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The Future of Public Health With the Use of the Electronic Health Record System

Juliana Carvajal

Candidate for the degree

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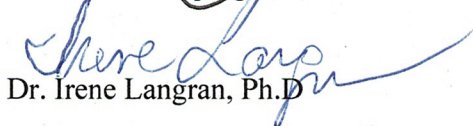
Departmental Distinction in Biology



Dr. Karen Campbell, Ph.D



Dr. Adam Hensperger, Ph.D



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Printed Name of Author: Juliana Carvajal

Street Address: 346 lake street

City, State, Zip Code: Ephrata, PA, 17522

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The Future of Public Health With the Use of the Electronic Health Record System

Biology & Honors Thesis
Juliana Carvajal

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The improvements that have been made to reform the public health system stem from a long history of dedicated people who have worked hard in hopes of making a difference in society. Early on, health threats consisted of poor hygiene, nutrition, and sanitation causing a variety of infectious diseases and low life expectancies. After legislations were passed and discoveries were made to improve these conditions, the world kept advancing with urbanization and commercialism. This caused more health threats to come about including those involved with motor vehicles, new diseases, and a lack of education on prevention of disease for people.

Although public health has made much advancement it still has a long way to go to keep up with the developments and discoveries that keep happening in the world. The technology revolution has made its way into the medical field as well as the scientific field and has found ways to improve the way medical care is given. One large impact into health care is the electronic health record system (EHR). Currently, the EHR works to improve the quality of care patients receive during a visit with a physician. With the use of this new technology, patient care and public health as a whole can be linked because it allows for physicians to connect with public health officials on matters of worldwide disease and common epidemics in their area. It also helps physicians contact mass populations of patients to increase preventative care. With further use of the EHR, the future of public health could be improved tremendously.

To understand how the EHR can possibly improve public health, one must understand where public health stems from and the strides people have made to improve it. During the 1600s, there was no concept of what disease was or how it was caused. This was a time where people lived in sewage infested towns and disease traveled on ships from country to country. Disease contributed to a low life expectancy of 35 years old for the people who were well off and 15 years for the poor [1]. A simple fever was believed to be caused and spread by miasmas or

“bad air”, not microbes. The solution for fevers was bloodletting, the draining of blood to cure an illness. This solution was inadequate since it caused many deaths and did not cure any disease. People learned to accept disease and death as a natural phenomenon without wondering its cause and never seeking a tactic for prevention. In all, death was a mysterious, unpredictable, and ever-present event.

The Age of Reason and Enlightenment revolutionized this nonchalant way of thinking about health, allowing for a change in mindset from uninterested to curious. This was during the 1600s to late 1700s, where the outlook of the educated changed and the errors of the past were observed and thought about logically [2]. The development of the educational system started at this time, improving the demand to learn to read and attend class since 80% of the population at the time was illiterate [4]. The Age of Reason and Enlightenment utilized the idea of reason and the scientific method allowing for education of the human race on matters of health, religion, philosophy, economics, and more. Focusing more on scientific reason versus biblical and philosophical beliefs, scientists were able to begin research and trace back the causes of many diseases. It was characterized by optimism, in hopes of humanity fixing mistakes and improving the world [3]. This era is what gave the idea to begin looking into the germ theory so people could start educating society on how to live healthier longer lives.

This was a start, but the industrial revolution overlapped with the Age of Enlightenment, in the late 17th and early 18th centuries where public health drastically took a toll. Mass populations migrated from rural to urban areas in hopes of improving their way of life with commercialism and industry. Migration worsened public health conditions, the large influx of people living in unsanitary conditions and working long hours for exploitative industries caused an increase in infectious diseases like smallpox, cholera, tuberculosis, and yellow fever [1]. This

created a recipe for disaster that was not only happening in America but across the globe. Most importantly, industrialized seaport cities welcomed disease with open arms allowing them to be transported with commercial cargoes so disease was spreading faster and farther than before.

