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Comparison of Primary Compliance in Electronic versus Paper Prescriptions Prescribed from the Emergency Department

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UNIVERSITY OF CALIFORNIA, IRVINE

Comparison of Primary Compliance in Electronic versus Paper Prescriptions Prescribed from the  
Emergency Department

THESIS

submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in Biomedical and Translational Science

by

Jessica Gwynne Andrusaitis

Thesis Committee:  
Professor Sheldon Greenfield, Chair  
Assistant Professor Shannon Toohey  
Assistant Professor John Billimek

2017



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## **ABSTRACT OF THE THESIS**

Comparison of Primary Compliance in Electronic versus Paper Prescriptions Prescribed from the  
Emergency Department

By

Jessica Andrusaitis

Master of Science in Biomedical and Translational Science

University of California, Irvine, 2017

Professor Sheldon Greenfield, Chair

The Medicare Improvements for Patients and Providers Act passed by Congress in 2008 has changed prescribing practices in the United States. Electronic prescriptions (e-prescriptions) have now become the most widely used form of prescriptions. The government in fact financially discourages the use of the older more traditional paper prescriptions.

Many emergency medicine physicians fear that this blanket policy is not in the best interests of their unique patient population. It is the belief of many of these physicians that emergency patients are more likely to fill paper prescriptions than e-prescriptions. This theory is predicated on the knowledge that many emergency patients are less established in the system and their visits are frequently rushed, chaotic, and unplanned. For these reasons, the e-prescription system is not ideal for them and the theorized consequence is that many e-prescriptions go unfilled, leaving patients to go untreated.

A retrospective analysis was conducted at the emergency department of the University of California, Irvine Medical Center to identify insured adult patients who were given a non-controlled substance prescription in either the paper or electronic form. Pharmacy claim data to

insurances was used to determine whether these prescriptions were filled. 405 encounters were included, 218 of which included e-prescriptions and 187 of which included paper prescriptions.

Our findings showed that paper prescriptions are filled at the same rate as electronic prescriptions (58.3% versus 57.8%  $p=1$ ). These results were surprising as they contradicted what many physicians believe is the situation. More studies are needed in order to be able to broaden these results to the entire emergency medicine patient population, but these results may begin to alter prescription practices in emergency medicine.



# CHAPTER ONE

## INTRODUCTION

### *History of Health Policy's Effects on Population Health*

Health policy and public health agencies are essential to guiding the health of this nation.

Irving Zola used this metaphor in reference to an upstream approach to healthcare:

There I am standing by the shore of a swiftly flowing river and I hear the cry of a drowning man. So I jump into the river, put my arms around him, pull him to shore, and apply artificial respiration. Just when he begins to breathe, there is another cry for help. So I jump into the river, reach him, pull him to shore, apply artificial respiration, and then just as he begins to breathe, another cry for help. So back in the river again, reaching, pulling, applying, breathing, and then another yell. Again and again, without end, goes the sequence. You know, I am so busy jumping in, pulling them to shore, applying artificial respiration, that I have no time to see who the hell is upstream pushing them all in.<sup>1</sup>

In order for healthcare to have maximum impact and effectiveness for the entire nation, it is absolutely imperative to have agencies in place to monitor large scale trends and to enact legislation and policy that protects the health of the people.<sup>2</sup> Individual healthcare practitioners are very much in need of an upstream entity sitting in a control tower that can see trends and guide the masses to better health and help them avoid disaster. Without that oversight, individual practitioners would spend their entire careers doing damage control in a river full of drowning patients.

Health policy and law have been responsible for some extraordinarily beneficial changes in medicine. In this country's infancy, health policy implemented strategies such as quarantines, vaccines, and hygiene to control the epidemics of yellow fever, tuberculosis, cholera, measles, and malaria.<sup>3,4</sup> These efforts are responsible for eradicating smallpox from this country.<sup>3</sup> In contemporary times, mandatory physician reporting of child abuse, elder abuse, certain infectious diseases, and history of seizures in potentially licensed drivers have all certainly contributed to the health and safety of the public. However, as important as the upstream oversight is to the downstream practitioner, it is equally important that the oversight committee has input from the practitioner on the front lines. No one would deny the landmark successes that health policy and law have achieved, but it must also be acknowledged that new policies and legislation must absolutely be tested and challenged to make sure they are in the best interests of patients.

It is imperative to ensure that health policies, once enacted, actually achieve what their creators intended them to. One example of an unfortunate unintended consequence of health policy is that because of mandated physician reporting, some people will avoid coming to the doctor despite needing care. The UK smoking ban provides another example that concerns a subgroup of the population that was potentially harmed by healthcare legislation. In the UK, mental health centers maintained a ban on indoor smoking because of the risk of second-hand smoke exposure. After some studies came out suggesting that smoking could have benefits for patients with schizophrenia, a group of residents of one facility brought their case in front of judge and argued that this smoking ban violated their rights to "better one's own health as he or she sees fit."<sup>5</sup> The judge eventually ruled in their favor. This thesis will cover another area in which health policy may be negatively affecting a subgroup of the population.

## ***Introduction of Health Information Technology into Healthcare***

In the early 20<sup>th</sup> century, the Institute of Medicine alarmed the nation about the high prevalence of medical errors<sup>6</sup> and this concern, along with a desire to improve databases for research, led the government to push for the integration of health information technology (HIT) into medical practice. This forced integration of HIT and electronic medical records (EMRs) into providers' practices proved to be a source of contention. Oversight committees argued that HIT improves quality of care, patient safety, and leads to cost reduction,<sup>7</sup> but across the country physicians and healthcare systems balked at being forced to alter their practice with something they believed would be cumbersome and expensive to implement, cumbersome, had a high potential for errors, altered workflow and efficiency, introduced additional work, and negatively altered the patient-physician interaction.<sup>7-12</sup>

Despite the pushback, EMRs are now widely adopted and we have seen some areas of undeniable improvement: continuity of records, legibility, and ease of research. We have more easily accessible data now than we ever had before because of HIT. It is because of the IT company SureScripts, who maintains health information exchanges and electronic prescription transmissions,<sup>13,14</sup> that we now have information about national trends in prescription practices such as the highest percentage (32%) of controlled substance prescriptions come from family practice.<sup>15</sup>

In 2008, Congress passed the Medicare Improvements for Patients and Providers Act (MIPPA) which contained provisions to promote the use of HIT and EHRs.<sup>6</sup> A specific section enacted provisions to encourage the use of electronic prescriptions and thus the discontinuation of written and printed paper prescriptions. This particular legislation is at the crux of this current study. In March 2016, New York became the first state to ban all non-electronic prescriptions

and to penalize non-complying physicians with fees and even imprisonment.<sup>16,17</sup> Minnesota has a similar ban but does not have associated penalties.<sup>16</sup> Electronic prescribing is now widely and predominantly used, but some are questioning if this could potentially be harmful to some patients in some settings.

Specifically, there is an unsettled debate in emergency medicine about whether emergency patients are more likely to fill e-prescriptions or paper prescriptions. Some providers believe that their emergency patients are unique and electronic prescribing may not be best for them. Emergency patients are typically quite different from those seen in primary care offices. The nature of emergency department visits (chaotic, rushed, emergent, unplanned, odd hours) may lead to a higher level of non-compliance in filling prescriptions. Many patients may be traveling and thus without a “preferred pharmacy.” The chaotic and urgent nature of the visit makes it hard for patients to recall everything that a provider said, including what was prescribed, or even *if* anything was prescribed, and the location to which it was electronically sent. It is for these reasons that some providers suspect a physical sheet of paper with a prescription printed on it is better for these patients than an electronic prescription.

