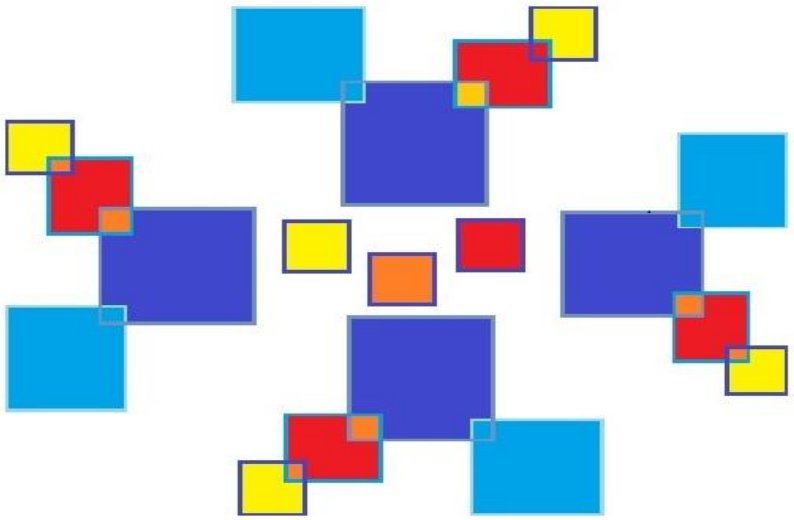
2014

Evaluating Connecticut's Health Information Technology Exchange

Pharmacy Survey Report



Prepared for
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Executive Summary

In 2010, the Connecticut Department of Public Health (DPH) entered into a Cooperative Agreement with the Office of National Coordinator for Health Information Technology (ONC), to stand up a State Health Information Exchange (HIE). DPH received an award of $7.3 million to initiate and sustain HIE activities in the state of Connecticut.[1,2] The Health Information Technology Exchange of Connecticut (HITE-CT), a quasi-public agency, was created by Public Act 10-117, "*An Act Concerning Revisions to Public Health Related Statutes and the Establishment of the Health Information Technology Exchange of Connecticut,*" Sec. 82-90,96 (codified at CGS §19a-750(c)(1)), by the 2010 Connecticut General Assembly and Governor Rell. HITE-CT received $4.3 million over the course of three years to stand up an HIE infrastructure and facilitate exchange activities in the state. Additionally, DPH contracted with the University of Connecticut Health Center (UCHC) to evaluate the ongoing development and implementation of Connecticut's Health Information Exchange (CT-HIE).

This report summarizes the results of 2011 (N=73) and 2013 (N=216) statewide surveys administered to licensed pharmacies in Connecticut to measure e-prescribing adoption rates among community pharmacies, gather pharmacists' opinions regarding the impact and value of e-prescribing, and gauge awareness of activity surrounding CT-HIE.

Even though we do not have an operational statewide Health Information Exchange in the state of Connecticut (CT-HIE) as of March 14, 2014, this report does demonstrate that e-prescribing activities have increased from 2011 to 2013 among pharmacies and prescribers. Most pharmacies (96%) of the pharmacies surveyed are enabled for processing e-prescriptions and 62% of the prescribers are e-prescribing. Independent pharmacies were more likely than chain/franchise pharmacies to indicate prescription transaction fees, low prescriber activity and maintenance costs as barriers to implementing e-prescribing.

Key Findings

Descriptive Characteristics of Pharmacies

- Greater than 70% of survey respondents represented pharmacies in towns categorized as urban periphery or urban core in 2011 and 2013.
- 59% of the responding pharmacies characterized themselves as independent in 2011 while 46% characterized themselves as independent pharmacies in 2013.
- Almost 64% of pharmacies reported Medicare as the most prevalent form of insurance utilized by customers, followed by private insurance, Medicaid and self-pay.
- A large proportion of survey respondents indicated an average daily prescription volume of 101 to 300 prescriptions with 60% of pharmacies indicating this volume range in 2011 and 54% in 2013.

Significant Changes between 2011 and 2013 in Methods of Receiving Prescriptions

- The proportion of pharmacies utilizing e-prescription systems in 2013 (96%) was significantly higher in comparison with 2011 (80%).
- There was a decline from 2011 to 2013 in the use of interactive voicemail (48%, 33%).
- The proportion of pharmacies that received new and/or renewal prescriptions by paper increased significantly from 85% in 2011 to 97% in 2013.

Level of Understanding

- Slightly more than half of respondents reported a deep understanding of e-prescribing in 2013 compared with 33% in 2011.

Prescribing Activity

- The estimated rate of e-prescribing activity among prescribers increased from 2011 to 2013, with 62% reporting more than half to all prescribers in the area as e-prescribing in 2013 versus 22% reporting this percentage range in 2011.
- The proportion of pharmacies enabled in 2013 (96%) was greater than the proportion who were enabled in 2011 (86%).

Influence of e-Prescribing on six IOM Domains

- From 2011 to 2013 there appears to be a general shift from positive responses to more neutral responses, or occasionally, more negative responses regarding the influence of e-prescribing over pharmacy practice.
- Fewer respondents in 2013 reported potential positive influence of e-prescribing on their pharmacy practice in comparison to 2011; Efficiency (82% vs. 86%), Patient Safety (60% vs. 82%), Patient-Centeredness (46% vs. 70%), Effectiveness (71% vs. 78%) and Timeliness (72% vs. 75%).
- The Equity domain saw the largest drop with 58% of respondents indicating positive influence in 2011 versus 31% in 2013.
- Based on the 33 pharmacies that responded to both surveys, the 2013 survey respondents were more likely to respond with neutral and negative responses for the IOM domains of Patient Safety, Patient Centeredness, and Equity than they did in 2011.

Barriers to e-Prescribing

- In 2011, the three leading barriers to e-prescribing as indicated by survey respondents were low prescriber activity (38%), prescription transaction fees (36%) and maintenance costs (33%).
- In 2013, the three leading barriers indicated were bugs in the e-prescribing process (38%), potential for an incomplete patient medication list (27%) and poor network connections in the area and/or network costs (21%).
- Of the 44 respondents that shared other barriers in 2013, more than two thirds reported various data entry issues as barriers to e-prescribing and 41% feel prescribers are not trained properly on the e-prescribing software.
- Independent pharmacies were more likely than chain/franchise pharmacies to indicate prescription transaction fees, low prescriber activity and maintenance costs as barriers to implementing e-prescribing.

Types of Pharmacy Transactions

- 100% of enabled pharmacies reported processing new prescriptions electronically in 2011 compared with 98% in 2013.
- 89% of the enabled pharmacies reported processing renewal prescriptions electronically in 2011 compared with 96% in 2013.
- Fill notifications to prescribers (37% vs. 26%) and medication history send/receive (25% vs. 6%), decreased in prevalence from 2011 to 2013.

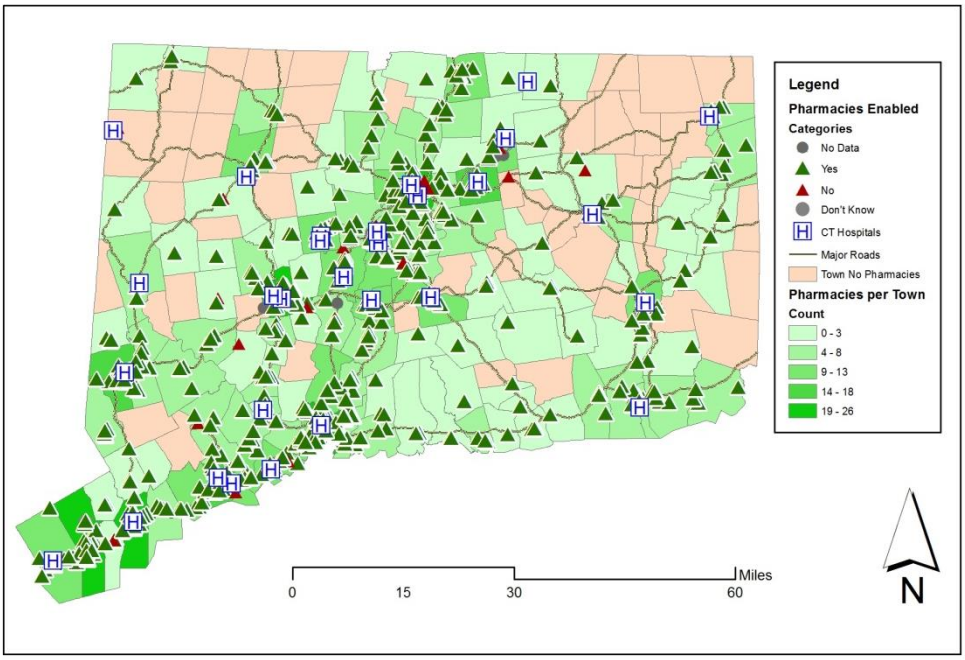
Knowledge of e-Prescribing Standards and terminology

- In 2013 three out of five pharmacies reported using the Surescripts network for e-prescribing. This is most likely an under-representation by our survey respondents, since our Surescripts data files indicate that 93% of independent pharmacies and 99% of chain pharmacies were activated on the Surescripts network by the end of 2013.
- Mostly respondents were unaware of whether or not the pharmacy paid transaction fees (57%), used standards (40%), had a system compatible with HL7 messaging standards (90%) and used standard terminology (89%).

Awareness of Health Information Exchange

- The majority of respondents indicated no familiarity with CT-HIE (70% in 2011 and 74% in 2013).
- 57% of pharmacies indicated sending electronic transactions to physicians, physicians' assistants and nurse practitioners in 2011 compared with 82% in 2013.

Pharmacy Locations



I. Introduction

In 2010, collaboration between the Connecticut Department of Public Health (DPH), the Office of National Coordinator for Health Technology (ONC), Connecticut Health Information Technology Exchange (HITE-CT), and other partners resulted in CT's initial State Health Information Exchange (HIE) Cooperative Agreement with an award of $7.3 million to sustain HIE activities in the state of Connecticut.[1,2] DPH contracted with the University of Connecticut Health Center (UCHC) to evaluate the ongoing development and implementation of Connecticut's Health Information Exchange (CT-HIE). The contract period for this evaluation was July 01, 2010 through March 14, 2014. The evaluation used survey research and in-depth interviews to measure the adoption of health information technology functions and overall opinions about health information technology (HIT) within Connecticut.

As of the writing of this report a statewide Health Information Exchange does not exist in the state of Connecticut (CT-HIE.) Thus, evaluation activities undertaken by UCHC assumed a modified focus. This section of the report encompasses e-prescribing, one facet within the broader framework of HIT, from the perspective of community pharmacies in Connecticut. In 2011 and 2013, statewide surveys were administered to licensed pharmacies to measure e-prescribing adoption rates among community pharmacies, gather input from pharmacists regarding the impact and value of e-prescribing and gauge awareness of activity surrounding CT-HIE.

II. Background

What is e-prescribing?

Definition

Electronic prescribing, or e-prescribing, "is the process of transmitting a prescription or prescription-related information electronically (typically from a physician directly to a pharmacy), rather than using the traditional paper route."[3] An in-depth description includes "secure bidirectional electronic information exchange between prescribing providers, pharmacists and pharmacies, payers or pharmacy benefit managers (PBMs), either directly or through an intermediary network."[4] E-prescribing encompasses the following functions:

- routing prescriptions
- checking the prescribed drug against the patient's health plan formulary of covered drugs
- checking for any patient drug allergies or sensitivities
- identifying any drug-drug interactions
- accessing patients' prescription medication histories from external sources such as claims databases sending or receiving acknowledgement of prescriptions filled[4]

E-prescribing can be done through full-featured electronic health records (EHRs) or stand-alone e-prescribing systems.

History

The earliest form of e-prescribing occurred within in-patient settings in hospitals and the technology was typically a component of a computerized physician order entry system (CPOE.) The very first implementation of a CPOE utilized for processing medication orders occurred in 1972 in El Camino Hospital in Mountain View, CA and the system implemented was beneficial in reducing errors of omission in medication ordering. By 1977, the notion of tailoring CPOE's for the outpatient setting was underway with much development and research pertaining to CPOE's and e-prescribing systems occurring in the 1980's and 1990's.[5]

In 2001, the nation's two largest health information networks were launched. RxHub was founded by the nation's three largest Pharmacy Benefit Managers (PBMs) – CVS Caremark Corporation, Express Scripts, Inc. and Medco Health Solutions, Inc. Surescripts was formed by the National Association of Chain Drug Stores (NACDS) and the National Community Pharmacists Association (NCPA).[6] The two networks merged in 2008, retaining the name of Surescripts, and became the largest clinical health information network in the nation.

E-prescribing garnered national attention in 2003 with the approval of the Medicare Modernization Act (MMA) that provided a formal definition of e-prescribing and offered a set of uniform standards for appropriate implementation and use.[7,8] In 2004, the Office of the National Coordinator for Health Information Technology (ONC) was formed to implement a nationwide health information system and facilitate the widespread use of health technology. In 2005 and 2006, the Centers for Medicare & Medicaid Services (CMS) proposed and tested the first Medicare Part D e-prescribing standards. By 2007, e-prescribing was legal in all 50 states.[9]

From 2008-2010 there was significant activity at the federal level concerning e-prescribing. In 2008, the Medicare Improvements for Patients and Providers Act (MIPPA) was passed that included incentives for e-prescribing.[9] In 2009, the enactment of the American Recovery and Reinvestment Act (ARRA) that included the Health Information Technology for Economic and Clinical Health (HITECH) Act created opportunities to enable widespread use of electronic health records (EHRs) and health information exchange by providing guidance and financial incentives, including $19 billion towards the adoption of health information technology.[9,10] Furthermore, in 2009, the ONC created the State HIE Cooperative Agreement Program to "fund states' efforts to rapidly build capacity for exchanging health information across the health care system both within and across states."[1] It is important to note that there were no funds set-aside to assist pharmacies or laboratories to increase their adoption of health information technologies. In 2010, the United States Drug Enforcement Administration (DEA) permitted the option of sending electronic prescriptions for controlled substances.[9] Currently, very few states are using e-prescribing to transmit prescriptions for controlled substances.

Adoption rates

Surescripts tracks e-prescribing adoption for community pharmacies in the United States who are enabled for the Surescripts network. Community pharmacies primarily include chain, independent and franchise pharmacies and most commonly operate as retail pharmacies, but may also operate as mail-order pharmacies, medical device manufacturers or pharmacies associated with federal and state governments.[9]

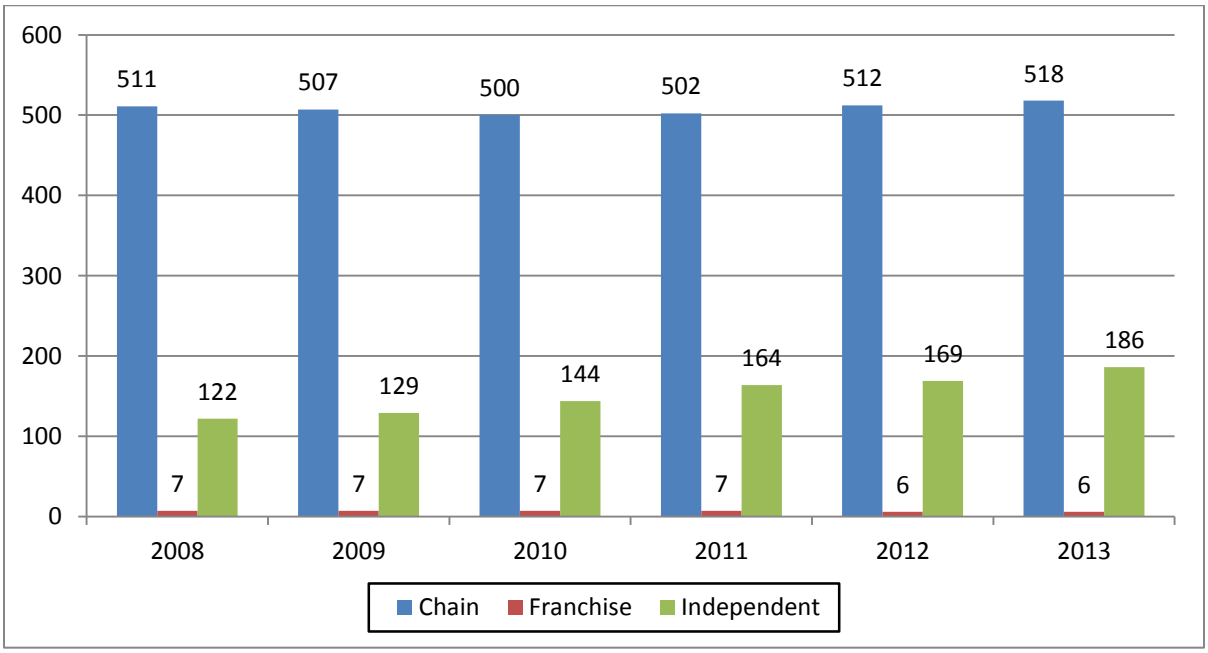
As indicated in Table 1 utilization of e-prescribing by community pharmacies grew steadily in the United States increasing from 76% at the end of 2008 to 93% by the end of 2012. According to Surescripts' State Progress Report on Electronic Prescribing, 97% of community pharmacies in Connecticut were activated for e-prescribing by the end of 2012.[13]

Table 1. E-prescribing adoption rates for community pharmacies

National[9,11]		
Year	**N**	**%**
2008	46,000	76
2009	53,000	85
2010	55,600	91
2011	56,900	91
2012	58,800	93

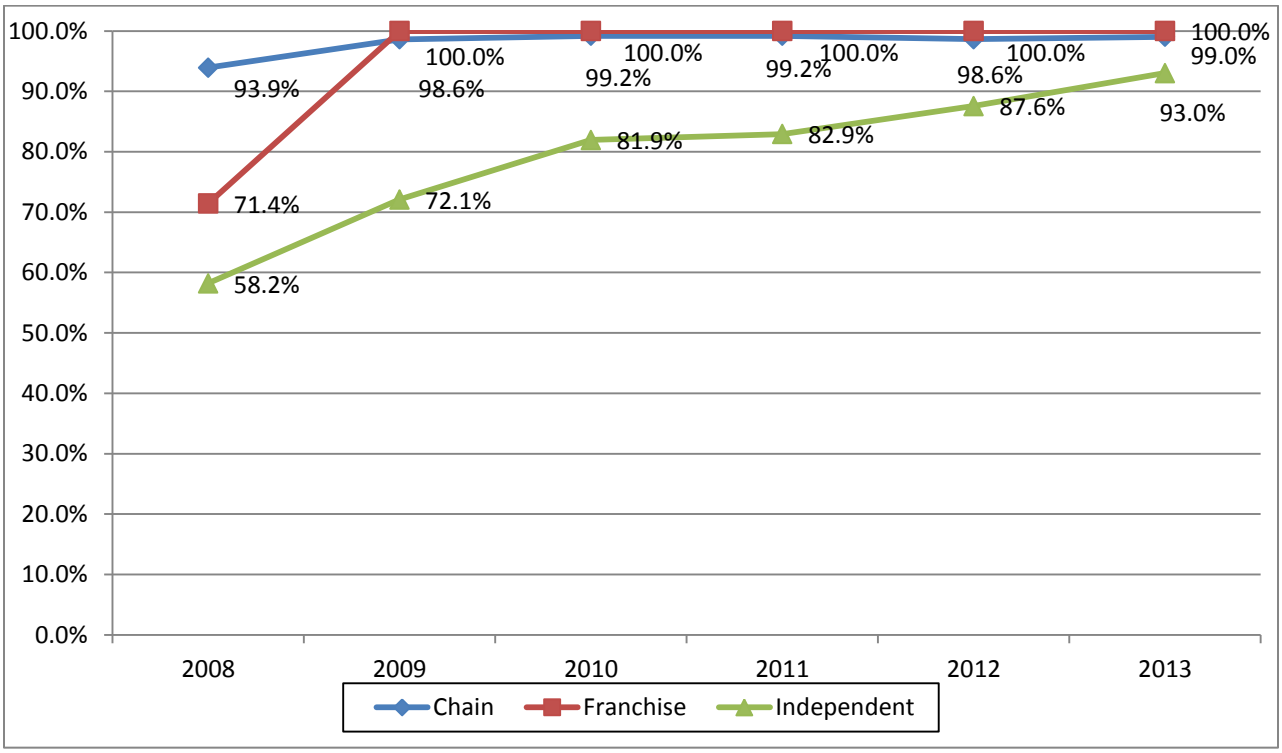
UCHC receives monthly Surescripts data files from ONC that include all Connecticut pharmacies in the Surescripts database with information pertaining to their e-prescribing status. Figure 1 includes the number of Connecticut pharmacies in the Surescripts database from 2008 to 2013 by pharmacy type; chain, franchise and independent. December data files from each year with duplicate pharmacies excluded were utilized to tabulate Connecticut Surescripts data.

