitators will be capable of receiving in order to avoid allergic reactions during care. In addition to the "Allergies" section, if one continues down the form, the "Other" section would be able to be populated by the information within the NHII.



UMASS MEMORIAL MEDICAL CENTER

EMERGENCY DEPARTMENT NURSING RECORD
Page 1 of 5

Date: ____________

NAME:
ADDRESS:
BIRTHDATE/AGE: SEX:
MEDICAL RECORD NUMBER:
PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

2

Last Name: | First Name: | DOB: | ESI □ 1 □ 2 □ 3 □ 4 □ 5
Arrival Time: | Age: | M / F | CC:
Arrived by: □ Walked In □ Wheelchair □ Helicopter □ Other □ Ambulance
Language Spoken: □ English □ Spanish □ Other ____
Interpreter: □ Professional □ Polycom □ Phone □ Family □ TTY
Behavioral Risk Assessment: □ NA
□ Y □ N In the past 2 weeks have you had any thoughts of hurting yourself or anyone else?
DIRECT TO: □ TRIAGE □ EMH □ PEDI □ Pedi Place □ Mask On
□ PROMPT CARE □ ED ROOM #
Allergies:
Signature:
Printed Name:

TRIAGE □ NA

□ WC □ Sling □ Ice □ Dsg □ EKG Time ____ □ Labs sent Time ____ □ X-Ray ____
Time: ________ RN Signature: ____________ Print Name: ____________
PRE-HOSPITAL CARE □ None □ O2 □ IV □ C-Spine Immobilized Medications:
PMH: □ Reports none

VITAL SIGNS | BP / | P | RR | Temp O/R /A | Pulse OX ____ RA O2 ___ L | Pain ___ /10 | Wtg □ NA ___ kg | TD - yr | LMP

□ Direct to Room # ______ Time: ________ PRIMARY NURSING ASSESSMENT

Pain	Current Living Situation	General Appearance	Fall Assessment
□ Denies ___ /10 Location ____ Radiates to ____ □ Sharp □ Dull □ Ache □ Stabbing □ Crampy □ Intermittent □ Constant	□ With family/friends □ Alone □ Assisted Living □ Rehab/Nursing Home □ Homeless/Shelter □ Social Service offered	□ Healthy □ Alert, oriented X ___ □ Cachectic □ Obese □ Unkempt Speech □ Normal □ Aphasic □ Slurred	□ Basic safety measures □ Known history of falls □ Gait disturbance □ Use of ambulation aids □ Altered mental status □ ETOH/drugs

Other	Barriers to Learning	
□ None □ Legally Blind □ Hearing Aid(s) □ HOH □ Cane □ Brace □ Walker □ Amputation/paralysis □ AV shunt □ R □ L □ Mastectomy □ R □ L	□ None □ Other ____ □ Unable to assess □ Emotional distress □ Cognitive issues □ Language □ Hearing/speech/sight	□ Y □ N Nutrition: Change in appetite/unplanned weight loss or gain in the past 6 months ____ lbs □ Y □ N Alcohol use: ____ □ Y □ N Drug use: ____ □ Y □ N Smoker: ____ □ cessation education offered □ Y □ N Do you feel safe at home?

BRIEF RISK ASSESSMENT □ NA
□ Y □ N Have you thought of ANY ways to hurt yourself?
□ Y □ N Do you have access to a gun or other means to hurt yourself? Plan? ____
□ Y □ N Have you tried to hurt yourself in the past year?
□ Y □ N Do you think you might try and hurt yourself here in the hospital or leave before completing treatment? □ Searched by ____ □ Belongings removed □ Section 12

□ LIP notified
□ EMH notified
□ UMass Police notified
□ Patient under observation
□ Patient with family

Time: ________ RN Signature: ____________ Print Name: ____________

Figure 2 - UMass Memorial ER Nursing Record 1

As one continues down the page, the “Time:______” field is the next piece that will be able to be automatically input by the computer. Even though this is not the first time that the “Time” is requested on this form, this time request refers to a specific action; in this case, when triage takes place. If this entire process is done through a computer program, when the “Triage” section of the form is completed, the program could automatically timestamp this process to keep a record of exactly when it took place.

The next item of importance on the form is the “Pre-Hospital Care” section. Although this section would only apply if the patient is transported in an ambulance, it could potentially offer another time saving solution associated with medical forms. Instead of having to record what care was done in an ambulance where the nurse filling out this form was not present, the EMS could simply fill out their own ambulance report form. Upon completion of this form, the “Pre-Hospital Care” section of the Emergency Department Nursing Record would not only be already completed, but recorded in much more detail than “None, O2. IV, C-Spine Immobilized, Medications:”

The final detail of importance for the first page of this form is the “Printed Name” field which occurs multiple times. This field is intended on being the name of the individual at the hospital who is responsible for the information related to that section. On this one sheet, the “Printed Name” request occurs in 3 separate places. However, in a computerized system of digital records, each individual will have a specific log-in name. Similar to the timestamps explained above, the name of the individual responsible for inputting various entries into the form will be recorded along with the information. Because of this, the need for a “Printed Name” field is completely eliminated.

As one begins to examine the second form (Figure 3 - UMass Memorial ER Nursing Record 2), it is obvious that the problems which could be eliminated on the first page continue onto the others. To begin, the date is requested again on this second page of the form which is directly next to the first page where the date is also displayed. To continue with the repetition, the entire top right area of the form is repeated on not only the first and second page, but on every page of this form. This alone would require a significant of extra, wasted, time in order to record multiple times. Instead of recording this information once and having it transfer over onto every other page of this form, somebody is required to write in this information by hand on every page. Another point of interest which occurs on this page is within the "Cardiac" section of the form. In this section, the pulse of the patient is requested. While the pulse of the patient is relevant within the cardiac section, it has already been recorded on the previous page along with the patient's vital signs. The final part of this form worth mentioning is the "Time" inputs within the bottom half of the form. There are 10 different time inputs in the section alone, 8 of which have room for multiple inputs. Depending on the severity of the patient's situation, the time could be repeatedly filled in on this form to detail every aspect of care associated with the patient. Instead of wasting time recording information which a computer could input into the form automatically, the clinician could be using their time to treat the patient.

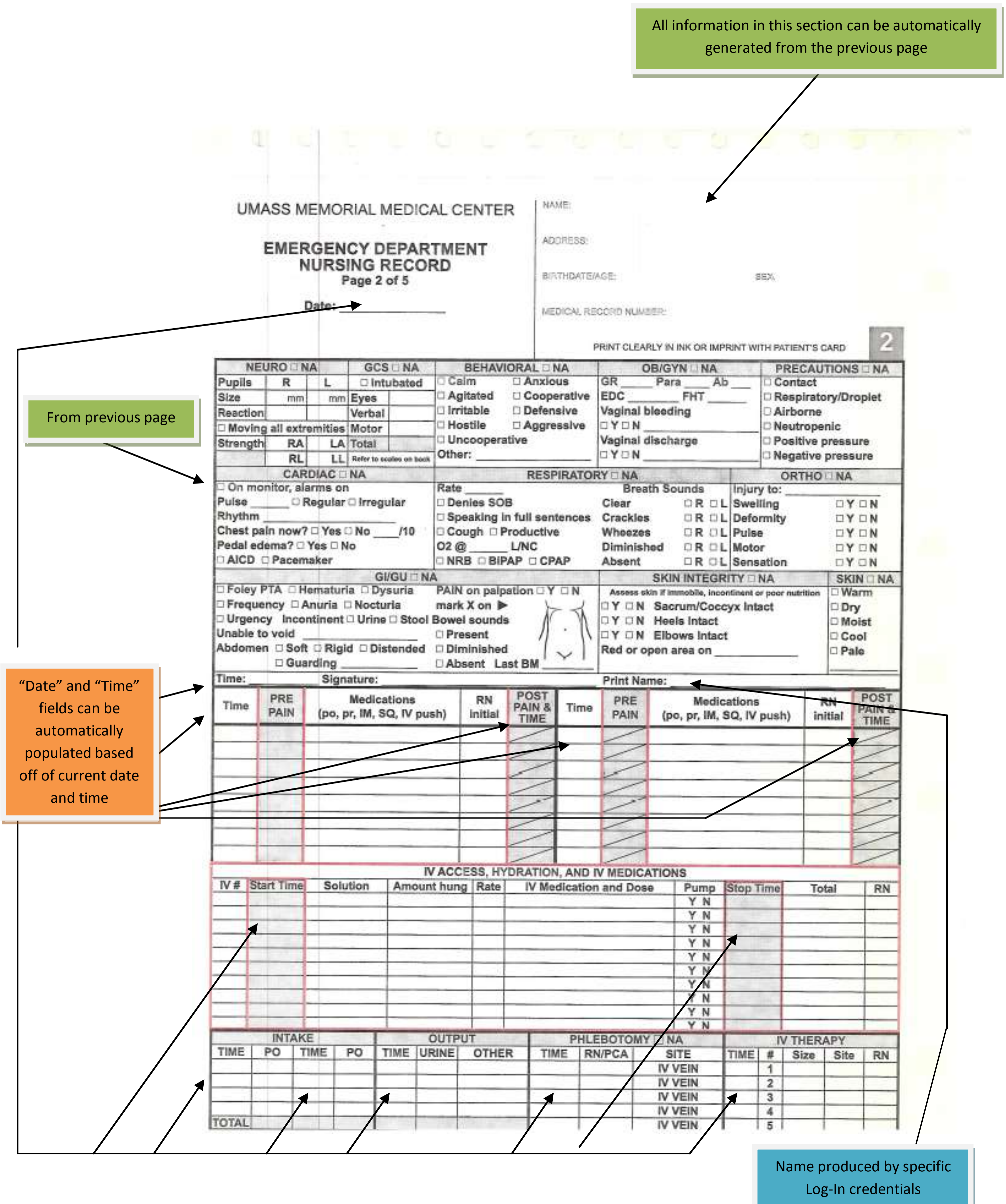
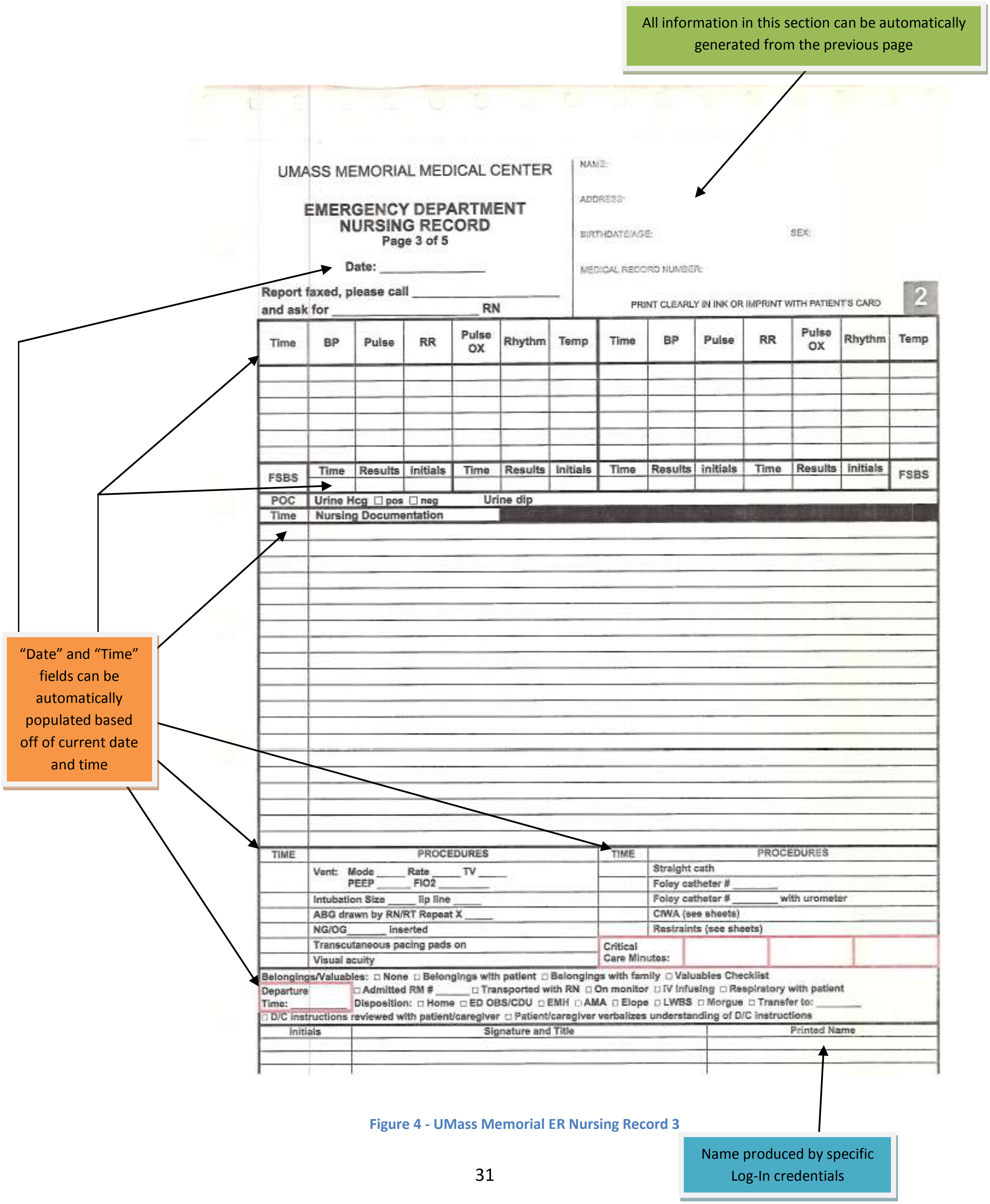


Figure 3 - UMass Memorial ER Nursing Record 2

In total, the second page of this form has 116 fields. 6 of these fields were known based off of the first page of the form. 14 of them requested information that can be input by a computer. However, it is important to note that the above statistics do not include the fields which can have multiple entries within them. Within many of the sections where time is requested, it is requested for every input within that section. With more inputs into these specific sections of this page, the percentage of computer generated information would greatly increase. Without additional entries within these various sections, page 2 of the UMass Medical Emergency Department Nursing Record is composed of 17% wasted information.

The remaining 3 pages of this particular form (Figure 4 - UMass Memorial ER Nursing Record 3, Figure 5 - UMass Memorial ER Nursing Record 4, Figure 6 - UMass Memorial ER Nursing Record 5) follow much of the same path as the first two. The most repetitive and simple fixed detail is the “Time” request. While this field is important in every juncture of the healthcare process, it is not necessary to have a clinician write it out every single time when any modern computer does this automatically. While the exact amount of time that it takes a clinician to write out the time is unknown, it is obvious that removing this need would save time in the most critical of moments for a patient, especially with regards to emergency department forms. In total, the entire 5 page form had 481 different fields for recording patient information. Out of the 481 fields, 164, or 34%, of them were wasted fields. In essence, the time that a clinician takes to fill out this form in its entirety could be cut down by 34%. This huge savings in time could lead to more people being treated and lower health care costs.



UMASS MEMORIAL MEDICAL CENTER

EMERGENCY DEPARTMENT
NURSING RECORD
Page 3 of 5

Date: ______________

Report faxed, please call ______________
and ask for ______________ RN

NAME:
ADDRESS:
BIRTHDATE/AGE: SEX:
MEDICAL RECORD NUMBER:
PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD
2

Time	BP	Pulse	RR	Pulse OX	Rhythm	Temp	Time	BP	Pulse	RR	Pulse OX	Rhythm	Temp

FSBS	Time	Results	Initials	Time	Results	Initials	Time	Results	Initials	Time	Results	Initials	FSBS

POC | Urine Hcg ☐ pos ☐ neg | Urine dip

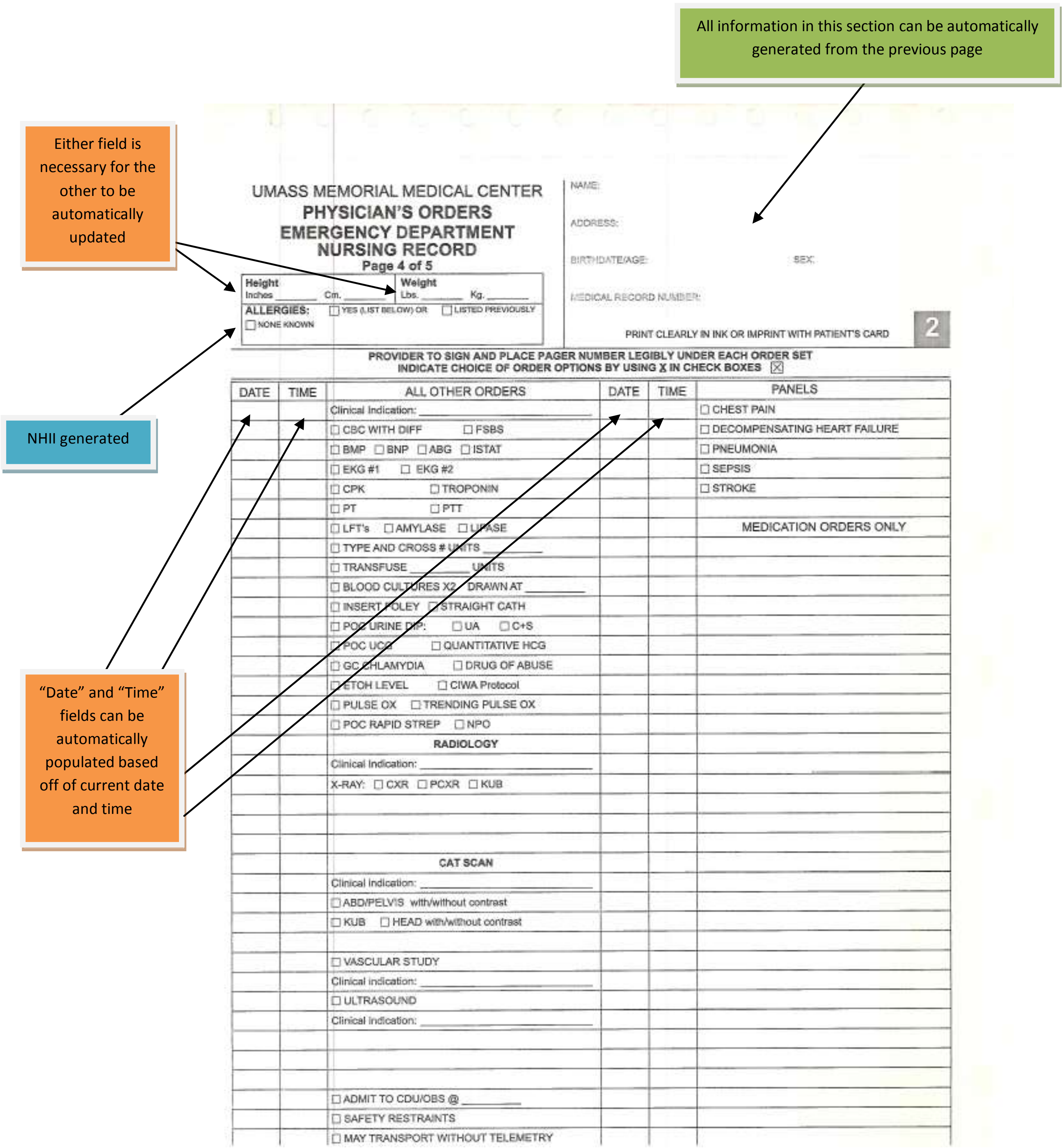
Time	Nursing Documentation

TIME	PROCEDURES	TIME	PROCEDURES
	Vent: Mode ____ Rate ____ TV ____ PEEP ____ FIO2 ____		Straight cath
			Foley catheter # ____
	Intubation Size ____ lip line ____		Foley catheter # ____ with urometer
	ABG drawn by RN/RT Repeat X ____		CIWA (see sheets)
	NG/OG ____ inserted		Restraints (see sheets)
	Transcutaneous pacing pads on	Critical Care Minutes:	
	Visual acuity		

Belongings/Valuables: ☐ None ☐ Belongings with patient ☐ Belongings with family ☐ Valuables Checklist
Departure Time: ☐ Admitted RM # ____ ☐ Transported with RN ☐ On monitor ☐ IV infusing ☐ Respiratory with patient
Disposition: ☐ Home ☐ ED OBS/CDU ☐ EMH ☐ AMA ☐ Elope ☐ LWBS ☐ Morgue ☐ Transfer to: ____
☐ D/C instructions reviewed with patient/caregiver ☐ Patient/caregiver verbalizes understanding of D/C instructions

Initials	Signature and Title	Printed Name

Figure 4 - UMass Memorial ER Nursing Record 3



UMASS MEMORIAL MEDICAL CENTER
PHYSICIAN'S ORDERS
EMERGENCY DEPARTMENT
NURSING RECORD
Page 4 of 5

Height Inches ______ Cm. ______ | Weight Lbs. ______ Kg. ______

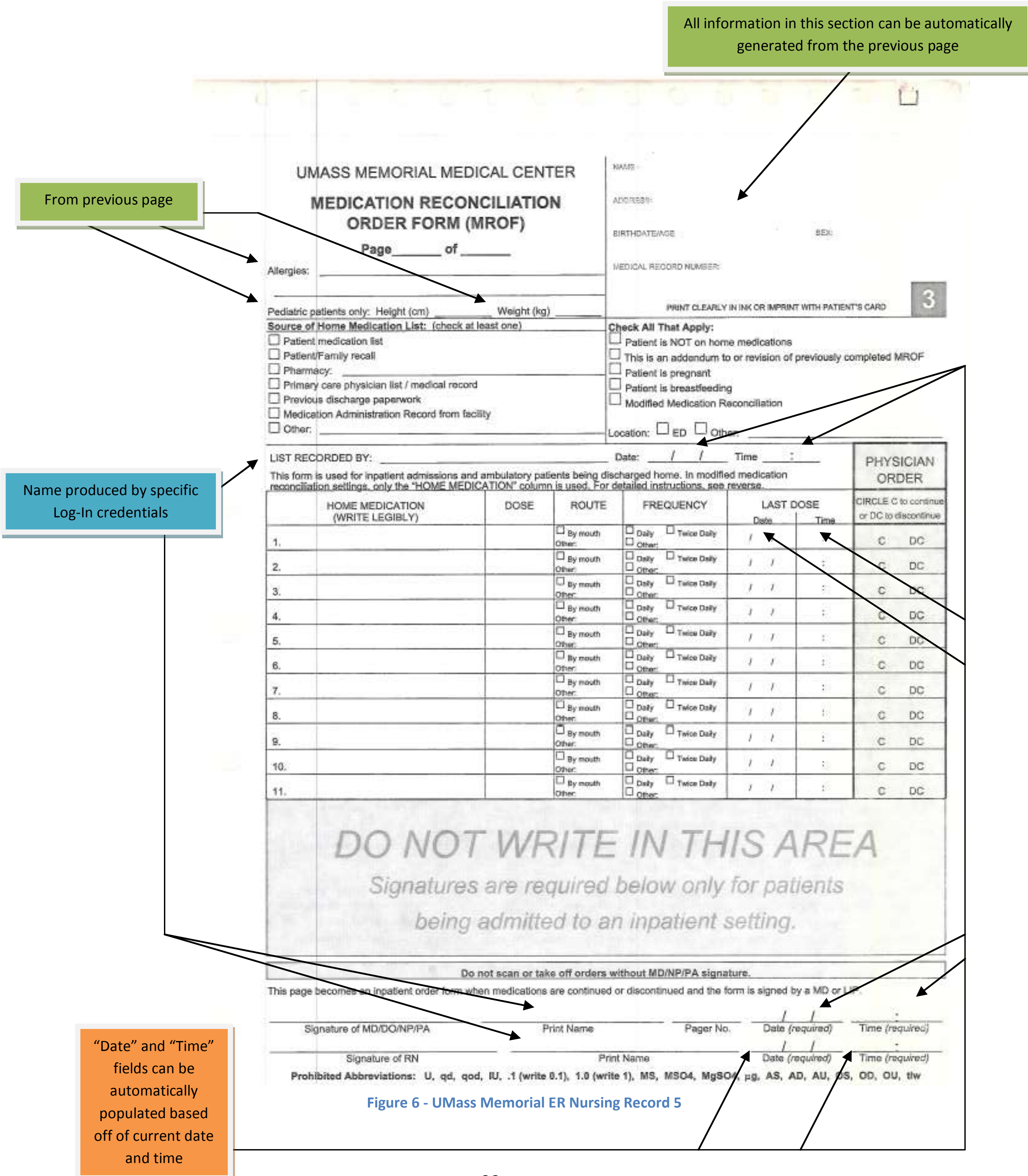
ALLERGIES: ☐ NONE KNOWN ☐ YES (LIST BELOW) OR ☐ LISTED PREVIOUSLY

NAME:
ADDRESS:
BIRTHDATE/AGE: SEX:
MEDICAL RECORD NUMBER:
PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD 2

PROVIDER TO SIGN AND PLACE PAGER NUMBER LEGIBLY UNDER EACH ORDER SET
INDICATE CHOICE OF ORDER OPTIONS BY USING X IN CHECK BOXES ☒

DATE	TIME	ALL OTHER ORDERS	DATE	TIME	PANELS
		Clinical Indication: ______			☐ CHEST PAIN
		☐ CBC WITH DIFF ☐ FSBS			☐ DECOMPENSATING HEART FAILURE
		☐ BMP ☐ BNP ☐ ABG ☐ ISTAT			☐ PNEUMONIA
		☐ EKG #1 ☐ EKG #2			☐ SEPSIS
		☐ CPK ☐ TROPONIN			☐ STROKE
		☐ PT ☐ PTT			
		☐ LFT's ☐ AMYLASE ☐ LIPASE			MEDICATION ORDERS ONLY
		☐ TYPE AND CROSS # UNITS ______			
		☐ TRANSFUSE ______ UNITS			
		☐ BLOOD CULTURES X2 DRAWN AT ______			
		☐ INSERT FOLEY ☐ STRAIGHT CATH			
		☐ POC URINE DIP: ☐ UA ☐ C+S			
		☐ POC UCG ☐ QUANTITATIVE HCG			
		☐ GC CHLAMYDIA ☐ DRUG OF ABUSE			
		☐ ETOH LEVEL ☐ CIWA Protocol			
		☐ PULSE OX ☐ TRENDING PULSE OX			
		☐ POC RAPID STREP ☐ NPO			
		RADIOLOGY			
		Clinical Indication: ______			
		X-RAY: ☐ CXR ☐ PCXR ☐ KUB			
		CAT SCAN			
		Clinical Indication: ______			
		☐ ABD/PELVIS with/without contrast			
		☐ KUB ☐ HEAD with/without contrast			
		☐ VASCULAR STUDY			
		Clinical indication: ______			
		☐ ULTRASOUND			
		Clinical indication: ______			
		☐ ADMIT TO CDU/OBS @ ______			
		☐ SAFETY RESTRAINTS			
		☐ MAY TRANSPORT WITHOUT TELEMETRY			

Figure 5 - UMass Memorial ER Nursing Record 4



UMASS MEMORIAL MEDICAL CENTER

MEDICATION RECONCILIATION ORDER FORM (MROF)

Page ______ of ______

NAME:
ADDRESS:
BIRTHDATE/AGE: SEX:
MEDICAL RECORD NUMBER:
PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

3

Allergies: ______

Pediatric patients only: Height (cm) ______ Weight (kg) ______

Source of Home Medication List: (check at least one)
- ☐ Patient medication list
- ☐ Patient/Family recall
- ☐ Pharmacy: ______
- ☐ Primary care physician list / medical record
- ☐ Previous discharge paperwork
- ☐ Medication Administration Record from facility
- ☐ Other: ______

Check All That Apply:
- ☐ Patient is NOT on home medications
- ☐ This is an addendum to or revision of previously completed MROF
- ☐ Patient is pregnant
- ☐ Patient is breastfeeding
- ☐ Modified Medication Reconciliation

Location: ☐ ED ☐ Other: ______

LIST RECORDED BY: ______ Date: __/__/__ Time __:__

This form is used for inpatient admissions and ambulatory patients being discharged home. In modified medication reconciliation settings, only the "HOME MEDICATION" column is used. For detailed instructions, see reverse.