It was during this time that scientists began to develop the idea of the germ theory. The germ theory states that diseases are caused by the presence of microorganisms in the body. The idea was eventually accepted replacing the idea that disease was caused by miasmas. This led to the jump-start of public health and scientists were able to find cures for diseases due to new technology. Scientists began to make big breakthroughs, Louis Pasteur discovered microbes allowing illnesses to be cured, Edward Jenner created the first smallpox vaccine, and anesthesia was discovered allowing for more humane and hygienic surgical procedures [1]. The large populations migrating to urban centers generated not only wealth, but also allowed for citizens of great knowledge to congregate and share theories [3]. With the new influx of money, research became possible allowing for inventions such as the microscope, telescope, and barometer allowing scholars the opportunity for accuracy. Economic growth improved living standards reducing the amount of people living in over crowded housing.

During the end of the 19th century and the beginning of the 20th the economy, government, and health of the US started changing dramatically [5]. The Interstate Commerce Commission was formed, the Sherman Anti-Trust laws and the federal Food and Drug Act were passed, and the Federal Trade Commission was passed showing the new found relationship between federal and state regulatory responsibilities. This led to an expansion in personal health allowing for an expansion in disease control, research, and epidemiology. One of the main advancements during this time was the expansion of research opportunities for the National Institute of Health [6]. This movement enacted a domino effect where other programs were

established like the center for disease control and the National Center for Health Statistics expanding federal programs to support individual health services and a numerous amount of health problems citizens were facing.

With the help of previous perseverance to improve public health, it only continued to progress throughout the 20th century. During this time, mortality rates in the United States declined severely. They fell by 40% from 1900 to 1940 and life expectancy at birth rose to 63 years of age [7]. The focus of public health was more concentrated in research and programs to respond to the effects of chronic diseases on the health of the public. Refining interventions and enhancing surveillance of mortality and morbidity kept the success of previous years. These improvements can be credited to new forms of technology as infiltration systems that filtered drinking water with chlorine to get rid of microbes accounting for about 1,484 lives saved each year. Other advancements in the US include the creation of vaccines for diseases like measles, polio, and tuberculosis two of which have since been eliminated.

Public Health has a vast history of improving the health of the people but it is often overlooked and misunderstood. Health is a homeostatic state of physical, mental, spiritual, and social well-being in addition to disease prevention [8]. In today's world, Public Health is defined as what society as a whole does to make sure that the people can achieve and maintain the needed state of health. It still holds the similar ideals and values it did throughout history of improving and protecting the health of families and communities by advocating healthy lifestyles, research, and controlling infectious disease [8]. It has also advanced to aid in disaster relief and recovery, to assure quality and accessibility of health services to all people, and prevention in general.

Even though public health has made much advancement in the United States it has begun to fall behind in progress compared to other wealthy nations. It has been calculated that the United States has the second highest death rate caused by non-communicable disease. In a study conducted by the National Research Council and the Institute of Medicine the health of Americans was compared to the health of international equivalents like Canada, Australia, and Japan [9]. The results showed that regardless of background or status, Americans live shorter lives and come across more injury and illness compared to others in any high-income country. The researchers credit these results to factors such as high caloric intake and having the highest diabetes rate compared to any other country in the world. They also believe that factors like medical errors, as in receiving the wrong medication and diagnosis, as well as having limited access to health care professionals in general, and a lack of primary care systems are negatively impacting the health of the United States.

When the researchers compared the risk factors between all of the countries, they did not find a large difference between the smoking habits of the US and other countries. When comparing obesity, they found that even though people in the U.S. are at higher risk for becoming obese in 1975 when the U.S. was not as far behind in life expectancy obesity rates were still high as well [10]. Peter Muennig MD, MPH stated his concerns saying:

“But what really surprised us was that all of the usual suspects—smoking, obesity, traffic accidents, homicides, and racial and ethnic diversity are not the culprits. The U.S. doesn’t stand out as doing any worse in these areas than any of the other countries we studied, leading us to believe that failings in the U.S. health care system, such as costly specialized and fragmented care, are likely playing a large role in this relatively poor performance on improvements in life expectancy. [10]”

Currently, the proposals for improving U.S. health care focus mostly on extending insurance coverage, reducing the cost by making health care more efficient, and expanding prevention and wellness programs [11]. Although, providing universal insurance coverage would protect families against financial burden while saving an estimated 18,000 to 44,000 lives, narrowing the gap of health outcomes between the United States and other high-income countries would demand a lot more than just providing insurance and would cost the US a lot more than they are spending currently. Since there are a numerous amount of preventable deaths associated with smoking (465,000 per year), hypertension (395,000), obesity (216,000), and other dietary risk factors, there is a plethora of opportunities to enact policies that could make a substantial difference in the performance of the health care system and in public health in general [1].