Figure 1. Number of Connecticut pharmacies in Surescripts database



The data in Figure 2 shows the percentage of Connecticut pharmacies activated on the Surescripts network to receive electronic prescriptions from 2008 to 2013. By the end of 2013, 93% of independent pharmacies and 99.0% of chain pharmacies in Connecticut were enabled on the Surescripts network.

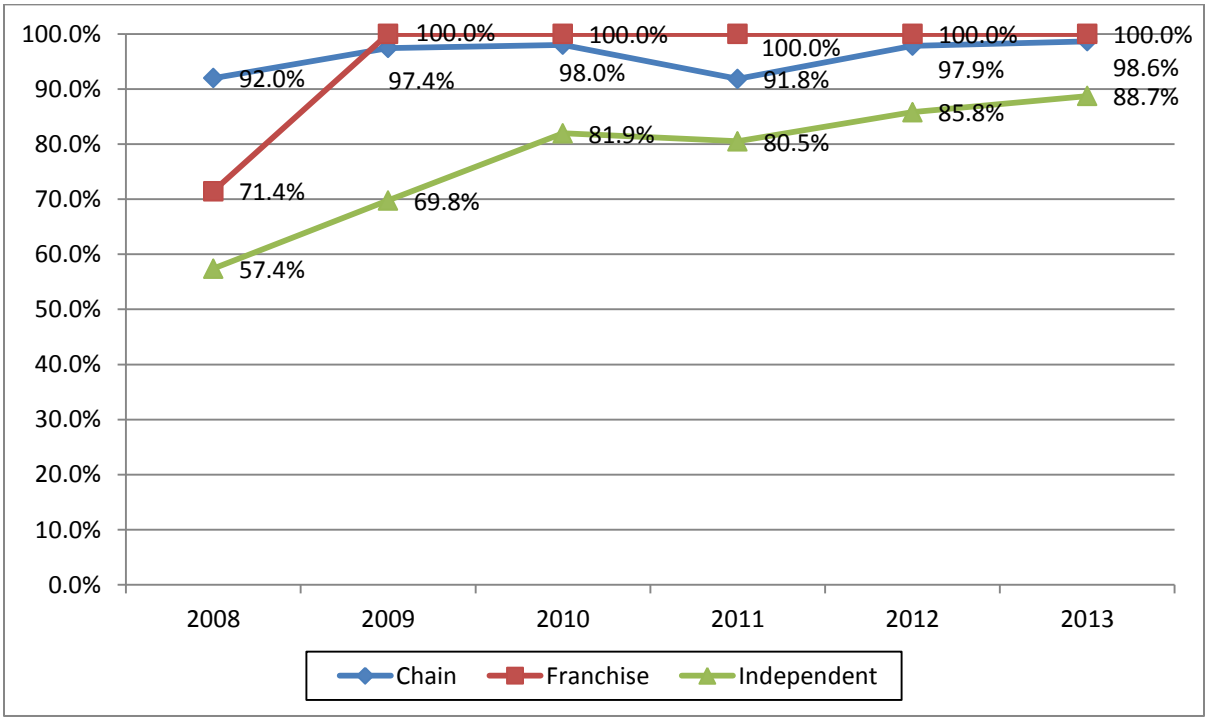
Figure 2. Percentage of Connecticut pharmacies activated on the Surescripts network



The Surescripts files also include an indication of which Connecticut pharmacies are actually sending or receiving new electronic prescriptions, refill requests or refill response messages during the measurement month. The numbers included in Figure 3 are similar, but slightly lower, than those included in Figure 2 because being activated on the Surescripts network does not always necessarily mean the pharmacies are actively utilizing their e-prescribing functionality. By the end of 2013, 88.7% of independent pharmacies and 98.6% of chain pharmacies in Connecticut were sending electronic transactions through the Surescripts network.

By the end of 2012, 93% of independent and 99.0% of chain pharmacies in Connecticut were enabled on the Surescripts network…but only 43% of all eligible prescriptions are routed electronically.

Figure 3. Percentage of Connecticut pharmacies sending/receiving electronic prescriptions on the Surescripts network



Another indicator of e-prescribing adoption is the total number of prescriptions routed electronically through the Surescripts network as a percentage of all prescriptions within each state that are able to be submitted electronically. Figures in Table 2 demonstrate that while this rate has grown over the past several years, by the end of 2012, in both Connecticut and nationally, less than half of all eligible prescriptions were being routed electronically.

Table 2. New & renewal prescriptions routed electronically through Surescripts network

	National		Connecticut[9,11-14]	
Year	**N**	**%***	**N**	**%***
2008	68M	4	1,181,557	6
2009	191M	11	2,692,510	14
2010	326M	19	4,735,488	25
2011	570M	32	7,484,424	37
2012	788M	47	8,863,119	43
*Percentage of all new and renewal prescriptions eligible to be submitted electronically.				

For 2012, Connecticut ranked 13th in Surescripts Safe-Rx annual rankings that measures the level of e-prescribing activity in each state and the District of Columbia.[13]

Standards

Expediting the adoption of electronic medical records and building a national electronic health information infrastructure is a key policy agenda in the United States. Developing national standards for health technology interoperability is an important piece of the HIT agenda. Establishing standards specific to e-prescribing has not only facilitated e-prescribing adoption, but has enabled e-prescribing technology to provide more seamless, accurate and efficient data exchange. The fact that Surescripts is the principal provider of electronic prescribing services across the nation has also contributed to seamless exchange of prescription data.

Electronic prescribing technology relies on multiple international and national standards including the Health Level International Seven (HL7) Messaging Standard, SNOMED CT, the National Council for Prescription Drug Programs (NCPDP) SCRIPT Standard, RxNorm and the Formulary and Benefit Standard. Please see the Glossary for detailed definitions of each of these standards. Table 3 includes a listing of e-prescribing standards that have been promulgated recently into federal law.

Table 3. E-prescribing standards promulgated into federal law

Rule	Published	Summary[15]
Interim Final Rule, Identification of Backward Compatible Version of Adopted Standard for E-Prescribing and the Medicare Prescription Drug Program (NCPDP SCRIPT 10.6)	July 1, 2010	• The regulation names NCPDP SCRIPT 10.6 effective for use July 1, 2010 and continues to support NCPDP SCRIPT 8.1. • Long term care may use standards established by the Medicare Modernization Act of 2003 (MMA), but are not required.
Final Rule, 42 CFR Chapter IV Part 423.160, Standards for electronic prescribing	October 24, 2011	• Proposed to move from the ASC X12 270-271 version 4010A1 to 5010, and from the NCPDP Telecommunication Standard version 5.1 to D.0, to be aligned with the HIPAA regulations for January 1, 2012 • The industry had requested this regulatory update so that the electronic prescribing and claims processing environments would be in sync for versions of standards used.
Final Rule with comment period, 42 CFR Parts 410, 414, 415, 421, 423, 425, 486 and 495	November 16, 2012	• Finalization of NCPDP SCRIPT 10.6 and retiring of SCRIPT 8.1 effective November 1, 2013 • Lifted the long term care exemption
Proposed Rule, Formulary Benefit and Standard Version 3.0	July 19, 2013	• Proposed rule to retire Formulary Benefits and Standard Version 1.0, and propose the adoption of Formulary Benefits and Standard Version 3.0 as the official Part D e-prescribing standard, effective July 1, 2014

Relevant policies: federal and state

The federal laws regulating health information technology standards were a result of broader health technology laws enacted over the past decade some of which prompted states to respond with their own legislation. Table 4 highlights key legislative milestones pertaining to HIT and e-prescribing at the federal level and highlights relevant policies in Connecticut.

Table 4. Federal and State e-prescribing laws

Law	Enacted	Summary
Federal Laws		
The Drug Enforcement Agency's (DEA) Interim Final Rule for Electronic Prescriptions for Controlled Substances, 75 CFR 16236[16]	2010	Allowed controlled substance prescriptions to be issued electronically and for pharmacies to receive, dispense and archive them electronically (but state laws prevail.)
Health Information Technology for Economic and Clinical Health (HITECH) Act[10]	2009	Designated e-prescribing as an essential requirement for meaningful use under the EHR incentive programs.
Medicare Improvements for Patients and Providers Act (MIPPA)[9]	2008	Authorized a new incentive program for eligible professionals who are successful electronic prescribers.
Medicare Prescription Drug, Improvement and Modernization Act (MMA)[8]	2003	• Required that Part D plans support an electronic prescription program. • Required e-prescribing standards to be issued by April 2008.
Conn. General Statute[17]		
4-168 and Subsection (c) of Section 21a-243-7 of the Regulations of Connecticut State Agencies, Public Act Number 12-55[18]	September 12, 2013	Proposed regulations classify marijuana as a Schedule II controlled substance instead of a Schedule I illegal substance so that marijuana can be legally produced, prescribed and dispensed under strict controls.
Connecticut SHB 6301, Public Act No. 09-22, An Act Concerning the Practice of Pharmacy and Electronic Prescriptions[19]	July 1, 2009	Various sections of the Connecticut general statutes were repealed and substituted with the following changes:
		Conn. Gen. Stat. § 20-614 • Permits a prescription to be transmitted in an electronic manner to a pharmacy. • A pharmacist who receives an electronically transmitted prescription must promptly record it on either a prescription form or a computerized printed record, • An "electronic data intermediary" (i.e., an entity that provides the infrastructure that electronically connects practitioner and pharmacy systems or devices to facilitate

Law	Enacted	Summary
		secure e-prescribing) must obtain approval of CT Commissioner of Consumer Protection before operating.
		Conn. Gen. Stat. § 20-615 • Electronic prescriptions must be assigned a serial number and filed in numerical order by pharmacist.
		Conn. Gen. Stat. § 21a-244a • In lieu of maintaining written drug records required by state or federal law, these records may be created and maintained electronically. • Electronic identifiers may be substituted in lieu of required written signatures or initials.
		Conn. Gen. Stat. § 21a-249 • To the extent permitted by the federal Controlled Substances Act, 21 USC 801, a prescribing practitioner may issue an electronically transmitted prescription order for controlled substances. • Electronically transmitted prescription orders for controlled substances shall be promptly reduced to writing on a prescription blank or a hardcopy printout or created as an electronic record and filed by the pharmacist filling it. • All prescriptions for controlled substances shall comply fully with any additional requirements of the federal food and drug laws, [federal laws and regulations Part 306, U. S. Department of Justice, Bureau of Narcotics and Dangerous Drugs-Federal Register Volume 36 No. 80 et seq.], the federal Controlled Substances Act, and state laws and regulations adopted under this chapter. • Pharmacies shall file filled prescriptions for controlled substances separately from other prescriptions.

Importance of e-prescribing

Electronic prescribing has many benefits. It is a commonly accepted notion that e-prescribing provides "a standardized, secure, and safe vehicle for transporting and sharing information across the health-system and community pharmacy environments and is a cornerstone of improved communication across all current domains of pharmacy practice."[20]

One of the most highly cited advantages of e-prescribing is the improvement of patient safety through the reduction of medication errors. Specifically, in the form of prescribing errors, which are subset of medication errors and are a result of a prescribing decision or prescription writing process. Prescribing errors are a common occurrence for pharmacists and include, but are not limited to, illegible handwriting by prescribers, inappropriate use of abbreviations, duration errors, direction errors, rule violations, omissions and dosing errors.[21] E-prescribing appears to have eliminated entirely the issue of pharmacists having to decipher illegible handwriting[21] and, overall, has proven to be effective in reducing

prescribing errors in various clinical settings (inpatient, primary care, hospital).[21-23] There is also some evidence to support a reduction in dispensing errors in community pharmacies owing to e-prescribing, i.e., in selecting medication, transferring dose units to a container and labelling the assembled product.[24]

Medication errors are known to lead to adverse drug events (ADE's.) Some research has demonstrated a positive relationship between e-prescribing and ADE's. A systematic review conducted by Ammenwerth and colleagues in 2008 identified studies that researched the impact of e-prescribing on the risk of ADE's and potential ADE's. Of the six studies focusing on the risk of ADE's, four of these studies demonstrated significant risk reduction for ADE's. Of the nine studies that researched the impact of e-prescribing on potential ADE's, six indicated significant relative risk reduction for potential ADE's.[22] The reason e-prescribing systems may help prevent ADE's is because of their capacity to effectively present prescribers with alerts, warnings and prompts when there are situations that may comprise patient safety. Examples include alerting the prescriber of potential drug-drug interactions, detection of patient specific drug allergies or revealing other patient circumstances, such as pregnancy, patient age or elevated laboratory results that could lead to an ADE if the prescriber was unaware of the condition when prescribing certain medications.[25-27] Furthermore, e-prescribing systems have demonstrated the capacity to act as a pharmacosurveillance tool by accurately detecting potential ADE's.[28]

While further research is necessary to definitively prove the effectiveness of e-prescribing in reducing medication errors and preventing ADE's, there is unquestionably a perception among providers and pharmacists alike that e-prescribing is beneficial within this realm. As a result of various focus groups and surveys conducted with prescribers and pharmacists throughout the country, it is apparent that these professionals believe there to be an inherent value to e-prescribing with regards to improving patient safety, primarily via the reduction of medication errors. Improved clarity and/or legibility of prescriptions, in particular, are frequent anecdotally cited advantages of e-prescribing. [7,16,29-35]

E-prescribing can also help with the management of chronic diseases. For patients with chronic diseases, daily medications are typically a key component of their care. The fact that e-prescribing systems provide electronic tracking of filled and un-filled prescriptions provides an additional mechanism for providers to identify gaps in the maintenance of individual patient's chronic diseases. Pharmacists also acknowledge that e-prescribing can lead to improved communication with prescribers in understanding unique healthcare needs of patients and can provide more opportunities to become engaged in the clinical aspects of patient care.[36,37]

Without question, e-prescribing is convenient for the consumer. With paper prescriptions, patients typically would have to drop off their prescription and either wait for the prescription to be processed or come back at a later time to pick up the filled medication order. The use of e-prescribing typically involves only one trip to the pharmacy for consumers and less wait time since, ideally, the prescription will be ready by the time the patient arrives at the pharmacy for pick-up. Moreover, a 2011 study conducted on patient pick-up adherence showed that first fill adherence increased by 10% for prescriptions sent electronically.[9]

Improved workflow and increased efficiency within pharmacies has not been evidenced consistently in the literature[38-41], nevertheless, there seems to be consensus among professionals that e-prescribing provides benefits to this end.[33,42,43] Specifically, pharmacists have reported the ability to process prescriptions faster when using e-prescribing systems[29,31,35,44], have reported that work seems easier with e-prescribing systems[29], indicate that they appreciate the consistent sequence in which electronic prescription information is presented to pharmacy staff[45] and have found archiving and retrieval of e-prescriptions to be quicker and easier than paper and scanned storage methods.[45]

While research assessing the relationship of e-prescribing to overall healthcare costs is limited, there is some evidence to support the notion that e-prescribing can reduce healthcare costs. A 2008 study found that prescribers utilizing e-prescribing systems with formulary decision support are more likely to choose medications with lower co-payments and/or generic medications, leading to potential cost savings of $845,000 per 100,000 patients and based on average costs for private insurers.[46] Presumably, the prevalence of this behavior among prescribers over time could lead to a reduction in overall healthcare costs. Furthermore, averting ADE's could lead to cost savings for both healthcare and malpractice insurance companies.[7]

Challenges

While there are proven and perceived benefits associated with e-prescribing as described above, there are still a number of challenges linked to e-prescribing, many of which are unintended consequences of e-prescribing systems.

Overall, the literature appears favorable to e-prescribing as a mechanism for reducing medication errors, yet, a small number of studies have revealed e-prescribing to be linked to an increase in prescribing errors and a higher risk for ADE's or potential ADE's.[22,47] When studying the occurrence of medication errors attributed to e-prescribing there are specific challenges that lead to a greater likelihood of prescribing errors. In a 2011 study conducted in a hospital setting, prescribing errors were three times more likely to occur on Sunday versus Monday through Saturday. The authors of this study speculate that this effect may be due to the presence of fewer technical, pharmacy, senior clinical or managerial staff on duty on Sundays who could potentially handle the incidents before they became adverse events.[48] Doctors with fewer years of training (junior doctors)[48-50], prescriptions that are complex in nature or involve multiple formulations[47,49,50], the inpatient setting (vs. outpatient setting) and the specialty setting (vs. primary care)[50] were factors found to be more highly associated with prescribing errors.

With regards to ADE's, the outpatient setting is more likely than the inpatient setting to be associated with ADE's.[50] Studies have also identified specific drugs and drug classes that appear to be more commonly associated with e-prescribing errors. Anticoagulants and cardiovascular drugs, both known to be associated with ADE's, have been significantly linked to e-prescribing errors.[50] Other drugs and drug classes that are routinely observed with e-prescribing errors include; antihypertensive, analgesics, antirheumatics, acetaminophen, salbutamol, omeprazole[49], warfarin, insulin and digoxin.[47]

Most strikingly, there is evidence that e-prescribing technology introduces a new set of prescribing errors that were previously non-existent, many of which may have a negative impact on patient safety.[41,47,50,51] Technical slips or lapses,[48,52,53] which includes issues such as prescribers picking the wrong drug from a drop-down menu or pharmacists receiving prescriptions with missing and/or omitted information are reported often in the literature.[48,52,53] Additionally, it has been found that prescribers frequently over-ride the drug-alerts within the e-prescribing systems.[27] Another challenge is issues arising due to the mixed economy of prescribing systems[48], i.e., paper prescriptions are often sent along with electronic prescriptions for one patient either as a result of multiple prescribers for one patient in a hospital setting or because of the inability to submit electronic prescriptions for controlled substances. There have also been reports of e-prescriptions being sent to the wrong pharmacy[52,54] or being sent for the wrong patient.[41]

In surveys and focus groups conducted with pharmacists and prescribers around the country, the concerns and potential barriers to e-prescribing that surface are aligned with those documented in the literature. Concerns pertaining to medication errors associated with e-prescribing are particularly prevalent[16,33,36,42,45,54-57] along with issues surrounding the mixed methods and/or bundling of e-prescriptions[16,54,58] and the potential negative impact that e-prescribing may have on patient care.[51]

E-prescribing appears to be associated with an increased amount of time pharmacists spend clarifying and/or resolving problems with prescriptions. While some studies have documented a neutral effect of e-prescribing on pharmacist intervention[38,40], others have found clarification contacts by pharmacists to be more likely with e-prescribing. This was found to be true when e-prescribing was compared to faxed and verbal prescriptions at a grocery store pharmacy[38] and when e-prescribing was compared to non-electronic prescriptions at three mail-order pharmacies.[39] A third study documented the frequent nature of clarification necessitated by the use of an e-prescribing system in an independent pharmacy and found the necessary clarification to not only include increased prescriber-pharmacist communication, but also elevated pharmacist-patient communication and pharmacist-pharmacist communication.[41] Communication among different pharmacies was typically due to prescription transfers between pharmacies when patients transferred their care and the sharing of patient history had to be done verbally instead of electronically. Other studies have documented decreased communication with prescribers and patients as a result of e-prescribing and suggest that the communication that does occur is more focused on problem resolution and less on patient care.[33,51]

The reasons pharmacists intervene for electronic prescriptions are, for the most part, related to the new errors introduced as a result of e-prescribing technology. Frequently documented reasons for pharmacist intervention include: dosing errors[24,32,39,40,49,50,59,60], omitted information including missing directions and missing signatures[32,39,48,49,52,59,60], invalid quantity, frequency and/or duration[24,38,50-52,59,60], wrong drug formulations[40,49,51,60], unclear routes of administration[50,52], violating legal requirements[38,52], duplicate prescriptions[59] and potential drug interaction.[60] A study by Maat and colleagues in 2013 conducted in a pediatric hospital found the more frequent usage of free-text fields within e-prescribing systems versus structured templates as more likely to require pharmacist intervention as well as prescriptions including oral dosage form and oral route of administration (rectal

dosage form was found to have a significantly low risk of pharmacist intervention.) Electronic prescriptions for younger patients were also more likely to require pharmacist intervention in this study.[40] Medication classes observed more routinely when pharmacists are required to intervene for electronic prescriptions include; inhalants, topical presentations, oral liquids[52], central nervous system agents, cardiovascular medications, and anti-infective agents.[32,59] Despite all of this, there seems to be a consensus among pharmacists that their interventions are providing an important safety net for patients.[49,59]