HOME MEDICATION (WRITE LEGIBLY)	DOSE	ROUTE	FREQUENCY	LAST DOSE Date	LAST DOSE Time	PHYSICIAN ORDER (CIRCLE C to continue or DC to discontinue)
1.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
2.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
3.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
4.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
5.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
6.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
7.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
8.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
9.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
10.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
11.		☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC

DO NOT WRITE IN THIS AREA

Signatures are required below only for patients being admitted to an inpatient setting.

Do not scan or take off orders without MD/NP/PA signature.

This page becomes an inpatient order form when medications are continued or discontinued and the form is signed by a MD or LIP.

Signature of MD/DO/NP/PA ______ Print Name ______ Pager No. ______ Date *(required)* __/__/__ Time *(required)* __:__

Signature of RN ______ Print Name ______ Date *(required)* __/__/__ Time *(required)* __:__

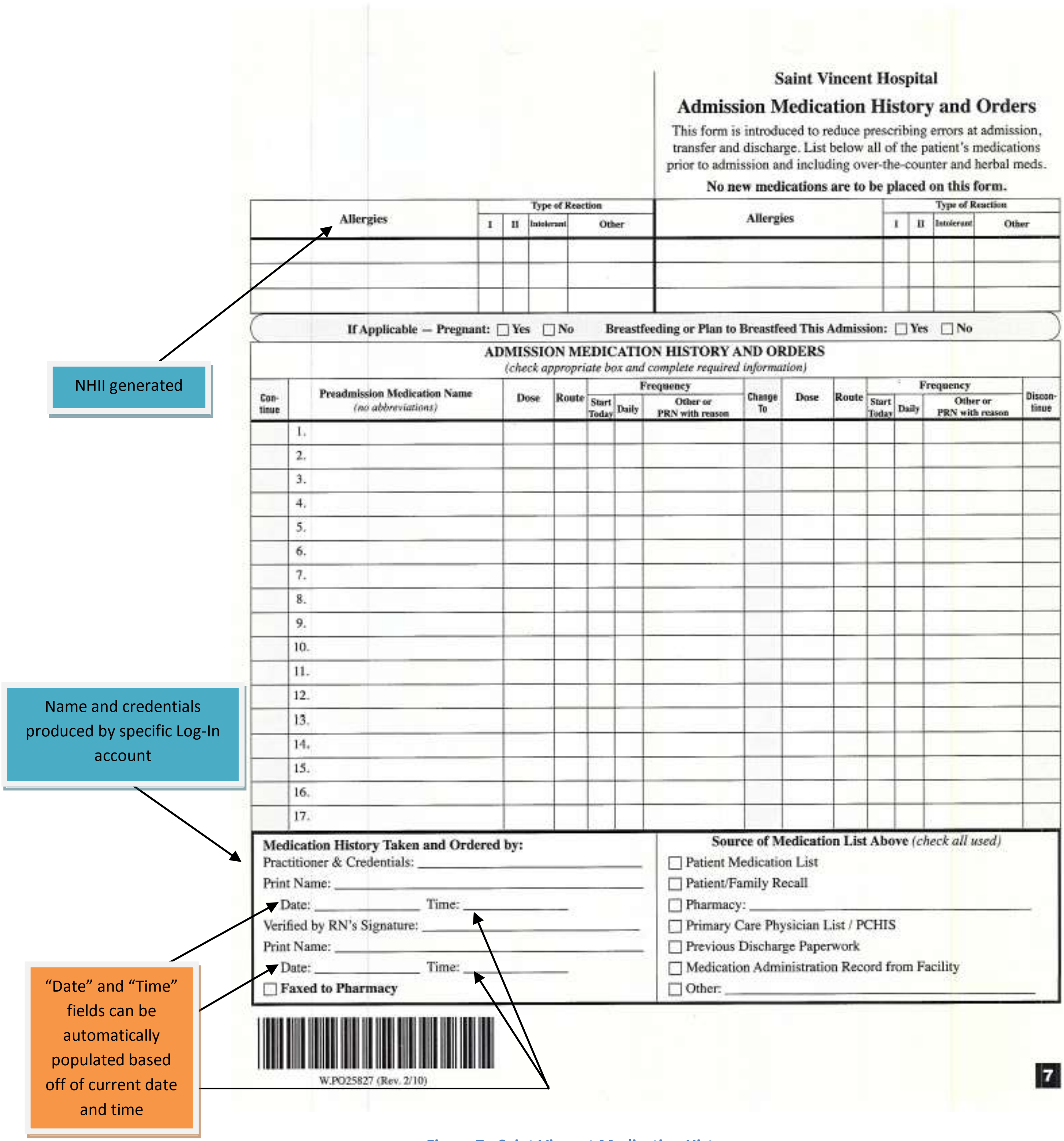
Prohibited Abbreviations: U, qd, qod, IU, .1 (write 0.1), 1.0 (write 1), MS, MSO4, MgSO4, µg, AS, AD, AU, OS, OD, OU, tiw

Figure 6 - UMass Memorial ER Nursing Record 5

As exemplified on many pages of the UMass Medical Emergency Department Nursing Record, the elimination of handwritten documents in the medical field, much more than the “Time” field will be able to be eliminated. As exemplified in Figure 4, automatic conversions can be helpful and time saving. On the top of this particular page, there is a request for the patients “Height” in inches and centimeters as well as a request for “Weight” in both pounds and kilograms. While it is unknown exactly how the hospital measures the patient’s weight and height or what the hospital’s need for measuring both of these items in both English and Metric units, it is requested on the form. Because of this, extra computations by a human are required. Within a digital system, the clinician would be able to put in a single measurement in each of the fields and have the conversion to the other measurement system automatically take place. While it may be true that this may only cut down on a few seconds of note taking, the combination of this time saving opportunity along with the multitude of others will result in a significant time savings.

The next set of forms to examine is those from St. Vincent Hospital in Worcester, Massachusetts. At this hospital, they are currently transitioning all of their forms over to computer software. While this assumedly cuts down on paper costs, time, and labor costs associated with filing paper, they still have some paper forms that have not yet been converted. In this section, the benefits of transitioning the remaining forms will be investigated.

The first form to be examined is the Admission Medication History and Orders form (Figure 7 - Saint Vincent Medication History). As stated on the form, “This form is introduced to reduce prescribing errors at admission, transfer and discharge. List below all of the patient’s medications prior to admission and including over-the-counter and herbal meds.” At the top of the page, Allergy information is immediately requested. Since this form is used to understand exactly what medications a patient is currently on in order to prescribe appropriate new medication which does not interfere with previous medications, an accurate record is necessary. Once the allergen information is recorded, the clinician is to fill out the current medications section of the form. This includes prescribed, over-the-counter, and herbal medication. This section of the form is extremely important. If there are any accidental errors, the new medication could end up resulting in a complication with another medication which was not properly recorded. In order to eliminate the majority of problems related to this, the NHII would be an incredibly helpful tool. By utilizing the NHII, one could completely eliminate the guess-work that occurs with accurately remembering the fine details of all prescribed medications. Instead, one could simple refer to past medications of the patient, examine when they picked up their last prescription, and completely understand what all of their current medications are. The only part of this section of the form which would remain unregistered by the NHII is the remaining medications which do not have to go through a doctor: over-the-counter and herbal medications. Using previously recorded medical history instead of relying on the patient's memory in the process of prescribing new medication is an extremely powerful dimension of digital forms and the NHII. The bottom of the form's request for date and personnel names, like forms previously examined, could be filled out automatically with simple computer software. The use of the NHII in order to populate forms is the perfect complement to digital forms.



Saint Vincent Hospital

Admission Medication History and Orders

This form is introduced to reduce prescribing errors at admission, transfer and discharge. List below all of the patient's medications prior to admission and including over-the-counter and herbal meds.

No new medications are to be placed on this form.

Allergies	Type of Reaction: I	II	Intolerant	Other	Allergies	Type of Reaction: I	II	Intolerant	Other

If Applicable – Pregnant: ☐ Yes ☐ No **Breastfeeding or Plan to Breastfeed This Admission:** ☐ Yes ☐ No

ADMISSION MEDICATION HISTORY AND ORDERS

(check appropriate box and complete required information)

Con-tinue	Preadmission Medication Name *(no abbreviations)*	Dose	Route	Frequency: Start Today	Daily	Other or PRN with reason	Change To	Dose	Route	Frequency: Start Today	Daily	Other or PRN with reason	Discon-tinue
	1.												
	2.												
	3.												
	4.												
	5.												
	6.												
	7.												
	8.												
	9.												
	10.												
	11.												
	12.												
	13.												
	14.												
	15.												
	16.												
	17.												

Medication History Taken and Ordered by:

Practitioner & Credentials: ______________

Print Name: ______________

Date: ________ Time: ________

Verified by RN's Signature: ______________

Print Name: ______________

Date: ________ Time: ________

☐ **Faxed to Pharmacy**

Source of Medication List Above *(check all used)*

☐ Patient Medication List

☐ Patient/Family Recall

☐ Pharmacy: ______________

☐ Primary Care Physician List / PCHIS

☐ Previous Discharge Paperwork

☐ Medication Administration Record from Facility

☐ Other: ______________

W.PO25827 (Rev. 2/10)

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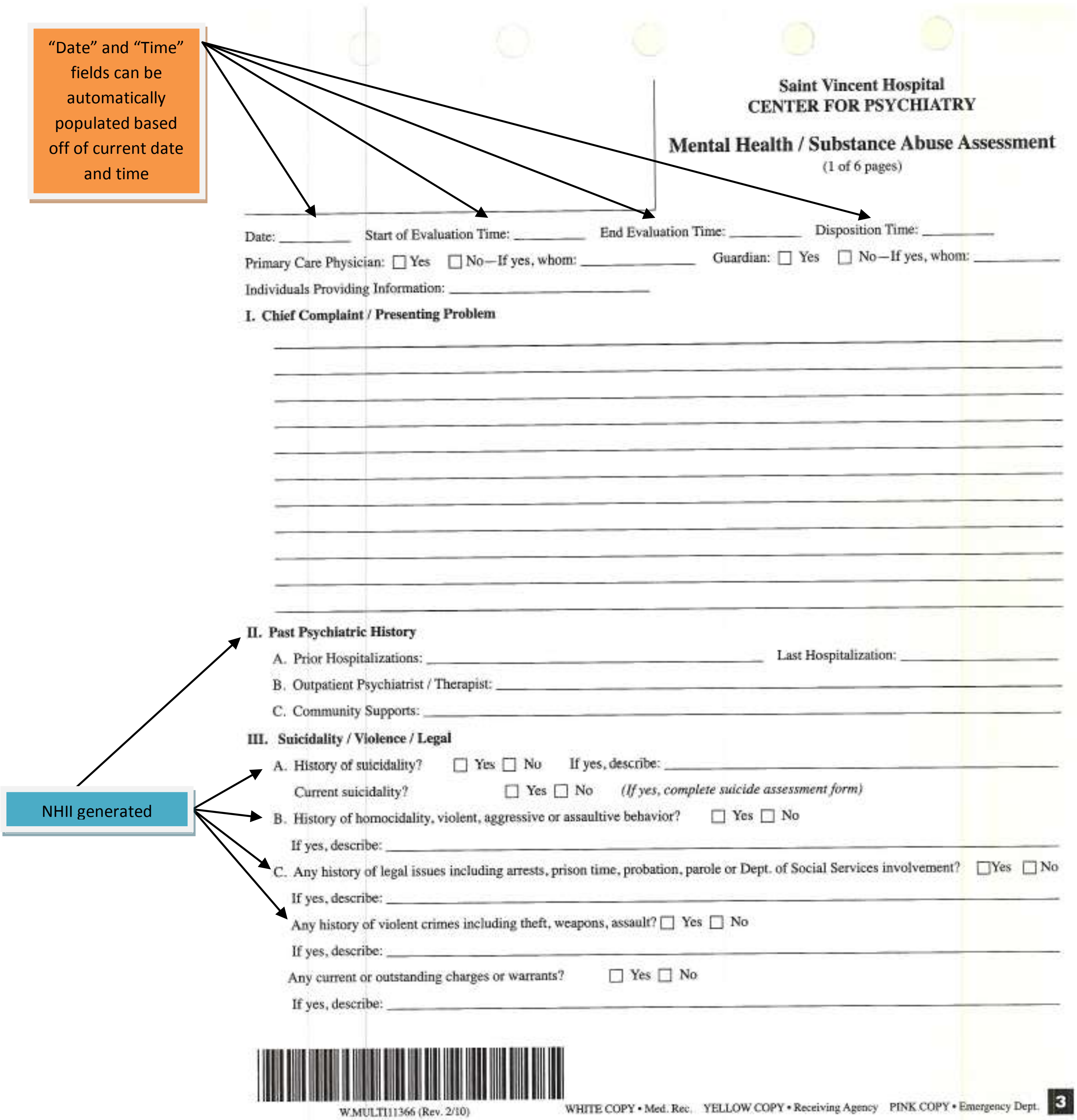
Figure 7 - Saint Vincent Medication History

The next form to be examined is the "Mental-Health/Substance Abuse Assessment" form (Figure 8 - Saint Vincent Mental Health/Substance Abuse Assessment). This form is used to understand the current psychiatric status of the patient. The majority of this form is used to gauge the patient's past with respect to hospitalizations, therapists, community supports, and history of suicidality, violence, legal issues, violent crimes, and warrants. This information is extremely important for the clinician to be able to understand exactly what the psychological status of the patient is for the patient and the clinician's safety. Additionally, if a patient is undergoing current psychological distress, they may not be willing to openly talk about past issues that they have faced. However, this information is extremely important for the hospital to have understanding of. In order to receive this information, the NHII may be used. This will be able to give insight and details into the patient's past hospitalizations and history of suicidality and violence. With the NHII's usage, this form will almost entirely be able to be completed by utilizing past information.



Saint Vincent Hospital
CENTER FOR PSYCHIATRY

Mental Health / Substance Abuse Assessment
(1 of 6 pages)

Date: ________ Start of Evaluation Time: ________ End Evaluation Time: ________ Disposition Time: ________

Primary Care Physician: ☐ Yes ☐ No—If yes, whom: ________ Guardian: ☐ Yes ☐ No—If yes, whom: ________

Individuals Providing Information: ________

I. Chief Complaint / Presenting Problem

____

II. Past Psychiatric History

A. Prior Hospitalizations: ________ Last Hospitalization: ________

B. Outpatient Psychiatrist / Therapist: ________

C. Community Supports: ________

III. Suicidality / Violence / Legal

A. History of suicidality? ☐ Yes ☐ No If yes, describe: ________

Current suicidality? ☐ Yes ☐ No *(If yes, complete suicide assessment form)*

B. History of homocidality, violent, aggressive or assaultive behavior? ☐ Yes ☐ No

If yes, describe: ________

C. Any history of legal issues including arrests, prison time, probation, parole or Dept. of Social Services involvement? ☐Yes ☐No

If yes, describe: ________

Any history of violent crimes including theft, weapons, assault? ☐ Yes ☐ No

If yes, describe: ________

Any current or outstanding charges or warrants? ☐ Yes ☐ No

If yes, describe: ________

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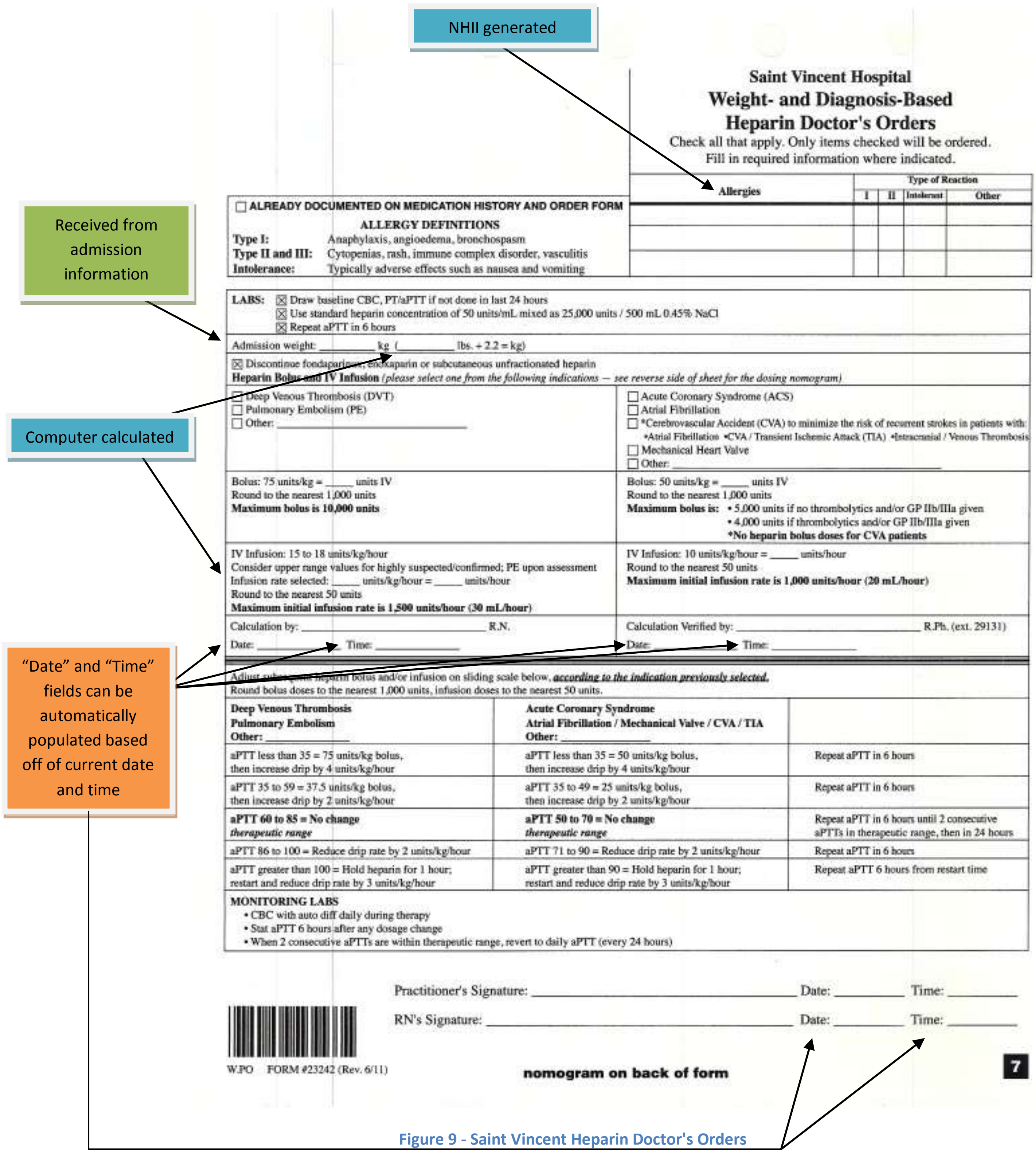
Figure 8 - Saint Vincent Mental Health/Substance Abuse Assessment

The final form to be analyzed is the St. Vincent Hospital's "Weight- and Diagnosis-Based Heparin Doctor's Orders" form (Figure 9 - Saint Vincent Heparin Doctor's Orders). This form is used to document the proper amount of Heparin and IV Infusions per patient based off of the patient's weight and specific health complication. Once again, the first field to be input onto this form is the allergy information of the patient. As previous explained, this information can be instantly populated by the NHII. A few lines down on the form, the patient's admission weight is requested. By using digital forms, this field will automatically be equal to the admission form's weight field. Because of this, this part of the form will be completed before it is even started. The conversion to kilograms for this part of the form will easily be completed by the software in use. The majority of this form is based off of calculations which can easily and swiftly be completed by the computer software. By doing so, time will be saved and accuracy will be insured by not having the clinician performing calculations that could potentially be incorrect; in this case a life threatening situation. Additionally, calculations will not have to be verified by another clinician. This will save time, and effort by other clinicians who can then focus on other patients. The digitalization of all forms and the adaptation of the NHII to populate various fields within forms is extremely beneficial to the entirety of the healthcare field.



Saint Vincent Hospital
Weight- and Diagnosis-Based Heparin Doctor's Orders
Check all that apply. Only items checked will be ordered.
Fill in required information where indicated.

☐ ALREADY DOCUMENTED ON MEDICATION HISTORY AND ORDER FORM

ALLERGY DEFINITIONS
Type I: Anaphylaxis, angioedema, bronchospasm
Type II and III: Cytopenias, rash, immune complex disorder, vasculitis
Intolerance: Typically adverse effects such as nausea and vomiting

Allergies	Type of Reaction: I	II	Intolerant	Other

LABS: ☒ Draw baseline CBC, PT/aPTT if not done in last 24 hours
☒ Use standard heparin concentration of 50 units/mL mixed as 25,000 units / 500 mL 0.45% NaCl
☒ Repeat aPTT in 6 hours

Admission weight: ________ kg (________ lbs. ÷ 2.2 = kg)

☒ Discontinue fondaparinux, enoxaparin or subcutaneous unfractionated heparin
Heparin Bolus and IV Infusion *(please select one from the following indications — see reverse side of sheet for the dosing nomogram)*

☐ Deep Venous Thrombosis (DVT) ☐ Pulmonary Embolism (PE) ☐ Other: ____________	☐ Acute Coronary Syndrome (ACS) ☐ Atrial Fibrillation ☐ *Cerebrovascular Accident (CVA) to minimize the risk of recurrent strokes in patients with: •Atrial Fibrillation •CVA / Transient Ischemic Attack (TIA) •Intracranial / Venous Thrombosis ☐ Mechanical Heart Valve ☐ Other: ____________
Bolus: 75 units/kg = _____ units IV Round to the nearest 1,000 units **Maximum bolus is 10,000 units**	Bolus: 50 units/kg = _____ units IV Round to the nearest 1,000 units **Maximum bolus is:** • 5,000 units if no thrombolytics and/or GP IIb/IIIa given • 4,000 units if thrombolytics and/or GP IIb/IIIa given ***No heparin bolus doses for CVA patients**
IV Infusion: 15 to 18 units/kg/hour Consider upper range values for highly suspected/confirmed; PE upon assessment Infusion rate selected: _____ units/kg/hour = _____ units/hour Round to the nearest 50 units **Maximum initial infusion rate is 1,500 units/hour (30 mL/hour)**	IV Infusion: 10 units/kg/hour = _____ units/hour Round to the nearest 50 units **Maximum initial infusion rate is 1,000 units/hour (20 mL/hour)**
Calculation by: ____________ R.N. Date: ________ Time: ________	Calculation Verified by: ____________ R.Ph. (ext. 29131) Date: ________ Time: ________

Adjust subsequent heparin bolus and/or infusion on sliding scale below, ***according to the indication previously selected.***
Round bolus doses to the nearest 1,000 units, infusion doses to the nearest 50 units.

