

E-Prescribing: History, Issues, and Potentials

J. Warren Salmon¹, Ruixuan Jiang²

¹University of Illinois at Chicago, School of Public Health

²University of Illinois at Chicago, College of Pharmacy

Abstract

Electronic-Prescribing, Computerized Prescribing, or E-RX has increased dramatically of late in the American health care system, a long overdue alternative to the written form for the almost five billion drug treatments annually. This paper examines the history and selected issues in the rise of E-RX by a review of salient literature, interviews, and field observations in Pharmacy. Pharmacies were early adopters of computerization for a variety of factors. The profession in its new corporate forms of chain drug stores and pharmacy benefits firms has sought efficiencies, profit enhancements, and clinical improvements through managed care strategies that rely upon data automation. E-RX seems to be a leading factor in overall physician acceptance of Electronic Medical Records (EMRs), although the Centers for Medicare and Medicaid (CMS) incentives seem to be the propelling force in acceptance. We conclude that greater research should be conducted by public health professionals to focus on resolutions to pharmaceutical use, safety, and cost escalation, which persist and remain dire following health reform.

Keywords: EMR, Electronic Medical Records, Physicians, Pharmacists, pharmacy, implementation, Medicare incentivizing, pharmacy benefits managers, PBMs, retail chain drugstores, Electronic Prescribing, CPOE, clinical decision support, Obamacare, e-prescribing, E-RX, adverse drug reactions.

Introduction

When thinking about innovation in the healthcare system, it is almost always *medical* technology (pharmaceuticals, medical devices, diagnostic and surgical inventions, etc.) that comes to mind. But other aspects of technology support needs to move forward as well to provide the most effective processes for both patients and providers. A key aspect of medical technology support lies in health information technology (HIT) systems, which may enable greater cost savings, efficiency, and eventually improved patient outcomes.

In general, healthcare, unlike other industries, has lagged in embracing innovations in information technology; though it is apparent that this sector is now well on its way. A few federal agencies are actively promoting HIT; hundreds of vendor firms are emerging; degree programs are mushrooming; and professional organizations are hopping on the bandwagon.

Back in the 1960s pharmacies were actually in the forefront of automation in health care. As soon as computer hardware firms rolled out early computers and software--with later transmission across telephone lines--pharmacies found practical business cost savings for accounting and inventory control (over ledger books and hand-counting tens of thousands of pills). Dispensing of prescriptions was matched to on-line purchasing from drug wholesale suppliers, which enabled quick shipments, cost analyses, and later patient billing through Third Party Administrators (TPAs). Recently, E-Prescribing technology has taken hold as an advance over hand-written drug treatments orders; E-RX, being one of the earliest adoptions in Computerized Physician Order Entry (CPOE), gained acceptance by certain physicians. Prescribing errors are the largest source of preventable errors in hospitals. E-Prescribing, according to the Institute of Medicine, can reduce the number of errors and indeed impact health outcomes.²

This paper presents issues surrounding Electronic Prescribing and developments in pharmacy related to the trend of Electronic Medical Records and examine the need for health services research for promoting better outcomes from the use of pharmaceutical use.

Pharmacies in the forefront

Today, most pharmacies use online, real time transactions for verifying the patient's coverage eligibility; the process beyond receiving the prescription to transmitting claims to payers and obtaining adjudication so that copayments and deductibles can be calculated and collected. Additionally, the pharmacist can perform prospective drug utilization reviews using information received from the insurance payer to counsel patients to prevent possible downstream hazards, such as inappropriate prescribing, drug-drug interactions, first time use, compliance, mandatory counseling for Medicaid patients, and more. Over 3.5 million harmful errors can be potentially prevented to save payers substantially in medical costs if Pharmacists in a clinical role help patients receive safer and more affordable choices.³

TPAs arose in the 1980s as government and corporate employers added drug coverage to their insurance benefit packages. By the early 1990s TPAs had begun to morph into nascent pharmacy benefit managers (PBMs). Today, PBMs number less than 50; with 5 to 8 national and regional PBMs controlling over 80 percent of the national dispensing market, for nearly 5 billion prescriptions written annually overall. PBMs pioneered mail order deliveries, and they politically secured Medicare Part D drug administration during the Bush era.⁴ This segment of the health industry has witnessed significant consolidation and reorganization, which is ongoing as smaller firms get quickly gobbled up.⁵

Put in place by the corporate giants are new pharmaceutical management strategies and clinical interventions to contain rising drug costs and utilization, while attempting to monitor and improve quality outcomes.⁶ It should be noted that PBMs--a few larger in revenue now than most multinational pharmaceutical firms--pose a formidable challenge to the hegemony of Big PHRMA and drug pricing.⁷