Disruptions to workflow within the pharmacy setting are also a challenge presented by e-prescribing and limitations of the e-prescribing software are often the basis for the disruption. Pharmacy software does not always provide complete seamless communication from the prescriber's system to the pharmacy system resulting in the manual re-entry and/or editing of prescription information in the pharmacy system.[33,41,42] Furthermore, the software does not always fully display drug names, forcing the user to look in a second location for the proper name.[41,42,58] Studies published by Odukoya and Chui in 2012 and 2013 found that e-prescribing information is typically presented on numerous screens forcing users to memorize and remember information from prior screens as they move through the prescription process. Furthermore, the 2013 study revealed interruptions during the handling of e-prescriptions as more burdensome than those with paper prescriptions. When interrupted during the processing of an e-prescription, pharmacists typically had to leave the computer terminal to deal with the interruption and upon return, often forgot where they were in the e-prescription process and, therefore, were forced to start the process over. When handling paper prescriptions, pharmacists appeared able to accommodate interruptions more fluidly since they had the paper in their hand as a reminder as to what they were doing before the interruption.[51,58]

Workflow disruptions and inefficiencies in the pharmacy also stem from the fact that pharmacists and pharmacy staff regularly address issues involving e-prescriptions. From the pharmacy perspective, this reality is usually due to a lack of understanding and/or training on the prescriber end and on occasion, on the pharmacy end too.[36,54,58] Organizations with timely access to high-quality technical support are typically successful in implementing e-prescribing while organizations with limited training and insufficient technical support are less likely to be successful in adoption and implementation.[61] Furthermore, the fact that most e-prescribing software is not bi-directional, i.e., pharmacists cannot communicate electronically back to the prescriber either via email or some other mechanism, forces pharmacists to call prescribers for problem resolution.[16,32] And most e-prescribing software does not include a diagnosis code which would give pharmacists another method for checking that the correct medication has been ordered.[32]

Connectivity issues are likewise a common challenge reported by pharmacists. Sometimes e-prescriptions are received instantaneously while others are delayed up to several hours.[41,58] This situation not only causes troubles in the pharmacy, but dissatisfaction with the consumer who typically arrives at the pharmacy for pick-up prior to the prescription arriving at the pharmacy for processing when these delays occur.[16,33,42] E-prescriptions can actually arrive in the pharmacy either via e-prescribing software or via fax transmission and sometimes it is the case that the same prescription arrives via both e-prescribing and fax, causing confusion and additional work for pharmacy staff.[33,41,42] And, pharmacists

commonly receive "bundled" prescriptions where it appears the prescriber has waited until the end of the day or a certain point in the day to send a large quantity of e-prescriptions at once. This situation is a source of tension in the pharmacy to process the prescriptions rapidly and accurately.[36]

Several researchers have studied e-prescribing and it's relation to pharmacist time which is typically examined by the number of minutes spent on processing e-prescriptions or number of minutes to resolve problems associated with e-prescriptions. While one study documented pharmacist time to be four minutes per e-prescription versus five minutes per non-electronic prescription[39], other studies found a neutral effect on pharmacist time[32,38,59] and a small pilot study conducted in 2012 found that a median time of 15 minutes was needed for pharmacists to resolve problems associated with e-prescriptions versus a median time of 10 minutes to resolve problems associated with non-electronic prescriptions.[60] The authors caution the results of this pilot study because of its limited scope. A study examining prescriber time found that e-prescribing takes longer than handwritten prescriptions in a primary care setting.[62]

The costs associated with e-prescribing are a real and perceived challenge for community pharmacies.[56,61,63] There are tangible costs such as purchasing, implementing and training on the e-prescribing software, costs for connecting to the Surescripts network, and transaction costs. And there are hidden costs such as staff time for responding to problematic e-prescriptions and insurance adjudication costs for prescriptions dispensed in error. The challenge can present itself either as an initial barrier as to why pharmacies delay the implementation of e-prescribing[55] or a financial burden once they are actively e-prescribing. A 2011 study conducted in a large independent pharmacy in Massachusetts reported that costs for e-prescriptions were $0.25 per electronic communication and an additional $0.05 to $0.20 per prescription for insurance adjudication costs (e.g., wrong day supply, non-formulary medication, missing prior authorization.)[41] A 2009 study by Warholak and Rupp quantified the amount of pharmacist time spent on resolving e-prescribing issues to be an average of 6.07 minutes per intervention representing incremental dispensing costs of $4.74 per e-prescription that required pharmacist intervention. This corresponds to an incremental cost of $0.18 for each e-prescription that was reviewed, processed, and dispensed during the study.[32]

Lastly, a few additional barriers to initial adoption and implementation of e-prescribing are the following: lack of time for pharmacists to implement a new system, lack of physician demand to e-prescribe in the local area and because pharmacists are satisfied with their current system.[55] Demographics of prescribers and pharmacists may also have an impact on adoption. In a survey conducted with over 400 pharmacists in Puerto Rico, it was found that male pharmacists were more likely to adopt e-prescribing than female pharmacists and years in practice was found to be negatively associated with pharmacist adoption of e-prescribing with pharmacists with less experience being more likely to use e-prescribing.[3]

Table 5 provides a summary from the literature of the benefits and challenges of e-prescribing from the perspective of pharmacists.

Table 5. Literature review summary of benefits and challenges of e-prescribing

Variable/ Benefit or Challenge	Detail
SAFETY	
Prescribing errors	
Benefit	Reduction in prescribing errors (primary care, hospital, medical center, Ammenwerth's systematic review article includes 25 articles from various clinical settings) [21-23,26]
Challenge	Increase in prescribing errors (various settings)[22*]
Neutral	Time of day; no difference between office working hours and non-office hours of prescriber (hospital)[48]
Challenge	Day of week; Sunday more likely than other days (hospital)[48]
Challenge	Years of training; junior doctors more likely to have eRx errors (hospital, veterans medical center)[48-50]
Challenge	Type of formulation; multiple oral formulations, complex orders more associated with eRx errors (hospital, veterans medical center, ambulatory)[47,49,50]
Challenge	Setting: inpatient more likely than outpatient, specialty more likely than primary care to be associated with eRx errors (veterans medical center)[50]
Challenge	Introduction of errors because of eRx (hospital, veterans medical center, ambulatory)[41,47,48,50-53]
Challenge	Mixed economy of prescribing system leading to errors (hospital)[48]
Challenge	Medication class; antihypertensive, analgesics, antirheumatics (hospital)[49]
Challenge	Specific drugs; acetaminophen, salbutamol, omeprazole (hospital)[49]
Dispensing errors	
Benefit	Reduction in dispensing errors (medical center, study group not fully operable on eRx, so weak finding)[24]
Adverse drug events	
Benefit	Detection of potential ADEs (primary care)[28]
Benefit	Reduction of potential ADEs/ADEs (Ammenworth's systematic review found 6/9 studies to reduce risk of potential ADE's and 4/7 to reduce ADE's, hospital)[22,49]
Challenge	Higher risk of potential ADEs/ADEs (Ammenworth's systematic review found 2 small studies that indicated increase in ADEs)[22,47]
Challenge	Medication class; anticoagulants and cardiovascular drugs more likely to have eRx errors that are known to be associated with ADEs (veterans medical center)[50]
Challenge	Specific drugs: warfarin, insulin, digoxin[47]
Challenge	Setting: outpatient more likely than inpatient to be associated with eRx errors that are known to be associated with ADE's (veterans medical center)[50]
Drug alerts	
Benefit	Effective in alerting prescribers to potential hazards (systematic review includes 4 articles from HMO and 1 hospital)[25]
Challenge	Prescribers over-ride frequently[27]
Pharmacist intervention	

Variable/ Benefit or Challenge	Detail
Benefit	Pharmacists provide important safety net[49,59]
Challenge	Medication class: inhalants, topical presentations, oral liquids[52]
Challenge	Medication class: central nervous system agents, cardiovascular medications, anti-infective agents[32,59]
EFFICIENCY	
Pharmacist intervention	
Challenge	Clarification contacts more likely with eRx (vs. fax and verbal at grocery store pharmacies and vs. non-eRx at mail-order pharmacies)[38,39,41]
Neutral	Clarification contacts no difference for eRx (vs. handwritten at grocery store pharmacy)[38]
Neutral	Time of day; no difference between shifts (pediatric hospital)[40]
Challenge	More likely when free-text fields used in eRx vs. structured templates (pediatric hospital)[40]
Challenge	Age of patient; highest risk for younger aged children (pediatric hosp.)[40]
Benefit	Type of formulation; rectal dosage form and route of administration low risk for intervention (pediatric hospital)[40]
Challenge	Type of formulation: highest risk of intervention for oral dosage form and oral route of administration (pediatric hospital)[40]
Pharmacist intervention, reasons for	
Challenge	Omitted information[32,39,48,49,52,59,60]
Challenge	Dosing errors[24,32,39,40,49,50,59,60]
Challenge	Invalid quantity, frequency, duration[24,38,50-52,59,60]
Challenge	Wrong drug formulations[40,49,51,60]
Challenge	Unclear routes of administration[50,52]
Challenge	Violating legal requirements[38,52]
Challenge	Duplicate prescriptions[59]
Challenge	Potential drug interaction[60]
TIMELINESS	
Pharmacist time	
Neutral	Intervention time for new eRx does not differ from verbal, fax or handwritten prescriptions (grocery store pharmacies)[38]
Benefit	Time spent: duration of contact 4 min. for eRx vs. 5 min. for non-eRx[39]
Challenge	Time spent: median time to resolve problems 15 min. for eRx vs. 10 min. for non-eRx[60**]
Neutral	Time spent: eRx required an average of 6.07 minutes (not compared to non-eRx), many issues take less than 30 minutes, but some > 8 hours[32,59]
Challenge	Takes longer for eRx (vs. handwriting in primary care setting)[62]
COST	
Generic medications	
Benefit	More generic medications prescribed leading to cost savings (outpatient)[46]
Pharmacist time	
Challenge	Estimated cost of $4.74 per problematic eRx[32]
Transaction costs	
Challenge	Trx costs range from 25 to 50 cents per eRx, insurance adjudication costs range from 5 to 20 cents per eRx[41]

Value of HIE to e-prescribing

There is considerable potential value in an HIE that incorporates e-prescribing related functionality. Integrating prescription fill status and/or medication fill histories into HIEs are the most likely e-prescribing components to be found in an HIE and ones that provide tangible and instant value to those accessing the information. Yet, there are other potentials for HIEs in the context of prescription information for pharmacists and pharmacy staff.

Pharmacists participating in focus groups in Arizona indicated potential advantages of HIEs to be the following: ability to document patient information; communication with providers; insurance coverage verification; increased decision-making information (i.e., access to medication history, allergy, and diagnoses); and opportunity for increased clinical practice.[36] Another potential advantage of HIEs would be easy access to prescription information in the event of a natural disaster. "Following Hurricane Katrina in 2005, complete cessation of patient care was avoided because medical records were readily obtainable. Pharmacists and providers were able to retrieve records of evacuees' medications through Surescripts."[7] Drug recalls can also be managed more efficiently when a pharmacy has e-prescribing capability, since the software enables pharmacists to trace certain medications to specific patients and expedite delivery of pertinent information.[7] These potential benefits of e-prescribing could be managed effectively through a statewide HIE if these data were centrally located and easily accessible.

State approaches for enabling e-prescribing include policy, legislative and licensure strategies, facilitating collaboration with Surescripts, coordination with Regional Extension Centers, incentives or grants to independent pharmacies, outreach to providers and/or pharmacies, data collection to determine appropriate strategy, establishing a plan for controlled substances and integrating medication history.

Electronic health records (EHR) that have been incorporated into community pharmacy practice provide a glimpse of additional possibilities of integrating HIEs into pharmacy practice. A study conducted in Canada where a universal provincial EHR was incorporated into community pharmacy practices found that for pharmacists operating in patient-centered care practices, the EHR was utilized to access patient medical information and medication histories to guide medication management decisions. Pharmacies whose practice was based on accurate and safe medication dispensing used the EHR primarily for patient demographic information. Two main barriers to this particular system were timeliness of data updates and limited information in the EHR, thus, for those pharmacies with access to physician-based medical records, they were more likely to use an internal system for their information needs.[64] Certainly, the issues of timeliness and breadth of data need to be considered in the development and implementation of any HIE.

While many states have working HIEs, most are lagging in incorporating e-prescribing functionality into the HIE. As a result, the Program Information Notice (ONC-HIE-PIN-001), issued July 28, 2010, prioritized three HIE capabilities: e-prescribing, sharing of patient care

summaries across unaffiliated organizations and receipt of structured lab results. In an evaluation of the State Health Information Exchange Cooperative Agreement Program for 27 states published January 2012, states report that the necessary infrastructure to support electronic transmission of prescriptions is, for the most part, in place. State approaches for enabling e-prescribing include policy, legislative and licensure strategies, facilitating collaboration with Surescripts, coordination with Regional Extension Centers, incentives or grants to independent pharmacies, outreach to providers and/or pharmacies, data collection to determine appropriate strategy, establishing a plan for controlled substances and integrating medication history. Examples of policy changes include requiring providers to use e-prescribing to participate in health plans and allowing e-prescribing of controlled substances.[63]

Delaware's Health Information Network (DHIN), a successful statewide HIE incorporating more than 1.6 million unique patient records, appears to be the first statewide HIE that will enable medical providers to access a patient's medication history. DHIN now incorporates ambulatory medication history information that the patient has filled through local and national pharmacies during the previous 12 months.[65,66] Prescription information available online helps eliminate prescribing drugs that may have dangerous interactions with other medicine the patient is taking. Having this information readily available is particularly helpful for doctors who are treating new patients and are therefore unaware of the patient's medication history.

Florida has laid a good foundation towards the easy exchange of prescription information across their state. Florida offers a free e-prescribing tool to Medicaid providers through the Florida Medicaid Health Information Network. This tool provides e-prescribing, refill requests, and medication history look-up capability at the point of care free of charge for Medicaid providers via a common platform used by Medicaid and two large insurance companies. Furthermore, Florida's Agency for Health Care Administration makes Medicaid prescription claims histories available to Surescripts enabling authorized providers to access patient medication history using any Surescripts certified e-prescribing system.[67]

Summary

In view of a national adoption rate of 93% of community pharmacies enabled for e-prescribing and a Connecticut adoption rate of 97%, it is clear that community pharmacies have embraced the technology. With overall electronic routing rates approaching 50% nationally, prescribers seem to be getting on board as well, most likely a result of the federally funded meaningful use incentives. It is quite clear that e-prescribing is here to stay.

While the literature does not appear to have reached a firm consensus, there are most definitely benefits to e-prescribing. There is good evidence lending support to the claim that e-prescribing reduces medication errors and may help prevent adverse drug events. The electronic storage of medication history is an important benefit as it can help both prescribers and pharmacists provide safer and more patient-centered care. Plus, there is some evidence linking e-prescribing with long term savings in healthcare costs.

While proponents of e-prescribing and the early literature focused mostly on the positive impacts of e-prescribing, recent research has painted a more realistic picture by surfacing

many of the challenges associated with the technology. Without a doubt, e-prescribing has introduced new errors into the prescribing process that did not exist prior to the introduction of the technology. Adjusting to the modified workflow required because of e-prescribing has clearly been a challenge in the pharmacy setting. And the potential long term cost savings are not always so apparent and relevant to organizations that have to deal with the very real costs absorbed by the pharmacy on account of e-prescribing. Yet, despite the challenges, surveys and focus groups conducted with prescribers and pharmacists have revealed that overall, healthcare professionals feel positive about e-prescribing while at the same time they acknowledge that there is definitely room for improvement with the technology.

There hasn't been much research conducted on the value and benefits of HIE. For e-prescribing in the context of HIE, the research is even more sparse. Yet, the belief persists that there is much untapped potential for HIEs in general and specifically, in the context of incorporating prescription information into HIEs. Unfortunately, the benefits of incorporating e-prescribing into a statewide health information exchange may never be recognized in Connecticut as Connecticut has been unable to implement a statewide HIE, and there are no immediate plans to do so. This is unfortunate for Connecticut pharmacists as it seems that community pharmacists would like to provide more patient-centered care and easy access to health information would certainly provide more opportunities to do so. One of the specific recurring themes that surfaced in the literature was the fact that e-prescribing technology is not bi-directional, i.e., pharmacists do not have the ability to communicate back to the prescriber electronically. This is frustrating for pharmacists because they would like to conveniently and immediately clarify issues and discrepancies with prescribers and ideally, be assured that the issues will be resolved for the subsequent electronic refill. It is clear that pharmacists appreciate the value of having accurate and reliable patient information and a statewide HIE could potentially provide this important tool to pharmacists.

III. Methodology

Study design

We conducted a cross-sectional survey of Connecticut pharmacists' adoption of health information technology and influence of e-prescribing over components of pharmaceutical practice. Pharmacies with English-speaking representatives were eligible to participate. The study was approved by the UCHC Institutional Review Board (IRB) on July 21, 2011.

Survey instrument

The UCHC evaluation team compiled the pharmacy survey based on a review of survey instruments utilized in other states that incorporated standard questions developed by ONC. The survey instrument included questions about pharmacies' locations (e.g. urban vs. rural), pharmacy type (e.g. independent vs. chain), prescription volumes, and current use of e-prescribing. It also asked about respondents' opinions on how e-prescribing can influence components of pharmacy practice and perceived barriers to implementing e-prescribing.

In 2013, the UCHC evaluation team added the following three questions to the survey instrument: please estimate the number of physician practices that submit electronic prescriptions to your pharmacy; please estimate the number of physicians represented by these practices that submit electronic prescriptions to your pharmacy; and select the number range that best describes your average electronic dispensing volume per day (all types- new and renewals); 0-50, 51-100, 101-300, 301-500, Over 500, Unsure. Copies of the 2011 and 2013 survey instruments are included in Appendix B.

Survey administration

The 2011 survey administration was conducted from August 3, 2011 through October 18, 2011. Trained interviewers contacted eligible pharmacies and obtained verbal consent to conduct the survey using a standard script. We obtained lists of licensed Connecticut pharmacies from three outside sources: SureScripts Connecticut pharmacy list as of March 2011; DCP Pharmacy Registry list dated April 13, 2011; and Connecticut pharmacy lists downloaded from LearnAboutEPrescriptions.com on May 10, 2011. Merging the three lists yielded a final survey sample of 696 eligible pharmacies, comprising 188 independent, 503 chain, and five franchise pharmacies (see Figure 4).

The 2013 survey administration was conducted from April 12, 2013 through August 26, 2013. Updated lists of Connecticut pharmacies were procured from the three sources: SureScripts Connecticut pharmacy list as of February 2013; DCP pharmacy registry list dated March 14, 2013; and Connecticut pharmacy lists downloaded from LearnAboutEPrescriptions.com on March 7, 2013. Merging the three lists yielded a final survey sample of 720 pharmacies, comprising 200 independent, 515 chain, and five franchise pharmacies (see Figure 5).

Of 696 pharmacies on the 2011 calling list, staff could not find working phone numbers for 25 (3.6%), 41 (5.9%) refused to take the survey, and 47 (6.8%) requested to take the survey on-line. The initial round of pharmacy survey calls in 2011 resulted in low response rates from chain pharmacies, thus, in late September 2011, the UCHC evaluation team decided to target a random sample of chain and franchise pharmacies for survey collection. The new calling list for the chain and franchise pharmacy sample was generated on September 28, 2011. (See Appendix C for a detailed description of this process.) While the same methodology was used for contacting chain and franchise pharmacies as was initially used in 2011, 2013 yielded a better response rate for this group of pharmacies.