New policies like the Affordable Care Act (ACA) have improved the health of the American people and their access to care. Around 16.4 million people who were uninsured have gained coverage since this act as put into place in 2010, which has drastically helped those who are at the greatest risk for lacking insurance; young adults, Hispanics, African Americans, and the underserved [12]. In recent surveys, it has been concluded that these newly insured people are content with their coverage and three quarters of them have made appointments with primary care physicians for the first time in more than a decade. Since the ACA was passed the rates of uninsured have dropped from 18.2% down to 10.5% in 2015 [13].

Although aiming to provide health insurance to more people is ideal, it is projected that by 2025 31 million people will still be living without access health insurance and the funding will drastically decline [14]. Instead of solely focusing on increasing health insurance, a more costly method, strides should be made to start improving these smaller less costly problems.

With the use of the electronic health record (EHR) system problems such as medical error, lack of education, and more personalized care could be greatly alleviated and headways can be made to improve public health. The EHR allows physicians to run their practices in a more efficient manner allowing things to be done like scheduling patients, billing, sending in lab scripts, viewing notes from other physicians, allowing for increased preventative care. All of the patient's information as in health history, medication, and specialty physicians is included onto the EHR.

On February 17, 2009 the American Reinvestment & Recovery Act (ARRA) was enacted to modernize the nation, this included the Health Information Technology for Economic and Clinical Health (HITECH) Act [15]. This act expressed that by 2014 every person would be logged into the electronic health record (EHR) instead of using paper records. The HITECH act aimed to reduce health care costs resulting from inefficiency, medical errors, and inappropriate care. With the use of the EHR health care providers have seen these improvements. A survey conducted by the NCHS compared physicians who adopted the EHR versus those who did not. The results found that 79% agreed that their practice ran more efficiently, 67% saw an improvement in financial benefits for the practice, 75% received lab results faster, and 75% thought it allowed them to deliver better patient care [16]. It was also found that aside from making practices more efficient the EHR had the ability to increase cost savings. Depending on the size of the health system and how the EHR is implemented, a large hospital could benefit ranging from \$37 million to \$59 million over a five year time span.

The EHR was established in hopes of not only helping the patient gain better care but also allow physicians to improve the quality of care they provide. A focus of the EHR is to improve quality and care coordination [17]. This is done on the EHR by allowing physicians to

use clinical decision support tools [16]. A clinical decision support tool is a panel that a physician can add onto the EHR specific to what area they want to focus on. This provides guidance when treating patients on which medication to provide and if the patient truly falls in the category for the specified illness.

Converting to using the EHR is often difficult for some physicians that were accustomed to paper records but many adjust to it. Dr. Anthony Donato, an internal medicine hospitalist at the Reading Hospital, previously transitioned from paper medical records in the military to the EHR EPIC used by the Reading Hospital. As a hospitalist, he has seen a vast improvement in his work. He has seen that the EHR provides the ability to locate ambulatory records, find contacts for nurses and physicians, and get labs all in one place. There are also less transcription errors and fewer middlemen so patient care is faster and more efficient. The downfall of the EHR he says is, "Right now for EHR is like a giant warehouse. It can be compared to using a spoon to dig a ditch since there is so much information and capability but not designed to use effectively. We have scribes and other work arounds, but the EHR should be designed to be like an exoskeleton to allow doctors to be able to make efficient and effective clinical decisions." This thinking caused Donato to conduct his study that involved the use of a clinical decision support tool to see if the support tool would improve how doctors make decisions when providing patient care.

A study conducted at the Reading Hospital, by Dr. Donato and the author, aimed to utilize a clinical decision support tool in the EHR as a way to improve the care of patients with venous thromboembolic disease (VTE) [25]. The problem areas aimed to focus on were lowering pulmonary embolisms since they plague about 1 million people a year and cost about \$40,000 per patient. Another hope was to decrease mortality and morbidity rates by using

appropriate anticoagulation medications. Venous thromboembolic disease is a blood clot that begins in the vein and if not treated can break off and lodge itself in areas like the lungs or lower legs [18]. VTD is one of the most preventable causes of death, but is the third leading vascular diagnosis and one of the most overlooked areas of public health. Often patients receive inappropriate testing for thrombophilia causing an overuse of resources and increased cost.