Deep Venous Thrombosis **Pulmonary Embolism** **Other:** ________	**Acute Coronary Syndrome** **Atrial Fibrillation / Mechanical Valve / CVA / TIA** **Other:** ________	
aPTT less than 35 = 75 units/kg bolus, then increase drip by 4 units/kg/hour	aPTT less than 35 = 50 units/kg bolus, then increase drip by 4 units/kg/hour	Repeat aPTT in 6 hours
aPTT 35 to 59 = 37.5 units/kg bolus, then increase drip by 2 units/kg/hour	aPTT 35 to 49 = 25 units/kg bolus, then increase drip by 2 units/kg/hour	Repeat aPTT in 6 hours
aPTT 60 to 85 = No change ***therapeutic range***	**aPTT 50 to 70 = No change** ***therapeutic range***	Repeat aPTT in 6 hours until 2 consecutive aPTTs in therapeutic range, then in 24 hours
aPTT 86 to 100 = Reduce drip rate by 2 units/kg/hour	aPTT 71 to 90 = Reduce drip rate by 2 units/kg/hour	Repeat aPTT in 6 hours
aPTT greater than 100 = Hold heparin for 1 hour; restart and reduce drip rate by 3 units/kg/hour	aPTT greater than 90 = Hold heparin for 1 hour; restart and reduce drip rate by 3 units/kg/hour	Repeat aPTT 6 hours from restart time

MONITORING LABS
• CBC with auto diff daily during therapy
• Stat aPTT 6 hours after any dosage change
• When 2 consecutive aPTTs are within therapeutic range, revert to daily aPTT (every 24 hours)

Practitioner's Signature: ____________ Date: ________ Time: ________
RN's Signature: ____________ Date: ________ Time: ________

W.PO FORM #23242 (Rev. 6/11)

nomogram on back of form

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Figure 9 - Saint Vincent Heparin Doctor's Orders

2.3 Wastes in Healthcare

Healthcare is a unique industry with a complex network of information technologies, procedures, and personnel that could benefit tremendously from an innovative information system. The information system should serve to decrease waste and increase effectiveness of the industry. Healthcare has been an industry nationally recognized to be wasteful. The combination of a complex problem and the unique way that most people feel about healthcare creates the environment that has to be considered when talking about waste in healthcare. Figure 10 - Waste in Healthcare shows where and how various categories are affecting waste in the healthcare industry (Fung, 2012).

$750 Billion Waste in Healthcare

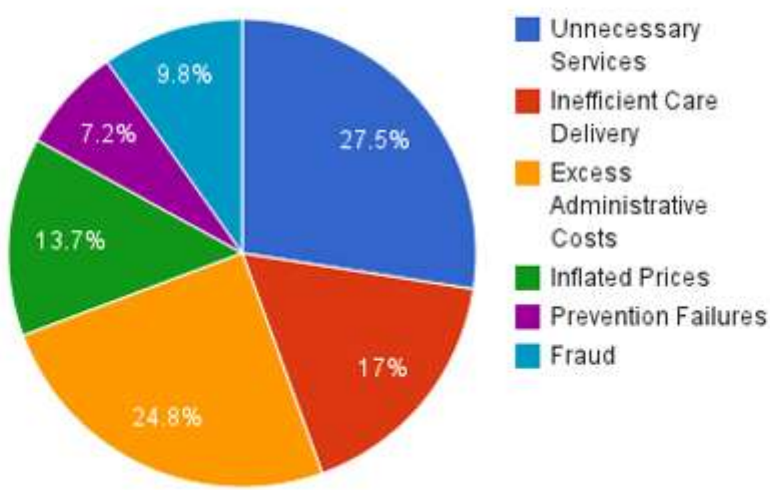

Figure 10 - Waste in Healthcare

The above figure lists “Unnecessary Services” and “Excess Administrative Costs” as more than 50% responsible for waste in the healthcare industry. These two categories would be the areas that could see the greatest immediate improvement because of Arrow and the NHII.

In such an industry, the cost of an individual's health care is typically not something that affects a decision to be treated. For example, when a Mother sees her daughter fall, while playing a soccer game, and bump her head, usually that Mother will rush to the emergency room to seek out the best possible care for her child. What is not considered is the cost; a pediatrician or doctor at a nearby clinic would probably be able to diagnose if her daughter has a concussion for a fraction of the cost, but the Mother wanted the best care possible so in her rush, she immediately thought to go to the emergency room. This insensitivity to cost inherent to the industry is not just present in some extreme situations.

The complexity of healthcare in the United States of America is partially responsible for the amount of waste produced. There are many different contributors to the system and each contributor has a specific role in helping people stay healthy. Those involved in healthcare include patients, which could be anyone in our nation feeling that they need health care, doctors, who have sworn an oath to help people lead better lives, insurance agencies, to make sure patients can economically support the health care they are receiving, clerical workers, and health care administration. People have emotions and emotions influence the flow of the money that is wasted in healthcare (Heeks, 2006).

Administrators of health care are similarly insensitive to price. The education they have received and oath they have taken both seek to treat symptoms and return a person to health as quickly and as painlessly as possible. This is favorable because a patient knows at all times that a doctor is looking for the best solution. However, if given an opportunity to wait a day or two, patients could avoid spending unnecessary amounts of money on an expensive test. There are not many people in the world that would turn that down. This insensitivity to price makes us human and contributes tremendously to the amount of waste in healthcare. Perhaps a change in the education of patients and doctors alike would result in more mindful spending habits.

Wasted or unnecessary use of resources contributes to wastes in the overhead production costs behind such resources. Every time a doctor orders a test that doesn't need doing, time, money, and paperwork are wasted. Every time a brand name pharmaceutical is used over the generic form of the drug, excess money is spent. A single instance of wasted resources barely matters, but when considered on a national scale, a lot more resources are spent than is necessary.

Technology also contributes to waste in healthcare. For the most part, each administration of health care uses its own blend of technology and personnel to achieve their goals. That means that each hospital, clinic, private practice, specialist, etc., uses a different method to manage the same thing. If an innovation were to occur in the technology of healthcare, for instance if a more structured approach could be established, it would lead to less wasted money. Once one hospital uses a cost effective technological platform, others would begin to implement the same uniformed technology and a shift in the industry of healthcare would be seen. Technology of the world today is advanced enough to support a change in the way healthcare is done; it is simply a matter of matching this advanced technology to the healthcare industry and implementing it widely enough to where real savings could be attained. The scale of such systems integration into the healthcare industry would be directly relatable to savings (Hillestad, et al., 2005).

Finding a solution is difficult because of the ambiguity of the problem. The problem is wasteful heath care, and that means very different things to people. For example, Manoj Jain says that "To reduce the waste in health care, American medicine requires a culture change, and the doctors have to lead it." In that same article Dr. Jain provides a few well backed arguments explaining away some of $750 billion wasted a year, citing unnecessary services, unnecessary administrative costs, inefficient delivery of services, and unnecessarily high costs of treatment as a few of the areas responsible for the wasted money. The culmination of the article is in suggesting that "…doctors need to become integral partners in the cost-cutting process" (Jain, 2012). The point being that a doctor educated to operate while keeping costs in mind would be a tremendous improvement from the current policy, which is to not consider money. The fact remains that doctor ordered expenditures usually don't take cost into account and that is not the only waste of the healthcare industry.

Until streamlined technological organization is implemented into healthcare, the industry must rely on the current systems in place. Each practice is different, with many of the same procedures occurring repetitively. This lack of a uniform model is inefficient. Because each administration is 'on an island', so to speak, the clerical work seen in health care is redundant. Every time an individual patient enters a different administrator of health care, the first thing done is the collection of information. This means that a patient must give out personal information each time in order to receive care, this is wasteful. Technology is at a point to where each individual could give out information just once, and with an increased network of communication between health care providers, would only need to update this information occasionally. The amount of time this would save is significant and would decrease time and paper with each time information collection is avoided.

Much of the waste in the healthcare industry is produced by procedural and organizational flaws. As previously stated, almost every health care administration has its own model of how to provide health care. Some of these models are very efficient, others are extremely wasteful. Unnecessary processes could be done away with and money would be saved. Many tests or procedures done today are not even proven to have benefits related to healthcare, and are simply done so that the patient feels better knowing that something was done. If there was a way to make health care providers more uniform in their functioning's, and a way to cut back processes that are not required, then much waste would be eliminated from health care.

A report written by Robert Kelley sheds light on an entirely different area of waste in healthcare. The paper states Medical Errors, Fraud and Abuse, Payments for services with no evidence that they contribute to better health outcomes, and inefficiencies in the production of healthcare goods and services as four regions of healthcare that could be improved upon. None of the categories talk about the same 'waste' that a practicing doctor recognized. Medical errors include clerical mistakes, and misdiagnoses that result in wasted services, treatments, and pharmaceuticals. Fraud and Abuse is defined as a use of the Healthcare system that did not need to happen. In this paper, it is stated that the Emergency Department could save $21 billion per year on a national basis if it got rid of these fraudulent or abuses of the system. The other two categories are more intuitive in that paying for useless things is a waste, and waste in production of goods. "Healthcare spending can be eliminated without reducing the quality of care…Therefore, an expenditure classified as waste according to this definition does not contribute to: the quality of healthcare services, the outcomes of care, or the health status of the population (Productivity Tools to Accomplish Work Faster, 2013).

A new business model could be all that the industry needs to make improvements from the present. Max Nisen from Business Insider wrote the article "Cleveland Clinic CEO Shares His Incredible Vision for the Future of Healthcare" and shows us how the Cleveland Clinic created a more innovative business model and brought down costs without changing the quality of care.

> *"One of the biggest issues in healthcare in the United States has been an emphasis on quantity of care rather than quality, as insurance companies and doctors often get paid more for expensive tests and procedures. That's led to a great deal of inefficient, expensive treatment. The Cleveland Clinic's solution? All doctors are salaried and on one year contracts. "We have no financial incentives to do more or less. We just try to look after what the needs are for a patient because it doesn't make a difference to us personally," Dr. Cosgrove (CEO of Cleveland Clinic) said. "We all have one year contracts, there's no tenure, and we have annual professional reviews. I don't know of another institution that has annual professional reviews and one year contracts. In the annual professional review we go over all individual contributions to the organization, and that contributes to our decisions about what we do about salary or whether we reappoint or don't."* (Nisen, 2012).

Doctors focus on what's best for the patient, rather than what gets them paid, leading to fewer unneeded tests and surgeries. They're evaluated on the quality of care rather than earnings. When you can have cheaper care that's also better for the patient, it's clear that there needs to be some change in the industry. This changing of incentives from getting paid to doing the best thing at the best price for the patient is relatively revolutionary in the industry, as is the concept of having professional reviews. Another innovation was to change their definition of cost, and to collect enough data to start solving some cost issues. "Part of changing the focus and how people are evaluated is actually having the data to do so. That's an area where hospitals can improve on cost and quality. "The more we measured, the more we found problems," Dr.

Cosgrove said. "And when you found a problem you could really sort of screw down into it and find out what the root of it was and begin to deal with that particular issue. And what resulted is that we got better and better as we went along" (Nisen, 2012).

Now, every part of the hospital system transparently publishes its outcomes, adds more data every year, and continually works to get better. Cost is even easier to measure, and it needs to start to be a part of every decision. "Cost has been looked at what you get paid to do something, not what it costs to do it," Dr. Cosgrove said." So what we've done, over the years we've begun to understand how much it costs to do each one of our procedures… and they were able to take out 25% out of the actual cost of what they did" (Nisen, 2012).

These innovations at the Cleveland Clinic are something that could be easily worked into health care administrations all over the country and would help reduce waste. Wasteful healthcare is one of the main motivations in the passage of legislature like the NHII. The country has recognized a growing problem in the way that healthcare spends its money, and is in the process of attempting to create or invent a solution. Waste in health care is complex and multi-faceted, but the time is ripe for change with pressure coming in from the government and the citizens of the United States of America.

2.4 History of Security and Privacy

The utilization of electronic information is a relatively recent development in the grand scheme of things. The security and privacy of this information is of the utmost importance, as skilled cyber criminals could potentially steal large amounts of sensitive information very quickly if it is under-protected. National standards for the treatment of this important information have only recently been introduced and refined. Their initial drafting and introduction were controversial matters, and their specific stipulations are sometimes hard to decipher. This section aims to highlight the most important aspects of the security which will be applied to information, as well as the privacy standards which will apply to the systems involved.

2.4.1 Privacy Rule

As demonstrated by previous sections, the information collected by healthcare providers is both extensive and unique for every patient. Depending on the area of patient care, different information is relevant. For instance, a primary care physician will be much more interested in their patient's social and mental wellbeing than a surgeon, so they will record different facts and observations about their patient. Throughout a visit with their healthcare professional, a patient is bound to come into contact with a number of specific information-gathering processes, where different specialists will record the information they need. The result is a menagerie of disjointed information, useful to the individual who recorded it, but not necessarily to anyone else. This information can be extremely private and potentially destructive to the personal life of the patient if it is misplaced or disclosed. For this reason, the privacy of this information is of the utmost importance, yet before 1996 there was not universal agreement on the treatment of said records. Depending on the state where the information is held or the organization that manages it, radically different guidelines could be applicable to the patient's records. This discrepancy in privacy standards was dealt with through a number of federal acts, though they were uncoordinated and often focused on a single aspect of privacy. This system was tolerated for far too long, especially as the advent and development of electronic technology radically changed the environment of information recording and processing. With this technological development, new dangers to the records of patients became apparent to Congress, such as hacking, identity theft, and fraud. In response, "universal requirements for how and when a person's health information is disclosed" were developed called the HIPAA Privacy Standard (Webmaster, HPO. "HIPAA - Background." HIPAA - Background. University of Chicago, 23 Oct. 2006. Web. 10 Apr. 2013.).

HIPAA, or Health Insurance Portability and Accountability, was first proposed by Congress in 1996 in response to security and confidentiality needs of patient information. The goal was a development of standards for each "Rule" or specific area of HIPAA (HIPAA Background, 2006). The Rules applied to four specific areas: transactions and code sets, identifiers, privacy, and security. Each Rule had its own compliance deadline; a specific assigned time by which the Rule was required to have well developed and defined standards.

The Privacy Rule specifically defines what is considered "protected health information" or PHI (HIPAA Background, 2006). After clearly stating what patient identifiers are considered PHI, the Privacy Rule outlines situations where use or disclosure of PHI is permitted with and without patient approval. Finally, guidelines for response to potential breaches in privacy of PHI, and civil penalties for disobeying the Privacy Rule are explained. The identifiers within Table 1 - Patient Health Identifiers (PHI), show insight into the various applicable sources of identifiers according to the Privacy Rule. The range and number of these identifiers had an impact on the development of the Arrow system, as we realized the complexity and gravity of the information we were dealing with. Identifying these key privacy factors early on allowed us to consider their organization and how they would fit in with the other information we intended to include with our system.

Table 1 - Patient Health Identifiers (PHI)

Patient Health Identifiers		
• Names	• Address (Including Zip Code)	• Medical Record Numbers
• Dates (birth, admission, discharge)	• Telephone numbers	• Account Numbers
• Fax Numbers	• E-mail Addresses	• Vehicle Identifiers and Serial Numbers
• Social Security Numbers	• Device Identifiers and Serial Numbers	• Web Universal Resource Locators
• Health Plan Beneficiary Numbers	• Internet Protocol (IP) Addresses	• Biometric Identifiers
• Certificate/License Numbers	• Full Face Photographic Images	• Other Unique Identifying Number

These key information points must be protected in "verbal and written communication, interactions with technology, and activities related to the privacy rules" (HIPAA Background, 2006). In order to use or disclose any of this sensitive information, the patient in question must provide written authorization in all cases but a select few. The special occasions when it is acceptable to use or disclose information without written authorization are very limited. The first case when authorization is not required is in treatment, defined as "the provision, coordination, and/or management of a patient's condition through diagnostic testing, referral for services in another specialty, and consultations between providers." Another acceptable case is for the purpose of payment; simply defined as "the activities of reimbursement for services, communication with insurers or others involved in the reimbursement process" (HIPAA Background, 2006). A third and broadly defined situation when authorization is not required is health care operations, or " all other areas including quality assurance activities, competency activities, residency and medical school programs, conducting audit programs for compliance, training programs for allied health, business planning and development." Aside from these three situations, workers compensation, law enforcement, victims of abuse, health oversight activities, and public health activities include other instances where information may be disclosed without patient authorization. The Privacy Rule also goes on to define psychotherapy notes, marketing, fund raising, and research information as topics which absolutely require specific authorization in order to be disclosed. The patient is guaranteed a few rights which are included under the "Notice of Privacy Practices" defining to their ability to:

- Access their own records and obtain copies
- Ask to amend or correct any inaccurate or incomplete PHI
- Request a restriction limiting access to or disclosure of PHI
- Request an accounting of how their PHI has been disclosed
- Receive written notice of how their PHI may be used or disclosed
- File a complaint if they believe their privacy has been violated

The February 2009 enactment of "HITECH - Health Information Technology for Economic and Clinical Health" established rules for the correct actions to be taken in response to a breach in privacy or security. A breach under HITECH regulations is defined as "the unauthorized acquisition, access, use or disclosure of PHI that compromises the security and privacy of the PHI" (HIPAA Background, 2006). Any individual whose information is inappropriately accessed must be notified within 60 days of the breach. In certain cases, many PHIs may be simultaneously breached, and if more than 500 individuals are involved in a single breach, media outlets and the U.S. Department of Health and Human Services are required to be notified. After the privacy rules have been clearly stated, the final entry addresses cases of civil penalties based on disobeying the rule. Levels of punishment are as follows (HIPAA Background, 2006):

Table 2- Electronic Records Violations

Violation	Each Violation	Multiple Violations in same year
Violations occurred without the knowledge of covered entity and by exercising reasonable diligence would not have known it violated the HIPAA Privacy Rule	$100- $50,000	$1,500,000
Violations due to reasonable cause	$1,000 to $50,000	$1,500,000
Violations due to willful neglect but are corrected within 30 days	$10,000 to $50,000	$1,500,000
Violations due to willful neglect and are not corrected	$50,000	$1,500,000

This figure illustrates how heavily penalized organizations can be if they fail to properly manage the private information which they are responsible for. Additionally, it gives an idea of the level of security that must be standard in a system which handles such sensitive information. These guidelines heavily influenced our decision making as a group to move away from a centralized system and database and instead pursue a modular solution.

2.4.2 Security Rule

A subset of the HIPAA Privacy Rule called the Security Rule was introduced as a means of defining safeguards for the ePHI previously described. These safeguards consist of administrative, physical, technical, and organizational standards which together ensure the confidentiality as well as security of electronic patient health information.

Within administrative standards, several measures are proposed for the requirements and standards necessary to assure that safeguards are established which will protect electronic records at nearly any conceivable level of administration. The first standard is the "security management process"; which encompasses all other basic elements of the rule by involving the “creation, administration, and oversight of policies to address the full range of security issues.” This essentially states that a systematic process must be followed in order to accurately establish policies for “prevention, detection, containment, and correction of security violations.” Under administrative procedures, an internal audit system was proposed in order to put responsibility with the entity who maintained records, citing need for records of system activity such as “logins, file accesses, and security incidents.” This initial standard is responsible for the formation of the other administrative standards, with a goal of forming a “foundation upon which an entity’s necessary security activities are built.” Even further, it is decreed that “all electronic protected health information must be protected at least to the degree provided by these standards” meaning that this process will systematically define the minimum acceptable standards for information protection ([68] FR [8336] ([2003-02-20]).

The second proposition is identified as the “assigned security responsibility” and it calls for a documented assignment of responsibility for security to a specific individual or organization ([68] FR [8335] ([2003-02-20]). The goal of this move is to ensure that there is an “organizational focus on the importance of security” when dealing with the sensitive information that may be present in a health record. Proper use of security measures that are in place for the protection of data as well as acceptable personnel conduct around sensitive data is defined as something all individuals within the organization are accountable for. Ensuring that all individuals treat sensitive information with the right level of respect is essential, but the final responsibility for the security of the organization’s protected information will fall to a single assigned individual who must be involved at the highest level of administrative decision making.

Workforce security is defined as the third administrative safeguard. This rule addresses the need for an overseer of maintenance personnel who has knowledge of the security policies and procedures, as well as keeping a record of authorizations for access to the system. This knowledgeable individual will be responsible for “establishing personnel clearance procedures” in order to guarantee a standard access procedure and rules surrounding said procedure ([68] FR [8337] ([2003-02-20]). Aside from these responsibilities, this workforce security officer will also have the task of certifying that any individual who has proper clearance to access the system also has the necessary training to properly operate the tools and options within the system. The workforce security clause also addresses the potential termination of employees or the stripping of user authorization. It does not specify reasons for termination of an employee’s access, as that is up to the discretion of the organization, but rather outlines the procedures that must be followed in the event of termination such as the revocation of passwords and limiting of access of the former user.

The next proposal to the administrative safeguards is referred to as information access management. This requirement addresses the need for documented policies regarding the different possible levels of access granted to those who would utilize the health information. Included in these documents should be a procedure for the granting and modifying of access to health records based on a set of potential user specifications. An organization will be required to define several levels of access based on user need as well as user qualifications. After these specifications have been defined, the implementation of safeguards and layers of security will be much more structured, and clearly defined for each class of user.

The need for security awareness is identified as another crucial administrative safeguard. This awareness is to be instilled in “all staff, including management” through a number of required training sessions. These sessions aim to inform all staff about key issues and concerns when private information is accessed as part of their company’s procedures. After training sessions, employees will be briefed on the importance of monitoring login success and failure, password maintenance, reporting discrepancies, and identifying and reporting malicious software. The amount and type of training is not specifically set by the standard, but instead defined as “dependent upon an entity’s configuration and security risks.” In response to complications involving employees who may only be temporarily active within the organization, a secondary training aid of “provisions of pamphlets or copies of security policies, and procedures” must be presented to the temporary employee ([68] FR [8338] ([2003-02-20]). This requirement is meant to impress upon any potential viewer of protected electronic health records the gravity of the potential for inappropriate disclosures or access. A well-informed body of employees is essential to prevention of such incidents, and the proactive protection of protected data.

The sixth administrative safeguard addresses procedures for security incidents; that they be “accurate and current” as well as outline “formal, documented report and response” measures ([68] FR [8340] ([2003-02-20]). While this is a broad statement; this standard points out the importance of prompt incident reporting in an environment where information flows so easily. It is recommended that any entity which utilizes sensitive information set forth parameters for the required information in documenting an incident, as well as response requirements based on the severity of the infraction as well as the type of information involved. Reporting of security incidents is meant to be an internal measure within a company, and there is no statement within this standard that defines when external reporting is required. That consideration cannot be applied broadly and instead depends on legal specifications of information as well as the business environment in which said information is utilized.

In the event of unexpected emergency situations which may increase the security risk of protected health information, a contingency plan is proposed with implementation specifications. This plan addresses several important factors that must be prepared in the event of a security issue, as there would be little warning and the company must not be caught off guard. To begin to craft this contingency plan, a criticality analysis must be performed. This entails an examination of critical factors and product features with respect to which internal function these factors relate to. Once internal roles have been identified, a data backup plan is the next most essential safeguard. The data backup serves as a remote point where data may be stored and avoid a potential memory wipe of the system. Other vital planning factors are "a disaster recovery plan, an emergency mode operation plan, and testing and revision procedures". These events must be planned for, as their occurrence may leave data exposed. If the event is not planned for, the "security measures may be disabled, ignored, or not observed" and that is exactly what the utilization of a contingency plan aims to avoid ([68] FR [8351] ([2003-02-20]).

The final administrative safeguard is an evaluation to be performed by an external entity that will ensure that all aforementioned safeguards are indeed up to standards. This evaluation method may differ depending on the business or type of data utilized by the company, or by the size of the company. Accreditation from an outside entity may be too costly for a small firm, so a periodic evaluation must be performed any time that their "security environment" changes based on "newly recognized risks to their information" ([68] FR [8351] ([2003-02-20]). The goal of this safeguard is to assure updating and continuous development of administrative functions. If the specifications are allowed to stagnate, the entity may have extreme difficulty in preventing the ever-evolving security threats to protected information.

Even with extensive and well maintained administrative safeguards, another class of required precautions include physical safeguards, defined as "security measures to protect a covered entity's electronic information systems and related buildings and equipment, from natural and environmental hazards, and unauthorized intrusion." The first regulation aims to regulate the "facility access controls" as a method of information protection. Within this subcategory of access controls, implementation specifications have been defined for the primary measures to be taken. These specifications identify the need for system implementation regarding "contingency operations, facility security plan, access control and validation procedures" [68] FR [8353] ([2003-02-20]). Together, these precautions aim to control access to the information system located at "an entity's business location". A pre-approved and practiced contingency plan was named as an administrative safeguard in the earlier sections, but this procedure would specifically address facility access and focus on the steps to be taken in the event of attempted unauthorized access. The facility security plan requirement entails an analysis of the ease of access to different parts of the facility, as well as areas where access is only available to authorized personnel. The close control of system access is essential to assure that only specific individuals have the opportunity to interact with devices which have a connection to the information system. Aside from limiting access to secure rooms, workstation use procedures must be strictly enforced to "maximize the security of health information" [68] FR [8354] ([2003-02-20]). Certain functions must be performed by every system user, such as logging off at the end of a session and preventing the workstation from being left unattended. The overall security applied to any workstation is dependent upon the specific company's risk management processes and level of risk associated with their industry.