Figure 4. 2011 Pharmacy contact lists consolidation process

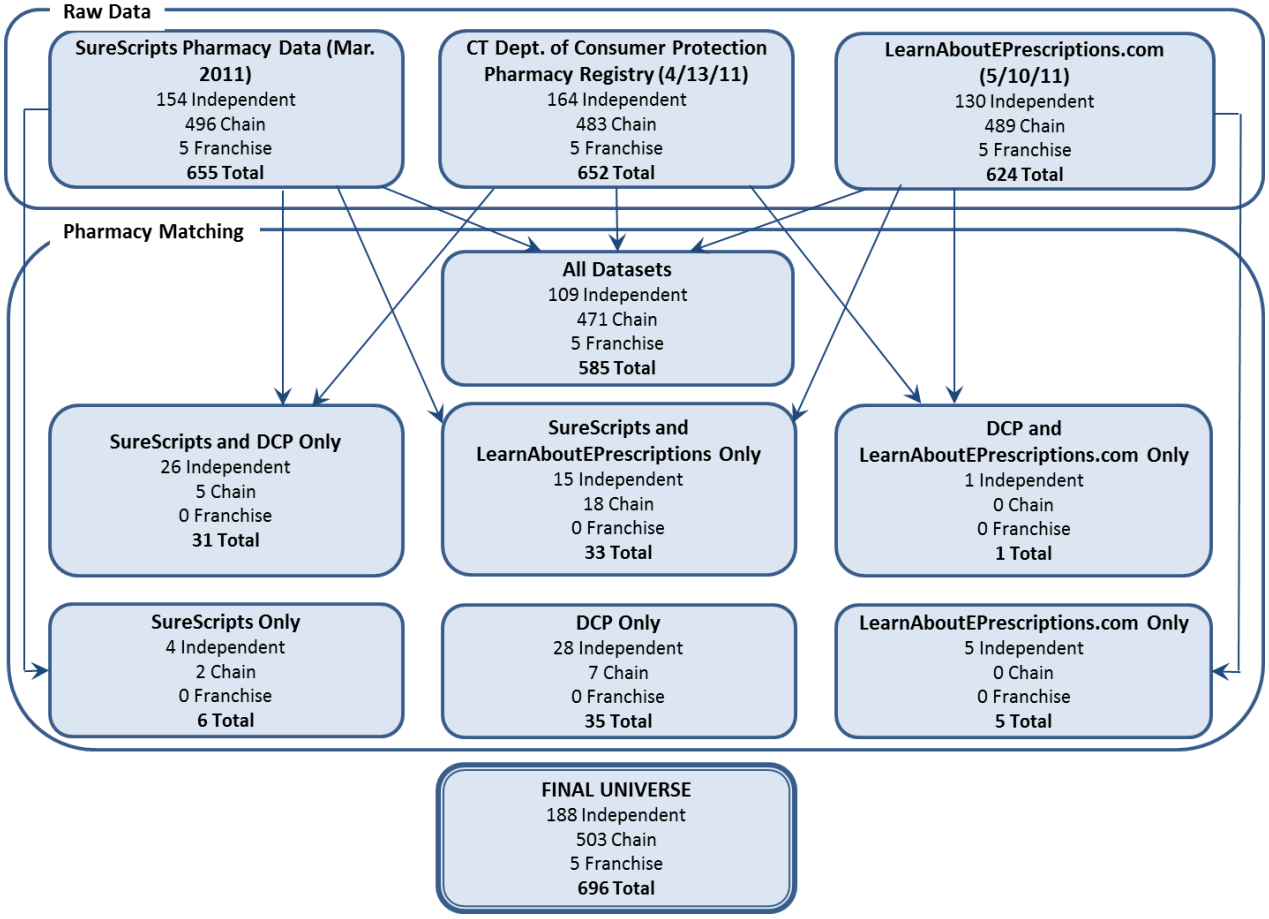
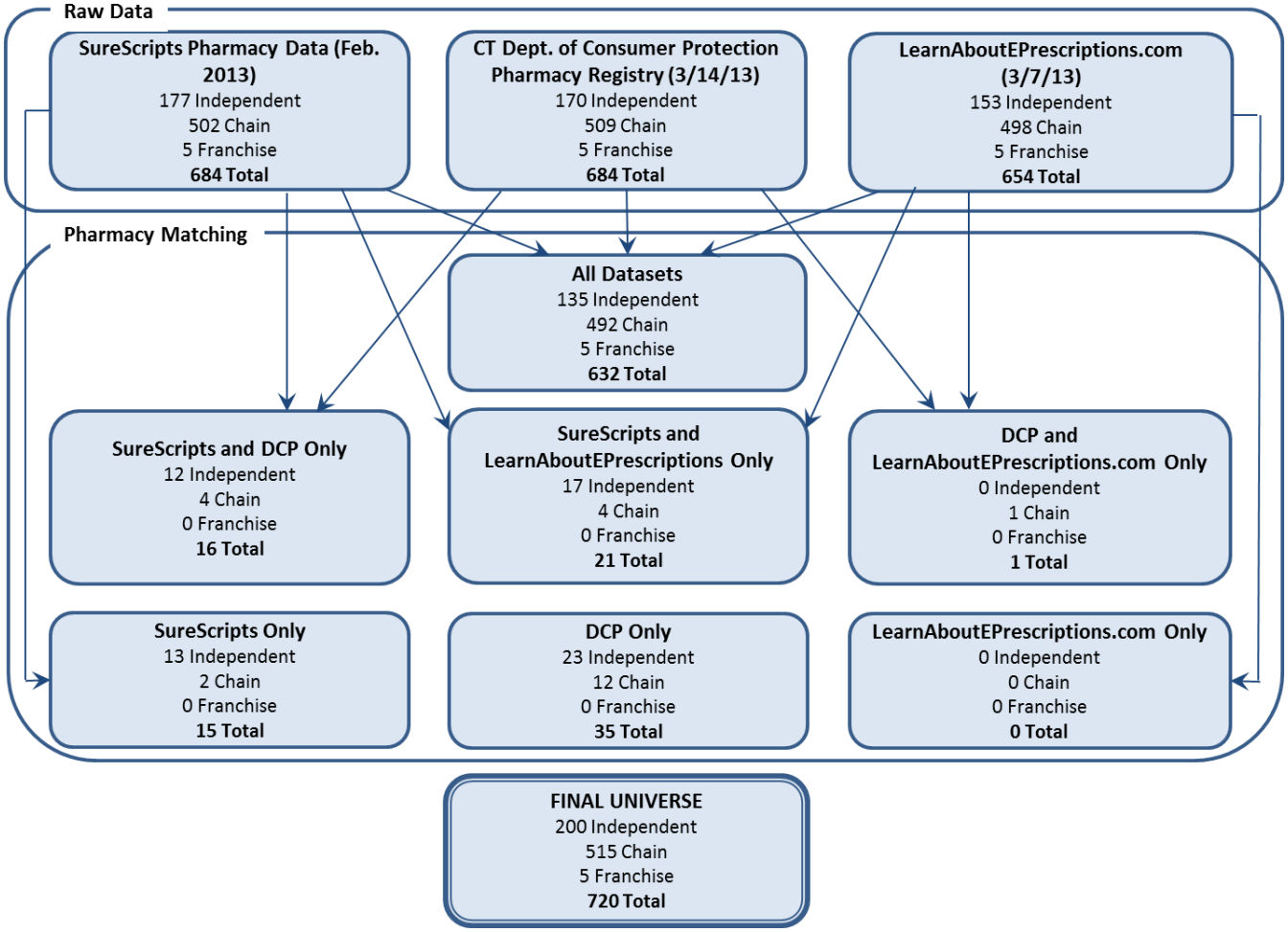


Figure 5. 2013 Pharmacy contact lists consolidation process



Analytic sample

Survey data were collected and managed using UCHC's Research Electronic Data Capture (REDCap) survey collection environment. In 2011, four of the 77 surveys entered into REDCap (5.2%) were excluded from the final analytic dataset. For the 2013 survey, 232 survey records appeared in REDCap and a total of 16 (6.9%) were excluded from the final analytic data set. This yielded a final count of 73 surveys in the 2011 dataset and 216 surveys in the 2013 dataset. The final combined survey dataset comprised 289 surveys across 256 unique pharmacies. Of these 256 pharmacies, 40 (15.6%) completed the 2011 survey, 183 (71.5%) completed the 2013 survey, and 33 (12.9%) completed surveys at both time-points. For the final analytic data set, UCHC classified each pharmacy as either an independent, chain, or franchise pharmacy based on a combination of the pharmacy type reported in the survey and the pharmacy type as reported by SureScripts at the time of the survey. Please see Appendix C for a detailed description of the exclusions and the logic used for pharmacy classification.

Analytic approach

Descriptive statistics were used to summarize the distributions of the survey variables. Variables from the 2011 and 2013 datasets and by pharmacy type were compared using chi-

squared and Fisher's exact tests. All tests were two-sided and considered significant at $p<.05$. IBM SPSS Statistics 21 was used for all statistical analyses of the pharmacy datasets.

The results of this evaluation have uncovered several areas that warrant further statistical examination. During the process of analyzing the survey results, logistic regression models were attempted to analyze the data in relation to four outcome variables; whether or not a pharmacy is enabled for e-prescribing, whether or not pharmacists know if they pay transaction fees for receiving e-prescriptions, pharmacists' understanding of e-prescribing and pharmacists' familiarity with CT-HIE. We sought to examine potential associations with these outcomes such as whether or not a pharmacy's daily prescription dispensing volume is associated with the probability of being enabled for e-prescribing or if independent pharmacies were more likely to be burdened by transaction fees than chain pharmacies. Yet, due to the extent of missing or unreliable data and sparse cells in variables that we thought would be viable predictors for examining these outcomes (e.g., daily prescription dispensing volume and estimate of prescriber adoption in pharmacy area) we determined that more work is needed with the logistic regression models before we are confident in the results.

For mapping, much of the data in this report has an address component which was collected as part of the data collection process. Through a process called geocoding, address information can be translated from an aspatial string data type to an x/y coordinate system that can be placed within a Geographic Information System (GIS) which has digital mapping capability. The geocoding process allows data to be visualized and contextualized within the geospatial and geographic context of the surrounding communities and placed into a map with a high degree of location precision. Locations as close as 100 feet can be distinguished.

Point data with address attributes was converted to x/y coordinates with the geospatial software called ArcMap 10.1 and run within the Geocoding toolset. Initially, the geocoding algorithm utilized the U.S. Census Bureau's Tiger shapefile as the basis for placement of the points along roads; however, many inaccuracies were discovered in shopping malls and large commercial areas and matching errors ranged up to 20%. An alternative for the "Locator" or conversion engine was utilized from the ESRI corporation using their "World" geocoding engine found at ArcGIS Online Geocoding Services[68] which is integrated into the desktop client. The error rate for this engine was less than 10% and often much lower. Point data was aggregated by town using the Overlay function called Spatial Join which ties points to the polygons that surround them. The GIS creates a Join Count field that aggregates the number of points per administrative boundary (i.e. towns of Connecticut). The data then is mapped at the town level using a Chlorolopleth map. Other shapefiles were acquired from the University of Connecticut Library Map and Geographic Information Center.[69]

Limitations

In both 2011 and 2013, the representative sample for chain/franchise pharmacies was targeted at 20% of the overall universe of chain/franchise pharmacies in Connecticut. In 2011, the initial response from chain/franchise pharmacies was so low that an additional

random sample of chain/franchise had to be generated mid-way through survey administration so the target of 20% could be achieved. Ultimately, the response rate in 2011 was 23.4% (44/188) for independent pharmacies and 26.5% (31/117) for chain/franchise pharmacies, but these rates were lower than expected and lower than the 2013 response rates of 52.5% (105/200) for independents and 65.7% (111/169) for chain/franchise pharmacies. Furthermore, the 2011 refusal rate of 69.2% (81/117) from chain/franchise pharmacies was much higher than the refusal rate of independents in 2011 (13.3%) as well as the refusal rates for both independents and chain/franchises in 2013 which was 8.5% and 11.8% respectively.

For surveys that were completed, respondents may or may not have been the person from the organization with the deepest level of understanding about e-prescribing activity within the pharmacy and/or the broader landscape of e-prescribing and HIT in general. The questions for which respondents seemed most unsure were the number of physician practices that submit electronic prescriptions, the questions pertaining to standards and terminology and the transaction fee question. Volume questions forced respondents into categorical response categories which are limiting, but the alternative would have been to halt the survey and seek a precise response from the person within the organization who had the exact information, which is not practical. Some pharmacists were reluctant to answer the insurance and prescription volume questions for privacy reasons.

In analyzing the data, inconsistencies were found when comparing responses to various questions. Primarily, inconsistencies were identified for pharmacies that indicated they were not enabled for e-prescribing, yet, they indicated processing various types of electronic transactions, e.g., medication history send/receive. Follow-up was conducted with these pharmacies and it was discovered that some pharmacies answered this question for all prescriptions processed by the pharmacy instead of just electronic prescriptions. Follow-up was not conducted with pharmacies that were enabled, but it can be assumed that this question was not clear for many respondents, regardless of their enabled status. Additionally, the survey included controlled substances as a response category for electronic transactions which yielded yes responses in both 2011 and 2013 further demonstrating the data to be potentially unreliable as the legalization of electronic prescribing of controlled substances in Connecticut was only coming to fruition during the period of survey administration. (As of January 2014, 27% of Connecticut pharmacies are enabled for e-prescribing of controlled substances through the Surescripts network.[70]) Data was corrected as clarification warranted, nevertheless, the overall results pertaining to types of electronic prescriptions processed are questionable and should be examined with caution.

Finally, the overall survey was limited in scope. The question set only focused on the pharmacy end of the e-prescribing process, which is merely one of the four main components needed for e-prescribing to occur (prescriber, pharmacy, transaction hub and PBM.) Furthermore, there were no questions that gauged the amount of time and effort pharmacists expend on problematic e-prescriptions and the amount of interaction with prescribers owing to the e-prescribing process. As evidenced by the literature, this is an unintended consequence of e-prescribing and it would have been helpful to get a sense of the impact of this situation on Connecticut pharmacies.

IV. Results

Descriptive characteristics

By socioeconomic grouping

All survey records were linked to the specific pharmacy that responded to the survey and included an address, town and zip code for each pharmacy. Utilizing the town, each pharmacy was categorized as one of five socioeconomic categories; urban periphery, urban core, suburban, rural or wealthy. These categories are defined in the 2004 state of Connecticut report, "The Changing Demographics of Connecticut-1990-2000, Part 2: The Five Connecticuts", that classifies each Connecticut town based on its average income, poverty level and population density.[71]

In 2011 and 2013, the majority of pharmacies responding to the survey came from Connecticut towns categorized as urban periphery which are considered to have below average income, average poverty and high population density. The second largest group of respondents, both in 2011 and 2013, came from towns categorized as urban core which are considered to have the lowest income, highest poverty and highest population density in Connecticut.[71] Overall, these two socioeconomic groupings represented 71% of survey respondents in 2011 and 70% in 2013. Please see Table 6 for further detail.

Table 6. Survey respondents by socioeconomic grouping

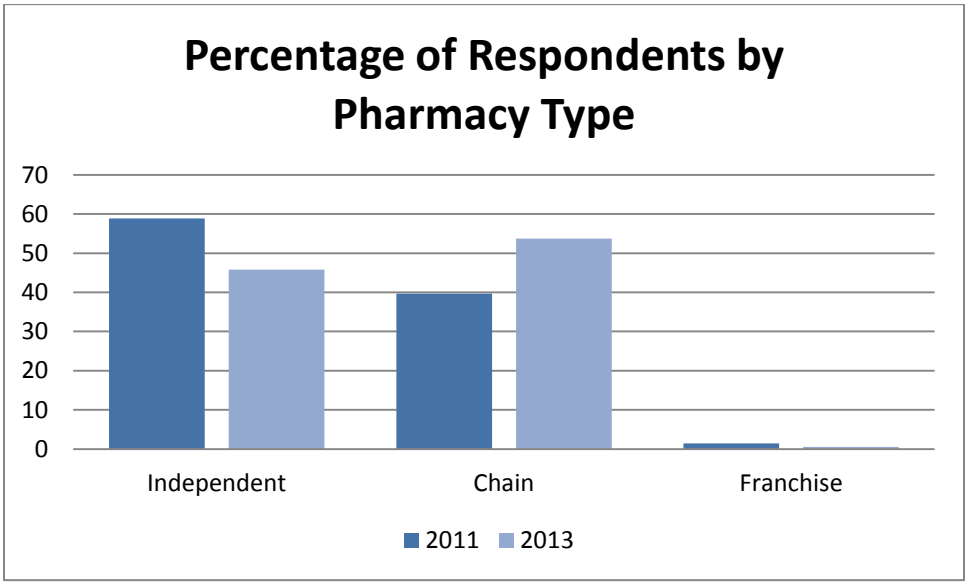
	2011 (N=73)		2013 (N=216)	
	N	%	N	%
Urban periphery (below average income, average poverty, high population density)	28	38.4	93	43.1
Urban core (lowest income, highest poverty, highest population density)	24	32.9	59	27.3
Suburban (above average income, below average poverty, lowest population density)	9	12.3	22	10.2
Rural (average income, below average poverty, lowest population density)	7	9.6	21	9.7
Wealthy (exceptionally high income, low poverty, moderate population density)	5	6.8	21	9.7

* Pharmacy town was utilized to categorize the pharmacies according to socioeconomic categories as defined in The Changing Demographics of Connecticut- 1990-2000: Part 2: The Five Connecticuts report.[71]

By pharmacy type

As represented in Figure 6, in 2011, 59% (n=43) survey respondents were from independent pharmacies and 40% (n=29) were from chain pharmacies. In 2013, the proportions were reversed with 54% (n=116) of the sample represented by chain pharmacies and 46% (n=99) by independent pharmacies. In both 2011 and 2013 there was only one franchise pharmacy that completed the survey.

Figure 6. Survey respondents by pharmacy type



By type of insurance

Survey respondents were asked to indicate what percentage of individuals served by their practice utilize Medicare, Medicaid, private insurance or do not provide insurance for payment (self-pay). Many survey respondents did not respond to this question and for those that did, the responses were approximate estimates given by the respondent who may or may not have had exact breakdown of payer mix within the pharmacy. As a result, the data in Table 7 for insurance type should be interpreted with caution.

Medicare appears to be the most prevalent form of insurance utilized by customers of survey respondents with almost two-thirds (64%) of pharmacies in both 2011 and 2013 reporting that 25-74% of their customer base pay with Medicare insurance. Customers' utilizing private insurance was the second most reported insurance type with 52% of pharmacies indicating 25-74% of their customers using private insurance in 2011 and 43% of pharmacies indicating this range in 2013. Medicaid looks to be the third largest insurance type with 34% of pharmacies in 2011 and 37% in 2013 indicating Medicaid as the type of insurance used by 25-74% of their customer base. Serving customers who self-pay for their prescriptions was the least predominant insurance type for the survey respondents.

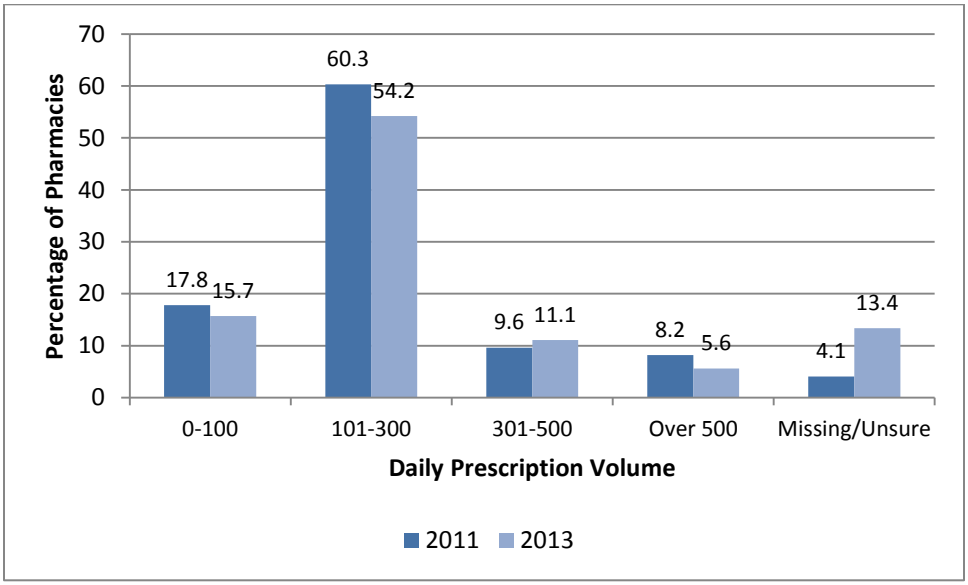
Table 7. Percentage of pharmacies by type of insurance utilized by pharmacy customers

2011 (n=73)	0%	1-24%	25-74%	75-99%	100%	Missing	Median
Medicare	2.7	8.2	64.4	16.4	0	8.2	40%
Private Insurance	1.4	34.2	52.1	4.1	0	8.2	30%
Medicaid	5.5	42.5	34.2	8.2	1.4	8.2	20%
Self-pay	16.4	74.0	0	0	1.4	8.2	5%
2013 (n=216)	**0%**	**1-24%**	**25-74%**	**75-99%**	**100%**	**Missing**	**Median**
Medicare	1.9	9.7	64.4	6.0	0	18.1	40%
Private Insurance	1.9	26.9	43.1	6.0	1.4	20.8	30%
Medicaid	4.2	34.7	36.6	6.0	0	18.5	25%
Self-pay	5.6	66.7	2.3	0.5	0.9	24.1	5%

Prescribing characteristics

Figure 7 displays the daily prescription volume for the survey respondents. A large proportion of survey respondents indicated an average daily prescription volume of 101 to 300 prescriptions with 60% of pharmacies indicating this volume range in 2011 and 54% in 2013. In 2011, 18% of pharmacies indicated a daily prescription volume of 0-100 and 16% indicated this range in 2013. Only six respondents in 2011 and 12 in 2013 indicated a volume of greater than 500 prescriptions daily.