For the study, a clinical decision support tool was created in Epic, the EHR the Reading Hospital utilizes. The support tool was created and embedded into the order set of the emergency department (ER) to direct the admitting physicians in the ER to choose low molecular weight heparin instead of heparin and to provide a basis on which tests were appropriate for the patient. Low molecular weight heparin and heparin are anticoagulant medications used to prevent blood clots. The idea to use low molecular weight heparin instead of heparin was because its progress does not have to be monitored periodically with lab tests making it cheaper for the patient, and it does not have as harsh of side effects.

Once the ER physician opened the order set there was a set of drop down boxes that allowed the physician to categorize their patient and help guide them towards the best method of treatment. The admitting physician in the ER was the only physician given the option to use the support tool. Secondary physicians, the physicians who saw the patient after admission, did not have access to the tool. When asked why Dr. Donato chose to base his study on a clinical decision support tool he answered, "To help doctors make decisions. We know therapy and info changes fast and all the time but getting the information from the study to doctors is slow. A clinical decision support tool helps get just in time information to physicians and hopefully one day these support tool can be sent to other ultimately improving public health."

The study population consisted of 827 patients. Adult patients admitted to the hospital with Pulmonary embolism were selected based on the ICD coding (ICD-9: 415 and ICD:10: I26) from December 30, 2013 until April 24, 2016. The support tool was not put into effect until March 2016. Efficiency of the order set was based on two criteria: the fraction of patients using low molecular weight heparin versus heparin and the percent of patients who received inappropriate thrombophilia testing upon admission.

Gene tests in unprovoked patients under 45, the average age a thrombus occurs, were considered appropriate, while all other testing was defined as inappropriate. Patients were considered provoked if they were bedridden for at least three days in the past four weeks, if they were post operative for the last 12 weeks, if they had active cancer and under treatment for the past six weeks, were diagnosed as inpatient with heparin induced thrombocytopenia, were pregnant, or had a history of inflammable bowel disease. All of these options are ways that a person is at risk for getting a thrombus.

Genetic testing was considered inappropriate for provoked patients because according to the guidelines for diagnosing thrombophilia it is not recommended to test if the person is already showing signs of a thrombus due to a previous medical encounter not a familial association [19]. It has been found that testing patients who are provoked does not predict the probability of recurrence therefore deemed inappropriate. A gene test would be deemed appropriate if the family of the patient has a common strong history of thrombophilia that is inherited.

It was hypothesized that the use of the new order set would increase the fraction of low molecular weight heparin used and inappropriate testing would decline. Inappropriate testing was compared before and after the clinical decision support tool was added. The results showed a decline in inappropriate testing with the use of the order set upon admission from 21% to 6.8%,

but secondary physicians had a 16% use of inappropriate testing. With the addition of the order set, the use of low molecular weight heparin increased to 61% from 48%. The order set was considered successful for admitting physicians (Figures 1 & 2).

These results show that with the use of the EHR medical errors and inappropriate testing can be reduced as well as reducing cost of resources used. In the future this study would be able to be furthered by supplying all physicians with access to the support tool. This study also helped show that it would also be beneficial to share clinical decision support tools and data across many hospitals so all physicians are able to be on the same page about diagnosing venous thromboembolic disease. The downfall is that this can only be done if each hospital has the same vendor, for example Reading Hospital uses EPIC as their vendor, and there are currently 15 vendors and none of them are compatible with each other.

Another aim of the EHR is to reduce health disparities. This new technology allows for data to be shared across many health organizations. Since 2009, the EHR has been providing emergency department and inpatient data to various health care organizations allowing for an increase in situational awareness [19,20]. Physicians have the duty of reporting lab results, immunizations, and certain diseases to the Public Health departments, which in turn work with the Center for Disease Control. Compared to the original method of filling out paperwork and faxing the information, this connection allows for faster detection, tracking, and management of diseases.

Public health officials use this data to better improve the community's health. Today, more than 1,800 medical providers in the nation use EHRs to electronically send immunization data registries allowing the determination of when to give the right vaccines at the right time [20]. It also allows for these officials to know what parts of the country are being affected the

most by disease so they can warn the population. For example, during the 2010 – 2011 flu season the Department of Health of Washington was able to determine in real time that only 20-30% of women who were pregnant were correctly vaccinated against the flu before their delivery. This finding allowed the state of health officer to send a letter to clinicians advising them to stress that pregnant and post-partum women to get vaccinated [21].