While in the late 1960s with the arrival of Medicare and Medicaid, hospitals began automating their insurance billings and accounting; since then, physicians remained reluctant to adopt

computerized protocols and clinical information systems into their practices. Numerous attempts at electronic medical records (EMRs) in hospitals faced rough terrain in their implementation, which inevitably soured and slowed early adopters across the nation.^{8,9,10} Such difficulties are to be expected as new ideas and complex systems rarely are implemented smoothly. EMRs are complex systems necessitating significant input from all health care providers. Physicians observed these problems and developed various resistances.¹¹

Advocated early on by managed care pharmacists, E-Prescribing became an easier positive step to help physicians identify benefits over paper prescribing pads.^{12,13} Prescription mistakes are rampant and under-reported.¹⁴ According to the IOM, handwritten notes, manual order entry, non-standard abbreviations, poor legibility, all lead to substandard care, including errors and injuries.² Computerized prescribing in a way has led the medical profession into the fuller electronic medical record compliance.

Several E-RX implementations were pioneered by large chain drugstores principally for steering patients from doctors' offices to their individual stores for business. One chain claims significant pharmacist efficiencies and overall paper reductions, thus profit improvement.¹⁵ Managed care organizations (HMOs and PPOs) also initiated computerized prescribing through distribution of personal digital assistants (PDAs) with their formulary (a list of preferred covered drugs) added as a built-in feature for doctors directed prescribing of chosen entities.¹⁶ With this new tech, extra communication between pharmacists and doctors could be streamlined, thus pharmacies could have prescriptions ready for patient pickup. Additionally, pharmacies can automatically conduct online communication to and from either the managed care organization or PBM to ensure formulary compliance, approval of the claim, and billing details. Some managed care organizations even can direct online clinical interventions to be conducted by the retail pharmacist.

Overall, computerized prescribing and other pharmacy management systems technology have indeed improved efficiency in pharmacy operations. Such a move forward is necessary given the huge number of added drug entities onto the U.S. pharmacopeia by drug firms, and the increased number of prescriptions written per capita today for an aging population. The scripts written for seniors and the coming cohorts of baby boomers (7.9 to 8.2 average) encompass multiple chronic degenerative conditions, with most prescribed for a lifetime use so require continuous renewals.

Proponents of E-prescribing technology herald such achievement as a vast improvement to the U.S. healthcare system, which is seemingly accepted as an axiom by numerous parties. Yet, there may be more to the situation: While computerized prescribing has become more widespread, the pockets of medical profession reluctance to EMRs in general may be due to required costs for equipment and software, and special training for their clinical staff. Internet access, as well as a comfort level with changing behavior; plus working with advanced technologies and protocols are key also. Since most practices must have automation today for insurance billing, this is remains a compatible software and comfort issue; yet, some physicians remain suspicious of greater encroachment upon their professional autonomy by administrators, private payers, and government.^{17,18} Privacy of patient information is a top concern of the medical profession as reports of hacked systems or stolen computers frequently pop up in the news.

Purported benefits to electronic prescribing

Policies to incentivize E-Prescribing and the purported benefits may be facilitating a positive attitudinal change toward electronic medical records (EMR) adoption. Of course, health information technology (HIT) has become more successful with user-friendly software; successful vendors have innovated to entice greater professional acceptance, convincing them by heralding computerized prescribing benefits, along with CMS Meaningful Use adoption. Some of the so-called "magical thinking" ascribed to EMRs by commentators appears to have carried over to E-prescribing. Most professionals of late seem to *not* view HIT as a panacea for quality and cost improvements, but realize a broader need for structural reforms.

Purported benefits of Electronic Prescribing have included:

E-RX enhances pharmacy efficiency. For sure, electronic delivery of the prescription eliminates the tried and true problems of doctors scribbling and enables the pharmacist to prepare the prescription to ease patient pickup.

E-RX promotes formulary adherence. Managed care organizations find that physicians choose the drugs for which they have contracted for cheaper purchase, thus it enhances their profits and perhaps promotes some quality where their pharmacy and therapeutic committee decision-making in all intents and purposes well assesses efficacy and cost-effectiveness of the various entities on the formulary.

E-RX enhances prescribing errors by physicians being caught. Pharmacy software can check for the proper drug being prescribed at the right dosage in many cases so medication errors may be minimized.

E-RX reduces adverse drug reactions (ADRs) by electronic entry into the pharmacy's computer allowing patient allergies, past bad experiences with certain drugs, and drug-drug interactions to potentially be identified, also pending pharmacist intervention.^{19, 20}

E-RX may catch dosage errors, particularly in light of the differences between pediatric formulations and adult dosage levels. This can also be part of the assessment done electronically before the pharmacist prepares the prescription.

E-RX decreases drug-drug interactions. Much existing pharmacy software already checks the patient's profile (assuming that patients use just a single pharmacy) to raise flags to the pharmacist before dispensing about any potential of multiple drugs interacting.

