The Adoption and Increased Use of Electronic Prescribing of Controlled Substances

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ABSTRACT: The electronic prescribing of controlled substances (EPCS) is now becoming implemented in most health care practices and pharmacies in the United States. This review aims to detail the steps needed for EPCS adoption and synthesize the most current literature on the benefits and challenges associated with its adoption. Our systematic review of seven published studies from 1990 to 2020 notes the benefits of EPCS in the reduction of errors, fraud, overprescribing, cost and efficiency improvements. There is limited published evidence of challenges, such as the cost of implementation and prescriber burden. With EPCS becoming a nationwide process, further research needs to be conducted to maximize the effectiveness of EPCS and explore additional benefits and challenges. We used a modified version of the GRADE (Grading of Recommendations, Assessment, Development and Evaluations) system for systematic reviews highlighted in the “Cochrane Handbook for Systematic Reviews of Interventions” to assess the quality of the primary studies reviewed. Each author was tasked with determining the quality of each primary study reviewed and assigning a quality score of either high, moderate or low quality. Evidence stemming from randomized controlled trials starts as high quality while evidence from observational studies starts as low quality. Quality can be lowered by five factors: risk of bias, imprecision, inconsistency, indirectness, and publication bias and can be raised by a large magnitude of effect and a clear dose-response gradient. We extracted data from the text, tables and graphs of the original publications. Appendix A illustrates the quality of the studies. Databases reviewed included PubMed, Google Scholar, Cochrane and SCOPUS. The search was started in 1990, with the first wave of the opioid epidemic and the first published studies of e-prescribing, and continued to the year of 2020. The key phrases “electronic prescribing of controlled substances,” “e-prescribing of controlled substances,” “fraudulent prescribing of controlled substances,” “EPCS with PDMP,” and “drug interactions with e-prescribing of controlled drugs” were used as an inclusion criterion to search online scholarly databases for articles. Only primary and secondary data from reports, reviews and research studies written in English were included. The Centers for Disease Control (CDC), National Institute on Drug Abuse (NIDA), Drug Enforcement Administration (DEA), Substance Abuse and Mental Health Services Administration (SAMHSA), American Academy of Family Medicine (AAFP), and nationally represented health information networks were used to obtain updated statistics regarding EPCS.

Introduction

The opioid epidemic continues to be one of the most significant public health challenges in the United States. In 2018, the CDC reported 67,367 drug overdose deaths in the U.S. Both prescription opioids and illicit opioids accounted for 69.5% (46,802) of those deaths, with increases across age groups, racial/ethnic groups, urbanization levels, and multiple states. The CDC estimates the “economic burden” of prescription opioid misuse alone in the United States is $78.5 billion a year, including the costs of health care, lost productivity, addiction treatment, and criminal justice involvement. Approximately one-third of people who misused pain relievers in the past year (37.5 percent) indicated that they obtained pain relievers the last time through prescription(s) or stole from a health care provider, as shown in Figure 1. While organizations such as Health and Human Services (HHS), DEA and the CDC are leading the way to find solutions to address this public health crisis, many health care professionals are still using paper scripts for controlled drugs.

To address the opioid epidemic, The Ryan Creeden Act (2011) was passed, and it amended the Controlled Substances Act (CSA) of 1970 by requiring practitioners to obtain particular training to meet standards established by HHS on controlled substance addiction and abuse, and appropriate use of such controlled substances. Originally, a written prescription for controlled substances signed manually by a provider was required as an attempt to prevent the misuse of controlled substances. Even with written prescriptions, concerns about fraud, patient safety and error rates continued. In 2010, the DEA published the DEA Interim Final...
As electronic prescriptions for opioids increased by 36% from 2018 to 2019, overall opioid prescribing rates declined. While EPCS is allowed nationally, each state is at a different stage of implementation. Thirteen states enacted e-prescribing requirements in 2019, with more than half of all states now requiring e-prescribing for opioids, all controlled substances, or all substances (Figure 2). EPCS is also utilized at different rates among specialties. The top five specialties using EPCS include Psychiatry (42%), Pain Management (40%), Family Practitioners (40%), Orthopedic Surgery (38%), Neurology (37%).