Figure 7. Daily prescription volume



Pharmacies were asked to indicate whether or not they receive new and/or renewal prescriptions by any of the following methods; phone, voicemail, interactive voicemail, fax, e-prescription system, paper or other methods.

Table 8 shows the methods reported by the survey respondents. In 2011 and 2013, the majority of pharmacies reported using fax (97%, 99%) and phone (95%, 98%) and paper and e-prescriptions systems were likewise predominant in 2013 (97%, 96%). The shift in the proportion of pharmacies utilizing e-prescription systems in 2011 (80%) compared to 2013

(96%) proved to be statistically significant (p=0.000). There was a significant decline from 2011 to 2013 for the proportion of survey respondents utilizing interactive voicemail (48%, 33%, p<0.05). And, the proportion of survey respondents who received new and/or renewal prescriptions by paper increased significantly from the first survey administration to the second with 85% reporting paper-based methods in 2011 versus 97% in 2013 (p=0.000).

Table 8. Methods of receiving new/renewal prescriptions

	2011(N=73)		2013 (N=216)	
	N	%[1]	N	%[1]
Fax	71	97.3	213	98.6
Phone	69	94.5	212	98.1
Paper	62	84.9***	210	97.2***
e-Prescription system	58	79.5***	207	95.8***
Voicemail	55	75.3	166	76.9
Interactive voicemail	35	47.9*	71	32.9*
Other	5	6.8*	4	1.9*

* p<0.05, *** p<0.001

[1]Total percentage may exceed 100 because respondents could select more than one method.

E-prescribing landscape

All survey respondents were asked three general questions pertaining to e-prescribing as a means of gauging the level of understanding, perception and potential of the e-prescribing landscape from the perspective of community pharmacists. First, respondents were asked to rate their level of understanding of e-prescribing. These answers are reported in Table 9. In 2011, a third of respondents reported a deep understanding of e-prescribing and more than half reported being familiar with broad e-prescribing terms and concepts. By 2013, the proportions seemed to shift towards a better understanding of e-prescribing with slightly more than half of respondents reporting a deep understanding and slightly less than half reporting being familiar with broad e-prescribing terms and concepts.

Table 9. Level of understanding of e-prescribing

	2011(N=73)		2013 (N=216)	
	N	%	N	%
Deep understanding	24	32.9	109	50.5
Familiar with broad e-prescribing terms/concepts	40	54.8	102	47.2
Know some e-prescribing terms/concepts	9	12.3	4	1.9
Have not heard anything about e-prescribing	0	0	1	0.5

Secondly, the respondents were asked to estimate a percentage range of prescriber adoption in the pharmacy's area. And lastly, the respondents were asked to report whether or not they were enabled for e-prescribing.

The proportion of pharmacies utilizing e-prescription systems in 2013 (96%) was significantly higher in comparison with 2011 (80%).

Table 10 shows that the proportion of survey respondents enabled in 2013 (96%) was greater than the proportion who were enabled in 2011 (86%). Additionally, there appears to be a shift in perception of prescriber adoption between the administrations of the two surveys with 62% reporting more than half to all prescribers in the area as e-prescribing in 2013 versus 22% reporting this percentage range in 2011.

Table 10. Enabled Pharmacies & Estimate of prescriber adoption in pharmacy's area

	2011(N=73)		2013 (N=216)	
	N	**%**	**N**	**%**
Pharmacies enabled for eRx				
Yes	63	86.3**	208	96.3**
No	9	12.3	8	3.7
Don't know	1	1.4	0	0
Estimate of prescriber adoption				
0-15%	20	27.4	8	3.7
16-50%	33	45.2	61	28.2
51-100%	16	21.9	133	61.6
Unsure	4	5.5	14	6.5
** p<0.01				

By utilizing monthly datasets available from Surescripts, Inc. we know that as of August 2013 there are 8,463 prescribers actively e-prescribing on the Surescripts network in Connecticut. Due to challenges in obtaining a complete set of prescribers in Connecticut who are eligible to e-prescribe we are unable to provide the overall prescriber adoption rate.

The proportion of survey respondents enabled in 2013 (96%) was greater than the proportion who were enabled in 2011 (86%).

Influence of e-prescribing

All survey respondents were asked six opinion-based questions pertaining to the influence of e-prescribing on their pharmacy practice. The six questions were based on the Institute of Medicine's (IOM) six aims for health improvement; Efficiency, Patient Safety, Patient-Centeredness, Effectiveness, Equity and Timeliness.[72] For each domain, the respondents were presented with a brief definition of the domain, a specific example of how e-prescribing relates to the domain and were asked to give their opinion as to whether or not e-prescribing (currently) influences or could influence certain components of their pharmacy practice based on the context of the specific domain presented. Respondents were asked to choose a response fitting into one of the following six categories; very positively, somewhat positively, neither positively nor negatively, somewhat negatively, very negatively or unsure. Table 11 contains the responses to these questions.

From 2011 to 2013 there appears to be a general shift from positive responses to more neutral responses, or occasionally, more negative responses. For the domains of Efficiency,

Patient Safety, Patient-Centeredness, Effectiveness and Equity fewer respondents in 2013 reported feeling somewhat positively about the influence e-prescribing could have on their pharmacy practice than they did in 2011. The Equity domain saw the largest drop with 43% of respondents indicating somewhat positively in 2011 versus only 18% indicating as such in 2013.

Table 11. How e-prescribing influences components of pharmacy practice

	2011(N=73)		2013 (N=216)	
	N	**%**	**N**	**%**
Efficiency				
Very positively	31	42.5	96	44.4
Somewhat positively	32	43.8	82	38
Neither positively nor negatively	4	5.5	14	6.5
Somewhat negatively	2	2.7	5	2.3
Very negatively	0	0	2	0.9
Unsure	4	5.5	2	0.9
Missing	0	0	15	6.9
Patient Safety				
Very positively	27	37	67	31
Somewhat positively	33	45.2	63	29.2
Neither positively nor negatively	7	9.6	50	23.1
Somewhat negatively	2	2.7	18	8.3
Very negatively	2	2.7	2	0.9
Unsure	1	1.4	1	0.5
Missing	1	1.4	15	6.9
Patient-centeredness				
Very positively	22	30.1	42	19.4
Somewhat positively	29	39.7	57	26.4
Neither positively nor negatively	11	15.1	79	36.6
Somewhat negatively	3	4.1	8	3.7
Very negatively	3	4.1	1	0.5
Unsure	3	4.1	12	5.6
Missing	2	2.7	17	7.9
Effectiveness				
Very positively	24	32.9	79	36.6
Somewhat positively	33	45.2	74	34.3
Neither positively nor negatively	12	16.4	37	17.1
Somewhat negatively	2	2.7	6	2.8
Very negatively	0	0	1	0.5
Unsure	1	1.4	3	1.4
Missing	1	1.4	16	7.4
Equity				
Very positively	11	15.1	29	13.4

	2011(N=73)		2013 (N=216)	
Somewhat positively	31	42.5	38	17.6
Neither positively nor negatively	15	20.5	95	44
Somewhat negatively	2	2.7	1	0.5
Very negatively	1	1.4	3	1.4
Unsure	12	16.4	31	14.4
Missing	1	1.4	19	8.8
Timeliness				
Very positively	29	39.7	76	35.2
Somewhat positively	26	35.6	80	37
Neither positively nor negatively	10	13.7	24	11.1
Somewhat negatively	1	1.4	15	6.9
Very negatively	4	5.5	4	1.9
Unsure	2	2.7	1	0.5
Missing	1	1.4	16	7.4

Barriers to e-prescribing

Survey respondents were presented with 10 factors that may be barriers to implementing e-prescribing and were asked to indicate whether or not they felt the factor was indeed a barrier. Table 12 contains the barriers reported by Connecticut pharmacists in 2011 and 2013. In 2011, the three leading barriers as indicated by survey respondents were low prescriber activity (38%), prescription transaction fees (36%) and maintenance costs (33%). In 2013, the three leading barriers indicated were bugs in the e-prescribing process (38%), potential for an incomplete patient medication list (27%) and poor network connections in the area and/or network costs (21%).

Table 12. Barriers to implementing e-prescribing

	2011 (N=73)		2013 (N=216)	
Factors	**N**	**%[1]**	**N**	**%[1]**
Low prescriber activity	28	38.4***	33	15.3***
Prescription transaction fees	26	35.6*	43	19.9*
Maintenance costs	24	32.9***	28	13***
Start-up costs/converting existing data into e-prescribing system	21	28.8	41	19
Potential for an incomplete patient medication list	20	27.4	58	26.9
Changes to existing workflow	16	21.9	32	14.8
Bugs in e-prescribing process	14	19.2**	83	38.4**
Concerns about privacy of patient data	11	15.1	24	11.1
Concerns about security of patient data	9	12.3	22	10.2
Poor network connections in the area and/or network costs	8	11	45	20.8
Other	5	6.8**	44	20.4**

*p<0.05, **p<0.01, ***p<0.001

[1] Total percentage may exceed 100 because respondents could select more than one barrier.

In 2013, respondents were forthcoming in sharing other barriers to implementing e-prescribing that might not have fallen into the 10 categories presented. The other responses aligned with barriers and issues documented in the literature. Of the 44 respondents that shared other barriers in 2013, more than two thirds reported various data entry issues as barriers to e-prescribing and 41% informed that they feel prescribers are not trained properly on the e-prescribing software. The summary of this feedback is presented in Table 13. Details of these barriers can be found in Table 27 in Appendix D.

Table 13. 2013 Summary of other barriers to implementing e-prescribing

	2013 (N=44)	
Factors	**N**	**%**
Safety	32[1]	72.7
Data Entry Issues	30[1]	68.2
Wrong drug	16	36.4
Wrong dose	8	18.2
Wrong drug directions/sig	5	11.4
Wrong pharmacy	5	11.4
Wrong patient demographics	4	9
Wrong strength	3	6.8
Wrong frequency	2	4.5
Wrong prescriber office specified	1	2.3
Other Safety Related Issues	2[1]	4.5
Physician staff send e-prescriptions	2	4.5
Efficiency	31[1]	70.5
Prescribers not trained properly	18	40.9
E-prescribing systems need better error proofing	6	13.6
Duplicate prescriptions	3	6.8
Standardization of software needed	3	6.8
Controlled substances sent in error	3	6.8
No bi-directional communication	2	4.5
No diagnosis code entered	2	4.5
E-prescribing leads to billing issues	1	2.3
Bundling of e-prescriptions (sending many at once)	1	2.3
Older doctors less likely to use	1	2.3
Patient-centeredness	6[1]	13.6
Patients waiting for e-prescriptions	5	11.4
Patients receive wrong prescriptions	1	2.3
Timeliness	6[1]	13.6
Processing delays	5	11.4
Hospital doctors don't have easy access to system	1	2.3

[1]Number of unique pharmacies reporting issues in general category. Combined totals of sub-categories may be greater than total of general category since pharmacies' responses may have been applicable to more than one sub-category.

E-prescribing characteristics

Survey respondents who are enabled for e-prescribing were asked to indicate all types of electronic transactions processed by their pharmacy. As discussed in the Methodology section, inconsistency was found between the responses to this question and other questions on the survey, therefore, results in Table 14 should be examined with caution.

One hundred percent of enabled pharmacies reported processing new electronic prescriptions in 2011 and 98% were processing new electronic transactions in 2013. Renewal prescriptions were the second most common type of electronic transactions processed with 89% of respondents reporting this type of electronic transaction 2011 and 96% in 2013. Fill notifications to prescribers and medication history, both send and receive, decreased in prevalence from 2011 to 2013 for survey respondents.

Table 14. Electronic transactions processed by survey respondents

	2011(N=63)		2013 (N=208)	
	N	**%[1]**	**N**	**%[1]**
New prescriptions	63	100	203	97.6
Renewal prescriptions	56	88.9	200	96.2
Fill notifications (to prescriber)	23	36.5	54	26
Medication history (send)	16	25.4***	12	5.8***
Medication history (receive)	16	25.4***	12	5.8***

*** $p<0.001$

[1]Total percentages may exceed 100 because respondents could select more than one e-transaction.

The 2013 survey included three additional questions pertaining to e-prescribing volume and prescriber volume that were not included in the 2011 survey. This information is displayed in Table 15. Sixty one percent of respondents reported their average daily e-prescribing dispensing volume to fall into the range of 0-100 e-prescriptions per day for new and renewal prescriptions. Most pharmacies were unable to provide estimates on the number of physicians and physician practices that submit e-prescriptions.

Table 15. E-prescribing and prescriber volume

	2013 (n=208)	
	N	**%**
Daily e-prescription volume for enabled pharmacies		
0-100	127	61.1
101-300	41	19.7
301-500	4	1.9
Over 500	2	1
Missing/Unsure	34	16.3
# of Physician practices submitting e-prescriptions		
0	2	1.0
1-10	14	6.7
11-25	24	11.5
26-99	23	11.1
>=100	7	3.4
Missing	138	66.3
# of Physicians submitting e-prescriptions		
0	2	1.0
1-10	3	1.4
11-25	6	2.9
26-99	29	13.9
>=100	22	10.6
Missing	146	70.2

Infrastructure and standards utilized for e-prescribing

For those survey respondents who indicated yes for being enabled for e-prescribing, they were also asked a series of questions pertaining to the infrastructure and standards utilized for e-prescribing within their pharmacy. Table 16 contains the responses to these questions. We know from the Surescripts datafiles that a majority of our survey respondents are enabled on the Surescripts network, yet, the survey respondents themselves were not always certain of the network being utilized as evidenced by the large number of missing responses for the question pertaining to network used. Likewise, many respondents were not certain whether or not their pharmacy paid a transaction fee to receive e-prescriptions with 57% indicating as such in 2013. Respondents did seem to have better knowledge on whether or not their pharmacy utilizes standards for e-prescribing with 67% indicating yes to utilizing standards in 2011 and 55% indicating yes in 2013. Yet, while the respondents may have been aware that standards were being utilized, the majority of respondents did not know if the standards were compatible with HL7 messaging standards nor were they familiar with what terminology was being utilized to code and communicate their e-prescribing data. For those who were aware of the terminology, the NCPDP standard was the most prevalent with 37% of respondents indicating usage of the standard in 2011 and 11% in 2013.

Table 16. Infrastructure and standards utilized for e-prescribing

	2011 (N=63)		2013 (N=208)	
	N	%	N	%
Network used for e-prescribing				
Surescripts	37	58.7	126	60.6
Other	4	6.3	6	2.9
Proprietary (private)	1	1.6	1	0.5
Emdeon	0	0	3	1.4
Missing	21	33.3	72	34.6
Pharmacy pays transaction fee to receive e-prescriptions				
Yes	32	50.8	73	35.1
No	5	7.9	9	4.3
Don't know	24	38.1	119	57.2
Missing	2	3.2	7	3.4
Pharmacy utilizes standards for e-prescribing				
Yes	42	66.7	114	54.8
No	2	3.2	6	2.9
Don't know	18	28.6	84	40.4
Missing	1	1.6	4	1.9
Standards outlined in final rule 42 CFR part 423				
Yes	31	73.8	66	57.9
No	1	2.4	2	1.8
Don't know	10	23.8	43	37.7
Missing	0	0	3	2.6
System used is compatible with HL7 messaging standards				
Yes	8	12.7	13	6.2
No	0	0	6	2.9
Don't know	55	87.3	188	90.4
Missing	0	0	1	0.5
Terminology used to code and communicate data[1]				
NCPDP	23	36.5***	23	11.1***
Other	10	15.9	1	0.5
SNOMED	0	0	0	0
RXNORM	0	0	0	0
Don't know	32	50.8***	186	89.4***

***p<0.001

[1]The predominance of don't know responses precludes meaningful inferences to be made on this data.

[2] Total percentages may exceed 100 because respondents could select more than one terminology.

Plans for implementing e-prescribing

For those pharmacies who were not enabled for e-prescribing at the time of the survey (n=9 in 2011 and n=8 in 2013), these pharmacies were asked questions pertaining to when they might implement e-prescribing and what might motivate them to do so. Responses are shown in 7. Most of the respondents indicated that they have no plans to enable e-prescribing. The remainder indicated it would occur within the year. The pharmacies were also asked what level of area e-prescribing activity would prompt them to implement e-prescribing and their likelihood of implementing e-prescribing if technical assistance was received. There was no predominant response for either of these questions.

Table 17. Plans for implementing e-prescribing for pharmacies not enabled

	2011 (N=9)	2013 (n=8)
	N	N
Timeline for enabling e-prescribing		
No plans to enable e-prescribing	6	5
Within 6 months	1	2
Within 1 year	1	1
Missing	1	0
Level of area e-prescribing activity that would prompt pharmacy to implement e-prescribing		
0%	3	4
1-5%	1	0
16-50%	2	1
51-75%	1	0
100%	1	1
Missing	1	2
Likelihood of implementing e-prescribing if technical assistance received		
Significantly likely	2	2
Somewhat likely	2	0
Neutral	2	2
Somewhat unlikely	1	1
Significantly unlikely	1	2
Missing	1	1

Health Information Exchange

All survey respondents were asked how familiar they were with Connecticut's Health Information Exchange (CT-HIE). As indicated in Table 18, the majority of respondents indicated no familiarity with CT-HIE (70% in 2011 and 74% in 2013).

Table 18. Familiarity with CT-HIE among Connecticut pharmacies

	2011(N=73)		2013 (N=216)	
	N	%	N	%
Very familiar	2	2.7	5	2.3
Somewhat familiar	10	13.7	22	10.2
A little familiar	9	12.3	15	6.9
Not familiar at all	51	69.9	160	74.1
Missing	1	1.4	14	6.5

Pharmacists who responded as being very, somewhat or a little familiar with CT-HIE were then asked three questions regarding their perceptions towards CT-HIE. These results are included in Table 19. For the small number of pharmacists who were asked these questions, most felt that an HIE in CT would be very useful, most were neutral regarding their level of satisfaction with CT-HIE and felt that CT would be successful in implementing a statewide HIE by 2014.

Table 19. Perceptions of CT-HIE among Connecticut pharmacies

	2011 (N=21)		2013 (N=42)	
	N	%	N	%
Usefulness of HIE in state of CT				
Very useful	12	57.1	13	31
Somewhat useful	6	28.6	6	14.3
Not useful at all	1	4.8	2	4.8
Missing	2	9.5	21	50
Level of satisfaction with CT-HIE				
Very dissatisfied	0	0	0	0
Dissatisfied	1	4.8	1	2.4
Neutral	14	66.7	18	42.9
Satisfied	4	19	7	16.7
Very Satisfied	0	0	5	11.9
Missing	2	9.5	11	26.2
Will CT be successful in implementing a statewide HIE by 2014				
Yes	11	52.4	12	28.6
No	5	23.8	10	23.8
Not sure	5	23.8	13	31
Missing	0	0	7	16.7

Lastly, survey respondents who are enabled for e-prescribing were asked to indicate whether or not their practice was sending electronic transactions to any other entities through an e-prescribing network. Responses to this question are included in Table 20. The most common use for the e-prescribing network (outside of e-prescribing) was for sending

electronic transactions to physicians, physicians' assistants and nurse practitioners with 57% of respondents indicating this in 2011 and 82% in 2013.