E-RX helps prevent injuries and reduce health costs. Alerts given to physicians reduce the likelihood and severity of ADRs, according to one study in the *Archives of Internal Medicine*.²¹

E-RX improves quality of care and reduces malpractice claims. Again, it is asserted to yield a reduction in medication misadventuring, reducing both physicians' and

pharmacists' making mistakes. Most of these depend upon the pharmacist's vigilance in interacting with a well-designed clinical software system with a caring professional role. EMRs in one study in the *Archives of Internal Medicine* saw an association with "a significant reduction in malpractice claims against physicians."²²

E-RX increases patient pickup from the pharmacy and patient compliance. This benefit is assumed by a few reports that patients arrive at the pharmacy to receive their drugs more so when delivered electronically, rather than when they carry a piece of paper. Patients with electronic prescribing allegedly pick up their drugs and take them more assiduously than those with paper prescriptions. Add-on programmed dispensing devices for patients have been found to work best to alert providers of non-compliance.²³

In the list above, such "findings" may be real for some settings, but regrettably cannot be generalized across different organizations. It must be emphasized that electronic prescribing is a tool that must be launched under clinical decision support systems (mentioned above), which are necessary to provide any benefits to patient outcomes and providers alike. Such support systems are not just "plug and play." Systems must be customized for each institution based on formulary needs and local prescribing practices; institutions need to constantly test, refine, update, and customize systems to keep up with changes in prescribing needs, trends, and practices. Overtime, adapting vendor packages has been hard for several provider groups, but now standardized protocols seem to be coming into place.

Nevertheless, little health services research to demonstrate major clinical and cost value has yet to be there. "Studies" are generally reports from single, unique organizational settings and often short-term snapshots. One must still be cautious of claims by vendors; observations by provider groups (group practices, hospitals, HMOs, PBMs) may capture some of the contributions from computerized prescribing; notwithstanding, assessments in the scientific literature are scant compared to numerous reports in the IT and medical "news" coverage.

Of note, computerized prescribing is not just a message system, but is placed within advanced pharmacy software systems for patient care management in the new clinical direction seen in ambulatory and hospital pharmacies. E-RX is also embedded in the many medical groups' fuller EMR systems. Patient profiles in pharmacies have long been initiated and advanced to assess many of the above-described issues in trying to improve medication management and to promote better drug outcomes. These systems in hospital and ambulatory settings may reduce prolonged hospitalizations, and prevent morbidity and mortality, as well as minimize added utilization costs by catching medication mistakes proactively.²⁴

It should be pointed out that, particularly in hospital settings and some PBMs, computerized prescribing is essential to hook into newer automatic dispensing robotics that greatly reduce professional pharmacist time devoted to dispensing. As the profession has sought a greater clinical role for the Pharm.D. graduate, these robots in hospital basements have freed up clinical pharmacists to interact with patients as the drug expert on the medical care team.²⁵

Where physicians were able to witness favorable computerized prescribing, doctor consideration to engage in broader electronic medical record activities was aided.²⁶ Elsewhere physicians had

little choice in adoption and use when pressured by medical groups and hospital systems. While the medical profession has shown overall resistance to EMR adoption, pharmacy professionals have seemed historically to be more open to health information technology. This may be due to their employee status under management dictates in chain drug stores and pharmacy benefit management firms (as might be compared to physicians in group practices or hospital-salaried). The major motivation for provider organizations to switch over to electronic medical records seems to be practice cost savings on many levels when they can be obtained. Insurers have begun to provide their preferred technology to medical groups for billing purposes, which has raised questions among consumer advocates as to how the information may be used.²⁷

Intuitively one might think that having a wealth of information at the practitioners' fingertips would eliminate redundancies in treatment or tests and lead to speedier diagnoses. So far in the implementation of EMRs, this has not been well proven. Earlier studies of a few models have actually shown that EMRs may not be any more cost-effective than traditional filing systems. Doctors may actually order more tests when the EMR is available rather than less. As to reasons behind this surge in utilization, perhaps gaps in the patients' medical care are being pinpointed as the overabundance of information from a centralized database is at the physician's finger tips. U.S. Health & Human Services is investigating cases of "upcoding" to inflate Medicare billings.²⁸

Because EMR systems vary significantly and are still in early stages everywhere, if adverse drug reactions and avoidable hospitalizations can be minimized, then cost effectiveness in the longer run will be demonstrated for many cases. Using HIT with patient-centered principles "improves care, according to the bulk of evidence published during the last 14 years."²⁹

Ongoing CMS incentivizing

To speed the adoption of electronic medical records, the Centers for Medicare and Medicaid (CMS) was given authority to incentivize physicians for electronic prescribing technology. Medicare Part D revisions passed in 2007 increase Medicare reimbursements to physicians who adopt E-prescribing. Bush administration officials had sought to mandate E-prescribing for all Medicare scripts under the drug program, but standards were undeveloped and numerous Part D providers had yet to develop capacity to follow them.³⁰ Details for the equipment, software, and standards for operations were discussed in commissions and at conferences. Provider organizations were divided on steps to take and how fast to proceed; they all chimed in with their varying perspectives. Thus, the proposing of incentives formulated for Medicare reimbursements for 2011 and 2012 began to attract EMR compliance.