**Technical Requirements**

**Overview and EPCS Certification**

Under the DEA Interim Final Rule, an EPCS program is defined as: “A voluntary program that gives prescribers the ability to electronically sign and transmit Schedule II-V prescriptions to pharmacies. These pharmacies may then receive, dispense, and archive these electronic prescriptions.” For EPCS to be effective and usable, providers, software vendors, and pharmacies all have to take certain steps to integrate EPCS. Providers, software vendors, and pharmacies must: update e-prescribing software to meet all requirements specified in the DEA’s Interim Final Rule, enable SCRIPT messaging that supports EPCS, undergo a third-party audit to ensure the software meets all DEA EPCS requirements, and achieve certification for EPCS from an accredited health information network, and make their audit results available to that network along with a completed EPCS audit attestation form. For providers from solo or small practices (who have an individual DEA number) and providers from health system affiliated practices (who have a shared DEA number), the steps for EPCS adoption are similar. Like pharmacies and software vendors, the software used must be certified and approved to use for EPCS.

**ID Proofing and Two-Factor Authentication**

The next step for the provider is identity (ID) proofing. ID proofing is done for prescribers via a third party by Rule rule, giving practitioners the option of submitting prescriptions for controlled substances electronically. Electronic prescribing of controlled substances (EPCS) allows prescribers to electronically send an accurate and comprehensible prescription directly to a pharmacy through a secured network. Regulations set in place allow pharmacies to receive, dispense and archive these electronic prescriptions. Since this rule was passed, EPCS has increased every year. According to Surescripts, a nationally recognized health information network, the percentage of providers using EPCS went from 26% in 2018 to 38% in 2019. In 2018, there were 115.16 million electronic orders for controlled substances. This number rose to 159.77 million in 2019. Most recently, Congress passed the Substance Use-Disorder Prevention that Promotes Opioid Recovery and Treatment (SUPPORT) for Patients and Communities Act to address the opioid crisis. The SUPPORT for Patients and Communities Act includes a provision requiring prescriptions for controlled substances covered by Medicare Part D to be transmitted electronically as of January 1, 2021.
verification of prescriber, which may be face-to-face or online. For online ID proofing, a security question may need to be answered, and email scanned copies of government-issued documents, a photo ID, and the provider’s medical license are required. The provider then receives a credential that is used to authenticate EPCS. Next, the authentication of the EPCS is completed by a two-factor authentication for each prescription written. There are three basic options for two-factor authentication, and any two used together are sufficient for keeping sensitive information inaccessible from unauthorized users. Table 1 shows the three different options (a hard token, knowledge of a linked password, and stored biometric data) and examples of each.

**Software Access**

The final step is to set up software access. This involves two separate people setting secure access controls for the provider’s EHR e-prescribing software. One person needs to be a DEA registrant who has been ID-proofed and has the two-factor authentication method in place — this can be the provider. The other is a person who can confirm the provider’s identity, such as an office manager or another member of the practice. Establishing secure access control for providers and pharmacies allows only the appropriately credentialed providers or pharmacy staff to have the ability to create or alter EPCS prescriptions. The secure network is then filled in by intermediaries (health information networks) between the provider EHR and the pharmacy.

### Table 1

| Authentication Type                      | Examples                        |
|-----------------------------------------|---------------------------------|
| What the Prescriber Possesses (Hard Token) | • Common Access Card           |
|                                         | • USB Stick Token               |
|                                         | • Display Hard Token            |
|                                         | • Networked Mobile Phones       |
| What the Prescriber Knows (Knowledge)   | • Username and Password         |
|                                         | • Personal Identification Number |
|                                         | • Security Question             |
| What the Prescriber is (Biometric Data) | • Fingerprint Scanner           |
|                                         | • Retinal Scanner               |
|                                         | • Voice Print                   |

* DEA regulations require electronic prescriptions to possess a two-factor authentication for prescribers to confirm their identities and prevent misuse of EPCS. Fulfilling two out of the three possible authentication types satisfies the two factor authentication requirements for prescribers.