### ***The Topic, Aims, and Hypothesis of this Thesis***

This thesis will address this exact unsettled debate: which type of prescription (paper or electronic) is better for the emergency department patient? This will be answered by comparing the compliance (fill rates) of printed prescriptions against that of electronic prescriptions. Because of the reasons stated above about the uniqueness of the emergency department patient, it was our hypothesis that paper prescriptions would actually be better than electronic prescriptions, specifically that paper prescriptions would have a higher compliance than

electronic prescriptions. We chose to look specifically at the population of emergency patients because we believed this to be the population most likely to have problems with e-prescriptions for all of the reasons stated above. For several reasons that will be explained later, this study looked at a broad emergency department patient population consisting of insured adults. We believed this study looking at a broad population was an appropriate initial step.

We currently lack data on the effectiveness of electronic prescribing, particularly in varying clinical settings. Specifically, there are no studies currently in the literature examining how this legislature-induced change in prescribing behavior has affected the patients in the emergency department. This legislation was designed to facilitate provider prescribing and reduce medication errors. However, now that it is integrated into practice, it is important to investigate its actual outcome to see if this change has achieved its goals and to see how it has affected patient retrieval of medication following the emergency department visit. If our hypothesis that e-prescriptions have a lower compliance than paper prescriptions is correct, then we will have drawn attention to an area that potentially needs to be revisited to see if patients of the emergency department are a special population needing special considerations for prescriptions to ensure retrieval of medications.

The study took place at a large university emergency department and was conducted by a retrospective chart review to identify adult patients that were discharged from the emergency department with at least one paper or electronic prescription. Then pharmacy fill data was used to ascertain whether or not the patients filled their prescriptions.

This thesis is organized into 4 chapters. Chapter 2 will provide background on what is currently known about electronic prescribing including prevalence, definitions, critiques and praises, as well as a review of relevant literature. Chapter 3 will describe in detail how the study

was actually performed. Chapter 4 will present the findings. Lastly, Chapter 5 will interpret the findings and discuss their meaning and importance.

## CHAPTER TWO

### BACKGROUND

#### *History of Electronic Prescriptions*

In recent decades, there has been a government-promoted shift towards adopting Health Information Technology (HIT) into our healthcare system. One such piece of legislation that was passed by Congress in 2008 was the Medicare Improvements for Patients and Providers Act (MIPPA). MIPPA contained provisions to promote the use of electronic health records (EHRs) and specifically to encourage the use of electronic prescriptions (e-prescriptions). E-prescriptions are prescriptions sent directly from a provider's computer to a pharmacy without ever being printed on paper. MIPPA was implemented in 2009 and provided a 2% financial bonus to the eligible professionals who used e-prescribing.<sup>18</sup> This 2% incentive was scheduled to decrease each year. In 2009, the Health Information and Technology for Economic and Clinical Health (HITECH) Act was signed into law to promote the meaningful use of HIT.<sup>19</sup> In the years following the implementation of the HITECH Act, the Centers for Medicare and Medicaid released its EHR Incentive Program which quantified what constituted "meaningful use" in order to receive the incentive.<sup>14,20</sup> In addition to the incentive, this program also instituted a penalty starting at 1% per year of Medicare reimbursement, up to a maximum 5% annual adjustment.<sup>20</sup> Stage 2 of the Incentive Program specified that 50% of an institution's prescriptions must be submitted electronically in order to avoid the penalty.<sup>21,22</sup>

Not surprisingly, this "carrot then stick" approach had the intended effect of greatly increasing the number of physicians who began e-prescribing, as well as increasing the number of e-prescriptions from those physicians already e-prescribing.<sup>14,15,23</sup> At the time of MIPPA, only 7% of physicians were electronically prescribing, by the passage of the Medicare EHR

Incentive Program in 2011, 24% of physicians were e-prescribing, and by 2014, 70% physicians were e-prescribing.<sup>14</sup>

### ***Definitions of Study Terms***

Electronic prescriptions, also called e-prescriptions, are prescriptions that a provider sends directly via computer to a patient specified pharmacy without ever printing or hand-writing anything to give to the patient. Paper or printed prescriptions are done exactly the same as e-prescribing, still entered on the EMR the same way, the only difference is the last step: paper prescriptions are printed on-site, signed by the prescribing provider, and then given to the patient. The primary difference between e-prescriptions and printed prescriptions is the mode of transmission. This study focused on these two types of prescriptions. A third type, which is becomingly obsolete and exceedingly rare, are handwritten prescriptions. For these, a physician keeps a prescription pad, writes the prescription on the paper, then gives it to the patient. This very rare third type of prescription is not used at the study location and thus was not included in this study.

Compliance broadly means the patient does as instructed by the physician and goes to the pharmacy to obtain the prescription and then takes the medication. This is synonymous with the terms adherence and concordance. The term compliance, however, can be broken down into two parts: primary and secondary. This thesis will focus on primary compliance which is specifically if the patient filled the prescription.<sup>24,25</sup> This can also be called fill rate or redemption rate. For the purposes of this thesis, the term compliance is referring to primary compliance. Secondary compliance is whether the patient takes the medication once they have it. Most studies concerning compliance actually measure secondary compliance by using pill counts and self-



reporting. There has not been as much focus on primary compliance which is arguably more important because patients cannot take their medications daily if they do not have it!

### ***Comparison of the Benefits and Shortcomings of Each Prescription Type***

There exists a debate in the medical literature regarding the benefits and shortcomings of the different types of prescription ordering methods. For our study, we were most interested in which type is filled at the pharmacy more often, but the following critiques are important as well as they may relate to factors determining compliance.

Proponents of e-prescriptions say that they are more efficient, cost-effective, and less error-prone.<sup>15,26,27</sup> Some patients like e-prescriptions because it makes for a streamlined process: they don't have to remember a paper and by the time they get to the pharmacy the medication is probably ready to pick up. Another potential benefit is that the electronic prescribing system can be linked in with other systems that will allow for easier information distribution and sharing between health institutions. For example, when the electronic prescription system in Massachusetts combined with formulary decision support, physicians were alerted when a cheaper option for the patient (because of his or her insurance) was available. The results were that physicians altered their prescribing practices by opting for the cheaper options.<sup>28</sup> Most of the other merits of e-prescriptions mentioned actually only apply when comparing to hand-written prescriptions, and not printed prescriptions. For example, with both types of computer-generated prescriptions (e-prescription and printed prescriptions), there are benefits of: eliminated legibility concerns, automated alert system by the computer if a potential allergy or drug interaction is triggered, and increased difficulty to forge.<sup>8,26,29</sup>

A number of critiques of e-prescriptions have been noted as well. Perhaps the most alarming critique is an increase in the error rate with e-prescriptions. As previously mentioned, one of the foremost reasons for implementing e-prescriptions was to decrease the errors found with the previous system! However, the empirical literature yields conflicting information regarding whether e-prescriptions have actually increased or decreased the medication error rate. There are sometimes issues with the prescriber's system failing to transmit the content of the prescription accurately to the pharmacy; the pharmacist then receives a prescription that may have a drug mismatch, patient name mismatch, or cut off free text sections that the physician typed resulting in a prescribing error. Since the single e-prescription database is responsible for syncing with the over 600 different types of EMRs that exist,<sup>13</sup> error-free prescribing is unlikely. Some older providers have definitely struggled with the forced HIT integration and struggle with e-prescriptions or rely on clerical staff to help them. When something is entirely electronic, it is easy to make a clicking error or juxtaposition error and not catch it because there is never a hard copy repetition in front of you.