Physicians who adopted E-prescribing would receive a 2% bonus in their Medicare reimbursements for 2009-2010. Procrastinating would reduce the bonus percentage and then reductions of 1% to 2% would occur through 2014 for those who did not use computerized prescribing. E-RX was sold for reducing prescribing errors caused by illegible writing, but it was imbedded in the push for EMRs to establish the Physician Quality Reporting System (PQRS). By 2008, \$92 million was paid to 85,000 physicians (up two-thirds from 2007) for reporting quality-related data. Federal funds were also released for state Medicaid programs to similarly have data collected under the PQRS.³¹

Again, computerized prescribing was attractive to physicians and began to lead them to fuller EMR consideration for the bonus payments. By 2010 the CMS criterion for providers was to write 40% of prescriptions electronically to qualify for funding, instead of the original 75% goal. Funds were available to providers to subsidize them for the cost of EMR setups; CMS and professional organizations undertook many efforts to support providers as Congress again increased the incentives. By 2010, 269,000 eligible professionals participated in the PQRS. As far as E-RX went, cardiologists, family practitioners, and internists were chief among those relying on this E-technology. \$391.6 million in incentives were given out. As implied, providers vary as to who more embraces electronic prescribing, but 131,000 were using it, up from 89,209. Physicians, pharmacists, nurses, nurse practitioners, and physician assistants found E-prescribing acceptable and useful. By March of 2012, \$4.5 billion in incentives were awarded by CMS.³²

Discussion

As readers of this *OJPHI* journal have followed development of EMRs and Meaningful Use, there are many nuances in this rollout for the new Medicare reimbursement, which go beyond the intent of this paper. Public health people realize that, since the U.S. remains the only major industrialized nation *not regulating prices set by drug companies*, prescription drugs generally cost 25% to 40% more than other nations.

Adding to the cost and expenditure problematic, significant drug misadventuring³³ and the lack of understanding how pharmaceuticals and their use truly affect public health outcomes is plenty of reason to spur forward the construction of researchable databases from electronic prescribing.³⁴ Prescription drug expenses are the single largest out-of-pocket spend. Drugs cost as much as expenses for physician care, vision care services, and medical supplies combined. The misleading percentage on the annual Federal pie chart grossly underestimates all pharmaceutical spending, since it is only ambulatory drugs counted, not including administrations in hospitals, nursing homes and doctor offices, which due to their exorbitant pricing and frequency far outpace the 9% ambulatory percentage. For 75% of our seniors, prescription drugs are the single biggest outlay. Older Americans with five or more chronic conditions incurred on average \$5,300 in prescription drug costs in 2008, while Medicare Part D coverage was being secured.^{35,36}

Clearly, there is a *health system imperative* to economize in the delivery of pharmaceuticals, and, more importantly to arrange for workable databases in order to investigate inappropriate and over-prescribing; monitor harmful adverse drug effects; prevent drug-drug, drug-herbal, and drug-OTC interactions that cause mishaps.³⁷ The use and misuse of pharmaceuticals has untold endpoints in ERs, hospital beds, and morgues. Addressing this somewhat in certain managed care firms are new pharmaceutical management strategies, along with clinical interventions to contain rising costs and curb utilization, while attempting to improve quality outcomes. Some analysts feel this has been only a start, however. Not all of these "innovations" have warmed the hearts of physicians to computerization and its data accumulation to scrutinize their behavior.³⁸

CMS' Stage 2 of Meaningful Use sought to focus on advancing interoperability and establish data exchange infrastructures. It has been recognized that the incompatibility of varying vendor systems have presented certain problems. The widely quoted 2005 RAND study³⁹ suggesting \$81 billion in savings from EMRs have many today believing it an overblown promise due to the paucity of health services research, the hopes of IT proponents, and vendor vested interests.⁴⁰