Table 20. Use of e-prescribing network for other electronic transactions

	2011(N=63)		2013 (N=208)	
	N	%	N	%
Physicians, physicians' assistants, nurse practitioners	36	57.1	170	81.7
Health Information Exchange (HIE)	8	12.7	8	3.8
Electronic health records	5	7.9	10	4.8
Patients	3	4.8	0	0

Pharmacies responding to survey in 2011 and 2013

Thirty three pharmacies responded to the survey in both 2011 and 2013. Thirty one respondents (94%) were from independent pharmacies and two were from chain pharmacies (6%). In 2011, 27 (82%) of these pharmacies were enabled for e-prescribing on the Surescripts network and only one additional independent pharmacy was enabled by 2013 (85%). Of the 33 pharmacies, 11 (33%) were classified as urban core, 9 (27%) were classified as urban periphery, 6 (18%) were classified as suburban, 4 (12%) were classified as rural, and 3 (9%) were classified as wealthy.

While there were no significant differences in the barriers to implementing e-prescribing between 2011 and 2013, there was a shift from 2011 to 2013 in the leading barriers as demonstrated by the numbers shown in Table 21. In 2011, the leading barriers were low prescriber activity (49%), prescription transaction fees (39%) and potential for an incomplete patient medication list (33%). In 2013, prescription transaction fees became the leading barrier (49%) and bugs in the e-prescribing process became the second leading barrier (33%).

Table 21. Barriers to implementing e-prescribing: 2011 and 2013 survey respondents

	2011 (N=33)		2013 (N=33)	
Factors	**N**	%[1]	**N**	%[1]
Low prescriber activity	16	48.5	8	24.2
Prescription transaction fees	13	39.4	16	48.5
Potential for an incomplete patient medication list	11	33.3	10	30.3
Maintenance costs	10	30.3	5	15.2
Changes to existing workflow	10	30.3	5	15.2
Bugs in e-prescribing process	7	21.2	11	33.3
Start-up costs/converting existing data into e-Rx system	6	18.2	8	24.2
Concerns about privacy of patient data	6	18.2	4	12.1
Poor network connections in the area and/or network costs	5	15.2	4	12.1
Concerns about security of patient data	4	12.1	3	9.1
Other	4	12.1	2	6.1

[1] Total percentage may exceed 100 because respondents could select more than one barrier.

Table 22 includes the responses to the level of understanding of e-prescribing question. The pharmacies responding to the survey during both administrations demonstrated a shift towards having a deeper understanding of e-prescribing technology by 2013 with almost half of the respondents indicating as such in 2013.

Table 22. Level of understanding of e-prescribing: 2011 and 2013 survey respondents

	2011(N=33)		2013 (N=33)	
	N	%	N	%
Deep understanding	10	30.3	16	48.5
Familiar with broad e-prescribing terms/concepts	19	57.6	15	45.5
Know some e-prescribing terms/concepts	4	12.1	1	3.0
Have not heard anything about e-prescribing	0	0	1	3.0

In examining the influence of e-prescribing on various components of pharmacy practice based on IOM's six aims for health improvement (Efficiency, Patient Safety, Patient-Centeredness, Effectiveness, Equity and Timeliness), the perceptions of this group did not change from 2011 to 2013. With regards to familiarity with CT-HIE, there were no significant differences from 2011 to 2013 for the pharmacies that completed both surveys. However, 39% of the respondents from this subset of pharmacies had some familiarity with CT-HIE in 2013 versus only 19% having familiarity from the overall 2013 cohort.

Significant findings

By survey administration

In order to examine the potential trends exhibited towards more neutral/negative responses with the Influence of e-Prescribing questions, the responses were re-categorized into dichotomous response categories of positive ("very positively" or "somewhat positively") or neutral/negative ("neither positively nor negatively", "somewhat negatively", or "very negatively") and the unsure and missing response categories were omitted. Significant findings associated with these questions are represented in Table 23. The 2013 respondents were more likely to select neutral and negative responses for the IOM domains of Patient Safety (p=0.002), Patient Centeredness (p=0.002) and Equity (p=0.000) than they did in 2011.

Table 23. How e-prescribing influences components of pharmacy practice by survey administration

	N	%	N	%
Patient safety	**2011 (N=71)**		**2013 (N=200)**	
Positive	60	84.5	130	65.0
Neutral/negative	11	15.5**	70	35.0**
Patient-centeredness	**2011 (N=68)**		**2013 (N=187)**	
Positive	51	75.0	99	52.9
Neutral/negative	17	25.0**	88	47.1**
Equity	**2011 (N=60)**		**2013 (N=166)**	
Positive	42	70.0	67	40.4
Neutral/negative	18	30.0***	99	59.6***

**p<0.01, ***p<0.001

By pharmacy type

Statistical tests were performed to determine if there were any differences between the survey responses based on pharmacy type. For the purposes of this analysis the two franchise pharmacies were grouped with chain pharmacies. Table 24 shows that chain pharmacies were more likely to be enabled than independent pharmacies in both 2011 and 2013 and overall.

Table 24. Enabled for e-prescribing by pharmacy type

	2011 (n=73)				2013 (n=216)				Total (n=289)			
	Chain		Independent		Chain		Independent		Chain		Independent	
	N	%	N	%	N	%	N	%	N	%	N	%
Yes	30	100.0**	33	76.7**	116	99.1*	92	92.9*	146	99.3***	125	88.0***
No/Don't know	0	0.0	10	23.3	1	0.9	7	7.1	1	0.7	17	12.0

*p<0.05, **p<0.01, ***p<0.001

Significant differences by pharmacy type pertaining to barriers to e-prescribing are shown in Table 25. In analyzing each of the barriers to implementing e-prescribing, independent pharmacies were more likely than chain/franchise pharmacies to indicate prescription transaction fees, low prescriber activity and maintenance costs as barriers. For low prescriber activity, the difference was only observed when the survey results were pooled and exhibited a non-significant trend in 2011 (p=0.095). For the barriers prescription transaction fees and maintenance costs, significance was found in the pooled results, the 2013 results and exhibited non-significant trends in 2011 (p=0.085 and p=0.076 respectively). It is possible that the statistical tests in 2011 did not reach the threshold for significance because of the smaller size of the 2011 sample.

Table 25. Barriers to implementing e-prescribing by pharmacy type

	2011 (n=73)				2013 (n=216)				Total (n=289)			
	Chain		Independent		Chain		Independent		Chain		Independent	
	N	%	N	%	N	%	N	%	N	%	N	%
Prescription transaction fees	7	23.3	19	44.2	8	6.8***	35	35.4***	15	10.2***	54	38.0***
Low prescriber activity	8	26.7	20	46.5	15	12.8	18	18.2	23	15.6*	38	26.8*
Maintenance costs	6	20.0	18	41.9	9	7.7*	19	19.2*	15	10.2**	37	26.1**

*p<0.05, **p<0.01, ***p<0.001

Each of the six influences of e-prescribing questions was analyzed to see if differences exist between chain/franchise and independent pharmacies regarding. There were no significant differences found for any of the six questions, but for the question pertaining to the domain of Effectiveness, there was a non-significant trend found in the pooled results with 27% of

independent pharmacies having more neutral/negative responses versus 17% of chain/franchise pharmacies (p=0.054).

Physician's e-prescribing

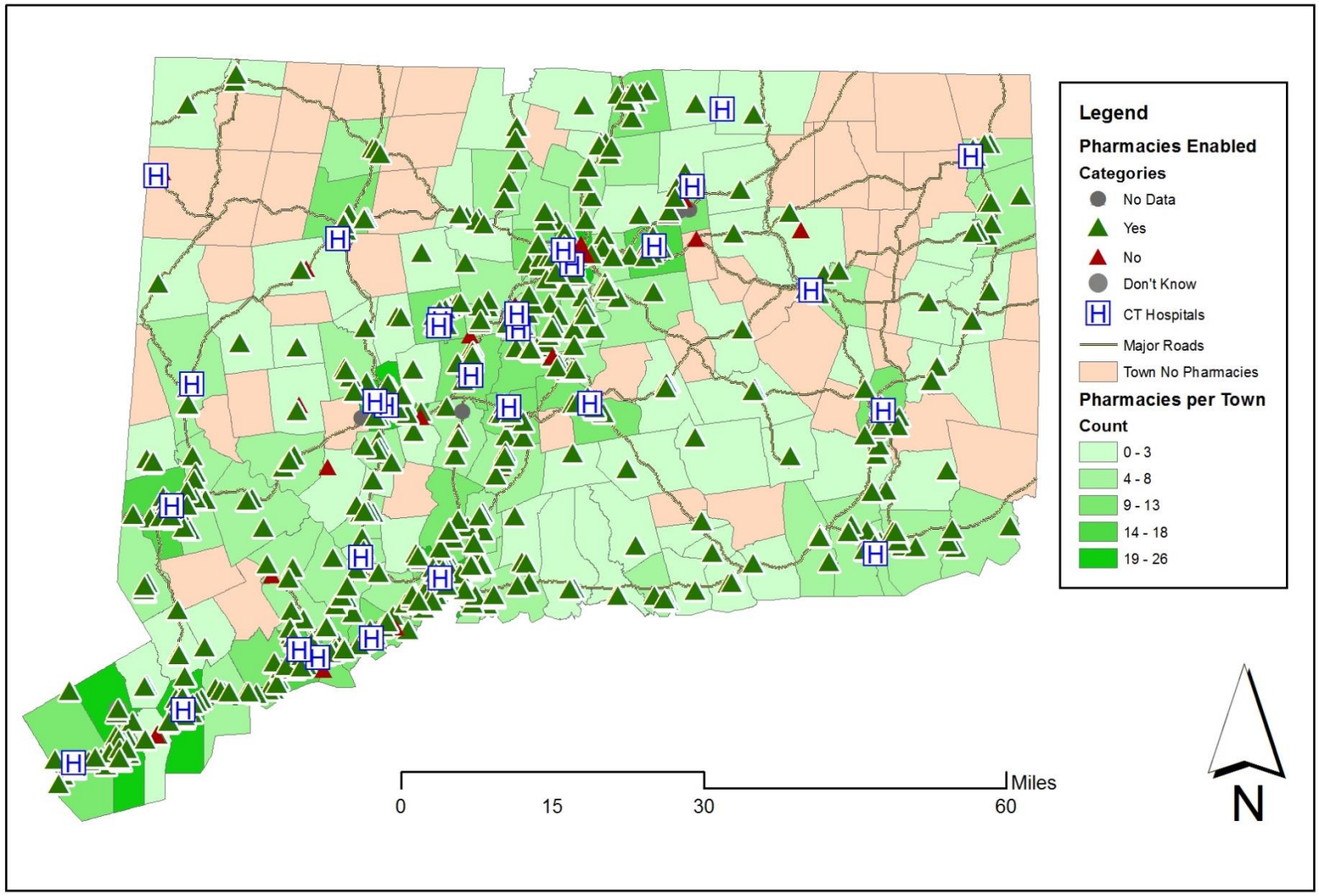
It is important to have enabled pharmacies, but it is even more important that the prescribers actually use e-prescribing. Based on the 2013 physician survey, 79.1% of the physicians report having access to a computerized system for ordering prescriptions and of those that had access to an e-prescribing system 87.5% were sending prescriptions electronically.

Pharmacy Locations

The 720 pharmacies from the 2013 final universe of Connecticut pharmacies were mapped to evaluate clustering versus dispersion of data by location. The number of pharmacies by town varied from 0-26. New Haven had 26 pharmacies, followed by 25 in Waterbury and 22 in Hartford. Forty-five towns had no pharmacies. There were 189 (26%) pharmacies within five miles of I-95, west of New Haven. There were very few pharmacies in Northeast Connecticut and Litchfield County. Pharmacies tended to cluster around each other leaving wide empty spaces in Connecticut without a pharmacy. Almost three out of four (N =520) pharmacies were within five miles of a hospital. Creating a five mile buffer around the cities of New Haven, Waterbury, and Hartford accounted for 226 (31%) pharmacies.

Map 1 on the following page depicts the enabled and the non-enabled pharmacies with the towns graded for the count of pharmacies.

Map 1. E-Prescribing Pharmacies in Connecticut



V. Summary and discussion

While this evaluation was originally intended to examine Connecticut's efforts in implementing a statewide HIE, that effort was not possible since Connecticut has not, as of the writing of this report, implemented a statewide HIE. Thus, this report is about the adoption of HIT with regards to e-prescribing for community pharmacists in Connecticut. Furthermore, it is a representation of the changes in HIT landscape as a result of the HITECH Act and the various state-level HIE activities rather than a result of the funding that HITE-CT received.

Several trends may be observed from the pharmacy survey data collected in 2011 and 2013. Clearly, pharmacists surveyed in Connecticut are utilizing e-prescribing technology and their usage has increased over the past few years. The fact that the proportion of respondents shifted from more independent pharmacies responding in 2011 to more chain pharmacies responding in 2013 may be indicative of a potential trend of independent pharmacies closing down because of the prevalence of e-prescribing. While we have no data to support this notion, research conducted on pharmacy name changes between the administrations of the two surveys confirmed the taking over of at least two independent pharmacies by chain pharmacies in Connecticut from 2011 to 2013. Our research also informed us that several independent pharmacies that completed the 2011 survey were no longer in business when we attempted to call them in 2013.

Pharmacists' understanding of e-prescribing technology seems to have increased over the past few years as evidenced by the larger proportion of respondents reporting a deep understanding of e-prescribing in 2013 versus 2011. However, for the subset of pharmacies completing the survey in both 2011 and 2013, there were no responses for the category "have not heard anything about e-prescribing" in 2011, yet, one respondent indicated this in 2013. This, unfortunately, brings to light another limitation of the survey in that the responses could vary depending on the knowledge and experience of the person answering the phone. It is clear for this one particular pharmacy the same person did not respond to the survey in 2011 and 2013, thus, making inferences across time is difficult.

While pharmacists' level of understanding of e-prescribing may have deepened, simultaneously, it seems that Connecticut pharmacists' attitudes towards e-prescribing have shifted in a less positive direction. The responses to the questions pertaining to influence of e-prescribing on pharmacy practice in relation to the six IOM domains were less positive and moving towards more neutral responses by the administration of the survey in 2013. Specifically, in the domains of Patient Safety, Patient Centeredness and Equity, the shift was statistically significant from 2011 to 2013.

The fact that the proportion of respondents that indicated receiving new and renewal prescriptions via paper in 2013 (97%) was greater than the proportion that indicated this in 2011 (85%) is a situation that may warrant attention. One might have expected this proportion to have gone down with the prevalence of e-prescribing technology, yet, as we

know from the literature, paper prescriptions are often received in conjunction with electronic prescriptions. This is in part due to the fact that the sending of electronic prescriptions for controlled substances only recently became legal, but receiving prescriptions via mixed methods seems to be prevalent even when controlled substances are not involved and the reasons aren't always so clear.

In 2011, pharmacists indicated low prescriber activity, prescription transaction fees and maintenance costs as three leading barriers to implementing e-prescribing. By 2013, the barriers seem to move from costs and financial reasons towards problems with the technology. The leading barriers in 2013 were bugs in the e-prescribing process, potential for an incomplete patient medication list and poor network connections. We also learned that independent pharmacies are more likely than chain pharmacies to indicate prescription transaction fees, maintenance costs and low prescriber activity as barriers to implementation. Since we know that more pharmacies were enabled and actively e-prescribing in 2013 than were in 2011, the feedback pertaining to barriers may simply be indicative of the fact that pharmacists are using e-prescribing more and are encountering the unintended consequences of the technology. With greater understanding of the technology, it is also possible that pharmacists have become more realistic as to what e-prescribing can and cannot do. And, perhaps the return on investment (ROI) is not as clear as pharmacists initially thought.

In examining the Connecticut survey results in light of similar pharmacy surveys conducted in other states, results are comparable. In an ONC report examining health technology in 27 states with data collected in 2011, cost was identified as a leading barrier to e-prescribing[63] as was the case for Connecticut pharmacies in 2011. Independent pharmacists from Florida surveyed in 2011 and Nebraska pharmacists surveyed in 2012 indicated transaction fees and maintenance costs as the two main reasons for not implementing e-prescribing[35,55], which were the second and third most prevalent scripted barriers reported by Connecticut pharmacists in 2011.

During focus groups conducted with Oregon pharmacists in late 2011, pharmacists shared that they do not see transaction fees as a barrier to promoting e-prescribing but rather the increased labor required to process e-prescriptions due to inaccuracies which is an indirect cost to the organization. Furthermore, they reported inaccuracies to be their most significant issue with e-prescribing and expressed concern over the impact the inaccuracies may have on patient safety. The inaccuracies reported by Oregon pharmacists are related to data entry errors on the prescriber end similar to the unscripted barriers reported by Connecticut pharmacists and as documented in the literature. (Please see Table 26 for a summary of the literature pertaining to pharmacists perceptions of incentives and barriers to adoption of e-prescribing.) Oregon pharmacists, similar to Connecticut pharmacists, described the problems of prescribers sending prescriptions to the wrong pharmacy, processing delays, the fact that prescribers lack proper training and concern over prescriber staff functioning outside their scope of practice by processing refill requests.[54] Ohio pharmacists surveyed in 2011 also reported issues similar to those reported by Connecticut pharmacists. Issues identified included: inadequate prescriber education and training; incorrect labeling; lack of electronic feedback to the prescriber office; and unrealistic expectations by the patient and prescriber as to the transmission time for e-prescriptions.[16] Results of focus groups

conducted with pharmacists in Arizona in 2007 and 2008 included all of the same concerns as those revealed by Ohio pharmacists and additionally included concerns over lack of diagnosis codes in e-prescriptions and concerns related to e-prescribing of controlled substances[36], similar to those reported by Connecticut pharmacists. Clearly, pharmacists across the country are having comparable experiences and express similar concerns related to e-prescribing.

The Ohio e-Prescribe Task Force asked their pharmacists a question omitted on the Connecticut survey regarding how much communication is needed with prescribers to verify the drug, dosage or directions for a prescription. Interestingly, it appears that fax and handwritten prescriptions generate approximately the same amount of phone calling to prescribers as do electronic prescriptions for pharmacies in Ohio.[16]

Table 26 contains a summary from various state reports and the literature regarding professional's opinions regarding reasons to adopt e-prescribing and positive aspects of it along with barriers to adoption and negative aspects of e-prescribing.

Table 26. Summary of professional's opinions on e-prescribing

Reasons to adopt/positive aspects of e-prescribing	Reduction in errors[7,16,29-31,33-36]
	Improved efficiency of processing[7,29,31,33,35,42-45]
	Financial incentives[63,73,74]
	Physician demand, local competition[11,13,55]
	Federal/state law changes and mandates (controlled substances, etc.)[63,74]
	Drug alerts may lead to improved patient safety[27]
	More opportunities for clinical practice[35-37]
	Improved communication with prescribers[36]
Barriers to adoption/negative aspects of e-prescribing	**Connectivity/software issues***[7,16,29,31,33,36,41,42,45,51,54-56,58,61,75,76]
	Learning curve, workflow issues*[7,16,33,36,41,42,51,54-56,58,61]
	Concern over errors*[7,16,33,35,36,42,45,54-57]
	Costs; start-up and transaction fees*, low-profit margin[3,7,16,36,41,54-56,61,63]
	Impact on patients/Patient wait time*[33,36,42,51,54,61]
	Mixed methods, **bundling***[7,16,54,58]
	Prefer direct communication with prescribers[33,51,55]
	Quality of drug alerts not ideal[27,77]
	Lack of time[55]
	Physician demand lacking*[35,55]
	Satisfied with current system[55]
	Greater number of years in practice less likely to use*[3]
	Sex; females less likely to use[3]

*Items in bold were corroborated by our survey.

VI. Next steps

Considering 96% of our survey respondents were enabled for e-prescribing in 2013, and Surescripts reports 97% of Connecticut pharmacies enabled by the end of 2012, it is clear that community pharmacists in Connecticut have embraced e-prescribing. Prescribers in Connecticut are slowly moving towards greater rates of e-prescribing adoption and current outreach efforts for prescribers to take advantage of meaningful use incentives should move things along at an even faster rate. Independent pharmacies are a bit slower to adopt e-prescribing as evidenced in our survey results and from the Surescripts adoption data.

Our survey results present potential opportunities for supporting e-prescribing technology in the state of Connecticut. Our survey results demonstrated that independent pharmacies are more likely than chain pharmacies to indicate prescription transaction fees, maintenance costs associated with e-prescribing technology and low prescriber activity as barriers to implementing e-prescribing. It is certainly feasible to envision grant dollars or some type of financial assistance to help independent pharmacies offset the direct costs of e-prescribing transaction fees and technology maintenance costs. Furthermore, the fact that low prescriber activity was identified as a significant barrier by independent pharmacies also presents a focused opportunity for the adoption of e-prescribing. While outreach for taking advantage of meaningful use incentives is currently underway with Connecticut prescribers, it may be worthwhile to target specific prescribers in the near vicinities of independent pharmacies that are not enabled. Assisting these prescribers to implement e-prescribing may ultimately result in more independent pharmacies also adopting the technology.