Another goal when the EHR was put in place was to improve patient centered care. When using the EHR physicians are able to monitor their own progress in areas they hope to improve like diabetes or hypertension surveillance. This works by grouping all of the patients in that particular population and seeing their health throughout various visits. By monitoring their own progress physicians are able to tailor their tactics for upcoming visits leading to improved care for their patients [19,20]. Since patients also have access to their medical records online, physicians are able to upload education material as well as after visit summaries allowing patients to be better informed and able to have a role in improving and maintaining their own health.

The EHR also lets physicians improve preventative care by letting them see which patient has to be immunized and sending notification to patients automatically who are due for a check up [21]. Since the records on the EHR can be seen by all of the patient's physicians this reduces repeated testing and misdiagnosis allowing for not only prevention but also a more efficient approach to treating the patient. Dr. Foldy MD has shared his story of how he successfully adopted the EHR in 1996. Although it took a lot of problem solving, he has seen a large improvement in-patient care. He has been able to call patients who have missed care like immunizations and diabetes care. His practice has also seen an improved rate of immunizations above the national average as well as just patient satisfaction has increased overall [21].

The EHR has shown vast improvement to health care and Public Health as a whole, but there are still some aspects that need development. EHRs are only as successful as the physicians who are using them. This means physicians must learn to use them properly in terms of the system as well as how to still incorporate patient interaction. A study conducted by the Northwestern University Feinberg School of Medicine observed 100 patient visits in a primary care clinic [22]. The videos were coded depending on gaze behaviors of patients and physician. The results found that physicians spend too much time looking at the computer when meeting with patients, which has the possibility of impacting patient interaction in a negative way.

There have been various methods tested to improve face-to-face interaction when utilizing the EHR. One method has been to hire a medical scribe so physicians can see more of their patients. The job of a scribe is to be in the room during the patient's visit and write down the notes of the session so the physician does not have to do so during the meeting. The EHR has a large focus on insurance claims so the more that is filled out on the form the better the insurance payback. This being said, it has been found that many physicians have been focusing and spending extra hours filling out their EHR's. With the use of a scribe all of this extra work can be cut back allowing for the physicians to spend more time with their patient's and less time doing paperwork.

Scribes have most commonly been used in the emergency department setting but an ongoing study conducted by Dr. William J. Lovett and Student Doctor Parth A. Javia at the Reading Hospital in Reading Pennsylvania hypothesized that utilizing a scribe in a primary care practice could increase patient and provider satisfaction [26]. Patient satisfaction was assessed across three domains and physician satisfaction on two domains. The three domains were office visits on a standard schedule without a scribe, a standard schedule with a scribe, and on a busier

schedule with a scribe. The two physician satisfaction domains were office visits with a scribe and without a scribe.

The researchers collected the data based on responses to a Likert Scale questionnaire, which assessed patient satisfaction during their office visit as well as with a scribe and physician satisfaction with their patient load and the scribe [26]. The researchers are still collecting the data, but data on available results from a population of 325 patient surveys and 115 physician surveys reveals two conclusions. The first is that with the use of a scribe, patient volume does not affect patient physician interaction. The second conclusion is that patient satisfaction was high at baseline and remained unchanged regardless of a scribe meaning that a scribe did not affect the patient's satisfaction if the physician was not seeing a larger population of people that day. Satisfaction does decrease when a physician sees a higher volume of patients without the scribe.

These results show that with the use of a scribe, patient physician interaction when using the EHR can be improved especially when the physician has a large patient population because it gives the physician more one on one time with the patient in a shorter amount of time. This is important since in the next few years it is estimated that there will be shortages of around 44,000 primary care physicians for the growing population [27]. The ratio of primary care physicians to population in urban areas is 100 per 100,000 populations. In rural areas it is 46 per 100,000 signifying that 21 percent of the U.S. population lives in rural areas, but only 10 percent of physicians practice in those areas. Similarly, these disadvantages exist in underserved areas.