EMR benefits as a fiscal brake will likely come only when they facilitate careful monitoring of clinical care with effective steps to improve quality amidst payment reforms, the strategic details of each being politically and technically quite underdeveloped as yet. Nevertheless, in our profit-based American health care system, larger providers seem better positioned to reap EMR economic returns on investments.⁴¹ Data mining on the use of pharmaceuticals has yet to be perfected much. Using electronic data more effectively will turn disparate information into intelligence with analytics that can lead to better clinical and operational decisions. "Indeed, a recent report from the Institute of Medicine points out that better use of data could lead to the "system-wide transformation" so sorely needed in the industry."⁴² Evidence-based alerts hold the most promise to aid practitioner prescribing. yet, the long trek into what former NEJM editor Arnold Relman called the "era of assessment and accountability" will reveal that the overall stakes are high for the near future.⁴³

Issues remaining are the electronic exchange of health data (patient summary to doctors) where physicians generally favor this, believing that it will increase their practice efficiency, and also feeling that the electronic data sharing will reduce overall costs in the health system. Yet, it is obvious that there's a greater need for a national strategy with negotiated technical standards, clearer CMS guidance, and support for best practices for both Medicare and Medicaid patients. Difficulties in EMRs persist: moving toward "value-based care" includes the record certifications, secure messaging, updating technical requirements, harmonizing incentive programs, penalty assessments, appeals processes, privacy of the data, downtime issues, among others to arise.

Moreover, the "technologicalization of medical practice" faces what all small business in America is attempting to deal with, including the impact of cloud computing, social media use, tablets, video conferencing, new apps, and the continued onslaught of innovations.⁴⁴

Stage 2 criteria had among its core set of meaningful use criteria to increase CPOE medication to 60% of orders. By October 2012 over \$8 billion was paid out to 165, 800 MDs and hospitals; 131,000 participated in the electronic prescribing incentive program in 2010. This number was increasing by the month.⁴⁵

As mentioned, early-on EMR users hit road bumps in implementation, which were perhaps due to provider-IT staff mis-communications and cultural clashes. Providers attempting EHRs into operation--whether successful or not--have *not* published much findings; so few real world lessons can be taken away with insufficient research in the literature. Nevertheless, HIT advances have recently reached a critical mass, with 69% of primary care physicians using EHRs.⁴⁶ In brief, does such adoption exemplify that key trends in the American health care system virtually go forward while insufficiently unexplored by health services researchers?

Meanwhile, professional roles and relationships get reshaped by technological and organizational forces.⁴¹

Published reviews of Canadian Electronic Medical Records⁴⁷ show that in the majority of cases, EMRs are considered positive for medical practices, but degrees vary with the aspect examined (e.g. CPOE, medication errors, prescriber productivity, etc.). This study quantifies "...findings suggest there is a 51% chance that an EMR can improve office practice, while in 30% of the time there may not be any effect, but only 19% may lead to negative consequences."⁴⁸ The main complaint provider users seem to feel is that systems are not "intuitive", therefore difficult to use if not a heavy regular user.⁴⁹

When E-RX and EMRs fit neatly into the workflow of the practice, saving capabilities for the practice can be found. But physicians need to have realistic expectations for the EMRs.⁴⁶ Lessons should, of course, be read with caution because each individual system should be fully integrated and up and running for an extended period of time--and then evaluated in research by someone other than the vendor and internal biased staff. As the global market for pharmacy automation expands to a projected \$3.9 billion by 2017 (\$2.6 B this past year) opportunities for evaluation of newer innovations will be likely.⁵⁰

Early studies of a few models suggest that EHRs may actually *not* improve cost effectiveness than the traditional paper filing system surprisingly due to doctors actually ordering more tests when the EHR is available to them rather than less as per expectations.⁴⁹

Additionally, EHRs may generate more insurance billing (thus increasing provider revenues) for previously undocumented services to ease use for supporting hardware and software upfront costs. But the frequently quoted RAND analysis³⁹ has been questioned for validity citing that the data extrapolation may not be scientifically merited and the comparisons drawn to the banking industry may not necessarily be valid.⁴⁰ Also "personal financial ties" linking some researchers and EMR producing companies suggest that available information seems thin at best; especially from a scientific point of view for more objective studies; providers may be skeptical to take on a new system.⁴⁰

Patients will experience benefits from E-RX and will likely support their use. Firstly, patients will see the improved service from the pharmacy and/or PBM in wait times reduced, safety more assured, and with efficiencies in the pharmacy, more professional face time for complicated regimens. Patient access to their medication list has yet to become widespread so they will want to utilize the Internet for fuller drug information. When properly operating, mistakes can be reduced through clinical management systems. In particular, prior authorizations (which are quite commonplace with expensive and specialty drugs) can be sped up for approvals with electronic communication of clinical data back and forth between the physician and pharmacy. In the U.K., pharmacists will soon be given access to patients full EMRs,⁵¹ a practice found only selectively in certain managed care organizations here. The British National Health Service thus has such an advantage for patients over the U.S. private system fragmented into competing corporate entities of HMOs, PBMs, and chain drug stores. The latter also poses barriers for the portability of information for the patient's benefit.