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**Figure 2**

**Stages of E-Prescribing Implementation in All 50 U.S. States**

- Currently required for all prescriptions
- Will be required for all prescriptions
- Currently required for all controlled substances
- Will be required for all controlled substances
- Currently required for some controlled substances (e.g., opioids)
- Will be required for some controlled substances (e.g., opioids)
- EHR adoption required
- Legislation in progress
Results

**Potential Benefits**

*Using EPCS with an EHR*

Implementing EPCS with an electronic health record (EHR) allows prescribers to access patient medical history, labs, possible allergic reactions and interactions with other medications when prescribing. It also promotes patient safety by potentially preventing fraud and diversion noted with paper opioid prescriptions. With up to 9% of opioid paper prescriptions linked to fraud or forgery, broad adoption of EPCS could have a significant impact on opioid prescribing. According to the DEA, EPCS will positively affect the following types of diversion: stealing prescription pads or printing them and writing non-legitimate paper prescriptions; altering a legitimate prescription to obtain a higher dose or more dosage units (e.g., changing a “10” to a “40”); phoning-in non-legitimate prescriptions late in the day when it is difficult for a pharmacy to complete a confirmation call to the practitioner’s office; and altering a prescription record at the pharmacy to hide diversion from pharmacy stock.

EPCS, when used with an EHR, reduces errors compared to both handwritten prescriptions and non-EHR generated prescriptions. A 2016 retrospective review of 510 opioid prescriptions processed at an outpatient pharmacy aimed to determine the opioid prescribing patterns, rates of errors, discrepancies, and variation from ideal opioid-prescribing. At least one error occurred in 89% of handwritten prescriptions. The error rate of (EHR) computer-generated prescriptions was 0%. There was a 12% error rate in the non-EHR computer-generated prescriptions. Of the handwritten prescriptions, 87% of these prescriptions were noncompliant with DEA rules, and 46% lacked two patient identifiers, whereas 0% of EHR computer-generated prescriptions were noncompliant with DEA rules; they all included two patient identifiers.

**Figure 3**

*Basic Steps for EPCS Transactions*

**Provider**

- EHR Software Update
  - EPCS Certification
  - Verified Audit

- Enable Provider EHR Systems
  - ID Proofing Setup
  - Dual Authentication
  - Training

Provider ready to send EPCS

**Pharmacy**

- EHR Software Update
  - EPCS Certification
  - Verified Audit

- Enable Pharmacy Systems
  - Access Controls Set
  - Training

Pharmacist ready to receive EPCS

Systems connected to intermediaries for secure transactions
Overprescribing Reduction

New York State passed a law on March 27, 2016, mandating practitioners to issue an electronic prescription for controlled substances in Schedules II through V and allowing a pharmacist to accept, annotate, dispense and electronically archive such prescriptions.16 There are certain exceptions in which a practitioner may issue an official New York State prescription (ONYSRx) form, oral prescription or a fax of an ONYSRx.16 New York State serves as a model to access the impact EPCS has on prescription accuracy, rates of opioid prescriptions prescribed and quality of health care treatment. As of 2019, 98.5% of pharmacies, and 81.6% of prescribers in New York State use EPCS, and 88.3% of controlled substances are prescribed electronically in the state.17 From 2015 to 2016, a retrospective, single-center study with a pre-/post-test design was done to describe the opioid-prescribing patterns of emergency physicians after the introduction of the New York State EPC mandate requiring EPCS.18 The results showed an absolute decrease of 724 (53%) opioid prescriptions (p < 0.0001), which is an absolute difference of 2.3%.18 There was a significant decline in the overall number of opioid prescriptions coinciding with the implementation of the New York EPC mandate.18