Some researchers have tried to quantify the error level associated with e-prescriptions. Cochran et al. found three sources of error in the process of an e-prescription: the physician inputted it incorrectly, the system transmitted it incorrectly, or the pharmacist bottled it incorrectly. They found the combined error rate of these 3 sources to be 2.2%.<sup>30</sup> In England, Abdel-Qader et al. found that 8.4% of e-prescriptions dispensed at the time of discharge from the hospital necessitated pharmacist intervention.<sup>31</sup> Kaushal et al. and Ammenworth et al. both published data showing a decrease in errors after adopting e-prescriptions.<sup>32,33</sup> In another study done by survey, Abdel-Qader et al. found that physicians and pharmacists believed e-prescriptions improved the efficiency of prescribing and decreased dosage regimen errors.<sup>27</sup>

Although it remains unclear whether error has increased or decreased with e-prescriptions, it is certainly a cause for concern for the obvious reason of causing harm to the patient. Odukoya et al. pointed out that these errors are also a significant concern because it causes long delays at the pharmacy while the pharmacists are forced to contact the physician to clarify what was meant.<sup>8</sup>

Other critiques against e-prescriptions regard the patient's experience with filling the prescription. In March of 2016, New York became the first state to ban all non-electronic prescriptions and to enforce this by penalizing non-complying physicians with fines and imprisonment.<sup>16,34,32,17</sup> Although the law is apparently not being enforced yet, several New York emergency physicians are concerned about what effect this may have on their emergency patients.<sup>34</sup> Heller et al. worry about the restricting nature of the e-prescription. An e-prescription can only be sent to a single pharmacy and problems can arise when the patient goes to that pharmacy and finds it is closed, or it does not carry what they need, or perhaps that pharmacy only carries expensive options for the drug, or they are out of stock of the medication.<sup>34,35</sup> Patients who have a well-established pharmacy that they are comfortable with are probably more likely to do well with e-prescriptions compared to emergency patients that are less likely to have an established pharmacy. These issues are relevant to this study as these could contribute to patients not filling their prescriptions.

Printed prescriptions also have merits and flaws. One area of benefit is that they are not as locked into the electronic structure as e-prescriptions and therefore do not suffer from as many system mismatch problems. This would mean that the system mismatches with e-prescriptions (cutoff boxes, name mismatches), would not be a problem with paper prescriptions. Another benefit is that the prescription is a physical document that tells the patient they have a

prescription and reminds them they need to go take it to a pharmacy. This is not the case with e-prescriptions which are much easier to forget. Ekedahl and Mansson determined through phone interviews that of 2,171 unclaimed e-prescriptions, 28% were because the patient did not know anything was prescribed to them.<sup>24</sup> A potential downside is that the paper could be lost. The whole prescription filling process may be slower as the patient will have to wait while the pharmacist fills the prescription after handing over the prescription.

### ***The Importance of Compliance***

Compliance is important and worth studying because it has a large impact on patient outcome. Numerous studies have shown that patients filling their prescriptions and taking the prescribed medication is linked to improved outcomes. Ho et al. showed noncompliance was linked to increased hospitalization and mortality in diabetic patients.<sup>36</sup> Lindenmayer et al. and Swartz et al. showed ill effects with noncompliant psychiatric patients.<sup>37,38</sup> Ho et al. showed a relationship between adverse outcomes and nonadherence in coronary artery disease.<sup>39</sup> Kane et al. showed an increased recurrence rate of quiescent ulcerative colitis in patients who refilled less than 80% of their prescribed medications.<sup>40</sup> Similar relationships between noncompliance and poor outcomes has been shown with HIV,<sup>41</sup> hypertension,<sup>42</sup> asthma,<sup>43</sup> and many other conditions.

Another reason compliance is important is its association with cost. As shown above, poor compliance leads to poor outcomes which of course increase healthcare expenditure. But noncompliance also leads to increased costs at the pharmacy. Abandoned prescriptions are prescriptions that are delivered via paper or electronically that are never picked up. These abandoned prescriptions incur expenses to the pharmacy because of uncompensated efforts to prepare the medication, repeated calls to the patient, and then returning the unclaimed

medication to stock.<sup>44</sup> Some estimate this cost to be \$10 per returned prescription,<sup>45</sup> but others estimate it to be as much as \$25.<sup>46</sup> Shrank found a 3.27% abandonment rate, meaning of all the prescriptions his studied pharmacies received, 3.27% were never picked up.<sup>47</sup> With a total of 4.3 billion prescriptions dispensed in 2014,<sup>45</sup> if we use the estimate of a \$10 cost to the pharmacy per returned prescription<sup>45</sup> along with the 3.27% abandonment rate, abandoned prescriptions are costing pharmacies *at least* 1.4 billion dollars a year, and this could be rising as e-prescriptions become ever more prevalent. Shrank et al. showed that electronic prescriptions are 1.64 times more likely to be abandoned than other types of prescriptions.<sup>47</sup> This seems intuitive given that electronic prescriptions lack a patient-initiated step and are just automatically filled, while paper prescriptions given to patients who do not intend to fill them never make it to the pharmacy in the first place.<sup>47</sup>

### ***Purpose of the Study***

The broad question of interest for this thesis was: are electronic prescriptions better than paper prescriptions? We have discussed the merits and flaws of each type of prescription in order to begin to address this question. The specific component of this comparison we analyzed in this thesis was compliance. We have established that obtaining the highest level of compliance with medications is important for patient outcomes. It should be clear now why some physicians and pharmacists are concerned about the government enforcing e-electronic prescriptions that may actually have a lower compliance than paper prescriptions. This study determined what the compliance rate is for electronic prescriptions compared to paper prescriptions coming out of the emergency department.

### ***Literature Review of Emergency Patient Prescription Compliance***

Although no data exist on this exact comparison of paper versus electronic prescriptions, several studies have given us information about emergency department prescriptions that are relevant to this study. Several studies have attempted to determine what the prescription fill rates are for emergency patients, although it must be noted that some of these studies took place before the implementation of e-prescriptions and none of them separated electronic prescriptions from paper. It should also be noted that different methods of obtaining data were used in these studies and it has been shown that methods of self-report (telephone, survey, etc) are inaccurate as patients tend to inaccurately over-report their filling behavior.<sup>48,49</sup> Nonetheless, these fill rates help us establish a baseline that is important to this study. **Table 1** shows a summary of these studies organized by year with the fill rates listed under the method used to obtain the data. As an overall trend, we see the rates based on self-reporting tend to be higher than those based on pharmacy fill data. Specifically, Ding et al. actually compared fill rates based on phone interviews versus pharmacy fill data for the same prescriptions and found that patients over-reported their fill rates by 16%.<sup>48</sup> This literature seems to support a fill rate for adult emergency patients to be somewhere between 75-90%. An additional study looked at exclusively e-prescriptions and found their fill rate to be 88%.<sup>50</sup>

Similar but fewer studies have looked at pediatric primary compliance with emergency department fill rates. Our study will not include pediatric patients but this is important to consider when trying to establish what baseline compliance is for emergency patients. The results from these studies can be seen in **Table 2**. For years there has been a suspicion that compliance rates from the emergency department are lower than that of other specialties such as primary care because of the nature of emergencies and the type of patients that tend to show up

in emergency rooms.<sup>51</sup> One study out of Scotland used pharmacy fill data to determine a 94.8% fill rate for one primary care office,<sup>25</sup> but another showed a 78.4% compliance rate determined by phone interviews of a primary care rural patient population.<sup>52</sup> From this data, it is difficult to determine which practice has a higher compliance, however the general sentiment remains that emergency patients are less compliant than others.

**Table 1** Adult compliance rates of all prescription types from emergency departments organized by year<sup>a</sup>

<i>Study (by year):</i>	<i>Self-report:</i>	<i>Pharmacy data:</i>
<i>Tackitt 1975</i> <sup>53</sup>	84% <sup>b</sup>	
<i>Freeman and Guly 1985</i> <sup>54</sup>		84%
<i>Saunders 1987</i> <sup>51</sup>	78%	
<i>Thomas et al., 1996</i> <sup>55</sup>	88%	
<i>Ginde et al., 2003</i> <sup>56</sup>		74.2%
<i>Hohl et al., 2009</i> <sup>57</sup>		19.8%
<i>Ding et al., 2013</i> <sup>48</sup>	90% <sup>c</sup>	74% <sup>c</sup>
<i>McCarthy et al., 2013</i> <sup>58</sup>	88%	

<sup>a</sup>Studies are organized by year, fill rates are listed under the methods by which the results were obtained: self-report (phone interviews, surveys) or by pharmacy fill data

<sup>b</sup>Rate determined before implementation of outpatient pharmacy, after implementation the rate rose to 92%<sup>53</sup>

<sup>c</sup>Two fill rates because they compared data using phone interviews versus pharmacy fill information