Conclusion

Because EHRs are still in the early stages everywhere and quite heterogeneous if the patient can avoid hospitalization or other adverse effects (drug allergies etc.) through the medical team's use of EHRs, then system cost effectiveness in the longer term can be realized. As one member of a family practice notes, primary care practices are key in patient monitoring for the much more expensive hospitalization stays and emergency room visits, and this point may possibly aid economizing expenditures for the nation as asserted by President Obama.⁴⁰ At this junction, the quality of patient treatment may be upgraded with adherence to evidence based medicine while patients can be better monitored. But of course, health services research will need to accurately assess the overall situation with appropriate analytics in development.^{52, 53,54}

This then raises the issue of long-term safety in the use of EHRs.⁵⁵ Given the widespread differences in EMR systems and their various implementations, amidst the issue of harnessing appropriate drug use, can patient safety in drug utilization achieve the most cost effective patient-oriented care. Health hazards linked to HIT are beginning to be noted.⁵⁶ Congressional attention may be leading HHS observation to minimize patient risks.⁵⁷ Here the larger structure of health reform under the ACA provokes the question of : Whither go the Accountable Care Organizations (ACOs) and Health Insurance Exchanges (HIEs)? ACO outreach to the most vulnerable populations will be key here if public health outcomes are to see remedy.^{58,59}

So will E-RX and EHRs really only be useful for provider cost savings and convenience, or Will they promote *patient-centered, patient focused care systems* that will alter health outcomes in the whole population? The complications over the next few years are vast to forestall predictions. Notwithstanding, public health researchers must engineer vital roles in illuminating the micro organizational issues and on the larger level, what works best in HIT for specific populations. Researchers can instill a population-based perspective and build toward public health outcomes measured for aging cohorts with multiple chronic conditions under poly-pharmacy regimens.

If the entire healthcare system is to see serious structural reform (ACOs and HIEs) and evidence a more patient oriented focus *across populations*, current clinical practice requires alterations that electronic prescribing and EMRs can greatly assist. Smoothing the transition between clinical decision making and completion of documentation requires changed roles and new jobs to emerge. At one particular location which implemented EHRs, a representative said, "...burdens have shifted and job descriptions changed. If anything, we have increased the number of clinical staff..."⁴⁰

Because the use of E-RX and EHRs is just beginning to become more commonplace, studies to examine the long-term effectiveness (both cost and safety) of these systems deserves attention. This is surely a frontier for how these technologies for cost effective and safety improvements can be properly fostered by public health professionals. The implementation of ACOs and HIEs under the Accountable Care Act provides a complex context yet determined to the further evolution of E-RX and EMRs.

Conflicts of interest

Neither author has any conflicts to disclose. This commentary's research was unfunded.

Corresponding author

J. Warren Salmon, Ph.D.
Professor of Health Policy and Administration
School of Public Health
University of Illinois at Chicago
jwsalmon@uic.edu

References

1. Numerous newsletters have arisen to herald HIT, along with a few journals (including this Online Journal of Health Informatics) including Health Data Management, Healthcare IT News, Technology News and Analysis, Mobile Health News, EHR Intelligence, Health Care Informatics, Journal of Biomedical Informatics, Health IT Strategist, Health IT. gov, Applied Clinical Informatics, and more. Medscape, American Medical News, and medical and pharmacy journals, along with the business press, follow HIT developments regularly too.
2. Institute of Medicine (2001) Crossing the Chasm: A New Health System for the 21st Century, National Academy Press, June 29.
3. Institute of Medicine (2006) Preventing Medication Errors, National Academy Press, July 21.
4. Navarro, R., (Ed.), Managed Care Pharmacy, Frederick, MD, Aspen Publishers, 1999.
5. CNBC (2012). Pharmacy benefits managers: Too powerful? Available from: [www.cnbc.com/id/46625424/Pharmacy_Benefits_Managers_Too_Powerful-US Business News Blog](http://www.cnbc.com/id/46625424/Pharmacy_Benefits_Managers_Too_Powerful-US_Business_News_Blog).
6. See studies in the Journal of Managed Care Pharmacy, American Journal of Managed Care, American Journal of Healthcare Pharmacy, American Drug and Health Benefits, among others.
7. Vogenberg, R. (2012). Changing market for pharmacy benefits. Managed Care. January, pp. 34-43.
8. Ammenwerth, E., Talmon, J, Ah, J.S., Bates, D.W.Beuscart-Zephir, M.C., Duhamel, A., Elkin, P.L. Gradner, R.M., % Geissbuhler, A. (2006). Impact of COPE on mortality rates--contradictory findings, important messages. Methods In Medicine 45(6):586-593.
9. Dolan, P.L. (2012) Doctors' love-hate relationship with EHRs. Amednews.com, May 7.
10. Stuckey, M. (2012). EHRs: Despite incentives, some physicians hesitant to transition to systems. American Health Line, November 8.
11. Wigger, U. (1992). "Use of Q-Technique in Pharmacy Student Selection." Thesis presented to the faculty at the UIC College of Pharmacy.
12. Spiro, R. (2012). The impact of electronic health records on pharmacy practice. Drug Topics April, pp. 46-54.
13. Gebhart, F. (2012). Better clinical decision support improves CPOE effectiveness. Drug Topics April, p. 40.