Financial Impact and Improvements in Efficiency

A study published by the Drug Enforcement Administration (DEA) showed a reduction in the number of callbacks to clarify prescriptions, wait-time for patients picking up prescriptions and the overall cost of storage of paper records in pharmacies. The report signifies the annual cost savings in these parameters to be $439 million, $1.1 billion, and $1.4 million, respectively.8 From 2008–2009, Thomas et al surveyed prescriber attitudes towards EPCS.19 102 prescribers were interviewed before EPCS implementation (expectation) and after implementation (experience).19 Questions of the Thomas, et al. survey included difficulty of security measures, the impact of EPCS on workflow, efficiency, practice management and patient safety.19 While 45% of providers expected that carrying a security token at all times would be a large inconvenience, only 10.3% found it to be so (p<0.001).19 Over half of the surveyed prescribers found EPCS to be easy to use (72.9%); to improve the accuracy of prescriptions (69.5%); to improve workflow (66.1%); to improve monitoring of medications (59.3%); to improve coordination with pharmacists (55.9%); and to lead to fewer calls to pharmacists (54.2%).19

Potential Challenges

Financial Impact

Lack of financial support for implementation is a barrier reported by more than 80% of primary care physicians.20 Additionally, the standards required by the DEA to ensure the privacy and security of EPCS, such as provider credentialing, certification of all components, two-factor authentication, data storage and auditing capabilities, can be costly to implement. Applying these measures for vendors was estimated by the DEA in 2010 to have potential costs from $43 million to $54 million, annualized over 15 years.21 The overall cost of EPCS for providers may vary and be a potential challenge to providers who write few controlled substance prescriptions.22

Burdens

Providers may feel burdened by EPCS security measures. In a 2009 survey with 246 providers of the Berkshire Health System in Massachusetts, prescribers expressed that keeping a hard token in possession at all times (35.3%), using a token or a flash drive with electronic signatures to authenticate and send all CS Rx’s (25.8%) and re-entering a password after computer screen timeout/brief period of inactivity (22.6%) would be a large inconvenience.23 In the same survey, 58.9% of prescribers did not respond or rarely (once a week) responded to warnings such as drug-drug interactions.23 From 2008–2009, Thomas, et al. surveyed prescriber attitudes towards EPCS. 38.4% of prescribers noted that the computer...
program used for EPCS was not always reliable, and 34.5% of prescribers said the flash-drive sized security token was hard to use.19

**Role of Prescription Drug Monitoring Programs Linked to EPCS**

The National Ambulatory Medical Care Survey (NAMCS) analyzed the effects of PDMPs on the prescribing of opioid analgesics and other pain medications in ambulatory care settings at the point of care in twenty-four states from 2001 to 2010.24 The NAMCS data sample included 26,275 ambulatory care office visits for pain.24 Results showed that implementation of a PDMP was associated with more than a 30% reduction in the rate of prescribing of Schedule II opioids.24 This reduction was seen immediately following the launch of the program and was maintained in the second and third years afterward.24

Although integration of EPCS with PDMPs may be helpful, there is inconsistency in PDMP programs across states.25 A cohort study published in 2016 by Dartmouth and UCLA researchers reviewed Medicare administrative data for fee-for-service disabled beneficiaries 21 to 64 years of age and eight types of state-specific laws, including PDMPs, surrounding prescription opioids to estimate how opioid outcomes varied according to these eight laws.26 The percentage of beneficiaries with a prescription yielding a daily morphine equivalent dose (MED) of more than 120 mg did not decline after the adoption of a PDMP.26 No meaningful reductions in the number of opioid prescriptions written in states adopting the eight laws were found.26

**Discussion**

This review from 1990–2020 yielded 28 references, including seven primary studies. The findings show the potential benefits of EPCS in error, fraud, overprescribing reduction and improvements in efficiency and financial impact. Challenges noted in the published studies focus on cost and technological burdens for providers.