Furthermore, with regards to e-prescribing technology, there is certainly room for improvement. The unscripted barriers to the implementation of e-prescribing as provided by our survey respondents coincide with the literature and other state reports. There is a general consensus among pharmacists that e-prescribing technology is better than paper methods for many reasons, particularly when it comes to medication errors, but the technology is not foolproof or error free. It would be a worthwhile investment to bring together Connecticut pharmacists, prescribers and technology vendors and conduct guided focus groups for the software vendors to hear first-hand the issues encountered by the end-users and suggestions they have for enhancement of the systems.

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Appendix A

Glossary

Chain pharmacy is part of a group of four or more pharmacies under common ownership according to Surescripts data dictionary and is defined by the state of CT as being publically traded.[78]

Community pharmacy is "where pharmacists store, prepare, and dispense medicinal preparations and/or prescriptions for a local patient population in accordance with federal and state law; counsel patients and caregivers (sometimes independent of the dispensing process); administer vaccinations; and provide other professional services associated with pharmaceutical care such as health screenings, consultative services with other health care providers, collaborative practice, disease state management, and education classes."[79]

Enabled for e-prescribing means that the pharmacy management system utilized by the pharmacy for processing prescriptions has the capability to process electronic prescriptions, but, it does not necessarily mean the pharmacy is actively e-prescribing.

Error of omission is an error that occurs when action is not taken or something has been left out.

Formulary is a list of prescription drugs, both generic and brand name, that have been selected and approved through health care plans for their safety, quality, and cost effectiveness.

Formulary and benefit standard, issued by NCPDP, is used by pharmacy benefit payers (including health plans and PBM's) to communicate formulary and benefit information to prescribers via technology vendor systems. The information provided allows the prescriber to consider the most appropriate drug choices for the patient, e.g., which drugs are considered to be on formulary, and alternative medications for those drugs not on formulary, limitations that may impact whether the patient's benefit will cover a drug being considered, and the cost to the patient for one drug option versus another.[15]

Franchise pharmacy defined as "independently owned pharmacies that have signed a franchise agreement with a franchisor wherein the franchisee receives services such as training, marketing, and other support from the franchisor in exchange for a franchise fee to the franchisor."[80]

Health Information Exchange (HIE) refers to the process of reliable and interoperable electronic health-related information sharing conducted in a manner that protects the confidentiality, privacy, and security of the information.

Health Level International Seven (HL7) messaging standard was first released in October 1987 and is the most widely implemented standard for healthcare information in the world. This messaging standard allows the exchange of clinical data between systems and is

designed to support a central patient care system as well as a more distributed environment.[81] The HL7 standards "define how information is packaged and communicated from one party to another, setting the language, structure and data types required for seamless integration between systems."[82]

Independent pharmacy defined by the state of CT as pharmacies that are privately owned and have 20 or fewer stores in the state.[78]

Medication error is a broad term defined as "a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient." Medication errors can be caused by doctors, nurses, pharmacists, caregivers or others involved with the patient and may include the manufacturing or compounding, prescribing, transcribing, dispensing, and administration of a drug, and the subsequent monitoring of its effects.[83]

National Council for Prescription Drug Programs (NCPDP) SCRIPT standard, first published in 1997, was created to facilitate the transfer of prescription data between pharmacies, prescribers, intermediaries, and payers. The current standard supports messages regarding new prescriptions, prescription changes, refill requests, prescription fill status notification, prescription cancellation, medication history, and transactions for long term care environments. The SCRIPT standard is updated annually based on business needs identified by the industry.[84]

REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.[85]

RxNorm, developed by the National Library of Medicine (NLM), provides normalized names and unique identifiers for prescription and over-the-counter drugs available in the United States and links its names to many of the drug vocabularies commonly used in pharmacy management and drug interaction software. By providing links between these vocabularies, RxNorm can mediate messages between systems not using the same software and vocabulary.[86] First published in 2004, the full RxNorm dataset is released monthly with weekly updates that include newly-approved drug information.[86,87]

SNOMED CT provides the core general terminology for the electronic health record (EHR) and contains more than 311,000 active concepts with unique meanings and formal logic-based definitions organized into hierarchies.[88] While SNOMED was first established in 1965 for the field of pathology with standards being released continously since that time, it later extended into other medical fields with the intellectual rights becoming the property of the International Health Standards Development Organisation (IHTSDO) in 2007.[89]

Surescripts Safe-Rx™ rankings measure each state's progress in advancing healthcare safety, efficiency and quality through the adoption and use of e-prescribing. The rankings recognize the full utilization of e-prescribing based on volume of use for all three e-prescribing services: Prescription Benefit, Medication History and Prescription Routing.[11]

Appendix B

2011 Survey instrument

PHARMACY SURVEY: BASELINE

Health Information Technology Exchange of Connecticut: UCHC Evaluation

The University of Connecticut Health Center, on behalf of the Department of Public Health, is seeking input from pharmacies on the subject of e-prescribing. Not only do we want to validate data received from Surescripts on the adoption rates for e-prescribing statewide, we would also like input on impact and value of e-prescribing for pharmacists. Your opinions are very important to us. Please answer the following questions below. If you have any questions or concerns, please contact us:

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I. Practice Characteristics

Please note the following definition of electronic prescribing (e-prescribing, eRx) when answering the survey questions:

"E-prescribing is the transmission, using electronic media, of prescription or prescription-related information between a prescriber, dispenser, pharmacy benefit manager, or health plan, either directly or through an intermediary, including an e-prescribing network. E-prescribing includes, but is not limited to, two-way transmissions between the point of care and the dispenser."

1. What is the location of your practice site in the state of Connecticut?

   _____ (Town)

2. Select the choice that best describes the location/community setting of your organization:

   ☐ Urban
   ☐ Suburban
   ☐ Rural
   ☐ Other:_____

3. Which title best describes your position?

   _____

4. Please select the pharmacy grouping that best describes your practice setting:

   ☐ Chain
   ☐ Franchise

- ☐ Independent
- ☐ Government
- ☐ Alternate dispensing site
- ☐ Other: _____

5. Roughly, what percentage of individuals served by your practice belongs to one of the following? (Percentage should total 100%).
   - _____ Medicare
   - _____ Medicaid
   - _____ Private Insurance
   - _____ Patient payments (self pay)
   - _____ Other: _____

II. Use of e-Prescribing and Health IT

6. Rate your level of understanding with electronic prescribing:
   - ☐ Deep understanding
   - ☐ Familiar with broad e-prescribing terms/concepts
   - ☐ Know some e-prescribing terms/concepts
   - ☐ Have not heard anything about e-prescribing

7. What percentage or range of percentages most closely estimates prescriber adoption of e-prescribing in your pharmacy's area?
   - ☐ 0%
   - ☐ 1-5%
   - ☐ 6-15%
   - ☐ 16-50%
   - ☐ 51-75%
   - ☐ 76-99%
   - ☐ 100%
   - ☐ Unsure

8. Select the number range that best describes your average prescription dispensing volume per day (all types – new and renewals):
   - ☐ 0-50
   - ☐ 51-100
   - ☐ 101-300
   - ☐ 301-500
   - ☐ Over 500
   - ☐ Unsure

9. Is your pharmacy enabled for electronic prescribing?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

10. If no, what is the timeline for enabling e-prescribing in your pharmacy information management system?
    - ☐ Within 6 months
    - ☐ Within 1 year
    - ☐ Within 2 years
    - ☐ More than 2 years
    - ☐ No plans to enable e-prescribing

11. What level of e-prescribing activity in your area by prescribers would prompt your pharmacy to take steps to implement e-prescribing?
    - ☐ 0%
    - ☐ 1-5%
    - ☐ 6-15%
    - ☐ 16-50%
    - ☐ 51-75%
    - ☐ 76-99%
    - ☐ 100%

12. How likely is your pharmacy to take steps to implement e-prescribing if you received technical assistance (from regional extension centers, Health Information Organizations (HIOs), and other organizations)?
    - ☐ Significantly likely
    - ☐ Somewhat likely
    - ☐ Neutral
    - ☐ Somewhat unlikely
    - ☐ Significantly unlikely

13. Does your practice use standards for e-prescribing?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

14. If yes, are these standards outlined in the Final Rule issued by the Department of Health and Human Services (42 CFR Part 423)? If you answered 'no' or 'don't know' to the previous question, please select N/A.
    - ☐ Yes
    - ☐ No
    - ☐ Don't know
    - ☐ N/A

15. Which terminology do you use to code and communicate data?
    - ☐ CPT
    - ☐ LOINC
    - ☐ SNOMED
    - ☐ RXNORM
    - ☐ NCPDP

- ☐ Other: _____ (please specify)

16. What electronic transactions does your pharmacy use? (Check all that apply)
    - ☐ New prescriptions
    - ☐ Renewal prescriptions
    - ☐ Controlled substances
    - ☐ Fill notifications (to prescriber)
    - ☐ Medication history (send)
    - ☐ Medication history (receive)

17. Which of the following describes ways that your pharmacy is capable of receiving prescriptions (either new or renewal)? (Check all that apply).
    - ☐ Phone
    - ☐ Voicemail
    - ☐ Interactive voicemail
    - ☐ Fax
    - ☐ e-Prescription system
    - ☐ Paper
    - ☐ Other: _____

18. Is the system used within your practice compatible with HL7 messaging standards?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

19. What version of HL7 do you use? (Leave blank if unsure).

    _____

20. Over what networks does your pharmacy exchange e-prescribing transactions?
    - ☐ Surescripts
    - ☐ Emdeon
    - ☐ Proprietary (private)
    - ☐ Other: _____

21. Is your practice sending electronic transactions to any of the following through an e-prescribing network?
    - ☐ Health Information Exchange (HIE)
    - ☐ Physicians, Physician Assistants', Nurse Practitioners
    - ☐ Electronic Health Records (EHR or EMR)
    - ☐ Patients

22. If you submit electronic information to an HIE, what is the name of the organization that sponsors the HIE? (Leave blank if unsure).

    _____

23. If you submit electronic information to patients, with approximately what percent of patients do you share data electronically? (Leave blank if unsure).

_____

24. Does your pharmacy pay a transaction fee to receive e-prescribed transactions from prescribers?

- ☐ Yes
- ☐ No
- ☐ Don't know

Overall, how do you think e-prescribing influences or could influence the following components of your practice?

25. Efficiency? (*Efficiency is defined as competency in performance. An example of how eRx can improve efficiency is by streamlining workflow*).

- ☐ Very positively
- ☐ Somewhat positively
- ☐ Neither positively nor negatively
- ☐ Somewhat negatively
- ☐ Very negatively
- ☐ Unsure

26. Safety? (*Safety is defined as being free from danger, risk, or injury. An example of how eRx can improve patient safety is by enabling checks for drug interactions and drug allergies*).

- ☐ Very positively
- ☐ Somewhat positively
- ☐ Neither positively nor negatively
- ☐ Somewhat negatively
- ☐ Very negatively
- ☐ Unsure

27. Patient-centeredness? (*Patient-centeredness is defined as maintaining a focus on the well-being of individual patients. An example of how eRx can improve patient-centeredness is by reducing process time for patients*).

- ☐ Very positively
- ☐ Somewhat positively
- ☐ Neither positively nor negatively
- ☐ Somewhat negatively
- ☐ Very negatively
- ☐ Unsure

28. Effectiveness? (*Effectiveness is defined as the extent to which an activity fulfills its intended purpose. An example of how eRx can improve effectiveness is by improving the ability to track patient medication adherence*).

- ☐ Very positively
- ☐ Somewhat positively

- ☐ Neither positively nor negatively
- ☐ Somewhat negatively
- ☐ Very negatively
- ☐ Unsure

29. Equity? (*Equity is defined as fairness or impartiality. An example of how eRx can improve equity is by allowing equal access to information*).
    - ☐ Very positively
    - ☐ Somewhat positively
    - ☐ Neither positively nor negatively
    - ☐ Somewhat negatively
    - ☐ Very negatively
    - ☐ Unsure

30. Timeliness? (*Timeliness is defined as occurring at a suitable time. An example of how eRx can improve timeliness is by reducing turnaround time for prescriptions*)
    - ☐ Very positively
    - ☐ Somewhat positively
    - ☐ Neither positively nor negatively
    - ☐ Somewhat negatively
    - ☐ Very negatively
    - ☐ Unsure

30. Of the factors below, please select those which you feel are preventing you from implementing e-prescribing: (Check all that apply)
    - ☐ Start up costs and converting existing data into the e-prescribing system
    - ☐ Maintenance costs
    - ☐ Potential for an incomplete patient medication list
    - ☐ Changes to existing workflow
    - ☐ Prescription transaction fees
    - ☐ Low prescriber activity
    - ☐ Poor network connections in this area and/or network costs
    - ☐ Bugs in e-prescribing process (e.g. poor software design, vendor support, downtime)
    - ☐ Concerns about security of patient data
    - ☐ Concerns about privacy of patient data
    - ☐ Other: _____

31. How familiar are you with the Connecticut Health Information Exchange (HIE) Initiative?
    - ☐ Very familiar
    - ☐ Somewhat familiar
    - ☐ A little familiar
    - ☐ Not familiar at all

32. Overall, please rate how useful you believe a health information exchange (HIE) could be within the state of Connecticut:

Not useful at all Somewhat useful Very useful

33. Overall, please rate your level of satisfaction with the Connecticut Health Information Exchange (HIE) Initiative:

- ☐ Very dissatisfied
- ☐ Dissatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very satisfied

Comments regarding HIE in Connecticut:

34. In your opinion, will Connecticut be successful in implementing a statewide health information exchange (HIE) by 2014?

- ☐ Yes
- ☐ No

35. If yes, why?
Comment:

36. If no, why not?
Comment:

37. Lastly, please describe any challenges you faced while following standards for e-prescribing:
Comment:

2013 Survey instrument

PHARMACY SURVEY: FOLLOW-UP

Health Information Technology Exchange of Connecticut: UCHC Evaluation

The University of Connecticut Health Center, on behalf of the Department of Public Health, is seeking input from pharmacies on the subject of e-prescribing. Not only do we want to validate data received from Surescripts on the adoption rates for e-prescribing statewide, we would also like input on impact and value of e-prescribing for pharmacists. Your opinions are very important to us. Please answer the following questions below. If you have any questions or concerns, please contact us:

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Phone 860-679-5559
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III. Practice Characteristics

Please note the following definition of electronic prescribing (e-prescribing, eRx) when answering the survey questions:

"E-prescribing is the transmission, using electronic media, of prescription or prescription-related information between a prescriber, dispenser, pharmacy benefit manager, or health plan, either directly or through an intermediary, including an e-prescribing network. E-prescribing includes, but is not limited to, two-way transmissions between the point of care and the dispenser."

1. What is the location of your practice site in the state of Connecticut?

   _____ (Town)

2. Select the choice that best describes the location/community setting of your organization:

   - ☐ Urban
   - ☐ Suburban
   - ☐ Rural
   - ☐ Other:_____

3. Which title best describes your position?

   _____

4. Please select the pharmacy grouping that best describes your practice setting:

   - ☐ Chain
   - ☐ Franchise
   - ☐ Independent
   - ☐ Government

- ☐ Alternate dispensing site
- ☐ Other: _____

5. Roughly, what percentage of individuals served by your practice belongs to one of the following? (Percentage should total 100%).
   - _____ Medicare
   - _____ Medicaid
   - _____ Private Insurance
   - _____ Patient payments (self-pay)
   - _____ Other: _____

IV. Use of e-Prescribing and Health IT

6. Rate your level of understanding with electronic prescribing:
   - ☐ Deep understanding
   - ☐ Familiar with broad e-prescribing terms/concepts
   - ☐ Know some e-prescribing terms/concepts
   - ☐ Have not heard anything about e-prescribing

7. What percentage or range of percentages most closely estimates prescriber adoption of e-prescribing in your pharmacy's area?
   - ☐ 0%
   - ☐ 1-5%
   - ☐ 6-15%
   - ☐ 16-50%
   - ☐ 51-75%
   - ☐ 76-99%
   - ☐ 100%
   - ☐ Unsure

8. Select the number range that best describes your average prescription dispensing volume per day (all types – new and renewals):
   - ☐ 0-50
   - ☐ 51-100
   - ☐ 101-300
   - ☐ 301-500
   - ☐ Over 500
   - ☐ Unsure

9. Is your pharmacy enabled for electronic prescribing?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

10. Please estimate the number of physician practices that submit electronic prescriptions to your pharmacy. _____

11. Please estimate the number of physicians represented by these practices that submit electronic prescriptions to your pharmacy. _____

12. Select the number range that best describes your average electronic prescription dispensing volume per day (all types- new and renewals):
    - ☐ 0 - 50
    - ☐ 51 - 100
    - ☐ 101 - 300
    - ☐ 301 - 500
    - ☐ Over 500
    - ☐ Unsure

13. If you are not enabled for e-prescribing, what is the timeline for enabling e-prescribing in your pharmacy information management system?
    - ☐ Within 6 months
    - ☐ Within 1 year
    - ☐ Within 2 years
    - ☐ More than 2 years
    - ☐ No plans to enable e-prescribing

14. What level of e-prescribing activity in your area by prescribers would prompt your pharmacy to take steps to implement e-prescribing?
    - ☐ 0%
    - ☐ 1-5%
    - ☐ 6-15%
    - ☐ 16-50%
    - ☐ 51-75%
    - ☐ 76-99%
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15. How likely is your pharmacy to take steps to implement e-prescribing if you received technical assistance (from regional extension centers, Health Information Organizations (HIOs), and other organizations)?
    - ☐ Significantly likely
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17. If yes, are these standards outlined in the Final Rule issued by the Department of Health and Human Services (42 CFR Part 423)? If you answered 'no' or 'don't know' to the previous question, please select N/A.
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    - ☐ No
    - ☐ Don't know
    - ☐ N/A

18. Which terminology do you use to code and communicate data?
    - ☐ CPT
    - ☐ LOINC
    - ☐ SNOMED
    - ☐ RXNORM
    - ☐ NCPDP
    - ☐ Other: _____ (please specify)

19. What electronic transactions does your pharmacy use? (Check all that apply)
    - ☐ New prescriptions
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    - ☐ Interactive voicemail
    - ☐ Fax
    - ☐ e-Prescription system
    - ☐ Paper
    - ☐ Other: _____

21. Is the system used within your practice compatible with HL7 messaging standards?
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    - ☐ Don't know

22. What version of HL7 do you use? (Leave blank if unsure).

    _____

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- ☐ Electronic Health Records (EHR or EMR)
- ☐ Patients

25. If you submit electronic information to an HIE, what is the name of the organization that sponsors the HIE? (Leave blank if unsure).

_____

26. If you submit electronic information to patients, with approximately what percent of patients do you share data electronically? (Leave blank if unsure).

_____

27. Does your pharmacy pay a transaction fee to receive e-prescribed transactions from prescribers?

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    - ☐ Unsure

33. Timeliness? (*Timeliness is defined as occurring at a suitable time. An example of how eRx can improve timeliness is by reducing turnaround time for prescriptions*)
    - ☐ Very positively
    - ☐ Somewhat positively
    - ☐ Neither positively nor negatively
    - ☐ Somewhat negatively
    - ☐ Very negatively
    - ☐ Unsure

34. Of the factors below, please select those which you feel are preventing you from implementing e-prescribing: (Check all that apply)
    - ☐ Start-up costs and converting existing data into the e-prescribing system
    - ☐ Maintenance costs
    - ☐ Potential for an incomplete patient medication list
    - ☐ Changes to existing workflow
    - ☐ Prescription transaction fees
    - ☐ Low prescriber activity
    - ☐ Poor network connections in this area and/or network costs
    - ☐ Bugs in e-prescribing process (e.g. poor software design, vendor support, downtime)
    - ☐ Concerns about security of patient data
    - ☐ Concerns about privacy of patient data
    - ☐ Other: _____

35. How familiar are you with the Connecticut Health Information Exchange (HIE) Initiative?

- ☐ Very familiar
- ☐ Somewhat familiar
- ☐ A little familiar
- ☐ Not familiar at all

36. Overall, please rate how useful you believe a health information exchange (HIE) could be within the state of Connecticut:

Not useful at all — Somewhat useful — Very useful

37. Overall, please rate your level of satisfaction with the Connecticut Health Information Exchange (HIE) Initiative:

- ☐ Very dissatisfied
- ☐ Dissatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very satisfied

Comments regarding HIE in Connecticut: _____

38. In your opinion, will Connecticut be successful in implementing a statewide health information exchange (HIE) by 2014?