The final and most vital physical safeguard proposed are "formal, documented policies and procedures that govern the receipt and removal of hardware and or software into and out of a facility" [68] FR [8354] ([2003-02-20]). This requirement is meant to control both the individuals who have access to the system, as well as what devices they are able to utilize the system with. It is a precaution against the illegal removal of data from the facility on any medium such as hard drive or portable flash drive. This rule includes several implementation features, including accountability, access control, data storage, and disposal. Users of the system will be educated before they are allowed access in order to ensure they understand that their logging in and out as well as their activity on the system will be tracked and recorded. Similarly, if they bring in or remove any hardware or software from the facility in which their system is housed, it will be recorded and noted in the case of future dispute. Knowing that any illegitimate activity which occurs will be monitored and traced back to their login information, system users will be especially careful to protect their credentials and properly operate the system. The punishment for removal of data from the system will be similarly outlined and users will all be responsible for their actions.

Technical security is arguably the most important of the safeguards protecting valuable and private information. The opportunity to defraud data is greatest in this environment, as individuals may attempt to secretly collect and export information from the system. The primary technical guard is the requirement of access controls featuring "emergency access procedures and provisions for context-based, role-based, and/or user based access" [68] FR [8355] ([2003-02-20]). The access controls will necessitate unique user identification in order to limit system access to individuals who possess the proper username and password. Aside from user identification, a higher layer of security would warrant unique entity identification, assuring that the user information is associated with the correct entity and the proper system is accessed. Other important access control implementation includes an automatic logoff function that will log the user out of the system in the event of an extensive idle time. These controls taken in aggregate will protect the system from access by users without authorization. Once access has been limited and regulated, audit controls will be implemented to “record and examine system activity” and keep record of what individual entities define as their own standard. The stringency of audit may be defined differently depending on the business of the entity, but a minimum level of security is defined and must be met by all as required by Federal law. In order to confirm that the data in possession of each entity has not been altered in any way, an integrity requirement regulation has been instituted. As the authentication of a vast amount of data may place an unfair burden on larger entities, different mechanisms and processes may be utilized as long as they meet the appropriate level of analysis of system data.

The final technical safeguard addresses communication and network controls which concern the transmission of secure data from the system. These security mechanisms are meant to keep private information private as it is transmitted over a communication network. The implementation of this safeguard is particularly entity-dependent, as different companies already use some form of encryption for their data transmission. Along with encryption, integrity controls are to be implemented in order to assure continuity of information sent by one entity to another. These measures may be prohibitively expensive for rural organizations or for entities which transmit large amounts of data at a high frequency. For this reason, the actual implementation of integrity and encryption controls is required “in a manner commensurate with the associated risk” [68] FR [8356] ([2003-02-20]).

While the specific implementation procedures of many of these safeguards are loosely defined and left to the interpretation of the entity, their overall application and development is essential to the protection of health information. Without the constant upkeep of administrative, physical, and technical safeguards, the potential for misuse of private information is too high to make electronic records feasible.

Since the introduction of these standards, records have been kept of the data breaches that have occurred, not only within the healthcare and medical provider sector, but several other organization types that deal with sensitive and private information. The following graphs compare the chronology of data breaches in US of the healthcare industry with the financial and insurance field.

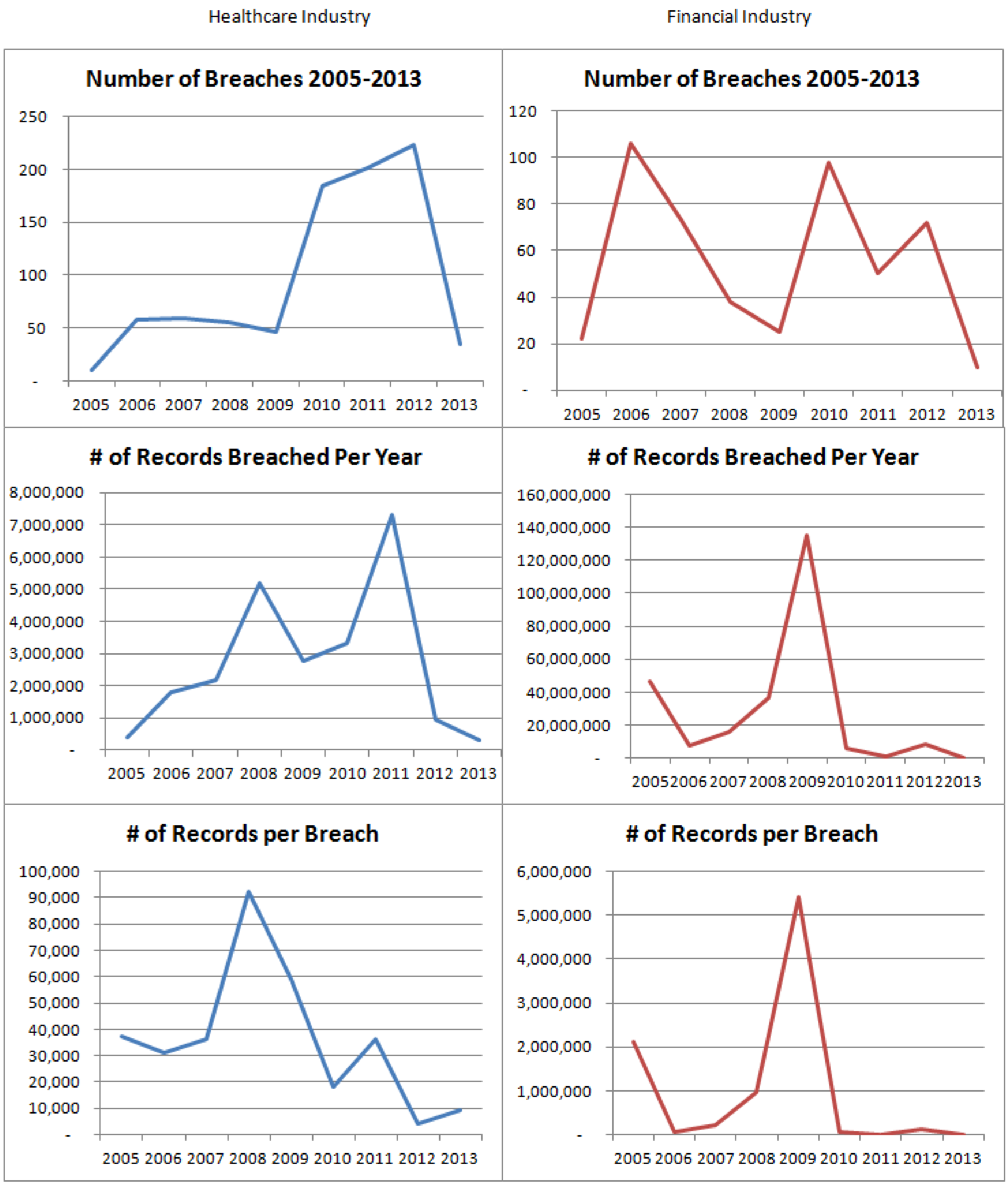

Figure 11 - Record Breaching Charts

The data in blue represents the Healthcare industry, while the data in red represents the financial and insurance industry. Both graphs use data collected from the U.S. over the past 8 years. These illustrations represent the number of individual breaches in security by year, indicating that in the past 4 years, there has been an increase in the number of successful attacks on the healthcare industry as electronic information gradually becomes more widespread.

Chapter 3: The World of Healthcare with Arrow and the NHII

Prospective benefits of Arrow coupled with the NHII extend far beyond monetary concerns. While in an ideal world, these factors are the driving force behind change. In the world we live in, monetary concerns are the primary motivations. No matter the potential for improvement of a system or satisfaction of the users of said system, change will not occur unless the financial incentive is strong enough. Figure 12 - Net Potential Savings during 15 year Adoption Period signifies a projection for the savings that could be realized by switching to an electronic medical record system. This gradual adoption period is very realistic, allowing fifteen years for careful implementation of new features and vital tools provided by Arrow.

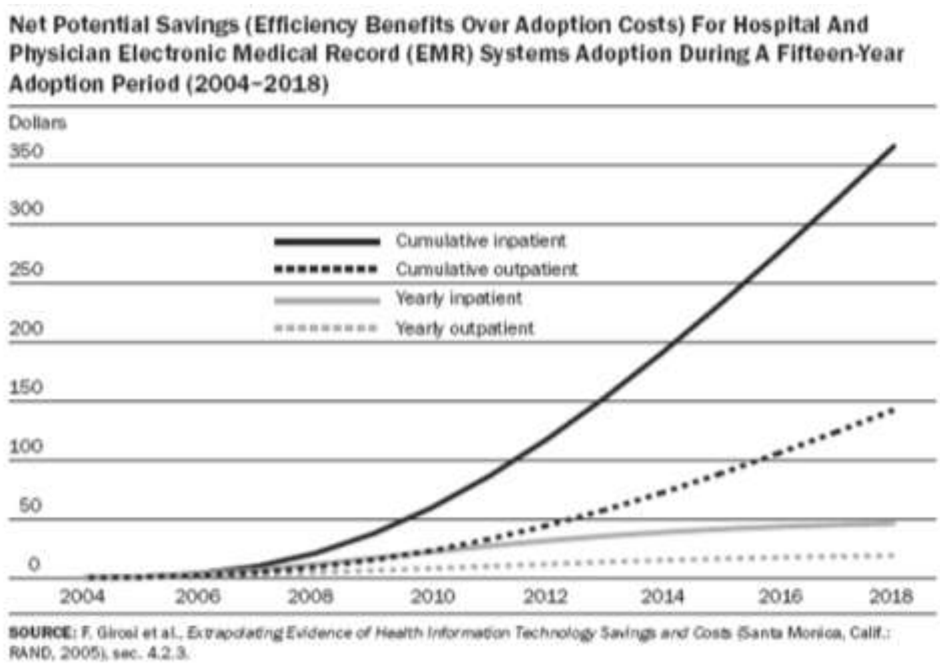

Figure 12 - Net Potential Savings during 15 year Adoption Period

As shown in the graph, fifteen years after the successful adoption of an electronic system would result in inpatient costs of almost $50 less per patient. This statistic alone has the potential to provide enough financial incentive to make administrators interested in Arrow and the NHII. In the following sections, the idea and plan of implementation of the proof of concept software, Arrow, will be explained. Additionally, this will include information about social implications of the NHII system as a result of Arrow, the changes necessary to begin an NHII, and the privacy concerns regarding this system. An entire software specification for Arrow will be included in this chapter. Through these specifications, one will be able to completely understand Arrow's purpose and how it will accomplish various tasks.

A common inconvenience experienced at healthcare facilities is the amount of repetitive forms that must be completed prior to treatment. These forms are very similar at each healthcare facility. At a general care physician's office, these forms will typically cover basic information such as patient contact data and emergency contact information. Next, these forms generally require the completion of a health questionnaire that asks a variety of questions such as current medications and allergies. Upon completion of this document, a patient waits on average 21.3 minutes until they are seen by a clinician (Webster, 2011). At this point, a nurse will take the patient's vital signs and will typically ask additional health related questions. After this is completed, the patient will generally wait an additional amount of time before being seen by the physician. When the patient finally gets to see the doctor, significant time has passed. Why does this process take so long and repeat itself at every health care facility? What can be done to fix this problem? The following sections will address these questions.

3.1 Patient Impact

With the implementation of the NHII, many changes will occur in the entirety of the healthcare industry. The most noticeable change for the patient will occur at the doctor's office. With the implementation of the NHII, patients can begin to expect drastic improvements in efficiency to take place at their local health care facilities. To begin, patients will experience a decreased wait time at the doctor's office. Additionally, patients will not have to complete the mandatory forms administered at most health care facilities upon arrival. The impacts of these simple changes are far reaching. Instead of spending time and money on the completion and organization of paperwork, these resources can be redirected at providing better quality care for the patient. The benefits of the creation and implementation of a National Health Information Infrastructure are extremely widespread and capable of creating unprecedented change in an industry that is in need of a revolution.

An important factor to understand about the NHII is that an individual's health profile will constantly be growing with every health visit that they have throughout their life. From the time that a person is born, to the present day, their health information will be compiled and can be viewed by medical professionals based on the patient's preference and healthcare needs. Because of the significant change in the way health information is compiled on an individual's basis, the day-to-day procedures of health care facilities, as well as patients, will drastically change (Goldschmidt, 2005).

Today, patients are almost always asked to fill out some sort of health questionnaire when they arrive for an appointment of any type. This questionnaire, consisting of low value information for the clinicians, is filled out and given back to the secretary. What is done with this information is a mystery to the average patient. Whether this information is simply "busy work" to make the patient's wait time seem shorter, part of liability procedures for their insurance coverage, or a combination of the two, this use of time and resources is unnecessary (Webster, 2011).

The patient of the National Health Information Infrastructure era has an entirely different experience. When this patient arrives at a health care facility, they are not given any medical history or insurance forms to complete. In fact, they are not asked to do any "busy work". Ideally, there would be no time for them to complete this paperwork because within minutes the doctor is ready to see them. The NHII will be responsible for this decrease in wait time. There will be less patient volume at each health care facility. This will occur for two main reasons. To begin, there will be less traffic at the doctor's office due to the increased effectiveness of diagnosis's and treatments administered. Secondly, less patient volume will be perceived because of the redirection of monetary resources at the health care facility (Information for Health: A Strategy for Building the National Health Information Infrastructure, 2001).

Increased effectiveness of diagnoses will take place within the NHII healthcare system due to the increased availability of individual's health information. Because of the NHII, an individual's pertinent health information will be easily accessible by certified clinicians. Currently, doctors either have the information that they can gather from the patient in front of them, or go through the hassle of requesting to have other health information sent to their office. This process alone usually requires an additional appointment since the receiving of requested information is typically not immediate. Within the NHII system, information will be able to be accessed immediately if the patient allows their specific information to be obtained by the clinician. Alternatively to returning for an additional visit, a quicker diagnosis can be made with the information received through the NHII system. This benefit will result in fewer patients requiring multiple visits to the doctor, saving time and money for the patient and healthcare provider. Additionally, by having the ability to view previous health problems that this patient has experienced, doctors will be able to examine exactly how various treatments and medications have affected this patient in the past. This type of insight into the complete medical history of an individual is invaluable in the healthcare field. Overall, diagnoses will be more effective and regulated due to the NHII (Information for Health: A Strategy for Building the National Health Information Infrastructure, 2001).

There are many social impacts regarding the implementation of the NHII. First, with the ability of a doctor to make more immediate diagnoses, people will be receiving the care that they need quicker. If this occurs for such medical issues such as infectious diseases that are easily spread, the infected rate of the population will have the potential to be drastically decreased. For example, a patient arrives at their health care facility complaining of a variety of symptoms that have grown from a previous visit at another health care facility. In the current healthcare system, a doctor would likely examine the patient's current symptoms, prescribe medication, and schedule a follow up appointment. However, in the NHII system of the future, the doctor would have many more options. The clinician could enter in the symptoms into the NHII database in order to see if this current combination of symptoms was currently trending across a specified area. Additionally, the clinician could pull up the information from the patient's last visit at a separate health care facility to check for changes in symptoms, deteriorating conditions, or anything else that could be gained from this information. The doctor could view current treatment information for this specific illness as well as the success rate of that treatment. The possibilities are endless for the health care industry when information is readily available.

Due to the NHII's elimination of paperwork and the managing of such, health care facilities will have previously needed resources available for various expenditures. Instead of having multiple employees that are simply assigned the tasks involved with maintaining paper records, the resources could be put towards another doctor, or simply eliminated in order to create more profit for the health care facility. Additionally, nurses will be able to do more effective work within the NHII system. While the nurse's job would not change, it would become much more important within the health care industry.

The nurse of today and the nurse of the NHII system is the same person with the same set of skills. However, the nurse of the NHII era will be able to do so much more with the same set of information simply because of the nature of the NHII system. For example, nurses generally will bring patients into the individual room where the patient will wait for the doctor to see them. When first arriving though, the nurse will take care of the so called "busy work" in order to make the doctor's task as efficient as possible. During this time, the nurse will usually ask some simple questions to the patient and record the vital signs. One important aspect of health that is recorded at every health care facility is blood pressure. This important health indicator can notify the physician of a variety of health issues. One current issue with testing blood pressure however, is the fact that most health care facilities where one has their blood pressure taken, the nurse does not have another blood pressure result to test the current reading against. While blood pressure is a number that is not individual to a single person, there are often times where patients will have a higher than normal reading. In today's health care field, the physician usually will just ask the patient if they have a history of high blood pressure. In the NHII system though, instead of inquiring from the patient, the nurse can simply add a new blood pressure reading on the current date into the patient's health file. If requested, the nurse could then pull the patient's blood pressure readings throughout a requested period of time. This information could then be displayed in a table, graph, or chart with a multitude of variables displayed as well. (The options for this type of user interface within the NHII software have the potential to be expansive, but are dependent on what the team of designers has in mind and what the current technology can allow) (Anonymous, 2006).

The world of referrals and prescriptions would also be drastically changed due to the NHII. Many times when one goes to a doctor, they are instructed that they will need to go somewhere else to receive a different service. This could be to get a prescription medication, a second opinion, to see a specialist, or to receive a different service. Regardless of the reasoning, this type of situation occurs very regularly. In today's health care system, a person will generally simple receive a prescription slip, a referral note, or some other form of paper information regarding the need for a patient to visit another doctor. This sheet of paper is a very non-immediate way of administering patient care. During the time that the patient leaves the original doctor's office, many different things can happen. They can simple forget to go to a referral doctor or get a prescription filled or simply think that they don't really need to do this. Additionally, the hassle of pursuing either of these options is generally very time inclusive. A more immediate call to action will be more helpful for the patient and take the options out of their hands.

By making the decision of whether or not to listen to a doctor's orders about getting an appointment with a specialist or filling a prescription for the patient, the health care facility is able to put the patient's needs at the forefront of their attention. Within the NHII system, prescriptions would be electronically sent to the most convenient pharmacy for that patient. Instead of having to walk into the pharmacy, request for their prescription to be filled, and then wait for the pharmacist to fill the prescription, they could simply have the prescription ready for pick up by the time that the patient got there. Additionally, by using electronic communication, a doctor could potentially set up a referral appointment at specialist's health facility. By taking the decision out of the patient's hands, receiving health care would seem much less like a burden. This would allow for a healthier society that spends less time within health care facilities.

Within health care facilities, particularly emergency rooms at hospitals, health care clinicians are generally under an extreme amount of stress. Due to the nature of their job, this high stress atmosphere is unlikely to change. Generally, with large changes to a specific field, everybody associated in that field is required to experience some sort of change. However, with the adaptation of Arrow, the clinicians will not experience any negative change, particularly regarding the forms that they fill out on a regular basis. While the forms will be entered electronically into the NHII system (through the Arrow interface), the forms will remain the same as they were before. By allowing for no change in the current forms that a doctor uses, change over costs for the clinicians will be nonexistent in this aspect. Additionally, with the increase in past health information that a clinician is exposed to, diagnoses and treatment decisions will be less based upon thought and more based upon fact (Information for Health: A Strategy for Building the National Health Information Infrastructure, 2001).

Through a health care system that allows for the use of all past patient health information, clinicians will be better suited to handle the needs of all of their patients. This will allow for a decrease in stress for doctors as health care decisions will be more based off of what statistically has worked in the past for patients with similar health conditions. The more information a doctor has access to, the better diagnosis/health care decisions they will be able to make. Additionally, the NHII conversion will allow for faster diagnoses as well. By having all health information available, a specific health care algorithm could be constructed that would recommend a health solution to the specific problem. Similar to the way that the online site WebMD® works, doctors will be able to input a patient's current health symptoms along with general health information, and a diagnosis will be output. While this type of system would not be available for quite some time, it offers an insight into the endless possibilities of the health care field with regards to available technology.

3.2 Initial Conversion to NHII Changes

Along with any effective system that provides change, a conversion to the NHII system will have to take place. However, with the use of Arrow, the conversion costs for health care facilities will be minimized by the use of its form conversion software. The conversion of forms would have been the most necessary change for health care facilities. By eliminating the need for this to occur, health care facilities will only have to deal with the minimal changes remaining such as registering forms within Arrow and adding an Arrow server to their facilities. For the patient, negative changes will be minimal and most likely will go unnoticed to the average person. The positive changes however will be completely noticed and will result in a revolution within the healthcare industry.

3.2.1 Changes within Healthcare Facilities

Along with the input of all forms into the Arrow software, a few minimal changes will have to take place in order for Arrow to exist effectively and create the change that it is capable of. One critical aspect of this would be the need of the instillation of a new Arrow server within each health care facility. This will allow for the connection to the Arrow home server which will allow for the use of all pertinent health forms. Without this server, connecting to the Arrow home server would be possible, but it would not be secure enough of a connection to handle this type of information. Additionally, the use of Arrow will cause a very large increase in the amount of Internet traffic through the health care facility. An extra server would be necessary to handle this increase regardless of the Arrow implementation.

Another conversion that would have to take place within the individual health care facility would be the change to electronic forms of information management. While this is not technically mandatory, it would defeat part of the purpose of the NHII system if there were employees required to convert paper forms into electronic entries. The most logical solution to this problem would be to allow the patients to modify their own electronic records. It is important to note that all aspects of a person's health situation will be monitored within the NHII system. This includes, but is not limited to, emergency treatments, allergies, current prescriptions, insurance information/billing, and dental and specialist work (Stead, Kelly, & Kolodner, 2005).

The majority of health information will be monitored within the NHII system. Every time that a patient sees a health care clinician, their health profile within Arrow will be updated accordingly. Because of this unique feature of the health care industry, the collection of information pertaining to a specific patient will be almost entirely regulated by their health status. However, having the infrastructure available for patients to update their health information manually is also an important feature. It is assumed that the best place for this update of health information would occur within the health care facility, possibly while the patient is waiting to see the doctor. While in the past, patients were asked to fill out "low value" information, this information will be directly related to their current health complication. This information could vary from one health care facility to another, but its purpose would be the same; inquire into the exact reason why a patient is currently at the particular health care facility. Information requested would include current symptoms, additional medications taken beyond known prescriptions, and timeline of recent changes in health since the last doctor's visit. The information requested would be limited to information that would immediately impact the current doctor's visit. An important feature of the implementation of the NHII system is to prove to the public (patients) that the request of somewhat useless health information has been eliminated (Ammenwertha, Gräberb, & Herrmannc, Evaluation of health information systems—problems and challenges, 2003). In comparison, the newly requested information will be immediate and brief.

The means through which to collect this information will be managed by the individual health care facility. The options will be limited though. As previously mentioned, this means will have to be electronic in order to eliminate inefficiencies. A tablet system would most likely be the best method of information acquisition. This would allow the patient to fill out their information while comfortably waiting for the doctor to see them. Additionally, a tablet with a simple user interface would require little to no instructions on how to use this technology. Another option would be to make a "Check-In Station" at a health care facility. This would essentially be a freestanding computer that a patient interacts with in order to update immediate health information as well as notifying the facility that one has arrived and is ready to be treated. This type of system could potentially eliminate the need for receptionists at health care facilities. If nothing else, the amount of receptionists needed could drastically decrease (Lippeveld, Sauerborn, & Bodart, 2000).

For individual patients, the transition from our current health information system to the NHII system would be mostly unnoticed. Initially within the NHII system, patients may still be requested to complete various forms. This would occur until one has input the information requested at least once. At this point, the information would be in the NHII system and would not require the patient to fill out duplicate information requests. As a patient continues to receive various health treatments, their profile within Arrow would continue to grow and the frequency for which they are requested to complete information forms will dramatically decrease. Once the NHII has been implemented, it will have the most impact on patients that have not even been born yet.

The use of the NHII for newborns will be the most effective use of the NHII system. Assuming that the newborn's parent's information is within the Arrow database, the birth of a child will immediately populate information for that new patient through its parent's information. Such information which would be transitioned to offspring would include family relations. Additionally, instead of a patient having to fill out a form stating family health history, the NHII system would operate with a family tree instead. By understanding relationships within an individual family, it can automatically populate the health warnings of an individual based off of family health history populated from that family member's individual health information. By allowing for the connectivity of various health forms within a family, the NHII system along with the Arrow software will be a comprehensive health profile that expands beyond the health information of a single person. All aspects of health information that impacts an individual will be recorded and maintained through this intricate system that is guaranteed to change the way that one receives and records health information. With the birth of this newborn, the recorded health information of this individual will be comprehensively updated throughout all health related events of this individual's life. This massive collaboration of health information captured throughout the life of a patient would be extremely valuable towards medical research which will be discussed later in this report.

Another immediate change of the Arrow software and NHII system is the experience associated with prescriptions. The most important of these changes for the patient will occur during the selection of a prescription medication that best suits the individual. For example, a patient has a certain health problem that will be fixed through the use of a prescription. The doctor inquires if the patient is on any other medications currently. The patient explains to the doctor that they are on other medications to treat various health issues, but due to a recent change in prescriptions, they are not exactly sure of what new medication they are currently using. The doctor then is forced to choose a medication that she hopes will interfere with the patient's other medications the least. This current system is a crap shoot that involves educated guessing and hoping that medication complications do not occur. Within the NHII system, prescriptions would be handled completely differently (Ludwicka & Doucettea, 2009).