While EPCS can be an independent system, linking it into the EHR system, and even a PDMP, can improve patient safety to reduce “doctor shopping,” over-prescribing, errors and opportunities for diversion compared to handwritten prescriptions. The Danovich, et al. study shows promise in EPCS’s role in reducing overprescribing but it is not clear if confounding

### Table 2

**Cost Associated with E-Prescribing and EPCS in the Most Widely Used EHRs**

| Electronic Health Record | E-Prescribing (Annual fee) | EPCS Setup (one-time) | Annual (ongoing) | Token |
|--------------------------|----------------------------|-----------------------|------------------|-------|
| Allscripts Professional  | $0.00 (included w/EHR)     | $340 per provider     | $150 per provider| Included in ongoing cost |
| Allscripts Touchworks    | $0.00 (included w/EHR)     | $6,000 per practice   | $150 per provider| Negotiated directly |
| Amazing Charts           | $0.00 (included w/EHR)     | $0                    | $250 per provider| Included in ongoing cost |
| Athena                   | $0.00 (included w/EHR)     | $0                    | $0 per provider  | Included in ongoing cost |
| Cerner                   | Varies with the number of providers |                       |                  |       |
| DrFirst                  | $948 per provider          | $90 per provider      | $75 per provider | Included in the setup fee |
| eClinicalWorks          | $0.00 (included w/EHR)     | $250 per provider     | $0 per provider  | $250 per year per provider |
| e-MDs                    | $0.00 (included w/EHR)     | $225 per provider     | $120 per provider| Included in ongoing cost |
| Epic                     | Varies with the number of providers |                       |                  |       |
| GE Centricity           | $0.00 (included w/EHR)     | $0                    | $5,988 per provider| Included in ongoing cost |
| Greenway Intergy        | $372 per provider          | $150 per provider     | $90 per provider | Included in ongoing cost |

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Published research, as with Thomas, et al. (2013) measured the impact of EPCS on quality of care not directly through the patient record but through prescriber perceptions before and after implementation, potentially limiting the precision of the reported data. While Thomas, et al. (2012) conducted a survey on expectations and barriers towards EPCS involving various specialties, the survey included prescribers affiliated with a single health care system, resulting in possible biases. The analysis from Bao, et al. (2016) was restricted to PDMPs implemented in the period 2001–2010 and thus does not represent the most recent association of PDMPs on opioid prescribing rates. In Meara, et al. (2016), the subjects of the study were disabled fee-for-service Medicare beneficiaries, who have higher rates of opioid use, poverty and coexisting complex medical conditions than the general U.S. population, resulting in limited generalizability of the study. Bicket, et al. (2017), which analyzed errors and discrepancies in opioid prescriptions, has results that may not be generalizable to non-hospital-based pharmacies. Most of the research examined in this review focuses on EPCS in primary care settings. Search results did not yield studies about the effects of EPCS in specialty clinics.

Conclusion

EPCS is required for Medicare Part D patients in all U.S. states as of January 1, 2021. As of 2019, half of all U.S. states have mandates requiring EPCS, with more states potentially following (Figure 2). Further research should evaluate the benefits and harms of EPCS on prescription accuracy, error reduction and prescriptions with additive risks, such as opioids and benzodiazepines together. With widespread utilization on the horizon with the new Medicare rules, research should evaluate the particular impact of EPCS on seniors, those with disabilities and end-of-life care.
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### Appendix A
Reference Table for Primary Studies Reviewed