14. LaGrone, K. (2012). Prescription mistakes are rampant and under-reported. Available from : http://doh.state.fl.us/mqa/enforcement/enforce_home.html
15. Wegmans reduces paper in drug refill information. (2009). Supermarket News. July
16. More managed care companies offer EHR services. (2009). Available from: www.medicalnewstoday.com/printerfriendlynews.php?newsid=143039.
17. Salmon, J. W., White, W. D., & Feinglass, J. (1994). The futures of physicians: Agency and autonomy reconsidered. In Salmon, J. W. (Ed.). The corporate transformation of health care, Part II: Perspectives and implications. Amityville, NY: Baywood Publishing Company.
18. Feinglass, J. & Salmon, J. W. (1994). The use of medical management information systems to increase the clinical productivity of physicians. In Salmon, J. W. (Ed.). The corporate transformation of health care, Part II: Perspectives and implications. Amityville, NY: Baywood Publishing Company.
19. DuBeshter, MD Brent., et al (2006). Experience With Computerized Chemotherapy Order Entry. Available from: <http://jop.ascopubs.org/content/2/2/49.full>
20. Kuperman, Gilad J., et al. Medication-related Clinical Decision Support in Computerized Provider Order Entry Systems: A Review. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2215064/>,
21. Dana-Farber Cancer Institute (2009, September 25) "Electronic prescribing helps prevent injuries and reduce health costs." Medical News Today Retrieved from: <http://www.medicalnewstoday.com/releases/165-165.php>.
22. Quinn et al (2012) Study links EHR adoption with decline in malpractice claims. Archives of Internal Medicine June.
23. Kaufman, M.B. (2008). Electronic medication management system available to improve medication adherence. Formulary June 1.
24. Chan, Amanda L. (2012) "Electronic Prescriptions: More Doctors Are Ditching The Old Rx Pad." May 17, Available from: http://www.huffingtonpost.com/2012/05/17/electronic-prescriptions-doctors-paper_n_1524426.html.
25. Kusserow, R.P. (1990). The clinical role of the community pharmacist. U.S.H.H.S. Office of the Inspector General, Washington, DC, November.
26. Conn, J. (2008). E-RX is big driver to full automation, Bria tells AMDIS. Modern Health Care. July 18. Available from: www.modernhealthcare.com/article/20080718/NEWS/164113712/?template=printpicart
27. Johnson, A. (2010). Doctors get dose of technology from insurers. Wall Street Journal August 8.
28. Editorial: Abuse of electronic health records (2012) New York Times September 25.
29. Berry, E. (2012) Health technology and patient-centered principles shown to improve care. Amednews.com July 9. Available from; <http://www.ama-assn.org/amdednews/2012/07/09/bis0709.htm>.
30. Kaiser (2007). AHIC recommends E-prescribing mandate for Medicare. November 30. Medical News Today, MediLexicon, Intl. Available from: <http://www.medicalnewstoday.com/releases/90318.php>.
31. Ault, A. (2012). More physicians get paid for quality reporting, e-Prescribing. Family Practice News, April 4. Available from: [www.familypracticenews.com/index.php?id=2934&type=98&tx_ttnews\[tt_news\]=126733&cHash=da](http://www.familypracticenews.com/index.php?id=2934&type=98&tx_ttnews[tt_news]=126733&cHash=da).