Through the Arrow interface, a doctor can quickly see exactly what medications a patient is currently on. Additionally, allergy information is displayed as well as insurance information. Instead of having to guess on which medication to give the patient, a doctor is simply able to select a medication within the patient's health profile. If a warning is issued upon selection of a medication, it will be apparent that this medication would not be appropriate because of allergy implications, other medication complications, or an inappropriate medication choice for treating the current health issue.

Another possible solution towards the change required for the NHII system to exist within any given health care facility is to implement the use of "Check-In Stations". These could simply be a computer which is protected from the view of others which a patient will go to when they arrive at the doctor's office. At this computer, they will be able to enter in any requested information pertaining to the reason why they are visiting the health facility on that day. Additionally, they will be given a wait time which is assigned using the health facility's scheduling software. The possibilities are practically endless with the NHII system as a result of Arrow.

3.2.2 Changes for Patients

One of the goals of the NHII system is to have no negative changes towards the healthcare of individual patients. In fact, there would be no need for changes in healthcare protocol towards patients. As stated previously, the change in the healthcare system is entirely based on the creation of an efficient program which is created to facilitate better patient healthcare with no negative impacts towards the patient. The reasoning for this is simple; the patients are the constant in this social experiment. Regardless of how healthcare is managed or facilitated, there will always be patients and they will always have health issues. The variable in this situation is how the health care facilities interact and deal with these patients. Because of this simple understanding of the healthcare system, it is clear that the patients are the “control” in this experiment. However, the patients will experience many benefits because of the change of the other variables present.

Below, Figure 13 - A Typical Patient Flow, is a flowchart that demonstrates the typical process by which a patient is processed when visiting a medical facility to receive care (Glenwood, 2007). These processes are often slow and can be very tedious for both medical personnel and patients. The goal of the Arrow software is to streamline many of these processes, thereby increasing efficiency and improving the overall quality of patient care. While the overall structure of this flowchart would not change with the addition of an NHII, the individual nodes in the chart will carry less weight in both time and resources, and in some cases, be eliminated all together.

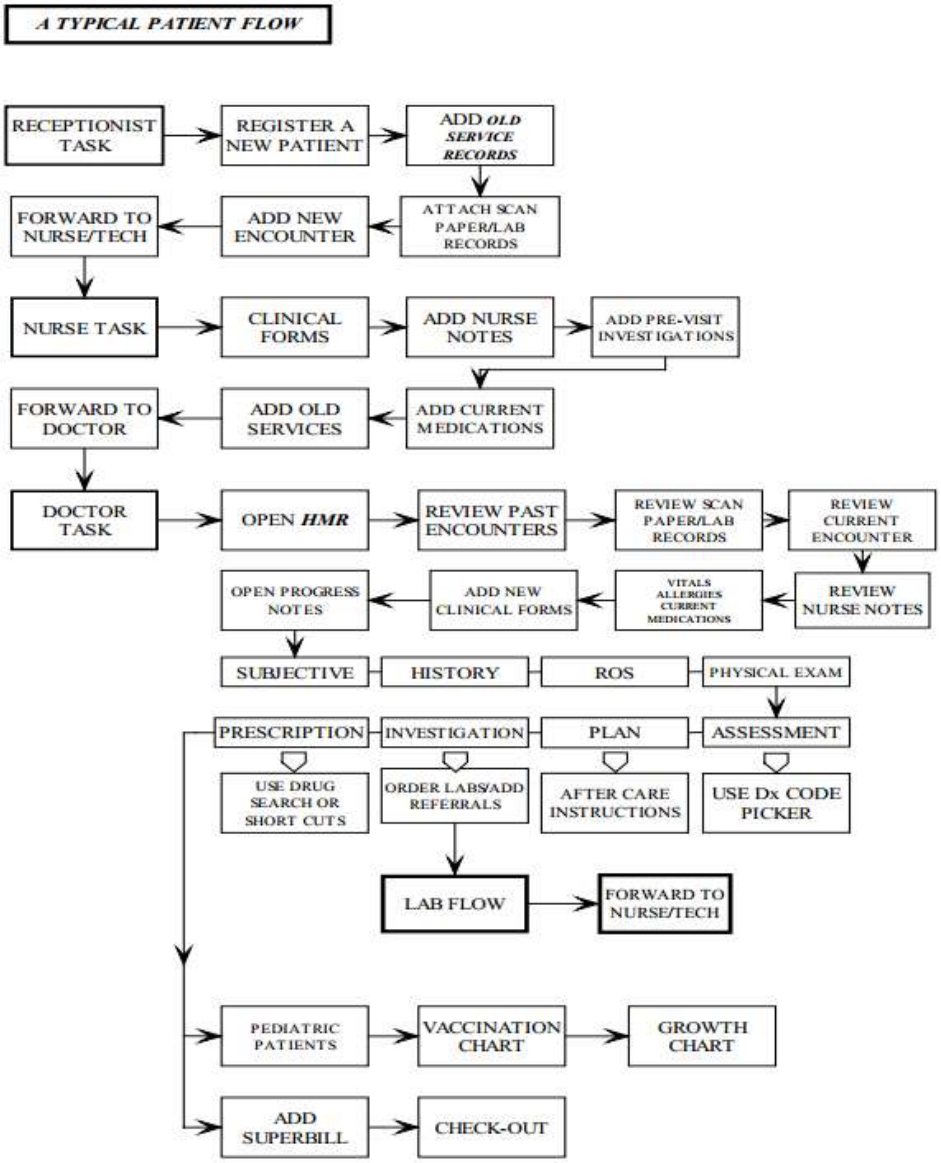

Figure 13 - A Typical Patient Flow

During the initial conversion to the Arrow system within the NHII, the patient experience will not be negatively affected. One change that could possibly be present would be the "Check-In Stations" mentioned previously. This slight change in how the patient enters information would assumedly be minimal and to no distress of the patient. Additionally, patients would continue to fill out the same forms that they did in the past. This will allow the Arrow software to fill the empty fields of patient information that the NHII system is requesting. However, a patient will never have to fill out any forms with repeating information. Once a field is complete, it will not have to change unless a patient notices a discrepancy such as a change in address or another small detail. However, with insurance company's interaction into this system, even these small details will be managed without the patient's interaction.

Another feature of the Arrow system which is important to note is the option for patients to fill out and view health information from home. While this feature would require only the strongest in Internet security, its applicability is possible. This would allow a patient to be able to track their own health status. This could result in a variety of possibilities. First, it could make patients more health conscious by allowing them to view their health results whenever they preferred. Next, it could allow them to be more in touch with their health issues as well as provide them with more information regarding their various health topics. Finally, a user could avoid the initial transition to the NHII system by simply logging onto their health portal and filling out all of the requested information. This would allow for faster patient treatments at the health care facilities. However, filling out health information from home will not be mandatory. In fact, it will be completely up to the individual to decide if they would like to use this feature. This is just another way that Arrow and the NHII will fight to not be a burden towards the patient.

As previously mentioned, the world of prescription medication will be changed forever due to the NHII system and Arrow. Patients in need of prescriptions will have fewer complications and less waiting times at pharmacies due to Arrow. Since the doctor will be able to match their medication with all other medications that they are taking, conflicts between various medications will practically be eliminated. Additionally, prescription fill requests can be immediately sent to the patient's pharmacy of choice so that it is ready for pickup the moment that they arrive. Finally, pharmacies will already be in contact with the insurance company so that payments and insurance deductions are immediately handled without a hassle from the insurance company or time wasted at the pharmacy.

The ability to eliminate complicating medications is an extremely important aspect of the Arrow software. While not extremely common, complicating medications do account for stress in patients that while recovering do not need additional stress in their life. By utilizing past patient information as well as large scale research studies in making decisions for an individual's proper prescription will allow the doctor's decisions to be insured. Eventually, many discrepancies involved with prescriptions will be completely eliminated.

One of the most important facets of the NHII, as mentioned previously, is the ability for doctors to make much more informed decisions regarding diagnoses. This is an extremely important benefit for the patient of the NHII era. Because of this system, the guesswork related towards exactly pinpointing the reason for a patient's specific symptoms with limited information will be broadened significantly. To further explain, the common day doctor's ability to perform a correct diagnosis on a patient with symptoms common to many different illnesses can be extremely difficult.

Often times, the chore of correctly diagnosing a patient could turn into a guess and check method with the prescriptions that were given to the patient. Instead of this taking place, doctors of the future will have all of the information that the current doctors have. However, the benefits start to take place due to the extra information that they have access to. For example, a doctor may see a patient that has symptoms which are extremely common to a multitude of different illnesses, all with different recommended treatments. Instead of attempting to guess which one the patient has, the doctor can utilize additional information to make a much more informed decision. The most important tool in this scenario would be the ability to track health trends in real time. As doctors across the entire Nation are constantly updating their patient's health profiles, this will be able to populate an entire data map of all of the different trends in the United States. More specifically, doctors could limit this information that they are seeing to the local area; possibly using anonymous health statistics from the school that the patient attends or the office where the patient works to see if these symptoms were trending within this same space. This would provide the doctor with an ability to properly diagnose their patient the first time. In today's healthcare system, doctors are constantly "reinventing the wheel" in the medical sense. To explain, doctors are constantly performing identical diagnoses on different patients that are experiencing the exact same symptoms. Instead of having to go through the entire step process of understanding whether or not a patient has a certain illness, doctors can simply understand that, for example, a patient has the exact symptoms that another patient had and they have been within the same building as each other for a period of time. This would immediately allow the doctor to make the same diagnosis on the second patient and every other patient that comes in with the same problem that these patients had. Because of this, doctors' appointments will be sped up, doctors will be able to see more patients in a day, more people are treated and less money is spent treating similar patients for similar problems. A simple change within the healthcare system has a long range of resulting affects which in this case are positive.

The social changes of the NHII system as a result of Arrow are far reaching and extremely beneficial to the entire healthcare industry. Because of Arrow, a wide array of changes will take place from prescription accuracy and tracking to increase diagnosis effectiveness. Additionally, the change over costs will be limited, in wide use by Arrow and its ability to populate and translate information in order to fill fields on any form that any health care facility uses. The healthcare world with the NHII will be a different world than we are accustomed to. However, it will be a world for the better due to the exponential changes to the entire healthcare industry.

3.3 Constraints

The Arrow concept must overcome many barriers to entry in order to realize full implementation. Factors such as administrator acceptance, consumer confidence, and system overhaul are all daunting challenges in the face of Arrow's realization. Many challenged will need to be overcome if the healthcare system is to appreciate the full benefits offered by the Arrow system. This section aims to illuminate some of the anticipated obstacles in the way of Arrow implementation. The current industry is replete with resistance to change and modernization, particularly with respect to the following issues.

3.3.1 Constraints from Healthcare Industry

The Healthcare industry offers unique challenges. It is very complex, involving a range of administrations designed to promote patient health care. Each administration of health care has unique personnel and practices to deliver health care as effectively as possible. This landscape of diverse opinions about the best delivery of healthcare is a struggle in itself; When designing software that is, at its basic function, improving communication, it would be easier to implement if people felt the same way about how to best operate that communication.

Hospitals are a major percentage of the Healthcare industry that Arrow would assist with information sharing. Differences between hospitals make this task difficult. Many hospitals in the United States are very technologically advanced and do most of their interactions with other administrations of healthcare securely over the Internet. Many other hospitals rely on a slower technology, the fax machine. In hospitals that don't communicate over the Internet, a form, chart, or other information first has to be requested from the other administration, the other party must then manually find the right information, consequently scan and fax the information to the hospital, and only then can the people at the hospital use the information to whatever end use it was originally needed for. This process is slow, and takes time away from the treating of actual patients. Arrow would facilitate the exchange and even deliver the information to the administration of healthcare in the format that that administration is used to working with.

Some administrations of healthcare may not want to use Arrow right away, because of the change in their process that it would require. The viewpoint of these hospitals is that this new, unproven software would just take time and effort to learn, and may ignore the opportunity based on this fact. This is a huge barrier that only the use of and exposure to the product can help with. The way that HIMA has approached this constraint is that this is the very issue we seek to solve. By taking the time to learn Arrow now, it will save time and become extremely convenient after that initial learning period. The ideal situation would be to have an administration partner with HIMA because they understand the benefits that are to be obtained. Having this partner to test the use of Arrow would be extremely beneficial to HIMA in that we could observe how professionals within the industry actually use it, learn what is intuitive to use and 'right' with the software, and correct any issues in the software to make the end user's experience better in any way that they suggest. Feedback from the industry would be a critical piece to driving the success of Arrow.

One interesting aspect of research that could help prevent running into certain constraints was into current products that are similar to the HIMA's proposed software. By looking at electronic health record (EHR), also known as electronic medical record (EMR), systems that are currently on the market, our project group can hope to avoid some of the issues that others have run into. One leader in the industry of electronic recordkeeping is EpicCare.

> *"The award-winning EpicCare EMR is known for being fast and physician-friendly. Integrated access and revenue systems simplify administration. The "one patient, one record" approach improves care in the Physician Group, Hospital, and Both. Millions of patients access their records via MyChart – literally the same chart used by their doctors. Patients can schedule appointments, get test results and print growth charts. Epic's freestanding personal health record, Lucy, completes the circle, with an interoperable health diary that can plug into MyChart – or disconnect from it and inform care wherever the patient receives it". Epic has won many awards and has earned many certifications over its lifespan. One feature that is a highlight is the ease of integration between EpicCare systems. The constraint that accompanies this is that "Epic's EMR has not been designed to facilitate sharing across other EHR platforms, which may impact the federal government's push for increased interoperability"* (HealthRecord, Epic EMR Overview, 2013).

Epic has won many awards and has earned many certifications over its lifespan. One feature that is a highlight is the ease of integration between other EpicCare systems. The constraint that accompanies this is that "Epic's EMR has not been designed to facilitate sharing across other EHR platforms, which may impact the federal government's push for increased interoperability" (HealthRecord, Meaningful Use, 2013). This interoperability would be hard to coordinate, but with EHR and EMR systems becoming more commonplace, perhaps there will soon be a government imposed standard that would make sharing data between systems a necessary function.

3.3.2 Technological Constraints

Technological constraints cover all of the challenges presented by the technology used in and associated with Arrow. These constraints have less to do with changing processes, and more to do with realistic issues that HIMA has encountered and is prepared to deal with in the future. The first constraint associated with technology, would be the time frame that HIMA has to make the necessary innovations happen.

The time frame of the project is one academic year. By comparing the amount of work that the project team has completed, and estimating the amount of work that still remains to be done, HIMA decided that the development of the product would take roughly two years. The people working on the development would ideally have extensive experience in software development. Another consideration is monetary resources, because while a project team of students could be responsible for the creation of Arrow, if there was a way to generate capital, the development of this project would be much easier due to financial incentive.

A good portion of Arrow's constraints lies within the healthcare industry's current access to technology. Different institutions have varying amounts of connectivity; some places have a policy that makes all information available online; other administrations may rely on paper forms and complicated filing systems. This diversity of technological advancement devalues the benefit that could be provided by Arrow at some institutions of healthcare. The institutions that are already operating wirelessly are the places that Arrow is designed for, and the institutions that still operate with mostly paper challenge the success of this innovation.

The implementation of the NHII will have a huge effect on Arrow. While the NHII is not fully operational, Arrow would function as a reliable means of communicating patient information. The drawback presented while the NHII is not operational is that the party responsible for requesting information would need to know where the patient's health records were currently stored. When the NHII is fully implemented and in use, an improvement in Arrow's functionality would be seen. Arrow would have to be updated, which would be a minor set-back, but the advantage to this update would be instrumental in making Arrow the most convenient product possible. The advantage would be that Arrow could communicate with the NHII to autonomously find patient records. The goal is that by the time Arrow is developed and operating, the NHII would also be operational. While the NHII is not in use it presents a large constraint to the effectiveness of Arrow.

3.3.3 Ethical Constraints

Ethical considerations are an area that will always provide setbacks and constraints. There are many codes and standards written for industries trying to determine what is ethical and what is deemed unethical. One such standard is "the American Recovery and Reinvestment Act (passed in 2009)…" which "…included the Health Information Technology for Economic and Clinical Health Act, known as HITECH. The Act enabled health systems and providers to get incentive money based on their billing to Medicare or Medicaid. Objectives were put in place requiring applicants to meet specific measures to receive incentive funds. One primary requirement is procuring or upgrading to a Meaningful Use certified electronic health record software (HealthRecord, Meaningful Use, 2013). The HIMA project group is of the opinion that the software Arrow would provide a small solution and help the industry move itself in a better direction, therefore any ethical constraints must be considered and addressed, but should not deter from the development of the product.

The main concerns that the HIMA project team has identified citizens will have is in the initial adoption of the software. The anticipation is that people will not want their personal health information stored in the cloud. This ethical constraint is something that should not affect Arrow too heavily, because of the nature of the software. Arrow is intended to be a means of easier communication, not an evil data-sucking entity that stores your information in the cloud to be used against you at a later date. This misrepresentation would only hinder Arrow early in its adoption. Once the public realizes that Arrow does not store any of the data, only creates an easier transmission, then this constraint will cease to be a constraint.

The ethical dilemma posed is how to change people with viewpoints in opposition to Arrow, into people who understand the benefits gained from Arrow. What will convince them that Arrow is secure enough? Or is there a way that HIMA could provide a means of opting out easily? The answer lies in clear communication. When the general public understands what Arrow does and doesn't do, that should clear up a lot of the issues. As for security, the development team must create a secure software that can comply with the stringent standards of the healthcare industry; but only making the software secure is not enough, the team must broadcast to the world that the software is secure, and ensure that citizens are comfortable with the level of privacy afforded by the software. The other logical option to consider while pondering these ethical dilemmas is the option of allowing patients to not be involved in the new system. This opting out would only serve to slow down that patients treatment, but it would placate the individuals who opposed the use of Arrow (Braa, Monteiro, & Sahay).

3.4 Related Infrastructure

Arrow is an incremental solution, meaning that it is not a complete solution to all the current challenges faced by the healthcare industry. Still, the successful implementation of Arrow is a large step in the right direction. Each phase of implementation will require unique collaboration of management, hardware, and software resource allocation. The required infrastructure to make this goal a reality will be outlined in this section. The key phases of installation, operation, and continuous improvement will be addressed individually in order to provide a complete description of the necessities of Arrow's application.

3.4.1 Installation

Installing Arrow into a place that delivers health care would be relatively easy, given that the administration was already using electronics as their primary method of data collection. If the administration was not previously using electronics that institution would require computers and Internet service before Arrow could be installed.

To begin the process of installation, the HIMA group decided it would be best to divide the process geographically. A geographical break down would help Arrow be effectively implemented at individual institutions, both nationally and globally. For the purpose of this section of this paper, we will use Massachusetts as our example. Below an image of Massachusetts' counties can be found; there are fourteen counties in total (Counties of MA, 2013).

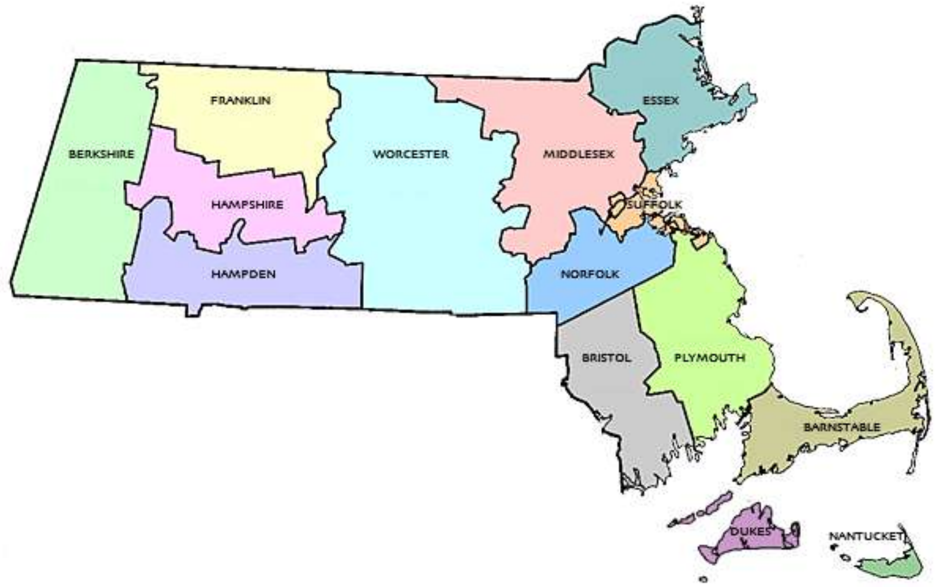

Figure 14- Counties of Massachusetts

Using the counties of Massachusetts is a simple way to break apart a large region into more manageable sections. The demographics of each county need to be determined, and that would make it easier to allocate resources appropriately. Arrow would need a location in Massachusetts to handle all of the logistics around the delivery and installation of these resources.

Installation is a phase that can determine the future success of a product. Accordingly, the HIMA group has determined a process that will ensure smooth installation. First, assess the region to see if any predetermined sections are available to use, like counties in the Massachusetts example above. Then the demographics of each section's health care industry would need to be evaluated. Factors like the number of administrations, the number of administrations that could simply install and use Arrow, and the number of administrations that would require new hardware and processes before installing Arrow would be the sort of factors evaluated at this step. By being prepared with this information, the HIMA project group would be equipped to solve any issues presented in each geographical section.

After the information had been evaluated, Arrow would be marketed and sold to the institutions where there would be the least amount of change required to install Arrow. After installing the product at the more desirable locations, the project group would then concentrate on the institutions that need new hardware before installing Arrow. The institution would ideally work with the Arrow production team to ensure that they are procuring hardware suited to handling the software effectively. Once Arrow had been effectively installed to a majority of the healthcare administrations in the region, the Installation phase would be completed.

3.4.2 Operation

Once Arrow has been installed, the only operational infrastructure necessary would be maintaining the supporting hardware, debugging any issues with the software, and keeping personnel trained and informed about Arrow. Maintaining hardware would primarily be the user's responsibility. Each institution would be free to make their own choices about what computers they are buying, what Internet service they are using, and how often they will upgrade this equipment. It is good to leave these decisions up to each individual healthcare institution because then the Arrow team would be free to concentrate on making the software more functional.

Since this software would be completely new, it is expected that there will be some issues. Hopefully by alpha and beta testing the product many problems could be caught before ever bringing Arrow to market, but nevertheless, some issues are sure to be present. During the early operational stage the main objective of the Arrow development team would be to correct these issues. The software would be updateable, and making these updates in a timely manner would improve the reputation of the new software. The development team may need to bring in more experts in order to make these changes, since it is always good to have a fresh perspective on the product.

The people using Arrow during the operational stage would be the most problematic area of all related infrastructure. Early kinks in the functionality of the software would be relatively easy to solve for the experts on the development team, but it would create frustration amongst the users. The HIMA group has decided that the best way to proceed in the operational stage would be to actively help users of Arrow. On-site training sessions and clear details about the changes created by upgrades are two ways that would help ease stress on users.

3.4.3 Improvements

The final phase of continuous improvements would rely heavily on the people using Arrow. The feedback that the Arrow development team will receive from users should be the driving force behind any improvements made to Arrow. Other goals of the improvement phase would be to make Arrow more intuitive to use, and speed up the back-end processes associated with the software. Computers will continuously getter faster and better and keeping hardware up to date is a task that would be up to each individual administration.

The method of gathering feedback from users can be found in a different section of this paper. The feedback received from these users would be very useful when determining what aspects of Arrow need to be improved. Mostly, the interface that users see is where the HIMA project group expects to see the most comments from users. Improving this interface would be handled carefully, making small adjustments would be ideal so as to not drastically affect the program. One small improvement that could be made would be a voice recognition system that would listen to doctors effectively and quickly. Having a simple transcribing feature is something that Kiran Raj Pandey thinks would help systems like Arrow tremendously. The addition of "Accurate automated transcribers could really speed up record keeping, thereby selling EMR to the unconverted while saving costs over manual transcription" (Pandey, 2012).

The processes behind finding patient information are another area that could see drastic improvement over time. Before the NHII is in use, Arrow would either need to be told where the patient information is stored, or could alternatively search for this information on its own. If Arrow was told where the information is stored, it would request the information from the Arrow at the other institution, and receive it relatively quickly after being autonomously approved through the Arrow-to-Arrow contact. The other institution not having Arrow would present a time delay because the request would then have to be approved by a human before the transaction could occur. This could be drastically improved with the implementation of the NHII. After the NHII is in use, Arrow would get a few identifiers from the user, consult the NHII to find the location of the health information and permission to retrieve, go retrieve it, and be done with no human time delay. This autonomy would be highly desirable. The reason it would be so desirable is because then the process could be broken into smaller parts, and operated simultaneously. This simultaneous operation could exponentially increase the time of each transaction. In regards to infrastructure, operating simultaneously would require much more computing power. At this phase of operation, it might be wise to take advantage of Amazon Web Service's Elastic Compute Cloud (EC2) because it would allow for scalable simultaneous computing and would keep expenses down significantly. The following description gives a brief description of Amazon EC2.

> *"Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers.*
>
> *Amazon EC2's simple web service interface allows you to obtain and configure capacity with minimal friction. It provides you with complete control of your computing resources and lets you run on Amazon's proven computing environment. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. Amazon EC2 provides developers the tools to build failure resilient applications and isolate themselves from common failure scenarios"* (Amazon, 2013).

Using this service would be secure and could handle the amount of traffic generated by the health care industry. The major advantage to the people behind Arrow is that they would not have to pay exorbitant amounts on upgrading their hardware in order to realize faster processes. This would be instrumental in keeping costs down while still providing a better experience to the administrations using Arrow, and through them, the patients involved in the health care system.