Another area where the EHR could be improved to increase Public Health benefits is how it impacts underserved communities. Recent studies have found that technology has the potential to improve efficiency and quality of patient care in Federally Qualified Health Centers (FQHC)

[23]. FQHCs are federally funded programs that focus their attention in underserved populations. These include community health centers, migrant health center, health care for the homeless programs, and public housing primary care programs that meet the definition of health center as stated in the Public Health Service Act. In 2009, 7.2 million uninsured patients were treated in these centers. That same year these areas served about 865,000 migrant workers, more than 1 million homeless individuals, and around 165,000 residents utilizing public housing making these areas a major focus for improvement.

Today, access to all types of technology and internet disparities has decreased compared to previous years allowing for the digital divide to shrink [23]. A survey done by the Pew Internet and American Life Project in 2010 showed that the gaps in internet access have decreased primarily in rural areas. It was found that internet access at home for white/non-Hispanic populations was at 67%, a 2% increase from 2009 and Hispanic/English speaking population was at 66% access to internet. The study did show however that rural populations have not had a significant change in internet access, with 50% rural populations having internet access compared to 70% of non-rural populations. This leaves the other percentage of the population who cannot gain internet access with a limited means of accessing the benefits of the EHR. Issues like this must be taken into consideration before technology can be used in a beneficial manor for the underserved communities.

The Reading Hospital runs a street medicine program where physicians go into the Reading community seeking underserved areas that do not have access to health care. Currently, medical records of the patient's are written on paper and not filed electronically. In a day, physicians are able to see about 30 patients in a morning allowing them to connect patients to doctors, schedule appointments, and prescribe some medication. In an interview with Dr.

Donato, the physician involved in the street medicine program, he was asked how the EHR would benefit the program. His answer was that the EHR currently helps the program because on the road physicians have access to the EHR on an app on their phones.

The patients can be looked up in the registry to see if they were previously treated at the Reading Hospital and if so physicians are allowed to have access to their medical history and previous physicians. There is also the possibility of implanting wearable devices into the patients so physicians track their health online but this is an option that is not very attainable. When asked about the negative impacts of the EHR for the program Donato answered, “ The EHR for a public health aspect is currently inoperable because it does not allow all physicians to communicate with each other since there are many companies who offer an EHR. So if a patient has been seen at a different facility outside of the Reading Hospital there is no way to see that information.”

If these obstacles can be tackled then the future of the underserved communities could improve. The use of the EHR has the capability of increasing patient safety and improved personal decision making allowing for a better quality of life [23,24]. Since the EHR is able to track populations, the cause of health care disparities could be discovered and more effective behavioral health care interventions could be implemented. With the use of phones, patients who reside in rural areas who have limited access to their health care provider can message their physicians questions about their health through the EHR instead of coming into the office. Most people receiving Medicaid are provided a cell phone as part of their plan allowing for further communication. The EHR can also be used in conjunction with Health IT like Telemedicine. This allows for rural based patients to talk over the phone or via webcam with a health care provider any time they need it.

The EHR has shown to be beneficial in underserved programs like the Boston Health Care for the Homeless Program. This is a program that serves the homeless population of Boston. They have begun using the EHR to access medical information about their patients like their histories, allergies, medications, and health conditions. They also use the EHR to send out electronic referrals to aid in coordinating the necessary care for the homeless individuals [23].

In conclusion, public health stems from a long history of overcoming obstacles to improve the health of the people. It began with citizens accepting disease and death. It expanded during the Age of Enlightenment when the population started to question the cause of disease and microbes. With new inventions and policies public health was able to expand and foster allowing for communities to have longer life expectancies and healthier lifestyles.

Although early on there were many advancements to improve public health, new diseases and illnesses are always being found and microbes are changing to adapt. This is creating a need to track and monitor the health of the public. This started the era of technology improving public health with the EHR. The EHR has been able revolutionize how health care is provided. It has increased public health by allowing patients to have a role in their health care, allowed for patient centered care, and added an aspect of preventative care. Although the EHR has worked to improve the care of the non-underserved communities, a lot of work has to be put into helping the underserved populations as well due to the digital divide. The EHR has the potential of vastly improving the quality of life of the underserved population by allowing for the discovery of new ways to implement health care and giving a better access of care. If done properly, the lack of equality in the health care for the underserved versus non-underserved could be better balanced creating a boost in public health overall.