| Reference | Methods | Results | Limitations | Quality Grading |
|-----------|---------|---------|-------------|-----------------|
| 3. The Economic Burden of Prescription Opioid Overdose, Abuse, and Dependence in the United States, 2013 (2016) | Incidence of fatal prescription opioid overdose from the National Vital Statistics System, prevalence of abuse and dependence from the National Survey of Drug Use and Health. Fatal data are for the US population, nonfatal data are a nationally representative sample of the US civilian noninstitutionalized population ages 12 and older. Cost data are from various sources. | The total economic burden is estimated to be $75 billion. Over one third of this amount is due to increased health care and substance abuse treatment costs ($28.9 billion). Approximately one quarter of the cost is borne by the public sector in health care, substance abuse treatment, and criminal justice costs. | Estimates of nonfatal costs based on prevalence of abuse and dependence, not adverse health outcomes. Health care cost estimates do not differentiate between prescription opioids and heroin. Depended on medical diagnosis of abuse and dependence, which could underreport true rates. | Moderate |
| 15. An analysis of errors, discrepancies, and variation in opioid prescriptions for adult outpatients at a teaching hospital (2017) | Examined 510 consecutive opioid medication prescriptions for adult patients processed at an institutional outpatient pharmacy for patient, provider, and prescription characteristics. Analyzed prescriptions for deviation from best practice guidelines, lack of two patient identifiers, and noncompliance with DEA rules. | Errors occurred in 89% of handwritten prescriptions, 0% of electronic health record (EHR) computer-generated prescriptions, and 1.2% of non-EHR computer-generated prescriptions. Inter-rater reliability by kappa was 0.993. | Only one abstractor reviewed all records, which raises the possibility of misclassification of some events. Results may not be generalizable to non-hospital-based pharmacies. | High |
| 18. Effect of New York State Electronic Prescribing Mandate on Opioid Prescribing Patterns (2019) | Retrospective, descriptive analysis of the ED prescribing patterns of opioid analgesics prior to and in the months following NYM EPCS. Data were obtained from the Emergency Department Information Systems and EHR for Staten Island University Hospital North ED. | Results showed an absolute decrease of 724 (53%) opioid prescriptions (p < 0.0001), which is an absolute difference of 2.3% (95% confidence interval 2.0–2.6%). There was a significant decline in the overall number of opioid prescriptions coinciding with implementation of the New York EPCS mandate. | Study measures opioid prescribing rates in ED only. Effect of the NY mandate on other specialties is not studied. | High |
| 19. Prescription Drug Monitoring Programs Are Associated With Sustained Reductions in Opioid Prescribing By Physicians (2016) | Data analysis from National Ambulatory Medical Care Survey (NAMCS). Study population consisted of patients ages eighteen and older who reported pain as the reason for a visit to an office-based physician. | Implementation of a PDMP was associated with more than a 30 percent reduction in the rate of prescribing of Schedule II opioids. This reduction was seen immediately following the launch of the program and was maintained in the second and third years afterward. | Could not evaluate whether patients' pain management needs were adequately met and whether this changed as a result of PDMP implementation. Analysis was restricted to PDMPs implemented in the period 2001–10. | Moderate |
| 20. Early experience with electronic prescribing of controlled substances in a community setting (2013) | Prescribers were surveyed in a community setting before and after implementation of EPCS, to assess adoption, attitudes, and challenges. | Half reported that EPCS is easy to use and improved workflow, accuracy of prescriptions (69.5%), monitoring of medications (59.3%), and coordination with pharmacists. | The impact of EPCS on quality of care is not measured directly in the patient record, but through prescriber perceptions before and after implementation. | Low |
| 24. Prescribers’ expectations and barriers to electronic prescribing of controlled substances (2012) | Prescribers of controlled substances affiliated with a regional health system were surveyed regarding the current electronic prescribing (e-prescribing) activities, current prescribing of controlled substances, and expectations and barriers to the adoption of EPCS. | Reported issues with controlled substances included errors, pharmacy call-backs, and diversion; prescribers expected that it would be disruptive to practice, and over one-third of respondents reported that carrying a security authentication token at all times would be so burdensome as to discourage adoption. | Surveys were conducted at ambulatory care test sites based at or affiliated with Berkshire Health System and may not be generalizable to other health care practices. | Low |
| 26. State Legal Restrictions and Prescription-Opioid Use among Disabled Adults (2016) | Tested associations between prescription-opioid receipt and state-controlled substances laws. Using Medicare administrative data for fee-for-service disabled beneficiaries 21 to 64 years of age who were alive throughout the calendar year. | Adoption of controlled-substance laws was not associated with reductions in potentially hazardous use of opioids or overdose among disabled Medicare beneficiaries, a population particularly at risk. | Disabled fee-for-service Medicare beneficiaries who were alive throughout the calendar year have higher rates of opioid use, poverty, and coexisting complex medical conditions than the general U.S. population. Some laws, such as pain clinic regulations, were new during our study period, and PDMPs are being adapted by states to enhance effectiveness. | Moderate |