**Table 2** Pediatric compliance rates of all prescription types from emergency departments organized by year<sup>a</sup>

<i>Study (by year):</i>	<i>Self-report:</i>	<i>Pharmacy data:</i>
<i>Kajioka et al., 2005</i>		65% <sup>b</sup>
<i>Sammons and Yin, 2015</i>		72.5%

<sup>a</sup>Studies are organized by year, fill rates are listed under the methods by which the results were obtained: self-report (phone interviews, surveys) or by pharmacy fill data

<sup>b</sup>Only looked at “high-urgency” prescriptions

We have another source of data that sheds light on this question from the point of view of the pharmacy. Although these studies do not isolate emergency prescriptions, they do provide some data about the difference in abandonment rates between e-prescriptions and paper prescriptions. Abandoned prescriptions are when prescriptions reach the pharmacy (either through paper or electronically), but then no one ever claims them. As mentioned previously, Shrank et al. showed that e-prescriptions are more likely to be abandoned than paper prescriptions. Ekedahl et al. found a 2.4% rate of abandonment of electronic prescriptions.<sup>24</sup>

Another important research area with this topic is identifying characteristics that correlate negatively or positively with fill rates. If we could somehow identify what makes patients more or less likely to go fill their prescriptions, we could presumably use this information to improve compliance. Factors shown to be associated with a higher fill rate are: older age,<sup>47,50</sup> low prescription copay,<sup>47</sup> prevalent pre-existing medication user,<sup>47</sup> insured,<sup>55</sup> and access to a regular physician.<sup>50,59</sup> Factors shown to be associated with a lower fill rate are: younger age,<sup>47,50</sup> substance abuse,<sup>59</sup> homelessness,<sup>59</sup> and newly prescribed medications.<sup>47,50</sup>



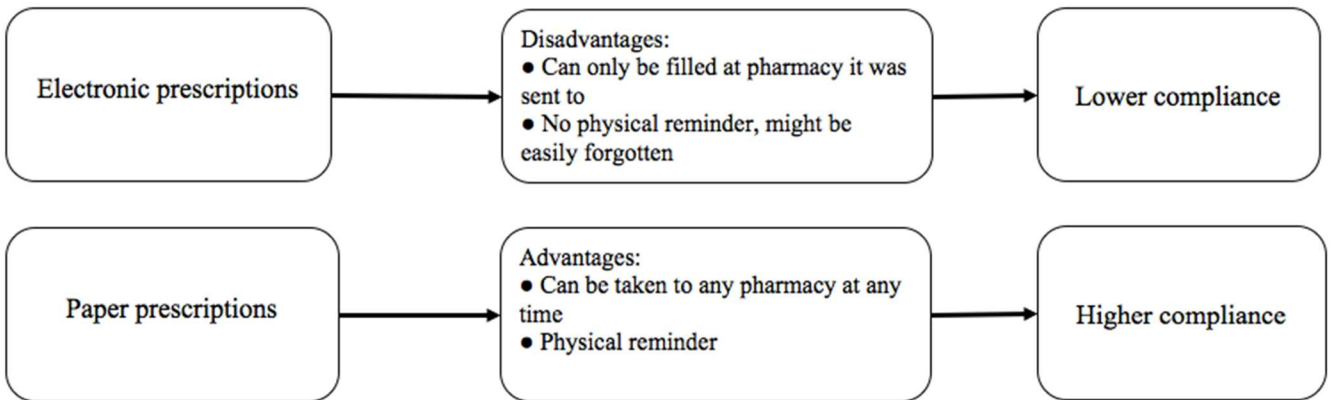
### ***The Potential Impact and Importance of this Study***

This concludes the summary of what is known about electronic and paper prescriptions. We looked at merits and flaws of each type. We discussed compliance and abandonment rates both within and outside of the emergency department. We looked at which factors lead to increased or decreased compliance with prescriptions. The literature suggests a compliance rate of 70-80% with emergency department prescriptions. The importance of this study was to determine if one factor (type of prescription) affected the compliance rate. The impact of this answer is that it could change prescribing practices in emergency medicine.

### ***Conceptual Model***

**Figure 1** is a conceptual model that graphically depicts our hypothesis about the difference in compliance rates between electronic and paper prescriptions. Our hypothesis was that hand-held paper prescriptions lead to a higher compliance rate in the ED patient population than electronic prescriptions because they are simpler to use, transferable, and they serve as physical reminder of a prescription that needs to be picked up. We believed that because e-prescriptions can only be filled at the pharmacy they were sent to and there is no physical reminder of them, they would have a lower compliance.

**Figure 1** Conceptual model of prescription compliance



# CHAPTER THREE

## METHODS

### *Study Population and Sample Description*

A retrospective chart review was performed of insured adult patients discharged from the emergency department of the University of California, Irvine Medical Center between July 2016 and December 2016. UC Irvine is a large urban academic hospital with tertiary care capabilities. There is no county hospital in its county and thus it serves a large population of uninsured and disadvantaged patients. IRB approval from UC Irvine was obtained before commencing this study. 405 total cases were included, 187 were paper prescriptions and 218 were electronic prescriptions.

Encounters included in this study were those of insured adult patients discharged home from the emergency department who received a non-controlled prescription (either printed or electronic) that could be tracked using pharmacy claims data. The exclusion criteria were: uninsured, pediatric patients (age <18 years), controlled substance prescriptions, patients not given a prescription, and patients given prescriptions for which pharmacy claims data were unavailable. It was also decided that if a patient was given both a paper and an electronic prescription, this visit would be excluded. Some low-cost over-the-counter (OTC) medications are not tracked in the dispense history and therefore if a patient received a prescription for only one of these low-cost OTC medications, that case was excluded. If the patient received prescriptions for other medications in addition to the OTC prescription, the case was still counted and the fill status of the other prescriptions was used to determine the success of the visit. **Table 3** displays the inclusion and exclusion criteria for this study.

**Table #3** Inclusion and exclusion criteria

<b>Inclusion Criteria:</b>	<ol style="list-style-type: none"><li>1. Adults (age &gt;18 years)</li><li>2. Insured</li><li>3. At least one prescription (either electronic or printed) was provided to the patient</li><li>4. Pharmacy claim data on the fill status of the prescription(s) was available</li></ol>
<b>Exclusion Criteria:</b>	<ol style="list-style-type: none"><li>1. Prescription was for a controlled substance</li><li>2. A single medication was prescribed BOTH electronically and by paper</li><li>3. Only one prescription for a low-cost OTC medication was provided</li></ol>

By law, controlled substances can only be prescribed by secure means. Until recently, this meant these prescriptions had to be printed, signed, and physically brought to the pharmacy by the patient. Although SureScripts now offers a service that allows providers to e-prescribe controlled substances, the department used for this study did not have that ability. All prescriptions for a controlled substance were excluded from this study since it was thought that these prescriptions might be associated with a higher incentive to be filled, thus skewing the fill rate for these printed prescriptions.

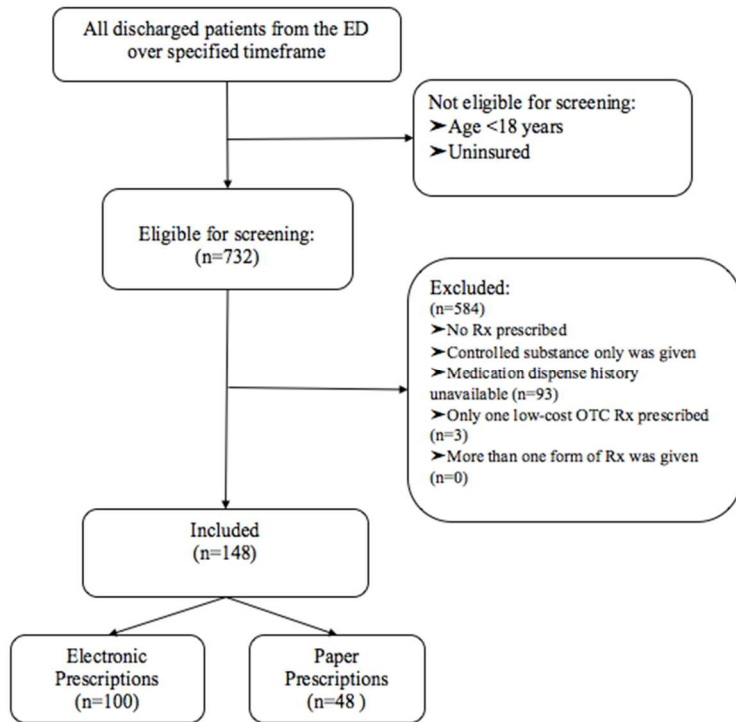
Additionally, only insured patients were included in this study. The method used to determine if the prescription was filled relied on pharmacies submitting insurance claims. It is for this reason that only insured patients could be used in the study; uninsured patients pay themselves and therefore do not have a record of pharmacy claims to an insurance company.