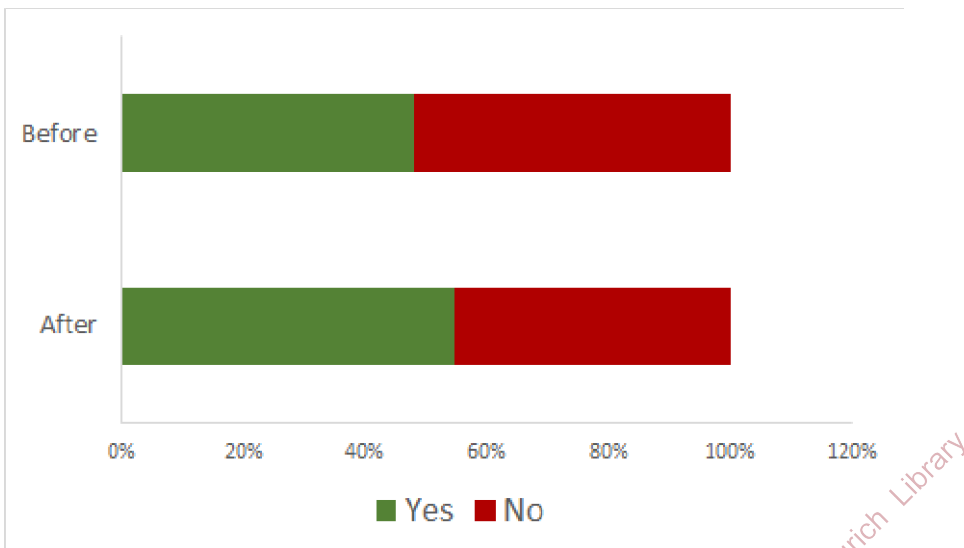


Figure 1. Percent of Low Molecular Weight Heparin Prescribed Before and After The Addition of the Support Tool. Green is percent of physicians who used the order set versus red the physicians who did not use the order set. [25]

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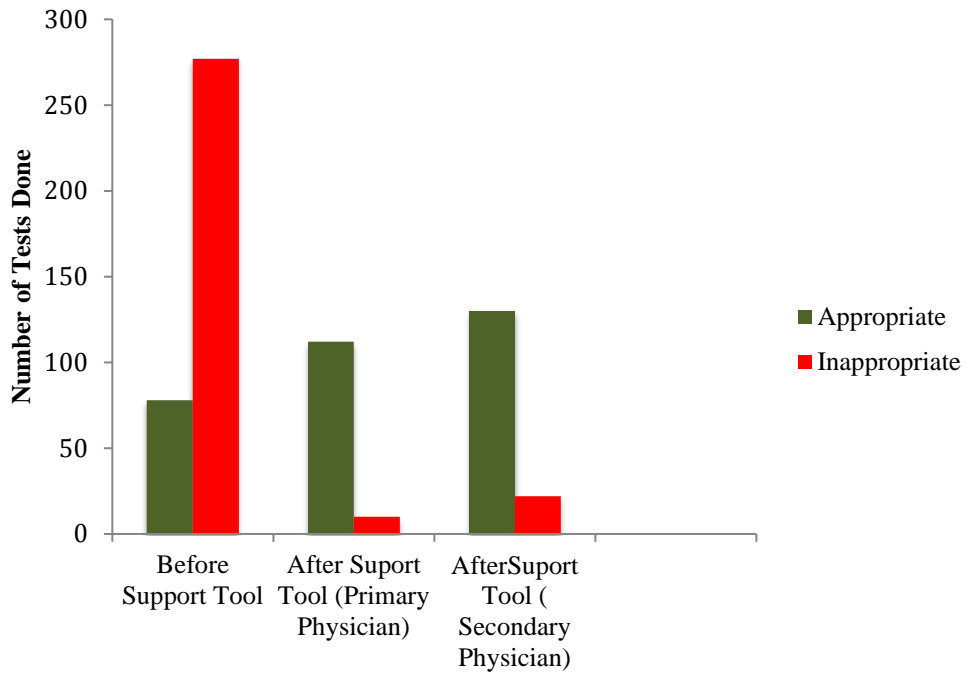


Figure 2. Number of Inappropriate Tests Ordered Upon Admission In the ER By the Primary Physician and By the Secondary Physician Before and After the Addition of the Support Tool [25]

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