32. Mosquera, M. (2012). EHR incentive payments tally \$4.5 billion to date. HealthCare IT News, Available from: <http://www.healthcareitnews.com/April20>.
33. Manasse, H. (1989). Medication use in an imperfect world: Drug misadventuring as an issue of public policy, Part 2. *AJHP* 46(6): 1141-1152, June.
34. Salmon, J. W. & Dedhiya, S. D. (1998). The vital role of pharmacy benefits management firms in health services research. *Journal of Managed Care Pharmacy* 4(1):23-28. January/February.
35. Medicare prescription drug coverage: estimating the financial impact on the pharmaceutical industry. *PharmaLive* 9/7/2004. Available from: <http://www.pharmalive.com/news/print.cfm?articleid=168486>.
36. Cosgrove, J.C. (2012). High-expenditure Part B Drugs. U.S. Government Accounting Office. Available from : <http://www.govtprintingoffice/GAO183print>.
37. Qato, D. (2010). Racial and ethnic disparities in the use of prescription medicines among older adults in the U.S. Unpublished doctoral dissertation, University of Illinois at Chicago.
38. Salmon, J. W. (1995). A perspective on the corporate transformation of health care. *International Journal of Health Services*. 25(1): 11-42.
39. Hillestad, R., Bigelow, J., Bower, A., Girosi, F., Meili, R., Scoville, R., & Taylor, R. (2005). Can electronic medical record systems transform healthcare? An assessment of potential health benefits, savings, and costs. *Health Affairs* 24(5) September. 14.
40. Baldwin, Gary. (2011). "The \$80 Billion Question." *Health Data Management RSS*. June 1. <http://www.healthdatamanagement.com/issues/19_6/health-care-electronic-health-records-42538-1.html>.
41. McKinlay, J.B. (ed.). (1984). *Issues in the political economy of health*. Tavistock, London.
42. Data: Managing it to make the most of it. (2012). *Health Data Management Digital Edition*. October 10. Available from: www.healthdatamanagement.com/digital_edition/data-managing-to-make-the-most-of-it-45022-1.html
43. Relman, AS. (1988). Assessment and accountability: the third revolution in medical care. *N Engl J Med* 319(18):1220-2.
44. Plantonics (2012). *Big Trends for small businesses*. Plantonics, Nova Scotia, Canada.
45. Mosquera, M. (2012). EHR incentive payments top \$8 billion in October. HealthCare IT News, Available from: <http://www.healthcareitnews.com/November/14/12>.
46. Commonwealth Fund. (2012) 69 percent of US primary care doctors now have electronic medical records. *Medical News Today*. Available from: <http://www.medicalnewstoday.com/releases/252857.php>
47. Lau, Francis, et al. (2012). "Impact of Electronic Medical Record on Physician Practice in Office Settings: A Systematic Review." *BMC Medical Informatics and Decision Making*. Feb 24. <<http://www.biomedcentral.com/1472-6947/12/10>>.
48. Wolfstadt, Jessie L, et al. (2008) The Effect of Computerized Physician Order Entry with Clinical Decision Support on the Rates of Adverse Drug Events: A Systematic Review. *Journal of General Internal Medicine*. 23(4): 451-8.
49. Conaboy, Chelsea. "Health & Wellness." *BostonGlobe.com*. 6 Mar. 2012. <<http://www.bostonglobe.com/lifestyle/health-wellness/2012/03/05/doctors-may-order-more-not-fewer-imaging-tests-with-electronic-access-results-study-finds/7pdhMQY8XeVVnpJoArdzrJ/story.html?camp=pm>>.

50. Pharmacy automation: Technologies and global markets (2012). Available from: [www.marketresearch.com/BCC-Research-v374/Pharmacy-Automation-Technologies-Global - 7148893/](http://www.marketresearch.com/BCC-Research-v374/Pharmacy-Automation-Technologies-Global-7148893/).
51. Pulse. Pharmacists to get access to patients' electronic records, UK. Medical News Today. Retrieved from: www.medicalnewstoday.com/releases/138807.php.
52. Robeznieks, A. (2012). Docs seek more research on IT results. Modern Health Care June 19.
53. Rajecki, R. (2011) Research needed to support eHealth technology. Medical Economics March 10.
54. Cortada, J.W. et al. (2012) The value of analytics in health care. IBM Institute for Business Value IBM, Global Business Service.
55. Goedert, J. (2012) Safety advocates seek national safety goals. Health Data Management. November 5. Available from: <http://www.healthdatemanagment.com/news/ehr-elctronic-health-records-national-safety-goals-45224-1.html?zkPrintable=true>
56. Goedert, J. (2012) Report: Many of top tech health hazards linked to IT. Health Data Management. November 8. Available from: <http://www.healthdatemanagment.com/news/health-information-technology-patient-safety-hazrds-ecri-45210-1.html?zkPrintable=true>
57. Conn, J. (2012). Lawmaker seeks answers in health IT safety. Modern Healthcare November 14.
58. Markle Foundation (2009). Health information technology and health care reform must be well-aligned to improve health and lower costs. Medical News Today Available from: <http://www.medicalnewstoday.com/releases/157684.php>.
59. Obaid, H. & Salmon, J.W. (2012). Community-Based Accountable Care Organizations to Improve Health Outcomes for the Illinois Medicaid Program, Poster at American Public Health Association Annual Meeting, San Francisco, California, October 28.

doi: 10.5210/ojphi.v4i3.4304

Cite this item as: Salmon, J., & Jiang, R. 2013 Jan 2. E-Prescribing: History, Issues, Potential. *Online Journal of Public Health Informatics* [Online] 4(3):e10.