Data extraction was completed in two phases. In the first phase, all ED discharges were examined sequentially. During this phase, it was determined that paper prescriptions were much less common than electronic prescriptions. In the first 732 charts that were screened, only 48 paper prescriptions were found, while 100 e-prescriptions were found. See **Figure 2** for a flow diagram of this initial phase of the data extraction process. At that point in the process, it was determined that the selection criteria needed to be altered in order to find enough paper

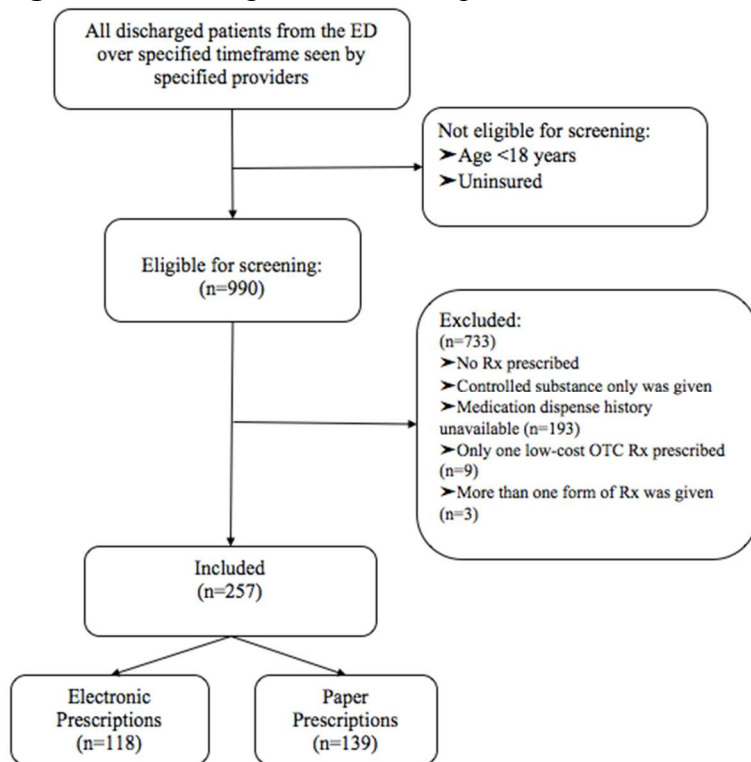
prescriptions to make this study meaningful. Therefore, we began a second phase of data extraction in which only patients seen by 2 particular providers known to periodically use paper prescriptions were selected. All other inclusion and exclusion criteria remained the same. Even though we altered our methods to find more paper prescriptions, electronic prescriptions remained quite prevalent because the providers we selected did not exclusively prescribe paper prescriptions. All prescriptions, regardless of form, that were found once opening these charts were recorded. See **Figure 3** for a flow diagram of the second phase of data extraction after provider selection (“MD selection”) was implemented. During this phase, 990 total charts were screened yielding 139 paper prescriptions and 118 electronic prescriptions.

**Figure 4** is a flow diagram of the entire study, combining the first and second phases of data extraction. A total of 1722 charts were screened, 1307 were excluded and 405 were included. Of those 1307 charts, 286 were excluded because no dispense history was available, 12 were excluded because only one low cost prescription was given, and 3 were excluded because both an electronic and paper prescription were given in the same visit. Of the final 405 that were included in the study, 218 were electronic prescriptions and 187 were paper prescriptions.

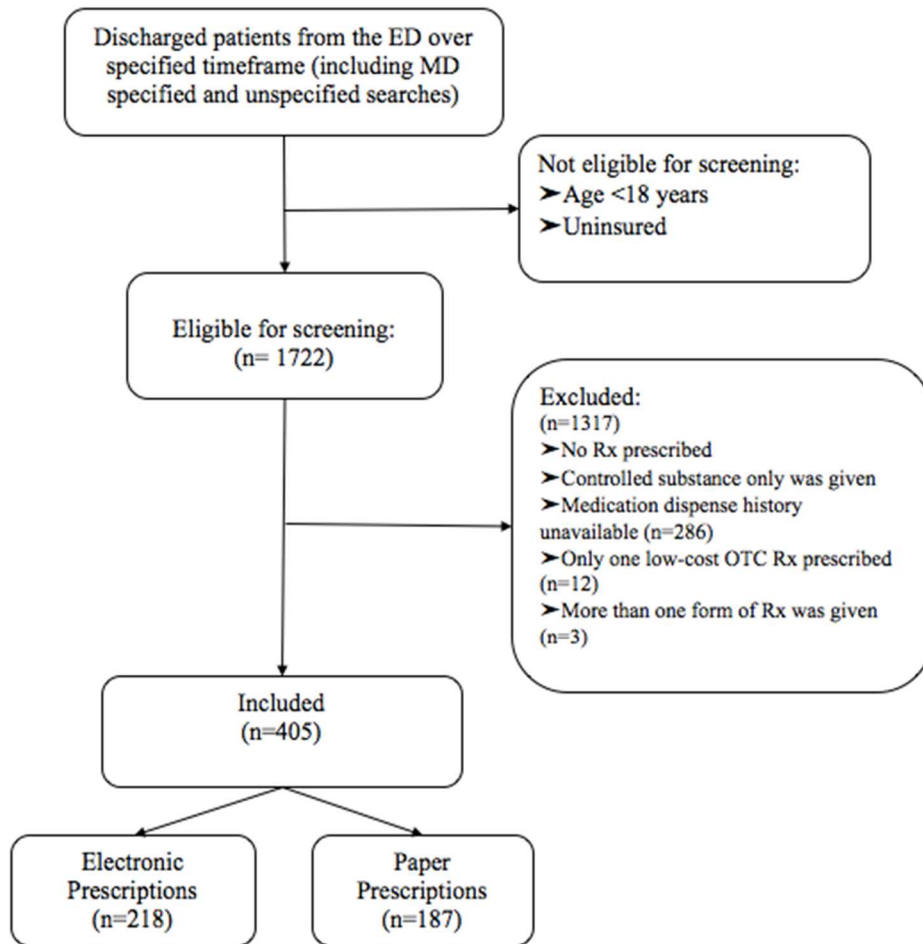
**Figure 2** Flow diagram for first phase of data extraction (before specifying MD)



**Figure 3** Flow diagram for second phase of data extraction (after specifying MD)



**Figure 4** Overall flow diagram (includes both phases of data extraction)



### ***Research Design and Data Management***

Determining primary compliance (whether the patient filled the prescription or not) was based on the SureScripts pharmacy claims database. This process involves the researcher first identifying a patient visit through Allscript’s EMR application that meets inclusion criteria, then requesting that patient’s medication dispense history. When the researcher initially queries that information, the EMR sends an “Eligibility Request” message containing demographic information about the patient (full name, date of birth, gender) to SureScripts.<sup>60</sup> SureScripts is an information technology company that supports electronic prescriptions and serves as an intermediary service through which medication dispense history can be retrieved. When

SureScripts receives an Eligibility Request, it attempts to match the demographic information to an individual in their system based on the “Master Patient Index.” If there is a successful match, SureScripts then identifies the Pharmacy Benefit Management (PBM) companies the patient is covered under, and sends a new Eligibility Request to each of them. The PBMs will send back a report detailing the claims submitted to the patient’s insurance by different pharmacies.