By looking to certain products already in the industry, the HIMA group can gain insight into what features of an electronic medical record system are being called for. The following table shows a few basic functionalities (HealthRecord, Meaningful Use, 2013):

Table 3 - Functionality Explanations

Functionality	Explanation
Automated Decision Support	Protocols can be built to notify a health care provider when specific tests are due or how a medication might interact with a patient's allergy
Patient Registries	Quick reporting capabilities can allow health care organizations to view patient populations as a panel. Outcomes can be measured and managed across the population. Outliers can be flagged to receive needed attention
Secure Clinical Messaging	Providers can communicate securely with their patients, and the communication could be automatically included in the chart documentation as appropriate. Also, care coordination can be improved when chart summaries are sent securely following a referral.
Electronic Order Management	Orders can be sent securely, and the returned results can be matched to the initiating order. This allows the primary care provider to quickly see and review results for their patient and also to identify patient compliance issues

These four functionalities ensure that our system would be accepted by the current standard of electronic medical information systems.

The same source also provides a look into the future of the industry. It does not directly discuss the related infrastructure, but it provides a good outline of benefits to be obtained after the hardware, software, and processes have been put in place. “We expect to see a greater integration with Health Information Exchanges, where information relevant to a doctor’s patient is pushed to their chart for the provider to review. We also anticipate the proliferation of patient portals, finally allowing patients to see all their health care data in one place, and to schedule appointments and pay bills. These technologies are available now, but not widely implemented. Great adaption will be driven by requirements in the Meaningful Use regulations.”

Chapter 4: Concluding Remarks

As the population of the United States grows and the average age of the general population rises, the demand placed on the healthcare industry increases drastically. Since the dawn of the 20^{th} century, waste in healthcare has been a phenomenon to be expected and dealt with. The issue is largely brushed under the table and the cost falls to insurance companies, and by association, consumers. As medicine advances, the cost of medical care is on the rise. Consumers can no longer afford to foot the bill of increased medical costs and the exorbitant amount of wasted time and money in the healthcare industry. Much of this waste occurs in the areas of administration and information management. Time, money, and resources are wasted on a daily basis collecting, storing, and transmitting patient data. These tasks are monotonous and repetitive, and therefore extremely easy to automate.

Many other industries have already adopted the use of computers as a way to streamline data management processes. Banks, insurance agencies, airlines, and universities all use virtually paper free methods of data collection and storage, so why not the medical industry? The answer to this question lies in the inherently sensitive nature of medical information. Extreme caution must be taken when dealing with patient data in any form. In fact, there have been several initiatives created by both private companies and the federal government to regulate the procedures by which medical information is handled. These regulations pose several obstacles to any initiative to centralize healthcare information, and so a different solution had to be conceived. The result was an idea for a system where medical data would be distributed between hospitals and clinics across the country and linked together using a framework that facilitated collaboration between these facilities for the purposes of improving patient care and expediting medical research. This system was dubbed the National Health Information Infrastructure, or NHII.

There have been several revolutionary ideas that have affected the way people interact with each other over the past 150 years. None of them have been the work of a single individual or even large corporation. Instead, these changes have come about because of a culmination of ideas and related infrastructure based on an economic need. As the cost of medicine increases, the economic need for efficiency and waste reduction in the medical industry becomes more and more apparent. This is the end goal of the concept we have created in this document. The Arrow software is designed to be one of the ideas that contribute to the creation of a National Health Information Infrastructure.

In order to realize this design, the issues facing this collaboration of medical facilities must be examined. We have addressed many of them in this document. The first, and possibly most important, is the current regulations surrounding the use of medical data. Regulations such as HIPAA and the Electronic Communications Privacy Act must be read and fully understood in order to design an effective and compliant system. Second is the distrust amongst medical professionals and administrators of information technology. It will be difficult to convince those facilities which have not yet converted to paper free data management to do so. The final major constraint is the sheer number of different formats in which data can be stored. Many medical facilities already use electronic health records, however there is no centralized standard for how information is collected, stored, transmitted electronically. This is the main function of the Arrow software. To allow facilities using different data formats to collaborate with one another without overhauling their individual database structures and medical software.

As the concept for the Arrow software moves forward, it will be important to note that the software specifications contained in this report, while loosely following the guidelines set by the IEEE, are not intended as a technical reference. A technical analysis of software with Arrow's scope and functionality are far beyond the intended latitude for this project. It is however, an outline for the overall software structure and a list of basic functionalities which, based on research and personal experience, would be required for Arrow to comply with national information security standards and perform its intended functionalities. These requirements specifications are intended as a living document, to be edited and added to by future groups of students undertaking this project.

Policy changes, shifts in demand, technological advancements will all have a role in shaping how the final Arrow product will be designed and implemented. As a final, closing remark, Although they will take time and a considerable amount of money to implement, Arrow and the NHII as a whole will have a profound effect on the way information is managed and consequently, on the quality of patient care and medical research. The benefits of such a system will far outweigh the costs of designing and maintaining it, and the undertaking of this project has been, and will continue to be, a vital step in realizing the next great change in the wellbeing of the citizens of the United States.

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Appendices

Appendix A: Arrow Software Requirements Specifications

Introduction

This section will provide an outline for the rest of the document. It will cover the purpose, scope, relevant definitions, references, and provide an overview for the rest of the document. The purpose will contain a high level summary of the motivation for the project and goals that the requirements will be designed to meet. It will also contain a description of the intended audience for the document. Scope will cover abstract functionalities and area of effect for the software. This includes what Arrow will and will not do, relevant benefits of implementation, and the overall latitudinal reach of the final product. References will include all references relevant to the construction of this document. The purpose of Section 1 is to familiarize the audience with information relevant to the design and maintenance of Arrow.

Purpose

The purpose of this document is to provide specifications for future teams of software engineers, systems analysts, and architects to design the software outlined herein. The requirements specified below will be designed to meet the following goals:

1.) Increase the availability of information in the healthcare industry.

2.) Decrease waste in both time and resources in the areas of information COST.

3.) Increase the overall quality of patient care.

The intended audience for this document includes the team developing the software, healthcare professionals who take an interest in the development of an NHII, policy makers both public and private, and individuals involved in the collection, transfer, and maintenance of health information.

Products to be Developed

The product outlined in this document is Arrow. Arrow will be a system for the standardization and dissemination of healthcare information. This document outlines requirements for both the front and back ends of software.

High Level Functionality Goals

This subsection outlines the functionality desired in the final product at a very high, abstract level. In order to meet the needs of the NHII, Arrow will need to do the following:

1.) Provide only relevant information to relevant medical personnel and patients.
2.) Provide anonymous market data and statistical analysis of medical trends for research purposes.
3.) Keep patient profiles to track trends over time for individual patient data and manage all information relevant to the patient.
4.) Standardize information between formats used at various hospitals, clinics, and private practice offices and allow for transmission of data between offices.
5.) This will need to be filled in later.

These requirements describe the functionality of Arrow in the broadest sense. They will be refined in further sections of this document.

Intended Uses

This subsection describes the context in which Arrow will be used. Arrow will be an application for providing health information to doctors, patients and researchers. The scope of its use will include university and commercial studies, allowing patients to view prescriptions and test results, providing information to doctors, providing patient medical history to EMS staff, translating medical forms between formats used at different locations, updating and building of patient information profiles, and providing information to medical insurance companies for billing purposes.

Providing Health Information to Doctors

Providing health information to doctors includes providing only information relevant to the nature of the appointment and treatment of conditions specific to the needs of the patient and qualifications of the doctor. This will only be done with explicit permission to be given to the doctor by the patient. If the patient is indisposed or otherwise unable to give express permission to the attending physician and staff, the doctor will be able to request a baseline of information critical to patient care including but not limited to allergies, current and past prescriptions, preexisting conditions, and emergency contact information to be previously designated by the patient. This emergency contact will also have the authority to grant the necessary permissions to the attending physician.

Allowing Patients to Access Test Results and Prescriptions

Patients will be able to access the Arrow application from their home computers through the individual facility's website. The facility will host the application on their own servers and patients will only be able to view prescriptions, test results and other relevant information. In the event that a facility is incapable of hosting a web application on its own servers, this feature can be omitted.

Providing Information to EMS Staff

Providing information to EMS staff will take place in the field, primarily on emergency response calls. The same criteria goes for this application of Arrow as with providing doctors with information in the hospital, with the added stipulation that the information needs to be available in a timely manner on a mobile platform and displayed in a manner that is easy to interpret in high stress situations.

Translating Forms between Facilities

Translating medical forms between locations will occur on the back end of the software. This will happen when a patient needs to change facilities for any reason. Relevant information will be taken from the first healthcare facility and used to populate the electronic forms used by the second one. Again this will only happen with explicit permission to be given by the patient.

Updating and Building Patient Profiles

Updating and building of patient profiles will happen during patient visits to medical facilities. Any data that is collected during the visit will be automatically stored on the facility's data storage devices and the user profile will be updated. The user profile object will be an organized collection of metadata that will allow Arrow to retrieve information from facility databases and in a structured and consistent manner.

Sending Billing Information to Insurance Providers

Information will be provided to insurance agencies for billing purposes only, and only to the insurance agency indicated by the by the patient in a format consistent with their coverage policy.

Definitions, Acronyms, and Abbreviations

This subsection provides the definitions of all terms, acronyms, abbreviations, and clarifications to ambiguous terms required to properly interpret this document.

Acronyms and Abbreviations

- COST – Collection Operation Storage Transmission, refers to treatment of data
- NHII – National Health Information Infrastructure
- SRS – Software Requirements Specification, refers to this document
- EMS – Emergency Medical Services
- IEEE – Institute of Electrical and Electronics Engineers
- HIS – Health Information System
- UI – User Interface

Additional Notes on Language Used

In the context of this document, the words "facility", "office", and "institution" are to be considered equivalent and will be used to refer to a medical facility in the broadest sense of the term.

Overview

The rest of this document will delve further into the details of Arrow's functionality and uses. It will begin with a general description in Section 2. This includes describing context and perspective, functions, characteristics of users, constraints, and a subsection on assumptions and dependencies. Section 3 goes into further detail, describing specific interface, functional, and nonfunctional requirements as well as detailing specific user stories. It is important to note that while this document does follow loosely the IEEE standards for software requirements specifications, it is not intended as a technical reference. Details of technical implementation are beyond the scope of this project. It is however a concrete list of requirements that can be used as a basis for designing and building the Arrow software.

General Description

Section 2 outlines and summarizes the general factors that will need to be taken into consideration during the design process. In effect, this section is intended to provide contextual and situational details for the stage on which the software will be set. It is not a list of requirements, but rather, information that will make the requirements easier to understand.

Product Perspective

Because the concept of an NHII is still in its infancy and because any implementation of such a system is virtually nonexistent, Arrow will not need to be compatible with any larger systems. Instead, it will need to be compatible with any medical information processing software currently in place at the individual facilities where it is used. Due to the nature of the current HIS, Arrow will interact with a variety of software and databases at different healthcare facilities. This should be reflected in the fluidity and robustness of its design.

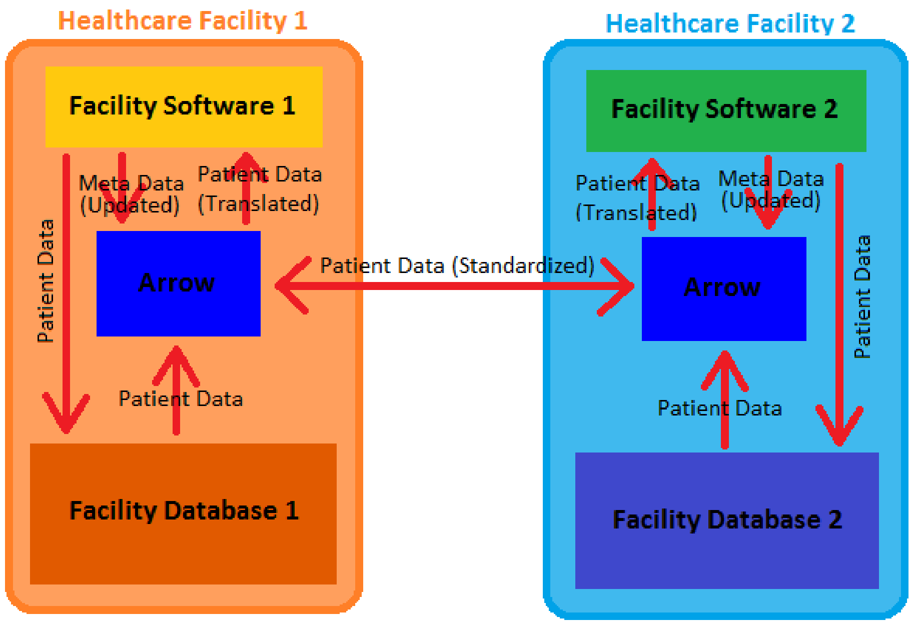

Figure 15 - Arrow Interaction Diagram

Product Functions:

Provide Relevant Information to Relevant Personnel

Relevant personnel include primary care physicians, attending physicians, specialists, surgeons, insurance agencies, and any other individuals whose roles require specific patient information. Relevant information is classified as the minimum amount of information required by medical staff for proper patient care. The patient will dictate which personnel can access their medical records, unless they are unable to. In this case, providers are given a baseline of information critical to patient care.

Provide Medical Data for Research Purposes

Patients will be able to allow their medical information to be anonymously sampled for use in studies requiring large sample groups. Any medical facility that implements Arrow can be mined for data based on criteria such as age, region, or gender.

Patient Profiles

Arrow will maintain a separate, relatively small, database containing profiles for each individual patient. The database will not contain any medical information; instead it will contain metadata that will allow information to be retrieved from the database in a well-structured and efficient manner. User profiles will also contain information about permissions for accessing data.

Standardize and Transmit Data

As shown in the diagram above, Arrow will have the capability of communicating and transmitting data between separate instances of the software at different healthcare facilities. The data will be transmitted in a standardized format and encrypted to ensure the privacy and security of the information being sent. The information will then be translated or mapped onto the format used by the facility requesting the information. These transmissions will happen on an as needed basis, during appointments, and will require permission from individual patients.

User Characteristics

Due to the wide variety of IT experience and education of the medical and administrative professionals who will be using the Arrow, ease of use will be a top priority in the design and implementation processes. This subsection contains general summaries of the characteristics of the individuals who will use Arrow on a daily basis.

Primary Users

These individuals will use the main Arrow application on a daily basis and will need to be familiar with its specific functionalities.

Doctors and Specialists

Doctors and specialists are included in the same group due to their similar levels of education, medical or otherwise. They will have attended medical school and overall will have a high level of intelligence and intuition. That said, they will not be overly comfortable working with computers as their primary concern is for patient care and safety. As such many doctors and specialists will be uncomfortable with using computers as part of their daily practice of medicine and some, especially older individuals, will have an inherent mistrust in technology. They will be used to working with people and will have highly developed communications skills. This must be taken into account during front end design. Technical implementation and installation will be of little concern to these individuals.

Receptionists

Receptionists will do the bulk of data entry, transmission, and other tasks which are vital to maintaining up-to-date patient records and health information. They will mainly interact with the front end of the application. An average receptionist will have a moderate amount of IT experience. They will be familiar with applications such as Microsoft Word and Excel, as well as the hospitals current software for information processing and data entry.

Facility IT Department

These individuals will be responsible for installation, implementation, error handling, and maintenance of the software and its corresponding hardware. They will be concerned with both client and server sides of the application. These individuals will normally have degrees in areas such as computer science and management information systems and be very technologically proficient.

Secondary Users

These are users who will rarely interact with the software directly, but will still have a stake in its costs, implications, and resources. These individuals will also interact with primary users frequently and will therefore be affected indirectly by ease of use, costs, and other factors.

Healthcare Administrators

These individuals will largely be concerned with the costs and implications of implementation, installation, front and back end use, maintenance, transmission, and data storage. They will interact with doctors, nurses, IT professionals, receptionists, and other primary users regularly and will perform assessments on waste and logistics concerned with health information infrastructure.

Patients

This user group will have the largest variation in IT experience and expertise. They will not usually interact with the interface of the software, other than the section of the application that will allow them to check test results, and some data entry to be done on site.

General Constraints

This subsection of the SRS will provide a general description of any other items that will limit the development team's options for designing the Arrow software.

Regulatory Policies

The regulatory law HIPAA (the Health Insurance Portability and Accountability Act) addresses the major issues related to privacy of health information, specifically electronically saved records. The overarching goal of HIPAA is to establish requirements as well as standards to be referenced when transmitting health information. These standards aim to increase efficiency of the health care system while at the same time preserving patient privacy.

The Privacy Rule within HIPAA defines the possible uses and disclosures that may be made without the consent of the patient. It also gives rights to those patients, enabling them to control their own information as they see fit, as well as making corrections to their record.

The Security Rule describes the various levels of protection for patient records, as well as protocols for an entity to implement their own safeguards. These safeguards include administrative, physical, technical, and organizational standards which outline the specific requirements that must be met in order to safely operate a system with access to patient records.

Interfaces to Other Applications

The Arrow software will need to interface with a wide variety of other health information processing software, and be able to standardize information between different applications both within a given facility and to other facilities nationwide. This includes receiving information such as patient metadata from these applications and providing correct patient information in a format consistent with the one used by the interfacing software. This should be done dynamically so that if a hospital installs a new application or creates a new form Arrow can be updated to communicate in the new format.

Reliability Requirements

Due to the criticality of health information, Arrow will need to be as close to one hundred percent reliable as possible. This include sub-five second response times for any use involving emergency medical care including but not limited to EMS, surgeries, and patients in intensive care facilities. For most other applications a response time of approximately fifteen seconds will be sufficient. The information provided should be correct and in the proper format. It must also be error free when it reaches the medical professional, because they will not have the time or expertise for any extensive error handling.

Criticality of the Application

Based on the nature of medical information, Arrow will need to operate at the highest levels of efficiency, security, and correctness. Health information is among the most critical information that can be shared on the internet, and as such, an application dealing solely in medical data must with this in mind.

Safety and Security Considerations

The standards for privacy and security regarding the implementation of the information system are largely based upon the entity's assessed risk and risk management procedures. Depending upon the sensitivity of the information utilized by the system and company, differing levels of security must be active. There are specific standards outlined in several federal releases including HIPAA, where required procedures and preparedness plans are defined. These statutes are loosely stated, in order to account for the vast differences among organizations who may potentially utilize a system which grants access to protected health records. In all instances, a required evaluation from an internal or external accreditation agency are required in order to ensure up to date policies and a constantly developing defense against malicious attempts to steal information.

Specific Requirements:

User Interfaces

Arrow will have several different user interfaces. A comprehensive list of all platforms and in depth descriptions of their respective UIs is beyond the scope of this project, but this section will contain general summaries of the user interfaces used on the most critical platforms and in the most critical scenarios.

Desktop Computer

This section refers to desktop computers used by medical professionals and administrators on site. Desktop computers are used in every medical facility and are an integral part in the collection and maintenance at each location. The desktop portion of the Arrow software will be the most powerful, and as such its user interface will be the most complex and have the most parts. The interfaces across all of these parts should be consistent in appearance and layout. Button and field labeling will all be done in the same font and color schemes will be the same across the entire application. Each page should be able to display the correct amount of information without clutter and limited scrolling. Data entry will be done in clearly labeled fields, check boxes, drop downs, and other forms of

Laptop

Technology today has evolved far enough that laptop computers have virtually the same capabilities as desktops, so the interfaces will be largely the same. The only differences will be screen size and the fact that laptops are portable. Portability is significant in this context because it means that the software could be used more potentially stressful situations. In these situations, information will need to be available much faster and be much easier access. This means larger fonts, color coding, and better organization of relevant information.

Tablet

Tablet platforms have considerably less processing power than desktops and laptops, and so they will less functionality and less complex user interfaces. Data entry is annoying on tablets, so this functionality will be limited. Tablets will primarily be used for viewing information such as patient charts, prescriptions, and medical history. The portability of tablets carries the same implications as the situations described above, and special care will need to be taken in the utilization of screen real estate, as tablet screens are even smaller than laptops.

Web Application

This platform will be used by patients to view test results, prescription information, and insurance co-pays. No data entry will be done on this platform. A Spartan user interface that displays information in a concise, easy-to-read format will suffice here.

Smart Phone

The smart phone platform will be an extension of the web application. It will be used by patients view information. An additional functionality on this platform will be the replacement of paper prescription notes. Patients will be able to bring their phones to a pharmacy and have prescriptions filled in a paper free transaction.

Software Interfaces

As stated above, Arrow will interface with a wide variety of different software in a dynamic way. If the software interfaces change, Arrow will need to change with them. Arrow will also interact with a wide variety of database formats and data transfer protocols and needs to have the capability to standardize this information and transmit it between different instances of the Arrow software.

Functional Requirements

Logging In

Introduction:

Due to the nature of healthcare information, secure login functionality should be a requirement on all platforms of the Arrow software. Secure information, known only by the appropriate individuals will be entered and will give the user access to the appropriate information.

Inputs:

Input will vary from a secure password to the social security number of a patient. At least two pieces of secure information will be required, with additional inputs allowed for added security and identity verification.

Processing:

Arrow will compare the information given with information stored in a secure location. If they are equal, the user will be granted permission to access all appropriate information.

Outputs:

The user is given access to all appropriate areas of the software and information based on user or patient profile metadata stored in the Arrow database.

Error Handling:

- The user enters an incorrect piece of information

    - The user is taken back to the login screen with the addition of a clear error message stating that they have entered information incorrectly and asked to re-enter the information required. This will be permitted to take place a set number of times. If the user attempts to exceed this number, they will be locked out for a pre-set amount of time and asked to try again later.
- The information stored in the database is incorrect
    - The user will need to verify their identity through other means, such as a driver's license or passport, to have the data corrected. This will happen on site.
- The software is unable to connect to the database
    - This is a larger issue and could have any number of causes. This will need to be handled by an IT professional under the employment of the facility, or a private contractor if the facility does not have an IT department.

Flagging Important Health Information

Introduction:

Flagging important health information will occur when doctors decide that certain health information, which is not generally considered pertinent, is in fact essential for all health care providers to be aware of. By flagging a certain health field, this information will be under the basic information that all future doctors will be able to view upon initial consent. Additionally, patients can flag their own information if they feel as though it is important for all health care facilitators to be aware of.

Inputs:

In order to flag an important piece of information, the doctor or patient will simply click the "Flag" icon within the software interface. A warning will appear within the patient's interface in order to inform the user of exactly what flagging their information will allow doctors to do.

Processing:

Arrow will simply take all flagged information and categorize it will all first-level protected information for doctors' use.

Outputs:

The patient's metadata profile will be updated so that the flagged information will be displayed with the first-level information.

Error Handling:

- Accidental flagging of information would most likely be the most common error. This could occur by accidentally flagging an item or by flagging the wrong line of information. A confirmation screen indicating all flagged information before logging out could help fix this problem.

Profile Family Linking

Introduction:

In order to fully understand medical history, many health care facilities will ask for family health history. Instead of asking the patient about their family health history, patients or doctors will be able to update family relationships in order to populate these fields automatically and in real time.

Inputs:

A doctor or patient will have access to updating their family relationships. Through the interface within Arrow, users will be able to link their profiles to blood related family members.

Processing:

The Arrow software will simply link the family relationship information and use that family member's health profile to populate the fields requested in this question from the health care facility.

Outputs:

The patient's metadata will be updated so that when viewing an individual's profile, one can determine whether or not there are any family health issues that the clinician should be aware of in order to properly treat and make diagnoses for the patient.

Error Handling:

- The user connects to somebody who is not a blood relative of themselves
    - Upon initial conversion to the NHII system, this may be a common issue. When connecting to another person's health profile, that other user will have to acknowledge that this person is a blood relative from their own health portal. Since no additional access to information is granted through the updating of family relationships, connecting with false blood relatives will not be effective for any reason. After the initial conversion, blood relatives will be automatically

updated at the birth of a child. That child will carry over all blood relatives from their parents.

Viewing Patient Information

Introduction:

Patient information viewing will be the essential feature of the Arrow software. The ability for a doctor to view patient information will allow the clinician to more accurately diagnosis patients as well as correctly prescribe medication. Additionally, patients will be able to login to the Arrow software to view their own health information as well.

Inputs:

Any patient identifiers including name, date of birth, address, etc. will be used to reach an individual's health information.

Processing:

Patient information input is matched with a specific patient metadata. If not enough information is entered in order to receive one unique patient, more information will be requested. In order to view information pertaining to a specific patient, the logged in person's profile will have to be given permission to view the patient's information by the patient. For a patient to view their own profile, they will simply have to login (see Logging In).

Outputs:

Patient information is displayed on the screen.

Error Handling:

- Spelling Errors
    - Much like the Log-In function, the information entered to receive information must be entered exactly how it is stored within the Arrow software (minus case sensitivity). In most cases, entering more information (assumedly spelled correctly) will yield the same desired patient metadata.

Updating Patient Profiles

Introduction:

The Arrow software and NHII system will be constantly updated by new patient information being entered into the health care facility's database. Updating patient profiles by entering new information will be essential towards the success of the NHII.

Inputs:

Any time a patient visits a doctor, that doctor will be taking notes about the patient. All notes will be considered the input towards updating a patient's profile.

Processing:

The Arrow software will take in any input information submitted. Arrow will then format this information by extracting information from individual fields and storing it in a single large form which is ready to populate outside health facility forms upon request and proper credentials.