- ☐ Yes
- ☐ No

39. If yes, why?
Comment: _____

40. If no, why not?
Comment: _____

41. Lastly, please describe any challenges you faced while following standards for e-prescribing:
Comment: _____

Appendix C

Methodology detail

LearnAboutEPrescriptions.com allows users to view and download lists of pharmacies within 25 miles of a specified ZIP code. To ensure thorough coverage of Connecticut, pharmacy lists within 25 miles of Bridgeport, Brooklyn, Columbia, Cornwall, Danbury, East Haddam, Hamden, Hartford, Manchester, New Haven, Norwalk, Preston, Simsbury, Stafford, and Waterbury were downloaded. These lists were consolidated, and then Excel sorting and searching functions were used to exclude out-of-state pharmacies and to de-duplicate the LearnAboutEPrescriptions.com list.

Chain pharmacies in Connecticut include: A&P; Big Y; Costco; CVS; McQuade's; Osco; Price Chopper; Rite-Aid; Sam's Club; Shop-Rite; Stop & Shop; Target; Triad Isotopes; Wal-Mart; Waldbaum's; Walgreen's; and X-Pect Discounts.

Franchise pharmacies in Connecticut include Medicine Shoppe.

Steps for random sampling of additional chain and franchise pharmacies in 2011:

For every five pharmacies within a chain or franchise, one was to be called for a survey. Theoretically, all individual pharmacies under a chain or franchise use the same IT systems, thus, calling a sample would inform UCHC how much variation existed within each organization. The listings were alphabetized for each chain and franchise by name and mailing address. A random number generator was used to pick the listing of the initial pharmacy to target and every fifth pharmacy after this initial pharmacy was also targeted. When the end of the list was reached, counting looped back to the top of the list until the sample size was met. For example, in a list of 16 pharmacies, the random number generator indicated that listing nine would be the initial pharmacy contacted. Counting off every fifth pharmacy after listing nine meant that pharmacy 14 would also be targeted. Since the list had 16 pharmacies, counting resumed at the top of the list and pharmacy four would, therefore, be the next pharmacy surveyed. In cases where a targeted pharmacy couldn't be contacted or refused to take the survey, the next pharmacy on the list would be called for a survey.

2011 chain and franchise survey respondents: Big Y (n=2), Costco (n=1), CVS (n=3), Medicine Shoppe (n=1), Price Chopper (n=1), Rite-Aid (n=3), Sam's Club (n=1), Shop-Rite (n=2), Stop & Shop (n=5), Target (n=2), Wal-Mart (n=2), and Walgreen's (n=7).

2013 chain and franchise survey respondents: Big Y (n=4), Costco (n=1), CVS (n=30), Rite-Aid (n=17), Medicine Shoppe (n=1), Price Chopper (n=2), Sam's Club (n=1), Shop-Rite (n=4), Stop & Shop (n=16), Target (n=4), Wal-Mart (n=8), Walgreen's (n=23), and X-Pect Discounts (n=1).

Response rate:
Of 188 independent pharmacies contacted for the 2011 survey, valid phone numbers could not be found for 19 (10.1%) of the pharmacies. Of the remaining 169 independent pharmacies, 44 (26.0%) completed the survey, while 25 (14.8%) refused to take the survey.

UCHC contacted 117 chain and franchise pharmacies to try to capture a survey sample of 100 pharmacies. Of these 117 pharmacies, 31(26.5%) responded to the survey, while 81 (69.2%) refused to participate.

Overall, 305 pharmacies were contacted for the 2011 survey. Seventy-three (23.9%) of these pharmacies completed the survey, while 106 (34.8%) refused to take the survey. While survey response rates for independent and chain/franchise pharmacies were close, 69% of chain/franchise pharmacies contacted in 2011 refused to take the survey versus 15% of independents.

For the 2013 survey, the UCHC survey team attempted to contact 200 independent pharmacies. For 14 (7.0%) of these pharmacies, the team was unable to find a valid phone number. Four (2.0%) pharmacies' phone numbers were out of service, and 17 (8.5%) claimed that they were not actually pharmacies. This left 165 independent pharmacies from which to try and capture surveys. Of these 165 pharmacies, 17 (10.3%) refused to take the survey, while 105 (63.6%) completed the survey. UCHC tried to contact 169 chain and franchise pharmacies in order to capture a sample of 111 follow-up chain/franchise surveys. Of these 169 pharmacies, 111 (65.7%) completed surveys, while 20 (11.8%) refused to participate. Overall, UCHC survey staff contacted 369 pharmacies to obtain surveys in 2013. Of these 369 pharmacies, 216 (58.5%) completed surveys and 37 (10.0%) refused to participate. The 2013 refusal rates were lower than those of the 2011 survey, especially for chain/franchise pharmacies with only 11.8% of those contacted refusing to participate in 2013 versus 69% in 2011.

Data cleaning:

Pharmacies in the calling lists were assigned ID numbers in order to distinguish their surveys in the REDCap system. During the 2011 survey administration it was discovered that 12 pharmacies in the calling list had been given duplicate ID numbers. UCHC survey staff researched these cases to determine which pharmacy was responsible for which survey and a new set of unique ID numbers was created. The pharmacy ID numbers used for the 2011 survey (that had duplicates) were mapped to the new unique IDs assigned to the 2013 survey allowing proper matching of the subset of pharmacies who completed the survey in both 2011 and 2013 (n=33.)

Surveys excluded from analytic sample:

2011: Two surveys were excluded due to no questions being answered, one survey was excluded as a duplicate was created due to a bug in the REDCap system and the fourth survey was excluded because an incorrect pharmacy ID was entered and it was impossible to determine the proper pharmacy.

2013: Three surveys were excluded due to no survey questions being answered, 11 were duplicates created by a bug in the REDCap system, one pharmacy completed the survey twice and only one survey was retained (per follow-up with pharmacy to determine which survey should be retained), and one partially-completed survey was deleted. (This pharmacy later completed a survey, which existed as a separate record in REDCap.) Additionally, research was conducted on five incomplete REDCap entries that

were able to remain in the dataset; two surveys were entered without pharmacy ID numbers, two surveys were entered with incorrect ID's and one survey was entered with an incorrect city and incorrect ID number. Utilizing address and other demographic information to cross-reference the survey records with the calling lists, UCHC research staff was able to determine the pharmacies that completed the surveys, preventing them from being excluded from the analytic dataset.

Master pharmacy type classification logic:

1) The pharmacy's entry in the monthly Surescripts file for the month in which the survey was conducted was selected. Pharmacies were matched between Surescripts and the analytic dataset based on their NCPDP IDs. In the few cases where an NCPDP ID was not available in the data set, pharmacies were matched based on name, address, and city. If the pharmacy was not listed in the Surescripts file corresponding to the survey month and to account for lag in data entry into the Surescripts files, an attempt was made to find a listing for the pharmacy in one of the Surescripts pharmacy files for three months after the survey month when available. The Surescripts listing for the closest possible month to the survey month was used.
2) Self-reported pharmacy types include Independent, Chain, Franchise, Government, Alternate Dispensing Type, and Other. The self-reported pharmacy type was compared to the pharmacy type retrieved from the SureScripts file. If the pharmacy types disagreed and the pharmacy self-reported as independent, then the pharmacy was classified as independent. Otherwise, the SureScripts pharmacy type was used.
    - Using this methodology resulted in four cases where the master pharmacy classification was overridden in order to produce sensible values. Two Shop-Rite pharmacies reported themselves as independent; these were instead classified as chain pharmacies in the analytic data set. One Arrow Prescription Center location reported itself as a chain and one reported itself as a franchise. Research indicated that Arrow pharmacies were independent and these records were classified accordingly.
3) The final master pharmacy classification was Independent, Chain, or Franchise.

Appendix D

Table 27. 2013 Detail of other barriers to implementing e-prescribing

2013 Detail of other barriers to implementing e-prescribing
SAFETY
Data Entry Issues
Wrong drug (n=16)
Doctors type in a drug and they pick the wrong drug type from the drop down menu (potentially an issue with the software design).
Prescribers selecting the wrong drug on the drop-down menu.
Doctors don't pay attention to drop down menus; more specifically, they put in the wrong drug strengths, doses, names, etc.
The physician will sometimes select the wrong drug name on the drop-down menu.
Depends on the person entering the data (from the prescriber's end); there are data entry errors (e.g. they put in the wrong drug name, etc.).
Inaccuracy of info being received from the prescriber (patient name, product selection, inaccurate sigs/directions).
Interpretation--physicians use the drop-down menu and when they pick drugs, sometimes they're picking randomly because they don't know what to pick. They need more standardized formats that are more easily translated/interpreted for users.
Operator at the sending end being unfamiliar with the product--they send an incorrect drug name/dosage. Or they'll send e-scrips for outdated medications.
Physicians don't always select the correct drug/dose/etc. on the drop-down menus.
Prescribers are selecting the wrong drug in the drop-down menus (not sure if the problem is related to the software design or the user/prescriber).
Selecting wrong entity from drop list, not easy to sort these problems out.
Sometimes prescribers are careless and pick random things/the first item on the drop-down menu and then we have to double-check if the drug/dose is correct.
Sometimes the prescriber selects the wrong drug from the drop-down menu.
Sometimes the wrong drug is being selected in the system (not sure if it's a problem with the system design itself, or something else).
The wrong drug name or dosage will be entered and then we have to call the prescriber's office to verify or fix the error.
There's a learning curve for using the system--some prescribers just select the wrong things/drugs in the system.
Wrong dose (n=8)
Doctors don't pay attention to drop down menus; more specifically, they put in the wrong drug strengths, doses, names, etc.
Doctors make a lot of mistakes, errors when typing in dosage, directions, etc. for their drug. This leads to a lot of time being spent.
Operator at the sending end being unfamiliar with the product--they send an incorrect drug name/dosage.
Physicians don't always select the correct drug/dose/etc. on the drop-down menus.

2013 Detail of other barriers to implementing e-prescribing
Sometimes prescribers are careless and pick random things/the first item on the drop-down menu and then we have to double-check if the drug/dose is correct.
The e-scripts we get sometimes are not clear; prescriber implementation is not always great--they put in wrong drug dosage/direction. Clarity of info received is not always good.
The wrong drug name or dosage will be entered and then we have to call the prescriber's office to verify or fix the error.
Wrong strength and doses are very frequent.
Wrong drug directions/sig (n=5)
Data entry errors--the drug doesn't match the drug directions.
Doctors make a lot of mistakes, errors when typing in dosage, directions, etc. for their drug. This leads to a lot of time being spent.
Inaccuracy of info being received from the prescriber (patient name, product selection, inaccurate sigs/directions).
Sometimes, the wording of the prescriptions is wrong.
The e-scripts we get sometimes are not clear; prescriber implementation is not always great--they put in wrong drug dosage/direction. Clarity of info received is not always good.
Wrong pharmacy (n=5)
There are a multitude of pharmacies with the same name as us but we're not linked-- there are 2 different sets of our pharmacies and I'll get the other pharmacies' e-scrips because the doctors are not paying attention to where they're sending the e-scrips.
Doctors send e-scrips to the wrong pharmacies sometimes.
Doctors sending prescriptions to more than one pharmacy; the prescription isn't waiting at the right pharmacy and that leaves the patient waiting around. Also, that creates the issue of prescriptions being duplicated.
E-prescriptions were getting sent to the wrong place and so the prescription does not get to us.
Sometimes we will send a request and the doctor gets it and sends it/a response to another pharmacy. It might be a user error.
Wrong patient demographics (n=4)
Data entry errors--the drug doesn't match the patient demographic.
When an office first starts out, they'll send something over, the patient profile isn't consistent (different drug strength/strength changes). We wonder if someone's not clicking the right thing on the system.
Inaccuracy of info being received from the prescriber (patient name, product selection, inaccurate sigs/directions).
Sometimes patient's information is not in the system and then we cannot fill the e-scrip; or, the physician and pharmacy have conflicting info on the patient and that creates a delay/issue with filling the e-scrip.
Wrong strength (n=3)
Doctors don't pay attention to drop down menus; more specifically, they put in the wrong drug strengths, doses, names, etc.
When an office first starts out, they'll send something over, the patient profile isn't consistent (different drug strength/strength changes). We wonder if someone's not clicking the right thing on the system.

2013 Detail of other barriers to implementing e-prescribing
Wrong strength and doses are very frequent.
Wrong frequency (n=2)
The system will pick the wrong day supply.
There are also Issues with billing, physicians will put in an inaccurate day supply (e.g. 30 tablets w/ 11 refills--a 365 day supply) and the insurance company will record that data even if patient only gets 30 tablets in total for the year.
Wrong prescriber office specified (n=1)
Recently, doctors work between 5 or 6 practices and then send e-scrips from 1 office. They sometimes end up telling us the wrong office and we have to call them to figure all of that out/resolve the issue.
Other Safety Related Issues
Physician staff send e-prescriptions (n=2)
I have had nurses contact us from medical offices that have e-prescribing, but the nurses can't figure out how to the e-prescribe system so they just call us instead.
There is the additional issue of identification of the prescriber/person putting in controlled substance e-prescriptions. Sometimes medical staff (not the physician/prescriber) from the prescriber's end will send in the e-scrip., using the physicians' name. That is not comfortable.
EFFICIENCY
Prescribers not trained properly (n=18)
Depends on the person entering the data (from the prescriber's end); there are data entry errors (e.g. they put in the wrong drug name, etc.).
Doctors don't know how to use the e-scribing system; they send out prescriptions that don't make any sense/that have data entry errors.
Doctors make a lot of mistakes, errors when typing in dosage, directions, etc. for their drug. This leads to a lot of time being spent.
When an office first starts out, they'll send something over, the patient profile isn't consistent (different drug strength/strength changes). We wonder if someone's not clicking the right thing on the system.
Incompetence of the providers/prescribers in terms of using the e-prescribing system.
There is also the problem of the impetus to purchase; some physicians mentioned that they were pushed by agencies (e.g. Insurance companies) to adopt the e-prescribing. They were told they would otherwise face a penalty of some sort. So, a number of these physicians pressured into using the system are just jumping into using it without any real knowledge of how it works/how to use it properly.
Knowledge of the system and working it correctly. I have had nurses contact us from medical offices that have e-prescribing, but the nurses can't figure out how to the e-prescribe system so they just call us instead.
No training for prescribers, don't know how to use and send wrong things over.
Older doctors are not on board with the system (e.g. they don't know how to use it properly or they don't want to use it).
Operator at the sending end being unfamiliar with the product--they send an incorrect drug name/dosage. Or they'll send e-scrips for outdated medications.

2013 Detail of other barriers to implementing e-prescribing
Prescribers are selecting the wrong drug in the drop-down menus (not sure if the problem is related to the software design or the user/prescriber).
Prescribers don't know how to properly use the system or they're not paying attention while entering information into the system. Because of this, they make data entry errors that we have to spend time double-checking/fixing.
Sometimes we will send a request and the doctor gets it and sends it/a response to another pharmacy. It might be a user error.
Prescribers/whoever is sending the prescription needs to be given training or improved training on the use of the system.
There's a learning curve for the doctors to use the system.
There's a learning curve for using the system--some prescribers just select the wrong things/drugs in the system.
Training issue, doctors have no idea how to use system
Training, get wrong Rxs or incomplete often.
E-prescribing systems need better error proofing (n=6)
Controlled substances do not have an extra verification step.
Doctors type in a drug and they pick the wrong drug type from the drop down menu (potentially an issue with the software design).
The system will pick the wrong day supply.
Prescribers are selecting the wrong drug in the drop-down menus (not sure if the problem is related to the software design or the user/prescriber).
There also needs to be some kind of error-proofing system in the e-prescribing software/system.
Sometimes the wrong drug is being selected in the system (not sure if it's a problem with the system design itself, or something else).
Duplicate prescriptions (n=3)
Doctors sending prescriptions to more than one pharmacy. Also, that creates the issue of prescriptions being duplicated.
Double e-prescribe. Prescribers keep clicking, send in a second Rx if they think they made a mistake on the first one and pharmacists don't always see the note on the second to disregard the first.
Sometimes you get a doctor sending the same prescription several times, or a refill screen is denied.
Standardizations of software needed (n=3)
Interpretation--physicians use the drop-down menu and when they pick drugs, sometimes they're picking randomly because they don't know what to pick. They need more standardized formats that are more easily translated/interpreted for users.
Physicians don't always select the correct drug/dose/etc. on the drop-down menus; there should be more standardization of the software being used as well.
Need better standardization process of Hospital Formulary system keep drugs more orderly like dewy decimal system which would make it easier and have less problems with selecting the wrong drug.
Controlled substances sent in error (n=3)

2013 Detail of other barriers to implementing e-prescribing
Doctors think they can e-scribe controlled substances (and they cannot) and that can slow things down as we have to spend time resolving the matter each time it occurs.
Many doctors don't understand that they can't e-scribe controlled substances and then we have to get in touch with them to clarify and fix any mix-ups or confusions.
Prescribers will e-scribe controlled substances which are often not verified nor valid. We have to call and verify these prescriptions each time that occurs. Pharmacists are not comfortable with e-prescribing of narcotics. The system is too new to be approving something like that.
No bi-directional communication (n=2)
E-prescription system should allow us to be able to comment back on the system to prescribers. It's a one way system right now.
We don't have a way of sending notes back to prescriber through the system. There is a note section in the system where we can type in notes, but for whatever reason the prescriber never receives them. I'm not sure if that's related to a glitch in the system or the prescriber not looking/finding them or something else.
No diagnosis code entered (n=2)
Doctors often do not use the diagnosis code option on the e-prescribing system, and they should start using it more.
There needs to be a diagnosis code box (as far as there being issues with software design). Otherwise, the diagnosis code ends up wherever/in random places or the prescribers don't put in a diagnosis code at all.
E-prescribing leads to billing issues (n=1)
There are also Issues with billing, physicians will put in an inaccurate day supply (e.g. 30 tablets w/ 11 refills--a 365 day supply) and the insurance company will record that data even if patient only gets 30 tablets in total for the year.
Bundling of e-prescriptions (sending many at once) (n=1)
Doctors prescribe a lot of different drugs at once. When a patient is being discharged, the prescriber tends to overprescribe (e.g. they prescribe many different drugs at once; not by mistake, rather, it seems that it's simply due to the ease/quickness of the system for them). This inflow of many prescriptions at once hinders our workflow. We have a time limit to get each prescription ready in an hour. So, for prescribers who are like send, send, send (sending a lot of scrips at once) that hinders our workflow and slows us down.
Older doctors less likely to use (n=1)
Older doctors are not on board with the system (e.g. they don't know how to use it properly or they don't want to use it).
PATIENT-CENTEREDNESS
Patients waiting for e-prescriptions (n=5)
Delay in processing makes patients upset; they don't understand that the system isn't always quick.
Doctors sending prescriptions to more than one pharmacy; the prescription isn't waiting at the right pharmacy and that leaves the patient waiting around.
Prescribers will sometimes forget to do the e-prescription and the patient is left waiting at the pharmacy.
Sometimes patient's information is not in the system and then we cannot fill the e-scrip; or,

2013 Detail of other barriers to implementing e-prescribing
the physician and pharmacy have conflicting info on the patient and that creates a delay/issue with filling the e-scrip.
There is a misconception among patients that e-scrips will be received instantly.
Patients receive wrong prescriptions (n=1)
Prescriptions could possibly end up in someone else's bag when they're coming out of faxes. That's tied into the concern about security and privacy of patient data. The concerns about security and privacy are moderate/in between (yes and no as a barrier).
TIMELINESS
Processing delays (n=5)
Delay in processing makes patients upset; they don't understand that the system isn't always quick.
Delay time 15-20 min.
Also, the above mentioned issues/barriers with network connections or bugs in the system are primarily on the prescriber's end.
Prescriptions are sent late, not sure why (maybe a connection problem, etc.?).
Occasionally, e-prescriptions are instantaneous but other times, there is a lag in transmission time (not sure why it happens though).
Hospital doctors don’t have easy access to system (n=1)
The biggest challenge is that we have a hospital next to us and everyone (i.e. doctors) needs an NPI. The hospital has residents and the system used to be one where the residents and doctors can all use a single institutional NPI, but each doctor/resident is now required to have individual NPIs. When residents change, you don't know their new NPI and that becomes a yearly issue. Also, some doctors only show up once per week at the clinic. If this doctor leaves, requests/etc. end up in cyberspace as that doctor is the only one allowed to access that information.