SureScripts compiles this data and ultimately sends it back to the researcher querying that information from the EMR.<sup>60</sup> If an individual prescription was listed on the report, it was deemed filled. If the medication did not appear on the report, it was deemed not filled.

It was found that the prevalence of unavailable medication dispense histories was higher than anticipated. Of the 1722 total charts screened, 286 were excluded because the fill history was unavailable. The medication dispense history will not be available if: the demographic data does not exactly match (ie the patient’s name is spelled differently), the patient is uninsured (thus why the uninsured are excluded), the insurance company is not linked with SureScripts, the pharmacy is not linked with SureScripts (can happen with small single location pharmacies), there is an error in pharmacy claim data, or the patient at some point elected to not have this information disclosed.<sup>60</sup> In order to assess for a pattern in our cases that did not fill, we recorded the insurance type of those 286 cases.

Once a patient encounter was found to fit the inclusion criteria and the medication dispense history was found to be available via SureScripts, then the following data points were extracted from the chart: MRN, patient name, patient age, patient sex, date of prescription, number of prescriptions, name(s) of the drug(s) prescribed, prescription type (printed or electronic), patient’s insurance, attending physician, whether or not a controlled substance was also prescribed in the same visit, and whether or not the medication dispense history showed the



patient filled the prescription(s). These data were stored in an online secure database called REDCap. REDCap was created by Vanderbilt University and provided to us through the University of California at Irvine. A copy of the blank data collection tool, designed by our study team using RedCap, is provided in **Appendix 1**.

### ***Hypothesis***

Our hypothesis was that the compliance rate of printed prescriptions given to adult emergency department patients would be higher than the compliance rate of e-prescriptions given to the same population.

### ***Variable Definition***

A prescription was determined to be “filled” if the identical medication appeared in the patient’s dispense history and the timeframe (within 2 weeks), prescriber name, prescribed quantity, and pharmacy matched what was prescribed from the emergency department. In a few instances, some of these data were missing from the fill history, such as provider name, but in those cases, the other information like medication name, quantity, and date of retrieval all matched the prescription and thus was counted as a filled prescription. A status of “not filled” was assigned when a prescription was given, but after examining the dispense history, no record of the medication being filled was listed. In rare cases, there would be the same medication listed, but it would have been filled weeks prior or months later and prescribed by someone other than the emergency room physician listed in their chart. These were all counted as “not filled.”

A conundrum arose when we encountered the issue of multiple prescriptions per encounter. As it turned out, it was quite common to receive multiple different prescriptions

when being discharged from the emergency department. Data about these individual prescriptions were collected for every patient (each drug prescribed, whether each drug was filled). However, when trying to calculate an overall fill rate, it was decided that we could not count each of these prescriptions as independent events. When looking at a set of prescriptions that were all given to one patient, the outcome of one prescription certainly is related to the outcome of the others. Each patient visit was counted once in our fill rate calculation, regardless of the number of prescriptions. For those visits with multiple prescriptions, “not filled” was assigned to the visit if none of the prescriptions were filled, and “filled” was assigned if one or more prescriptions were filled. The logic for this determination is that we figured if one of the prescriptions was able to get the patient as far as physically getting to a pharmacy, then that should count as a success. If the records showed the patient did not fill *all* the medications, then most likely something else happened at the pharmacy to cause this, such as the patient did not want the other medications or perhaps they were too expensive and the patient elected to forgo them. It was not, for example, because the patients could not remember that they had medications e-prescribed for them or they did not know where they were sent to because we know they made it to the pharmacy.

A prescription was determined to be electronic or printed by looking at the “Transmit Method” field in the Prescription Writer (an area of the EMR). In a few instances, a prescription of one type was canceled and then re-ordered in the other format. This was determined when two similar prescriptions were shown in the system, but one showed the status of “discontinued” and the other said “active” or “completed.” In those cases, only the actual transmitted prescription was counted. In all instances, if it was shown that a prescription had been canceled, deleted, or for any other reason not transmitted, then it was not included in the study.

## *Analytic Methods*

### *Sample size and statistical power*

We wished to detect a minimum difference of at least 15% between the two study groups at 5% significance level and with a power of 80%. Given the large range of estimates of fill rates published in the literature,<sup>48,51,53–58</sup> we assumed maximum uncertainty in an outcome (a baseline rate of 50%). Entering those parameters in an online sample calculator<sup>61</sup> applying the formula in **Figure 5**, the required sample size for each group was determined to be 187. Our actual sample size was 405 in total with 187 paper prescriptions and 218 electronic prescriptions.

**Figure 5** Formula used in Calculating Sample Size<sup>61</sup>

$$n = f(\alpha/2, \beta) \times [p_1 \times (100 - p_1) + p_2 \times (100 - p_2)] / (p_2 - p_1)^2$$

### *Statistical analysis*

Data were analyzed using SPSS software. Initially, the characteristics of each study group (electronic vs. paper prescriptions) were compared. Additionally, a comparison of the cases in the first phase (all cases screened) and the second phase (cases from specific providers screened) of data extraction was done to ensure this change in selection process did not alter the characteristics of the study population. The fill rates during each of these phases were also compared. Next, a comparison of the fill success rate for electronic prescriptions was compared to the fill success rate for paper prescriptions using Fisher's exact test. Lastly, we compared the fill rates of visits that had an accompanying controlled substance prescribed to visits without a controlled substance. We wanted to determine if the controlled substance had an effect on the fill rate and therefore was a factor we would need to control for.

## CHAPTER FOUR

### RESULTS

405 total prescriptions were included in this study with 218 electronic prescriptions and 187 paper prescriptions. The baseline characteristics of each study group are presented in **Table 4**. The baseline characteristics between the two groups were compared using Fisher's exact test for the dichotomous variables and independent samples t-test for the continuous variables. The mean age of the electronic prescription group was 45.6 years (SD 17.5) and the mean age of the paper prescription group was 40.4 SD (16.7). This was a statistically significant difference ( $p < .05$ ). The only other characteristic that was found to be statistically different between the two groups was the percentage of prescriptions that had an accompanying controlled substance prescription. This happened for 40% of the paper prescriptions but only for 18% of the electronic prescriptions ( $p < .05$ ).

The electronic group was comprised of 61% females and 39% males. The paper group was comprised of 61.5% females and 38.5% males. The majority of the patients in this study had Cal-Optima insurance. The next most common insurance type was private, followed by dual coverage and then MediCal. A single prescription was given to 67% of the electronic group and 53.5% of the paper group. Two prescriptions were given to 23% of the electronic group and 34% of the paper group. CVS and Walgreens were the most commonly used pharmacies for both groups.

A similar analysis was done on each phase of the data extraction process to ensure the change in selection criteria did not alter the study population characteristics. **Table 5** shows the baseline characteristics of the first phase (all cases screened) and **Table 6** shows the second phase (cases from specific providers screened).

**Table 4** Overall patient characteristics\* (includes both phases of data extraction)

<b>Characteristic:</b>	<b>Electronic Prescription (n=218)</b>	<b>Paper Prescription (n=187)</b>	<b>p-value**</b>
Age, mean (SD)	45.6 (17.5)	40.4 (16.7)	<.05
Sex, %			1.0
Female	61	61.5	
Male	39	38.5	
Insurance Type			.39
Private	18	26	
Cal-Optima	54	51	
Medicare	3	3	
VA	0	0	
MediCal	11	7	
Dual coverage	14	13	
Number of Prescriptions			.03
1	67	53.5	
2	23	34	
3	6	9	
4	4	3	
5 or more	0	.5	
Pharmacy Used			.5
CVS	37	39	
Walgreens	39	35	
RiteAid	4	8	
Walmart	6	5	
Other	14	12	
Accompanying Controlled Substance Prescription	18	40	<.05

\*Table entries are in percentages (%) unless otherwise indicated

\*\*p-values were calculated using Fisher's exact test for dichotomous variables and t-test for continuous variables

In the first phase of the trial, there was not a significant difference in the ages of the two study groups ( $p=.13$ ) but there was in the second phase ( $p=.01$ ). The gender ratios remained constant in each phase. In the first phase, the paper prescription group had a higher rate of privately insured patients (38%) compared to the electronic prescription group (18%). There was a higher rate of Cal-Optima patients (38%) in the electronic group than in the paper group (55%). The second phase had no significant difference in the insurance types of each group.