Outputs:

The result will simply be an updated patient profile which is ready for other doctors from other health care facilities to be able to view.

Error Handling:

- Wrong Input Information
  - Information will be able to be updated the inputting individual for a specified amount of time. After this time expires, the person inputting information will have to request from the patient to change incorrect information.
- Information Input to Wrong Profile
  - Either doctor can request from the patient to remove the incorrect information or the patient can request from the inputting doctor to change the incorrect information. In order to change health information after the initial appointment, the inputting doctor as well as the patient will have to approve the change.

Logging Out

Introduction:

Due to the nature of healthcare information, secure login functionality should be a requirement on all platforms of the Arrow software. Secure information, known only by the appropriate individuals will be entered and will give the user access to the appropriate information. When these individuals have completed their task, they will log out of their profile to prevent others from using their credentials to view information.

Inputs:

The input will simply be the user clicking the “Log Out” button and then closing their browser.

Processing:

Once the user clicks the log out button, the system will delete all viewed information and view history.

Outputs:

After logging out, the user will be sent back to the original login screen.

Error Handling:

Accidental Log Out

- User will be logged out when the log out button is clicked whether or not this was intentional. User can simply log back in after accidental log out.

Changing Passwords

Introduction:

In order to keep information secure, user profiles will have to be extremely secure as a correct login gives access to immense amounts of delicate patient information. Due to this, user passwords will have to be changed periodically in order to maintain safe information access.

Inputs:

The input will be the user being prompted to change their password after a certain amount of time since the last password change (6 months) or a voluntary action of the user by clicking the "Change Password" button under "Account Settings."

Processing:

Once the user is brought to the Password Change screen, they are prompted to enter their current password, new password, and once again their new password. All passwords will appear as asterisks (*) as they are entered to increase security.

Outputs:

If the old password is correct and the 2 new passwords match, the current password will be changed to the new password which was just entered.

Error Handling:

- Old password is incorrect
  - User will have an opportunity to repeat the previous page to enter their old password in correctly
- New passwords do not match
  - User will have an opportunity to repeat the previous page to enter their new password again
- User forgets old password
  - User will be prompted to enter in other information in order to verify that they are the correct user. This information could include social security number, birth date, etc.

Locking Account

Introduction:

Due to the serious nature of the information accessed during login, accounts must be extremely secure to ensure that the information that a user is allowed to access is not seen or stolen by other people for any reason. In order to help accomplish this task, a way for a user to lock their account is necessary.

Inputs:

The user will simply click the "Lock Account" button in order to lock their account at any time.

Processing:

Once the user clicks the "Lock Account" button, the screen will change back to the original welcome screen and the correct password will be required for the current user to go back to the information which they were viewing. Additionally, a countdown will start which will log the user out after a set amount of time.

Outputs:

If the countdown is complete without a correct password being entered, the account will be completely logged out and the welcome screen will be shown. If the correct password is entered before the countdown is completed, the user will be taken back to the page which they were accessing when they originally accessed their screen.

Error Handling:

- Accidental account lock
    - User will be required to enter in their password to return to the screen which they were previously viewing

Setting Information Security Levels

Introduction:

Different information will be relevant for different users. Doctors may need to view more information than a patient may be able to view or a surgeon may be able to access more specific information that relates to their task, but not basic information that is unrelated.

Inputs:

When inputting information, users will be able to assign security levels to each set of information. The levels would range from “Basic” to “Sensitive” and possibly “Custom” depending on the severity and private nature of the information.

Processing:

Based on the security range, different users will be able to access different levels of information. Basic information will be available to all users permitted to view a patient’s information. Different clearance levels will be permitted by the patient or healthcare facility officials based on the user’s task with regards to the specific patient.

Outputs:

Once gaining access to different levels of information, users will be permitted to view this information and any preceding information in accordance with all other functionality requirements related to viewing information.

Error Handling:

- Access Denial
  - This could occur when a clinician has been granted information but it is not yet processed. The clinician will simply have to wait; however, this process should be immediate due to the design of the system.

<u>Associating Specific Information</u>

Introduction:

Information will be able to be associated with various healthcare aspects. For example, information can be categorized as specific to various fields. Generally, a dentist will not need information regarding a patient's history with high blood pressure. With the ability to associate specific information, patients will be able to provide health care clinicians with the exact information that they need while keeping other health information, which may be sensitive, private.

Inputs:

Similarly to assigning security levels, users will be able to associate information with different healthcare fields from "Insurance" to "Sexually Transmitted Infections". Based on the association provided for specific information fields, users will be able to request information within the various fields which will affect the way in which they administer care.

Processing:

Specific information which is associated with clinician's specific tasks is given to the clinician in order to fully inform the people which need to be informed. For example, a surgeon doing surgery on a patient's hand will be aware that this specific patient has experienced numbness in this hand in the past and has broken a finger as well.

Outputs:

After logging out, the user will be sent back to the original login screen.

Error Handling:

- Unrelated Information Association
    - If information is not specifically associated, errors may occur where clinicians are given information which is related but not relevant to the current situation.

<u>Uploading Files to Patient Profiles</u>

Introduction:

The ability to upload and attach certain files to a patient's profile will allow for the share of information and information sources beyond simple text.

Inputs:

A user can simply click the "Upload File" in the relevant section of the patient's profile to attach a file such as an EKG report or an X-ray result.

Processing:

The Arrow software will store this attachment with the rest of the patient information and it will be available to any clinician with proper credentials to view this file.

Outputs:

Users with proper credentials will be able to view the information just as they would view the regular text patient information.

Error Handling:

- Improper Upload Format
    - According to the specific software capabilities, not all file types may be able to be uploaded. If this is the case, different file types will have to be chosen such as a .jpg.

Collecting Market Data

Introduction:

Patient information will be stored in hospital databases across the United States, and the Arrow software will have access to all the information at a given hospital. This is a powerful tool when it comes to research requiring large amounts of anonymous medical data such as following trends in certain health statistics.

Inputs:

Input will be a query including parameters such as the type of information, geographical location of desired results, target patient demographic, and other factors important for sorting medical data.

Processing:

The query will go to all medical facilities in the target area that collect the type of information desired by the user and collect all patient information fitting all parameters of the search query. All queries will also check if the patient has agreed to participate in market studies. If they have not, the information will be passed over, if they have, the information will be stored in a file and sent to the origin of the query and compiled.

Outputs:

The output will be compiled list of the desired statistics which can then be displayed graphically, either in the Arrow software, or using a third party application.

Error Handling:

- Most error handling to do with data transfer will be handled by layers below the arrow application, such as the transport and IP layers. If a user enters an incorrect query they will be able to cancel the query at any time and begin again. This will discard any information picked up by the incorrect query.

Transferring Patient Data between Facilities

Introduction:

Patients often need to change healthcare facilities for various reasons. The process of moving patient information between facilities is currently one that wastes a considerable amount of time and resources. Arrow will have the capability of transferring all of an individual's information to a new healthcare facility in a paper free transaction.

Inputs:

The input involved here will be the patient's identification and authentication information, the attending physician's authentications and an identifier for the medical facility the information is to be sent to.

Processing:

Arrow will retrieve all of a patient's from the current medical facility's database, compile it into a file readable only by the arrow software. This file will then be encrypted and over the internet to the new facility. At the new facility, the file will be decrypted and translated to the new facility's format of data storage. The medical information will then be stored on the facility's database, and a patient profile will be created and updated in the arrow database at the new location. The information will then be deleted from the old facility's databases if the patient so desires.

Outputs:

The output here will be the transfer of all of a patient's information to the new facilities database, including an up-to-date patient profile so that the information can be stored and accessed consistently.

Error Handling:

- Most error handling to do with data transfer and encryption will be handled by layers below the arrow application, such as the transport and IP layers. If there is a user error, such as sending the wrong information about the patient or the wrong patient's information, the data can be deleted through a command from either the sender or recipient of the information.

Translating Patient Information

Introduction:

While Arrow will have a standard format in which all data is sent and received, individual facilities manage and store their data using a large variety of software, database protocols, and object types. Arrow will need to be able to map these various formats to and from the standard Arrow format.

Inputs:

The input here will be either a block of standard Arrow information or un-standardized facility information.

Processing:

Arrow will use a user defined mapping to translate objects and fields used at individual facilities to translate between the two formats. This will include a large amount of file conversion as different facilities will store images, videos, sound files, and a cornucopia of other files in different formats.

Outputs:

The output will either be an Arrow standardized chunk of information to be sent to another healthcare facility or data organized in the format used by the facility for storage on site.

Error Handling:

- Patient information is translated incorrectly
  - It's possible that this is a user error, individual facilities are responsible for creating and maintaining their own data mappings and so this is the first check that should be made. If this is the case, arrow will have an option for translating between correct and incorrect mappings so that any incorrect information can be fixed.
  - If all data mappings are correct, it's possible an error could be caused by a bug in the Arrow software. If this is the case, the Arrow development team should be contacted.

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Error Handling:

- Patient information is translated incorrectly
    - It's possible that this is a user error, individual facilities are responsible for creating and maintaining their own data mappings and so this is the first check that should be made. If this is the case, arrow will have an option for translating between correct and incorrect mappings so that any incorrect information can be fixed.
    - If all data mappings are correct, it's possible an error could be caused by a bug in the Arrow software. If this is the case, the Arrow development team should be contacted.

User Defined Data Mapping

Introduction:

In order to be able to translate between the standard Arrow format and the individual facility formats, arrow will need a guideline for mapping data between various fields. This will be defined on site at the individual facilities by those administrators responsible for patient data management.

Inputs:

The input here will be commands from the user pointing fields in the Arrow software to fields used by the facility. These commands will specify file types, data forma, and specific syntax.

Processing:

Arrow will use a user defined mapping to translate objects and fields used at individual facilities to translate between the two formats. This will include a large amount of file conversion as different facilities will store images, videos, sound files, and a cornucopia of other files in different formats.

Outputs:

The output will either be an Arrow standardized chunk of information to be sent to another healthcare facility or data organized in the format used by the facility for storage on site.

Error Handling:

- Patient information is translated incorrectly

- It’s possible that this is a user error, individual facilities are responsible for creating and maintaining their own data mappings and so this is the first check that should be made. If this is the case, arrow will have an option for translating between correct and incorrect mappings so that any incorrect information can be fixed.
- If all data mappings are correct, it’s possible an error could be caused by a bug in the Arrow software. If this is the case, the Arrow development team should be contacted.

Temporary Information Highlighting

Introduction:

Due to the plethora of information displayed at any given time to the Arrow user, the ability to highlight information for the period of time where they are utilizing the information would enhance the readability of the requested information.

Inputs:

Input will be the selection of the highlight tool and one of 9 distinct colors. The user must click and drag over the information they wish to temporarily highlight. All 9 of the colors may be used to highlight different information on a given page.

Processing:

Arrow will maintain the highlight on the information selected from the time the user selects it until the time that the user logs out of Arrow. Arrow will remove the temporary highlight at this time and the next viewer of the information will see it in its default form.

Outputs:

Selected information will be easily visible to the user on the on-screen output for the duration of the Arrow session. Output is only a visual representation of the requested information and will not affect the original information records in any way.

Error Handling:

- Accidental highlighting of a large block of text
    - Highlight handle at top left of highlighted block may be clicked and dropdown menu will appear. Options include removing highlight, and if selected, the most recently highlighted block of text will have its highlight removed.

<u>Calculator</u>

Introduction:

For Arrow users to complete both basic and complex mathematical processes and analyses without having to leave the Arrow window, a built in virtual calculator tool will be available.

Inputs:

Input may either be from user entered numbers and operators, or from highlighted and dragged information in the Arrow window. The calculator may only handle one equation at a time.

Processing:

Calculator will perform the commands from input in standard order of operations. May process functions form keyboard input or from special expanded function window such as exponential, logarithmic, or other complex operations.

Outputs:

Output will consist of a single answer referenced below the original equation. While calculator is open, a continuous log of all operations will be listed in succession in the function window. This record is only temporary and serves as short term reference for the user, and will be erased upon closing the calculator, starting with a blank function pane the next time it is opened.

Error Handling:

- Unrecognized inputs
  - Characters with unknown functions will cause the output to result in an error message rather than a solution for the equation. This message will identify the unknown character in brackets as well as notify the user of the error.

Clipboard Manager

Introduction:

When sensitive information is being viewed, processed, or interacted with in any way, the risk of copying and defrauding this vulnerable data is a constant one. To ensure that any malicious or unauthorized user does not have the chance to commit this act, a clipboard manager would strictly govern the ability of copy and paste functions while Arrow is active.

Inputs:

The user will activate the clipboard manager by highlighting information and entering the copy keystroke (Ctrl+C). Any data that was highlighted and copied will also be input into the clipboard manager.

Processing:

The data that is copied will be managed temporarily by the clipboard manager, and ensure that pasting only occurs in specific windows. The data will be managed by the clipboard for a ten minute period, after which it will be removed and pasting of the information is no longer possible.

Outputs:

Pasted information is the potential output depending on if the user attempts to paste within 10 minutes of copying desired information. Other potential output is a dialog window stating that the clipboard is empty, in the case that the clipboard manager had refreshed.

Error Handling:

- User Attempts to Paste Data in non-Arrow window
  - Dialog window will appear stating a warning about pasting information in incompatible windows. Clipboard will automatically refresh to deny another attempt at pasting.

Patient Comparison

Introduction:

The ability to compare certain aspects of patient information will allow those with access to Arrow to investigate trends between patients clearly and easily. By selecting two or more patients, the user may simultaneously view their information with regard to a specific section of the patient record.

Inputs:

User will choose compare tool then select section of patient record that he wishes to compare to another patient's. Next, a search bar will appear within the comparison window that will allow the user to search for the other patient or patients he wishes to compare this specific section of each of their record with.

Processing:

Selected patients and corresponding sections of record will be concatenated and organized in the order of their initial selection by the user.

Outputs:

Once the user selects up to five patients, he will hit the execute button and a side by side comparison will appear listing only the section of information of concern for each of the selected patients. This window will be open until the user closes it or the time limit of 20 minutes is reached. At this time the window will automatically close.

Error Handling:

- User attempts to compare patients who lack corresponding data sections.

- In the instance that a particular section for comparison does not apply to all selected patients, a warning window will notify the user and the patient will be left out of the final comparison frame.

Historic Use Explorer

Introduction:

In one continuous session of use, Arrow may explore through extensive amounts of information on multiple patients. The user may wish to review something they previously viewed, but do not remember the exact path they took to reach the information. Their solution is the history explorer which they may reference in order to review their activity from their current session, as well as their previous session.

Inputs:

User may select "Historic Use" in order to bring up browsing window for past sessions. Information will be displayed in chronological order, most recent activities listed at the top. User may filter results by patient name, time of access, or by keyword.

Processing:

Filters applied by user will prune list of historic activity, based on selection by user. Keyword search allows user to filter out all viewed records which do not contain the key word or phrase. Patient name may be partially typed in order to identify specific record or action.

Outputs:

Once desired filters have been applied and had time to sort history completely, a list of links will remain displaying time of access, patient name, and which information was interacted with. If filter is enacted by keyword, the phrase containing the keyword highlighted will be displayed beside the time of access and patient name. Filtering by patient name will narrow down listed actions in real time until either matching records are displayed or no records exist that match the partially typed name.

Error Handling

- User attempts to search activities that took place in a temporary window.
  - Certain Arrow functions warrant the creation of a temporary information viewing window which will be closed when the user is finished with their analysis. The information concatenated into this temporary window will not be viewable in its original format when accessed through the history explorer. The user must recreate the window based on their site activity if they wish to view the same specific information for a second time.

Screenshot Blocker

Introduction:

Many devices support some type of screenshot feature which copies a full display of the current screen onto a temporary clipboard, so it may be pasted into several types of documents. This function could potentially be used to compile an entire patient record in simple .jpeg images, and steal information from secure records. The screenshot blocker feature will cause Arrow's screen to blank out if a screenshot is attempted, protecting critical private information.

Inputs:

The potential keystrokes for screenshots will be the trigger for blocker to operate. This keystroke combination is dependent upon the device that Arrow is being used on. If these keys are accidentally depressed for even a moment, Arrow will recognize the attempt.

Processing:

The keystrokes that operate the system screenshot function of the device and the screenshot blocker of Arrow will be triggered simultaneously. Arrow will activate it's blocker for a period of as long as the keys are depressed and two seconds after the keys are released.

Outputs:

The open Arrow window will instantly change from what it was previously displaying into a blacked out box which will censor the entire area. No information will be visible in the pasted system screenshot as the image will contain nothing but the blackened Arrow window. After the blackened screen disappears and the record being viewed is back, a small dialog box will appear stating a warning against screenshots.

Error Handling:

- User attempts to screenshot more than two times within one session
    - Dialog window will appear stating that screenshot attempts have been recognized and they will be logged off of Arrow. Notification will be sent to admin detailing user in question, times of screenshot attempts, and the record(s) being viewed at the time of the screenshot attempt.

User Stories

User Story #1

While inputting new patient information into a specific patient profile, User A realizes that a certain piece of information should be known by all clinicians treating this patient. After inputting this information, User A clicks the “Flag” button located next to that information field. When clicked, the flag turns a red color to show that it is activated. After flagging, a notification will be sent to the patient whose profile is being flagged. The patient will be requested to consent to this information being available to all clinicians they encounter. If accepted, all clinicians interacting with this patient in the future will be able to immediately view the flagged information. If denied, future clinicians treating the patient will simply treat the patient without knowledge of the denied flagged information.

User Story #2

Patient A would like to link family members to their account in order to inform clinicians of the health problems which occur within their family. Patient A goes to the “Family” tab within the software window and inputs the family member’s basic information including “Full Name” and another identifier such as “Address” or “Social Security Number.” After inputting correct information, the Patient is able to request to be linked to the patient which they searched for. If any of the information is incorrect, the patient will not find the correct family member. Once Patient A selects that the searched patient is part of their family, they specify the exact relationship and a notification is then sent to that patient, Patient B. Patient B receives a notification of the family request. They review the patient information which is attempting to be family linked. If Patient A is indeed part of Patient B’s family and is showing a correct relationship status, Patient B may accept this request. If Patient B realizes that Patient A is not a part of their family, they can deny this action.

User Story #3

User A is treating Patient A and would like to view their information in order to make a full diagnosis of the current ailment. In order to do so, User A realizes that it would be beneficial to see if this same occurrence has happened in the past for Patient A. User A accesses Patient A's health profile and views all flagged information. User A is able to make a more complete diagnosis due to the additional information retrieved from the NHII database regarding the patient.

User Story #4

User A is currently meeting with Patient A during a routine check-up. During this check-up, User A would like to add information to Patient A's health profile. While viewing Patient A's profile, User A can click the "Update Information" button located at the top of the profile. This will bring User A to a screen where new information can be added to Patient A's profile. Upon completion of adding new information, User A will save the information added and this will now appear within Patient A's health profile.

User Story #5

When User A is finished accessing health information, or is about to step away from their computer, they must log out of their profile in order to maintain patient privacy. In order to do so, User A will click the log out button at the top of the screen. This will immediately stop all processes being done by the NHII software and will return User A to the original login screen.

User Story #6

In order to keep login information secure, User A must change their password at minimum every 6 months. In order to do so, User A must click the "Change Password" button under the account settings tab. By clicking this button, User A will be brought to the Change Password screen. Here, User A will be requested to input the current password along with the new password and a repeat of the new password. If the old password is correct and the two new passwords match and have not previously been used by User A, the password change request will be complete. If the old password is not correct, or the new password has been previously been used or do not match each other, User A will be returned to the main screen and given an error message explaining what went wrong.

User Story #7

When stepping away from the computer for any reason, User A must either lock or logout of their account. In order to lock their account, User A will click the lock account button next to the logout button. This "Lock Account" request will automatically put a freeze on User A's current work and hide the screen that they were accessing. A countdown will also start for a specified amount of time. User A will have until that time to return to the computer and input their correct password to unlock their profile and resume work. If they do not return in time, they will automatically be logged out and returned to the original login screen.

User Story #8

While inputting new patient information, User A will be able to control the security level for specific pieces of patient health information. To set a security level for specific information, User A will click the "Security" logo next to the new information. Once clicked, a drop-down menu will appear where User A will be able to select the appropriate security level for this information. If this information is not sensitive, a lower security level will be chosen. If more sensitive, a higher security level will be selected. Once a security level is picked, a notification will be sent to the user who will have a chance to review or change the security level of input information within their health profile.

User Story #9

User A is currently meeting with Patient A regarding pain in the patient's hand. While inputting new information regarding the current health issues that Patient A is facing, User A will be able to associate this information with as few or as many keywords as necessary to aid in the future search of this information. In this specific instance, User A selects the keywords, "Pain", "Hand", and "Arthritis" from the list of active keywords.

User Story #10

After taking X-rays of Patient A, User A would like to add this documentation to the health profile of the current patient. In order to do so, User A accesses the digital file of the X-Ray. User A then goes to Patient A's profile and in the relevant section, clicks "Upload File." At this point, User A is able to browse through their files in order to find the relevant file for this patient. Once found, User A clicks the "Submit" button and the file is now uploaded to the NHII database where future clinicians will be able to access the information uploaded.

Non-Functional Requirements:

Performance

Arrow should be able to retrieve the bulk of on-site patient data almost instantaneously. Any off-site data will suffer from a performance bottleneck based on the nature of the physical link and distance between sender and receiver; however the time Arrow spends processing the information at either end should also be well under one second.

Reliability

Due to the nature of health and patient information, downtime of the Arrow software should be limited to less than a few minutes per week. Any downtime will be the result of scheduled maintenance and occur during the night and early morning, when doctors and patients are the least active. System downtime as a result of memory leaks, software crashes, or hardware failure are unacceptable.

Availability

The Arrow software will be available on all information processing platforms currently used in the medical industry today. This includes personal computers, tablets, and smart phones.

Security

Concerns for security have already been examined in depth in other parts of this document. At a high level, any data sent over the network by the Arrow software will need to be encrypted. Login/password combinations will need to be stored in secure databases using the most complicated salting algorithms, and various processes regarding the use of the Arrow software will have to be developed.

Maintainability

Updates to the Arrow software will occur in small incremental patches. This will happen on a weekly to bi-weekly basis. This is to keep the system downtime for processing updates to a minimum.

Portability

In the software sense of the word, the Arrow software should not be portable. The arrow software will need to be re-downloaded and reinstalled on every new computer; the application will not be able to be run from a flash drive or portable hard drive. In fact measures should be taken to prevent this type of activity and block any workarounds.

Appendix B: Various Hospital Forms

Saint Vincent Hospital ANTICOAGULATION RECORD

Weight: ______ kg ☐ Measured ☐ Stated ☐ Estimated
Baseline (within last 24 hours OR before initiation of anticoagulant): aPTT ______ PT ______ INR ______

☐ **High Dose Heparin Indications** (target aPTT 60-85 units)
25,000 units/500mL 0.45% NaCl (50 units/mL)
☐ Deep Venous Thrombosis (DVT)
☐ Pulmonary Embolism (PE)
☐ Other: ______________________

☐ **Argatroban - Heparin-Induced Thrombocytopenia (HIT)**
250mg / 250mL NS
Argatroban Initiation: Date: ______ Time: _____ Rate: _____ mL/hr

☐ **Lepirudin - Heparin-Induced Thrombocytopenia (HIT)**
50mg / 250mL NS
Lepirudin Bolus: Date: ______ Time: ______ Dose: ______ mg
Lepirudin Initiation: Date: ______ Time: ______ Rate: ______ mL/hr

☐ **Low Dose Heparin Indications** (target aPTT 50-70 units)
☐ Acute Coronary Syndrome (ACS) e.g., acute MI, UA
☐ S/P thrombolytics/GP IIb/IIIa **(max. initial bolus 4,000 units)**
☐ No thrombolytics/GP IIb/IIIa given **(max. initial bolus 5,000 units)**
☐ Atrial Fibrillation
☐ CVA/TIA *(no boluses to CVA patients)*
☐ Other: ______________________

Heparin Initiation: Date: __________ Time: __________
Initial Bolus: ________ units Initial Rate: __________ units/hour

Date / Time	aPTT Value	Current Infusion: Dose/hour units or mg	Current Infusion: mL/hr	Bolus: Time	Bolus: Dose in Units or mg	Medication Infusion: Time	Medication Infusion: Rate Change	Medication Infusion: New Rate Dose/hour units or mg	Medication Infusion: New Rate mL/hr	aPTT Due	Comments include times when infusion is stopped	IV Bag Changed	RN Calculation, Verification of Dose & IV Pump Setting (signature & title)	2nd RN Independ. Check of Calcul., Verif. of Dose & IV Setting (signature & title)	R.Ph. Verification (signature & title)
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					
										Date: ____ Time: ____					

Saint Vincent Hospital

CONSULTATION SHEET

Called/Notified ______ Date ______ Time ______ Initials ______

To: ____

Probable Diagnosis: ____

Reason for Consult: ____

____

____

____

CONSULTANT'S NOTES

Please Sign

Date: ______________________ Time: ______________ ☐ a.m. ☐ p.m.

____

☐ Notes Dictated: ____

Signature

W.CONS10885 (Rev. 3/10)

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6

Saint Vincent Hospital

Progress Notes

Note progress, complications, change in diagnosis, treatment (with indications for same), removal of drains and sutures, condition of wound, etc., also condition and instructions in discharge notes, with complete final diagnosis and code numbers.
DATE, TIME AND SIGN ALL NOTES.