**Table 5** Patient characteristics from first phase of data extraction\*

<b>Characteristic:</b>	<b>Electronic Prescription (n=100)</b>	<b>Paper Prescription (n=48)</b>	<b>p-value**</b>
Age, mean (SD)	44.1 (17.6)	39.3 (17.8)	.13
Sex, %			.73
Female	55	58	
Male	45	42	
Insurance Type			<.05
Private	18	38	
Cal-Optima	55	38	
Medicare	1	8	
VA	0	0	
MediCal	8	6	
Dual coverage	18	10	

\*Table entries are in percentages (%) unless otherwise indicated

\*\*p-values were calculated using Fisher's exact test for dichotomous variables and t-test for continuous variables

**Table 6** Patient characteristics from second phase of data extraction\*

<b>Characteristic:</b>	<b>Electronic Prescription (n=118)</b>	<b>Paper Prescription (n=139)</b>	<b>p-value**</b>
Age, mean (SD)	46.9 (17.5)	40.8 (16.3)	<.05
Sex			.6
Female	66	63	
Male	34	37	
Insurance Type			.15
Private	18	22	
Cal-Optima	53	55	
Medicare	5	1	
VA	0	0	
MediCal	13	8	
Dual coverage	11	14	

\*Table entries are in percentages (%) unless otherwise indicated

\*\*p-values were calculated using Fisher's exact test for dichotomous variables and t-test for continuous variables

286 patients were excluded from this trial because SureScripts was unable to obtain a medication dispense history for them. The insurances of those patients were recorded and are displayed in **Table 7**. 42% of those patients had MediCal, 28% had Cal-Optima, and 22% had

private insurance. This excluded group had a much higher percentage of MediCal patients (42%) than the two included groups (11% and 7%).

**Table 7** Insurance types for patients without a medication dispense history\*

<b>Characteristic:</b>	<b>Patients without a medication dispense history (n=286)</b>
Insurance Type	
Private	22
Cal-Optima	28
Medicare	2
VA	0
MediCal	42
Dual coverage	6

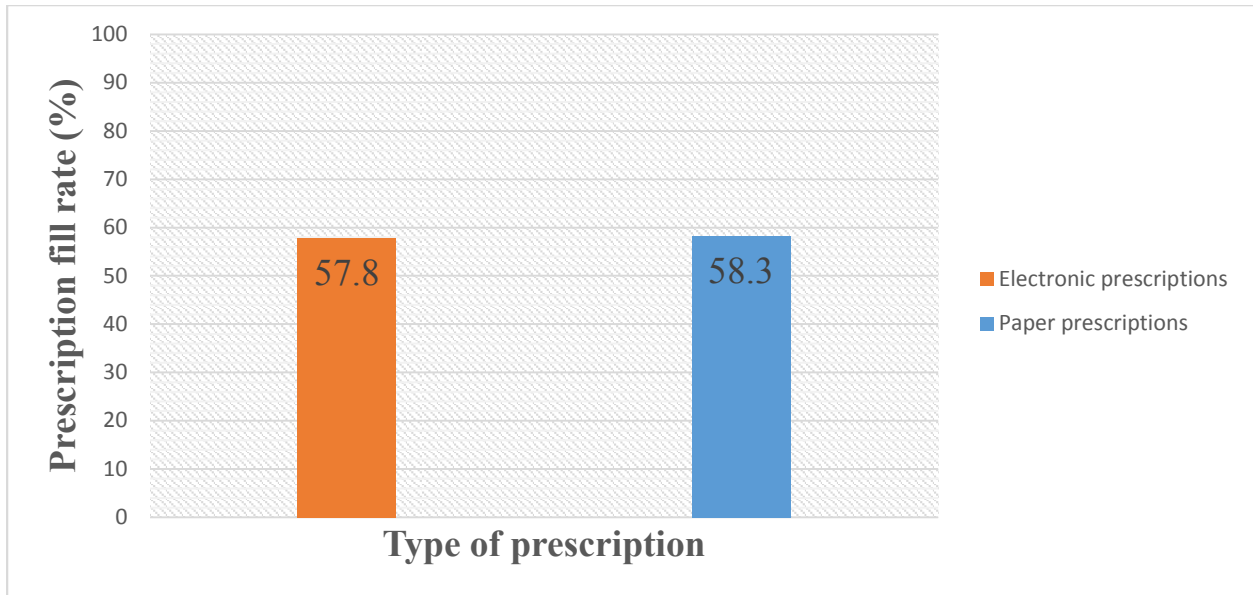
\*Table entries are in percentages (%)

Paper prescriptions were determined to have a fill rate of 58.3% and electronic prescriptions had a fill rate of 57.8%. Using Fisher’s exact test, these rates were not found to be significantly different ( $p=1$ ). These results are presented in numerically in **Table 8** and graphically in **Figure 6**.

**Table 8** Comparison of prescription fill rates for electronic versus paper prescriptions

	<b>Fill rate, %</b>	<b>95% CI</b>	<b>p-value*</b>
Electronic prescription (n=218)	57.8	57.3-58.4	1.0
Paper Prescription (n=187)	58.3	57.8-59.0	

\*Calculated using Fisher’s exact test



**Figure 6** Comparison of fill rates for electronic and paper prescriptions

In an effort to further assess for the presence of unintentional influence on compliance by selecting for particular providers, fill rates for each prescription type were compared in each phase of data extraction. **Table 9** shows there was no significant difference between the fill rates of electronic prescriptions during phase 1 and phase 2 of data extraction (57% and 58.5%,  $p=.9$ ). There was also no significant difference between the fill rates of paper prescriptions between phase 1 and phase 2 of data extraction (54.2% and 59.7%,  $p=.5$ ).

**Table 9** Comparing fill rates for each type of prescription during each phase of the data extraction process

	Phase 1 of data extraction	Phase 2 of data extraction	p-value*
Electronic prescription fill rate, %	57	58.5	.9
Paper prescription fill rate, %	54.2	59.7	.5

\*Calculated using Fisher's exact test



**Table 10** shows the effect of an accompanying controlled substance prescription on the fill rate of the other prescriptions prescribed at the same time. 58.4% of prescriptions with an accompanying controlled substance prescription were filled, while 57.9% of prescriptions prescribed alone were filled. There was no significant difference in these rates (p=1).

**Table 10** Effect of the presence of a controlled substance prescription on prescription fill rates

	<b>Controlled substance prescribed</b>	<b>No controlled substance prescribed</b>	<b>p-value*</b>
Fill rate, %	58.4	57.9	1.0

\*Calculated using Fisher's exact test

## CHAPTER FIVE

### DISCUSSION

Our findings show that in the insured adult emergency department patient population, paper prescriptions are filled at the same rate as electronic prescriptions (58.3% versus 57.8%). This disproves our original hypothesis that paper prescriptions would have a higher fill rate than electronic prescriptions. Several theories are proposed to explain this. First, the ideas previously put forth about less established patients having a more difficult time with the e-prescription process may still hold true, but our study simply did not detect this because only insured patients were included. Secondly, perhaps the barriers to e-prescriptions are not as great as theorized, or perhaps they have advantages that are not yet realized. For example, maybe the persistent and somewhat unrelenting automated reminders that CVS and Walgreens employ make it difficult for patients to forget about their e-prescriptions. And lastly, perhaps the disadvantages with paper prescriptions are greater than expected.

The baseline characteristics of each study group were well matched. The only characteristics that were significantly different were age and accompanying controlled prescriptions. In regards to age, only some studies have found age to be a significant contributor to compliance<sup>47,50</sup> and even then it was only with extremes of age. It is unlikely that a difference of 5.2 years in a middle-aged population would alter the outcome of this study.

There was some concern, however, about the difference in controlled substance prescriptions. It was discovered early on that paper prescriptions were much more likely to have an accompanying controlled substance prescribed with them. This is because controlled substances must be physically printed and signed by hand and a lot of providers believe it is easier and simpler to prescribe the other medications by printing them on the same paper as the

controlled substance. It was thought that patients might see controlled substances as more desirable and thus would fill them more often. If this were true, then these controlled substance prescriptions could affect the fill rate of the other medications prescribed along with them. For instance, if a patient is highly motivated to go to the pharmacy to pick up a narcotic pain medication (controlled substance), he or she might be more likely to pick up the accompanying prescription for an antibiotic. It was determined from our data that the presence of an accompanying controlled substance had no significant effect on the fill rate of the other prescriptions. Therefore, even though the paper prescription group had a much higher percentage of controlled substances provided, this should not have had an effect on the fill rates.

Early in this study, there arose a need to adjust the data extraction process in order to find sufficient paper charts to make this study useful. It is important to assess whether this alteration (selecting particular providers) could have altered the outcome. The examination of the baseline characteristics of each group during each phase of the data extraction process showed that the characteristics did not change drastically after the extraction process changed. The smaller initial phase (n=148) had some significant differences in insurance types between the groups, but the larger second phase (n=257) and the overall study did not. The difference in age that was seen with the overall population was demonstrated in the second phase. Additionally, fill rates of each type of prescription were compared in each of the phases of data extraction. There was no significant difference in the fill rates. It on this basis that we believe the alteration of data extraction did not affect our outcome.

The actual fill rates obtained in this study were surprisingly low (57.8 and 58.3%). Previous studies using pharmacy data to determine adult emergency department prescription fill rates showed rates ranging from 74-84%,<sup>48,54,56</sup> with one as low as 19.8%.<sup>57</sup> Since we only

looked at insured patients, it was expected that our fill rates would actually be *higher* than those seen previously. It is unclear why our study had a much lower fill rate than most of the others. These other studies are not numerous in quantity, so perhaps the numbers are too few to be accurate. Or perhaps the populations studied vary drastically causing a wide variation in results.

### ***Implications***

The importance of this study is that it showed patients in this study population are just as likely to fill an electronic prescription as they are to fill a paper prescription. Our findings have countered the beliefs of many emergency physicians who are still using paper prescriptions because they believe their patients are more likely to fill them. One of the strongest arguments for paper prescribing is this belief that paper prescriptions are more commonly filled. Now that our findings have contradicted this theory, we may see prescribing trends start to change in favor of more e-prescriptions and less paper prescriptions.

### ***Limitations***

A limitation of this study is its observational design. Although we showed that the basic patient characteristics were similar between the groups, we acknowledge there might be additional factors that determined which type of prescription a patient received. It could be possible that providers were selecting prescription types based on what they thought would be best for the patient.

Another limitation for this study was the restricted study population. In order to use pharmacy claim data to insurance companies, we were limited to only using patients that were insured. The entire premise behind the belief that paper prescriptions for the emergency patient are more commonly filled is predicated on emergency patients being less-established, transitory,

and disadvantaged. By studying only the insured population, we miss the portion of patients thought to be most affected by this issue of prescription type.

An additional potential limitation is the reliance upon SureScripts and the medication dispense history it powers. Firstly, we know that there is probably some error in this system, either with data entry error or with error in reporting the information. We did our best to limit this source of error, for example if we suspected a prescription was for a low-cost over-the-counter medication that would not be included in the fill history, it was excluded. However, there could still be some instances when medications were not included in the fill history but were in fact actually filled at the pharmacy. Examples of this would be: the patient asked for the information not to be disclosed, or the patient chose to pay cash instead of billing their insurance. The actual disclaimer produced by Allscripts with every medication dispense history is provided in **Appendix 2** in its entirety.

Another issue that was encountered in the data extraction process was that many patients' medication fill histories were unable to be filled. Presumably this was due to issues such as name mismatches or insurances and pharmacies not being linked to the SureScripts system. A large portion of these excluded patients had "presumptive eligibility" for MediCal, which meant these patients were not actually insured and thus the fill history could not be tracked. Nevertheless, it is important to acknowledge this unexpected high prevalence of absent fill histories and question how it could have altered our outcome. We have no reason to believe that there was any difference in fill history functioning between the two study groups of paper and electronic prescriptions.

Lastly, our alteration in data extraction process should be acknowledged as a potential source of bias. In order to complete the data for this study, we began selecting particular

providers that we thought would prescribe paper prescriptions more often than other providers (not exclusively). Our analysis showed there was no difference in the fill rates after we did this and there was little difference in the patient populations as well. It is important to note that after we made this change, we continued to get many electronic prescriptions as well because our selected providers use both forms, and it was common for other non-selected providers like residents, PAs, NPs, or even other attendings to be the ones ultimately prescribing the patient's medications. If there was any bias introduced by these selected providers, for example perhaps in their way of delivering and encouraging the different prescription types, we believe it would be very small.

### ***Suggestions for Further Research***

Further research on this issue should try to capture a broader patient base that includes non-insured patients. In addition to this, it would also be helpful to look at a broader prescriber population as well. A multi-center approach might be able to achieve both these goals.

### ***Conclusion***

The data obtained in this study show that the insured adult emergency patient is as equally likely to fill an electronic prescription as a paper prescription. These findings are contrary to what many emergency medicine physicians believed to be the case. Future studies are needed in order to be able to broaden these results to the entire emergency medicine patient population. As Health Information Technology is increasingly implemented into medicine, however welcome or not it may be, it is important to continually assess whether the changes are in the best interests of all the patients affected. There still remain other concerns about e-

prescriptions, but this study is at least a first step to alleviating the concerns about compliance with e-prescriptions. If the results found in this study can be generalized to the greater population, perhaps prescribing practices in emergency medicine will begin to change.

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# APPENDICES

## Appendix 1 Data collection sheet Confidential

eRX study  
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### eRX data collection form

Case Number	_____
MRN	_____
Include this chart?	<input type="radio"/> yes <input type="radio"/> no
Reason for excluding?	<input type="radio"/> No rx given <input type="radio"/> Uninsured <input type="radio"/> Couldnt find fill info (but insured) <input type="radio"/> Age <input type="radio"/> Controlled substance rx'd <input type="radio"/> other reason
Name	_____
Age	_____
Gender	<input type="radio"/> Female <input type="radio"/> Male
Date of Visit	_____
Insurance type	<input type="checkbox"/> Private <input type="checkbox"/> Cal-Optima <input type="checkbox"/> Medicare <input type="checkbox"/> VA <input type="checkbox"/> MediCal
Name of private insurance	_____
Form of Rx	<input type="radio"/> Electronic <input type="radio"/> Paper <input type="radio"/> Mixed
Number of Rx's	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5+
Drug #1 prescribed	_____
Drug #1 filled?	<input type="radio"/> Yes <input type="radio"/> No
Drug #2 prescribed	_____
Drug #2 filled?	<input type="radio"/> Yes <input type="radio"/> No
Drug #3 prescribed	_____
Drug #3 filled?	<input type="radio"/> Yes <input type="radio"/> No
Drug #4 prescribed	_____
Drug #4 filled?	<input type="radio"/> Yes <input type="radio"/> No





**Appendix 2** Allscript's disclaimer provided with every medication dispense history

**MedsFromOtherSources Disclaimer:**

The electronic medication history here should be independently verified with the patient. This information is based on insurance data; it may be inaccurate or missing medications due to one or more of the following: items that the patient specifically asked not to be disclosed, over the counter medications, low cost prescriptions, prescriptions paid for directly by the patient or by sources that do not share prescription information, prescriptions older than two years, and/or errors in insurance claims.