DO NOT USE	DO NOT USE	DO NOT USE	DO NOT USE
'U' for units 'IU' for international units	'QD' for daily 'QOD' for every other day	Lack of leading zero (.X mg)	Trailing zero (X.0 mg)
		MS, MSO_4, $MgSO_4$ for morphine sulfate or magnesium sufate	

DATE & TIME	DISCIPLINE	

W.PN FORM #10904 (Rev. 2/10)

4

Saint Vincent Hospital

Sitter Observation Flow Sheet

Reason for Sitter
(check all that apply)

- ☐ Suicidal
- ☐ Falls
- ☐ Assaultive (harmful to self or others)
- ☐ Seizures
- ☐ Elopement / Flight Risk
- ☐ Detox
- ☐ Other: ____________

Date: ____________ Shift: ____________

RN's Narrative Report *(specify behavioral assessment and findings, and instances when the RN must be notified, e.g., confusion and patient's signs and symptoms)*: ____________

____

____

____________ RN's Signature: ____________

ACTIVITY KEY
If #9 through #13 is new for the patient, RN must be notified
1. Sleeping
2. Resting
3. Out of Bed
4. Eating
5. Watching TV
6. Reading
7. Talking on Phone
8. Visiting
9. Moaning / Mumbling
10. Fidgeting / Pulling at Catheter or Equipment
11. Yelling
12. Trying to Get Out of Bed
13. Hitting / Punching Fighting

BEHAVIOR KEY
For #1 through #7, see reverse side of flow sheet; any one of these items checked off requires an RN assessment
1. Suicidal
2. Falls
3. Assaultive
4. Seizures
5. Elopement / Flight
6. Detox
7. Clinical Assistance

ACTION KEY
1. No Action Required
2. RN Notified
3. PCA / CCT Notified

Date																
Time																
Observation checks every 15 minutes																
Activity *(key)*																
Behavior *(key)*																
Action *(key)*																
Rights / Dignity / Safety Maintained																
PCA / CCT Follow-up																
RN Follow-up																
Date																
Time																
Observation checks every 15 minutes																
Activity *(key)*																
Behavior *(key)*																
Action *(key)*																
Rights / Dignity / Safety Maintained																
PCA / CCT Follow-up																
RN Follow-up																

Signatures of Nonclinical Personnel

____________ ____________

____________ ____________

W.NURS26011 (Rev. 2/10)

UPON COMPLETION, FILE IN PATIENT'S MEDICAL RECORD

11

Saint Vincent Hospital
CENTER FOR PSYCHIATRY

Suicide Assessment

SUICIDALITY

1. None ☐ ____
2. Vague ideation ☐ ____
3. Ideation with a vague plan, high chance of rescue ☐ ____
4. Plan, previous low level attempt, high chance of rescue ☐ ____
5. Lethal plan, intent to die, low chance of rescue, hx serious attempt ☐ ____

METHOD

1. Limited access to pills, superficial cuts ☐ ____
2. Availability of lethal prescriptions or OTC drugs ☐ ____
3. Access to lethal means: guns, noose, CO poisoning ☐ ____
4. Knowledge and clear plan of how to use lethal means ☐ ____

PSYCHOSOCIAL STRESSORS

1. Mild (i.e., promotion, change in living situation) ☐ ____
2. Moderate (i.e., health problems, job problems) ☐ ____
3. Severe (i.e., divorce, separation) ☐ ____
4. Catastrophic (i.e., death of loved one, trauma) ☐ ____

EMOTIONAL SIGNS AND SYMPTOMS

1. Present symptoms acute (less than 24 hours), stress related ☐ ____
2. History of major mental illness, current symptoms lasting more than1 week ☐ ____

COMORBID MEDICAL ILLNESS

1. Minor medical illness ☐ ____
2. Debilitating illness, chronic pain ☐ ____
3. Terminal illness ☐ ____

COMORBID SUBSTANCE ABUSE

1. Alcohol or illicit drug abuse/dependence ☐ ____
2. Prescription drug abuse/dependence ☐ ____

PSYCHOSOCIAL SUPPORT (family, friends, providers, others): ____

ASSESSMENT OF RISK: ☐ Low ☐ Moderate ☐ High

Signature & Credentials: ____ Date: ____ Time: ____

Print Name: ____

W.MULTI24761 (Rev. 4/10)

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Symptoms or Behaviors to Observe and Report to Nurse Immediately or as Soon as the Situation Safely Allows

1. Suicidal Patients
   - Increasing isolation, staying in their room, avoiding others, refusing visitors / phone calls
   - Increased level of activity — especially with ADLs (e.g., the patient who suddenly wants to get cleaned up when in the past he/she had been unkempt)
   - Presence of command hallucinations — voices telling them to hurt themselves
   - Change in sleep pattern / appetite from what you were used to observing at the time of admission or in recent days
   - Increase in crying, anxiety, psychomotor agitation
   - Verbalized plan or intent
   - Wanting to give items away, change a will
   - Self-deprecating statements — "I do not deserve to have these nice things." " I am not worth anything." "I do not deserve all this attention."
   - Gut feeling — If you have a gut feeling something is wrong, report it no matter how small it may seem

2. Patients Who May Fall
   - Attempt to get out of bed or a chair without waiting for or asking for assistance
   - Confusion and inability to follow directions
   - Cannot use call button when asked to demonstrate to staff how it works
   - Frequency or urgency of bowel and bladder (if so, place on a schedule)
   - Unstable gait or shuffling gait
   - Patients with neuromuscular disorders (e.g., Parkinson's Disease)
   - Patients with pain who have been given medicine for the pain
   - All patients on psychiatric medications
   - Patients on diuretics (usually heart patients that use the medication for excess fluid)
   - Patients who have come back from a procedure for which they were sedated

3. Assaultive Patients
   - Swearing or talking loudly, negative verbalizations directed at others or property
   - Command hallucinations to harm others
   - Hits walls, the mattress, the pillow
   - Throws items at others or at objects
   - If intoxicated, consider a high potential for assault
   - Psychomotor agitation
   - Patients states intent to harm others or objects

4. Patients with Seizures
   - Patients may stare off
   - Change in speech
   - Unaware of surroundings
   - Actions may appear clumsy, may wander without regard for obstacles or limitations, may have repeated movements, may fumble with clothing

WHEN A SEIZURE HAPPENS
- Do not restrain or inhibit movements — If the patient is sitting in chair, lower to floor to facilitate opening of airway
- Remove articles in immediate vicinity that may cause harm to the patient (e.g., chair, bedside table)
- Turn patient to the side if possible
- Keep track of the time it started, when it ended, and what the patient did during the seizure
- Assure others and the patient to maintain a calm environment
- Do not leave the patient alone. Keep the patient safe and prevent injuries.

5. Elopement Patients
   - History of elopement
   - Extremely curious about the environment
   - Tries doors / windows to see if they are open
   - Elopement patients should not have smoking privileges or, if allowed, should be one-to-one
   - Involuntary patients are more apt to elope than voluntary patients

6. Detox
   - ETOH / Drugs — Gross confusion, disorientation, profuse diaphoresis, severe agitation and elevated vital signs

7. Clinical Assistance
   - e.g., toileting, pain medication, repositioning, etc.

8. Patients Repeatedly Trying to Get Out of Bed
   - Report this observation to the RN immediately
   - Reorient the patient as to where he/she is
   - Reinforce that the patient needs help getting out of bed
   - If you are a PCA, inform the patient that you will take him/her to the bathroom every 2 hours or more frequently if needed. If you are a nonclinical sitter, tell the patient that you will call the PCA or RN every 2 hours or more frequently if needed.
   - If the RN cannot resolve the issue of the patient trying repeatedly to get out of bed, page the Director of the Unit; if the Director is not available for the 3-11p and 11p-7a shifts, page the Administrative Coordinator (Nursing Supervisor) at beeper #0070 to help you with the situation.

UMASS MEMORIAL MEDICAL CENTER

EMERGENCY DEPARTMENT
NURSING RECORD
Page 1 of 5

Date: ______________

NAME:

ADDRESS:

BIRTHDATE/AGE: SEX:

MEDICAL RECORD NUMBER:

PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

2

Last Name:		First Name:	DOB:	ESI ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
Arrival Time:	Age:	M / F	CC:	

Arrived by: ☐ Walked In ☐ Wheelchair ☐ Helicopter ☐ Other ☐ Ambulance ______

Language Spoken: ☐ English ☐ Spanish ☐ Other ______

Interpreter: ☐ Professional ☐ Polycom ☐ Phone ☐ Family ☐ TTY

Behavioral Risk Assessment: ☐ NA

☐ Y ☐ N In the past 2 weeks have you had any thoughts of hurting yourself or anyone else?

DIRECT TO: ☐ TRIAGE ☐ EMH ☐ PEDI ☐ Pedi Place ☐ PROMPT CARE ☐ ED ROOM # ☐ Mask On

Allergies:

Signature: ______

Printed Name: ______

TRIAGE ☐ NA

☐ WC ☐ Sling ☐ Ice ☐ Dsg ☐ EKG Time ____ ☐ Labs sent Time ______ ☐ X-Ray ______

Time: ________ RN Signature: ____________ Print Name: ____________

PRE-HOSPITAL CARE ☐ None ☐ O2 ☐ IV ☐ C-Spine Immobilized Medications:

PMH: ☐ Reports none

VITAL SIGNS	BP /	P	RR	Temp O/R /A	Pulse OX ____ RA O2 __ L	Pain ___ /10	Wtg ______	☐ NA kg	TD - yr	LMP

☐ Direct to Room # ______ Time: ______ PRIMARY NURSING ASSESSMENT

Pain	Current Living Situation	General Appearance	Fall Assessment
☐ Denies ____ /10 Location ______ Radiates to ______ ☐ Sharp ☐ Dull ☐ Ache ☐ Stabbing ☐ Crampy ☐ Intermittent ☐ Constant	☐ With family/friends ☐ Alone ☐ Assisted Living ☐ Rehab/Nursing Home ☐ Homeless/Shelter ☐ Social Service offered	☐ Healthy ☐ Alert, oriented X___ ☐ Cachectic ☐ Obese ☐ Unkempt **Speech** ☐ Normal ☐ Aphasic ☐ Slurred	☐ Basic safety measures ☐ Known history of falls ☐ Gait disturbance ☐ Use of ambulation aids ☐ Altered mental status ☐ ETOH/drugs
Other	**Barriers to Learning**		
☐ None ☐ Legally Blind ☐ Hearing Aid(s) ☐ HOH ☐ Cane ☐ Brace ☐ Walker ☐ Amputation/paralysis ☐ AV shunt ☐ R ☐ L ☐ Mastectomy ☐ R ☐ L	☐ None ☐ Other ______ ☐ Unable to assess ☐ Emotional distress ☐ Cognitive issues ☐ Language ☐ Hearing/speech/sight	☐ Y ☐ N Nutrition: Change in appetite/unplanned weight loss or gain in the past 6 months ______ lbs ☐ Y ☐ N Alcohol use: ______ ☐ Y ☐ N Drug use: ______ ☐ Y ☐ N Smoker: ______ ☐ cessation education offered ☐ Y ☐ N Do you feel safe at home?	

BRIEF RISK ASSESSMENT ☐ NA

☐ Y ☐ N Have you thought of ANY ways to hurt yourself?
☐ Y ☐ N Do you have access to a gun or other means to hurt yourself? Plan? ______
☐ Y ☐ N Have you tried to hurt yourself in the past year?
☐ Y ☐ N Do you think you might try and hurt yourself here in the hospital or leave before completing treatment? ☐ Searched by ______ ☐ Belongings removed ☐ Section 12

☐ LIP notified
☐ EMH notified
☐ UMass Police notified
☐ Patient under observation
☐ Patient with family

Time: RN Signature: Print Name:

UMass Memorial Children's Medical Center

EMERGENCY DEPARTMENT NURSING RECORD

Page 2 of 5

Date: _______________

NAME:

ADDRESS:

BIRTHDATE/AGE: SEX:

MEDICAL RECORD NUMBER:

PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

2

PEDIATRICS

NEURO □ NA | **GCS □ NA**

Pupils R L □ Intubated
Size mm mm Eyes
Reaction Verbal
□ Moving all extremities Motor
Strength RA LA Total
RL LL Refer to scales on back

BEHAVIORAL □ NA

□ Calm □ Anxious
□ Agitated □ Cooperative
□ Irritable □ Defensive
□ Hostile □ Aggressive
□ Uncooperative
□ Age Appropriate

OB/GYN □ NA

GR ____ Para ____ Ab ____
EDC ____ FHT ____
Vaginal bleeding □ Y □ N
Vaginal discharge □ Y □ N
Sexually Active □ Y □ N
Birth Control □ Y □ N

PRECAUTIONS □ NA

□ Contact
□ Airborne
□ Neutropenic
□ Respiratory/Droplet
□ Positive pressure
□ Negative pressure

CARDIAC □ NA

□ Monitor, alarms on
Pulse ____ □ Regular □ Irregular
Rhythm ____

RESPIRATORY □ NA

Rate ____ Stridor □ Y □ N Breath Sounds
□ Denies SOB Grunting □ Y □ N Clear □ R □ L
□ Speaking in full sentences Retractions □ Y □ N Crackles □ R □ L
Wheezes □ R □ L
□ Cough □ Productive Absent □ R □ L
□ NRB O2 @ ____ L/NC Diminished □ R □ L

ORTHO □ NA

Injury to: ____
Deformity □ Y □ N
Swelling □ Y □ N
+CSM □ Y □ N

GI/GU □ NA

□ Foley PTA □ Hematuria □ Dysuria
□ Frequency □ Anuria □ Nocturia
□ Urgency Incontinent □ Urine □ Stool
□ Unable to void (time)
Abdomen □ Soft □ Rigid □ Distended
Guarding □ Y □ N
Testicular Pain □ Y □ N
□ Vomiting ____ □ Diarrhea # of stools ____ and color ____

PAIN on palpation □ Y □ N
mark X on ▶
Bowel sounds
□ Present
□ Diminished
□ Hyper □ Hypo
□ Absent Last BM ____

SKIN INTEGRITY □ NA

□ Y □ N Sacrum/Coccyx Intact
□ Y □ N Heels Intact
□ Y □ N Elbows Intact
Red or open area on ____

SKIN □ NA

□ Warm
□ Dry
□ Moist
□ Cool
□ Pale
□ Flushed
□ Bruising
□ Mottled

Newborn Assessment ≤ to 8 weeks

Weeks gestation ____ Birth weight ____ Complications at birth ____
Breastfeeding □ Y □ N Formula □ Y □ N
Placed on Ohio warmer □ Servo mode

Time: ____ RN Signature: ____ Print Name: ____

Time	PRE PAIN	Medications (po, pr, IM, SQ, IV push)	RN Initial	POST PAIN & TIME	Time	PRE PAIN	Medications (po, pr, IM, SQ, IV push)	RN initial	POST PAIN & TIME

IV ACCESS, HYDRATION, AND IV MEDICATIONS

IV #	Start Time	Solution	Amount hung	Rate	IV Medication and Dose	Pump	Stop Time	Total	RN
						Y N			
						Y N			
						Y N			
						Y N			
						Y N			
						Y N			
						Y N			
						Y N			
						Y N			

INTAKE				OUTPUT			PHLEBOTOMY □ NA			IV THERAPY				
TIME	PO	TIME	PO	TIME	URINE	OTHER	TIME	RN/PCA	SITE	TIME	#	Size	Site	RN
									IV VEIN		1			
									IV VEIN		2			
									IV VEIN		3			
									IV VEIN		4			

UMass Memorial
Children's Medical Center

EMERGENCY DEPARTMENT NURSING RECORD

Page 3 of 5

Date: ______________

NAME:

ADDRESS:

BIRTHDATE/AGE: SEX:

MEDICAL RECORD NUMBER:

PEDIATRICS 2

Handoff faxed @ ______________ (time)

PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

Time	BP	Pulse	RR	Pulse OX	Rhythm	Temp O/R/A	Time	BP	Pulse	RR	Pulse OX	Rhythm	Temp O/R/A

FSBS	Time	Results	initials	Time	Results	initials	Time	Results	initials	Time	Results	initials	FSBS

POC	Urine Hcg ☐ pos ☐ neg	Urine dip

Time	Nursing Documentation

TIME	PROCEDURES	TIME	PROCEDURES
	Vent: Mode _____ Rate _____ TV _____ PEEP _____ FIO2 _________		Straight cath
			Foley catheter # ________
	Intubation Size _____ lip line _____		Foley catheter # ________ with urometer
	ABG drawn by RN/RT Repeat X _____		Restraints (see sheets)
	NG/OG ______ inserted		
	Visual acuity	Critical Care Minutes:	

Belongings/Valuables: ☐ None ☐ Belongings with patient ☐ Belongings with family ☐ Valuables Checklist

Departure Time: ________ ☐ Admitted RM # ______ ☐ Transported with RN ☐ On monitor ☐ IV infusing ☐ Respiratory with patient

Disposition: ☐ Home ☐ ED OBS ☐ EMH ☐ AMA ☐ Elope ☐ LWBS ☐ Morgue ☐ Transfer to: ________

☐ D/C instructions reviewed with patient/caregiver ☐ Patient/caregiver verbalizes understanding of D/C instructions

Initials	Signature and Title	Printed Name

PEDIATRICS PEDIATRICS PEDIATRICS PEDIATRICS PEDIATRICS

UMass Memorial Children's Medical Center

PHYSICIAN'S ORDERS
EMERGENCY DEPARTMENT
NURSING RECORD

Height Inches ______ Cm. ______	Weight Kg. ______
ALLERGIES: ☐ NONE KNOWN	☐ YES (LIST BELOW) OR ☐ LISTED PREVIOUSLY

NAME:

ADDRESS:

BIRTHDATE/AGE: SEX:

MEDICAL RECORD NUMBER:

PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

2

PEDIATRICS

PROVIDER TO SIGN AND PLACE PAGER NUMBER LEGIBLY UNDER EACH ORDER SET
INDICATE CHOICE OF ORDER OPTIONS BY USING X IN CHECK BOXES ☒

DATE	TIME	ALL OTHER ORDERS	DATE	TIME	MEDICATION ORDERS ONLY
		☐ EKG ☐ ABG ☐ ISTAT (G8) ☐ FSBS			☐ Acetaminophen (Tylenol) 15mg/kg PO x 1
		☐ CBC WITH DIFF ☐ BMP			Dosage ordered: ______
		☐ PT ☐ PTT			☐ Ibuprofen (Motrin) 10mg/kg PO x 1
		☐ LFT's ☐ AMYLASE ☐ LIPASE			Dosage ordered: ______
		☐ TYPE AND SCREEN			
		☐ TYPE AND CROSS # UNITS ______			
		☐ TRANSFUSE ______			
		☐ POC UA ☐ C+S ☐ URINE DIP			
		☐ STRAIN CATH ☐ INSERT FOLEY			
		☐ POC UCG ☐ SERUM QUANTITATIVE HCG			
		☐ GC ☐ CHLAMYDIA			
		☐ DRUG OF ABUSE ☐ ETOH LEVEL			
		☐ TYLENOL LEVEL ☐ ASA LEVEL			
		☐ BLOOD CULTURES ☐ X1 ☐ X2			
		RADIOLOGY			
		Clinical Indication: ______			
		X-RAY:			
		CAT SCAN			
		Clinical Indication: ______			
		CT:			
		☐ NEW ONSET IDDM (EDDMI)			
		☐ SEPSIS WORK UP (EDPEDSEPTC)			
		☐ LP (EDLPPEDI)			
		☐ NS Bolus 20mL/kg			
		☐ D5NS Bolus 20mL/Kg			
		☐ ADMIT TO OBSERVATION @ ______			

PEDIATRICS

PEDIATRICS

PEDIATRICS

PEDIATRICS

UMASS MEMORIAL MEDICAL CENTER

MEDICATION RECONCILIATION ORDER FORM (MROF)

Page 5 of 5

NAME:
ADDRESS:
BIRTHDATE/AGE: SEX:
MEDICAL RECORD NUMBER:

PRINT CLEARLY IN INK OR IMPRINT WITH PATIENT'S CARD

3

Allergies:

Pediatric patients only: Height (cm) ________ Weight (kg) ________

Source of Home Medication List: (check at least one)
- ☐ Patient medication list
- ☐ Patient/Family recall
- ☐ Pharmacy:
- ☐ Primary care physician list / medical record
- ☐ Previous discharge paperwork
- ☐ Medication Administration Record from facility
- ☐ Other:

Check All That Apply:
- ☐ Patient is NOT on home medications
- ☐ This is an addendum to or revision of previously completed MROF
- ☐ Patient is pregnant
- ☐ Patient is breastfeeding
- ☐ Modified Medication Reconciliation

Location: ☐ ED ☐ Other:

LIST RECORDED BY: Date: / / Time :

This form is used for inpatient admissions and ambulatory patients being discharged home. In modified medication reconciliation settings, only the "HOME MEDICATION" column is used. For detailed instructions, see reverse.

PHYSICIAN ORDER

	HOME MEDICATION (WRITE LEGIBLY)	DOSE	ROUTE	FREQUENCY	LAST DOSE Date	LAST DOSE Time	CIRCLE C to continue or DC to discontinue
1.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
2.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
3.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
4.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
5.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
6.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
7.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
8.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
9.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
10.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC
11.			☐ By mouth Other:	☐ Daily ☐ Twice Daily ☐ Other:	/ /	:	C DC

DO NOT WRITE IN THIS AREA

Signatures are required below only for patients being admitted to an inpatient setting.

Do not scan or take off orders without MD/NP/PA signature.

This page becomes an inpatient order form when medications are continued or discontinued and the form is signed by a MD or LIP.

Signature of MD/DO/NP/PA ________ Print Name ________ Pager No. ________ Date *(required)* / / Time *(required)* :

Signature of RN ________ Print Name ________ Date *(required)* / / Time *(required)* :

Prohibited Abbreviations: U, qd, qod, IU, .1 (write 0.1), 1.0 (write 1), MS, MSO4, MgSO4, µg, AS, AD, AU, OS, OD, OU, tiw

Weight- and Diagnosis-Based Heparin Dosing Nomogram

Check appropriate diagnosis category

Indications
Deep venous thrombosis (DVT)
Pulmonary embolism (PE)

Indications
Acute coronary syndrome (ACS)
(chest pain, acute myocardial infarction, unstable angina...)
Atrial fibrillation
Mechanical valve
Cerebrovascular accident (CVA)* / Transient ischemic attack (TIA)*

Make calculations based on body weight

HIGH-DOSE NOMOGRAM

Bolus heparin
75 units/kg IV
IV heparin infusion
15-18 units/kg/hour

LOW-DOSE NOMOGRAM

Bolus heparin*
50 units/kg IV
IV heparin infusion
10 units/kg/hour

Laboratory Tests
Baseline CBC, PT/aPTT if not done in last 24 hours
CBC with platelet count every 3 days during therapy
Stat aPTT 6 hours after any dosage change
When 2 consecutive aPTTs within therapeutic range, revert to daily aPTT

IV HEPARIN ADJUSTMENT
Adjust heparin infusion according to sliding scale of appropriate indication

HIGH-DOSE NOMOGRAM
Therapeutic aPTT range
60-85 sec.

LOW-DOSE NOMOGRAM
Therapeutic aPTT range
50-70 sec.

***No bolus for CVA / TIA**

W.PO FORM #23242 (Rev. 6/11)

Saint Vincent Hospital

WEIGHT- AND DIAGNOSIS-BASED HEPARIN PROTOCOL
Part A: LOW DOSE NOMOGRAM

DIAGNOSIS: **ACUTE CORONARY SYNDROME (ACS)**
ATRIAL FIBRILLATION
CEREBROVASCULAR ACCIDENT (CVA) / TRANSIENT ISCHENIC ATTACK (TIA)

1. Labs: Draw baseline CBC, PT/aPTT if not done in last 24 hours.

   Use standard heparin concentration of 50 units/ml (25,000 units/500 ml 0.45% NaCl)
   Repeat aPTT in 6 hours.

2. Admission weight: ___________kg (lbs.÷ 2.2 = kg)

3. Heparin bolus: 50 units/kg = _______________ units IV. Round to the nearest **1000 units.**
   Maximum bolus is:
   5, 000 units if NO thrombolytics and/or GP IIb/IIIa given
   4, 000 units if thrombolytics and/or GP IIb/IIIa given
   NO bolus for CVA patients.

4. IV heparin infusion: 10 units/kg/hr = _____________units/hour. Round to the nearest **50 units.**
   Maximum *initial* infusion rate is 1,000 units/hr (20 ml/hr).

5. Adjust heparin bolus and/or infusion on sliding scale below.
   Round *bolus* dose to the nearest *1,000 units*, *infusion* dose to the nearest *50 units.*

aPTT <35	50 units/kg ***bolus***, then Increase drip by 4 units/kg/hr	Repeat aPTT in 6 hours
aPTT 35-49	25 units/kg ***bolus***, then Increase drip by 2 units/kg/hr	Repeat aPTT in 6 hours
aPTT 50 – 70	No change ***(therapeutic range)***	Repeat aPTT every 6hrs until 2 consecutive aPTTs in therapeutic range, then in 24 hrs
aPTT 71 – 90	Reduce drip by 2 units/kg/hr	Repeat aPTT in 6 hours
aPTT > 90	Hold Heparin for 1 hour Restart and reduce drip by 3 units/kg/hr	Repeat aPTT in 6 hours from restart time

Revised 06/11