Medical Education
E-prescribing
by Jorge G. Ruiz, MD, and Brian Hagenlocker, MD

Both the federal government and private sector experts have recommended the use of electronic prescribing, or e-prescribing, as a response to the problem of adverse drug events. The Institute of Medicine report, "To Err Is Human: Building a Safer Health System," exposed the serious nature of this category of medical errors [1]. Most such errors occur during the process of ordering medications [2]. E-prescribing refers to the computerized ordering of specific medications for individual patients by clinicians [3]. A key component of e-prescribing software is often a clinical decision-support system (CDSS) [4]. These may be rule-based systems that provide information about drug interactions, drug-diagnosis interactions and drug-allergy problems. They may also include treatment algorithms, information about alternative medication regimens, and computer-based clinical pathways, or may have more advanced scoring and expert systems that assist clinicians by providing reliable and objective estimation of disease prognoses, probability of adverse events and outcomes.

E-prescribing is generally the core function of a more comprehensive computerized physician order entry (CPOE) system that allows clinicians to order not only medications but also diagnostic tests, patient care activities and referrals [5]. Advocates claim that e-prescribing increases accuracy and legibility of prescriptions, integrates the prescription information into electronic medical records, helps physicians adhere to hospital formularies and is cost-effective [6]. The advantages of e-prescribing translate into reduced medical errors and potentially better patient outcomes [7]. Despite these purported benefits, hospitals and clinics have been slow to adopt e-prescribing systems, principally because of the substantial cost of acquisition and set-up [8], resistance from physicians or administrators, concerns about privacy and discrimination, and vendor immaturity [9].

Critics maintain that the introduction of e-prescribing into clinical practice requires substantial organizational changes and may unintentionally disrupt the clinicians' workflow. They point out difficulties in calculating return on investment; concerns about physicians taking too long to input an order, resulting in poor compliance with recommendations; and a lack of research evaluating different models of system implementation [10, 11].

The evidence base
Indeed, potential benefits aside, there is no evidence that e-prescribing systems with or without clinical decision-support systems result in any significant decreases in morbidity and mortality [4, 12]. Most of the evidence refers to improvements in the process of care and practitioner performance. On one hand, it's true that initial studies demonstrated substantial reductions in medical errors and potential and adverse drug reactions in tertiary academic medical centers with homegrown e-prescribing systems and rudimentary decision support [7, 13]. These studies also yielded limited evidence of decreased lengths of stay and overall hospital costs [14]. On the other hand, early evidence in one of the "successful" studies also revealed an increase in potentially life-threatening adverse drug events due to a system bug in the process of ordering potassium infusions [15]. Growing evidence of both homegrown and vendor-developed products revealed disturbing findings, including frequent medication error risks [6], higher rates of adverse drug events despite the high use of a CPOE-based e-prescribing system at a Veterans Affairs hospital [16], elicitation of intense and mostly negative emotional responses from physicians after implementation of e-prescribing [17], and an association with increased mortality in a seriously ill pediatric population [18].

Have we then traded one set of problems for another? This evidence does not disqualify e-prescribing and computerized physician order entry as valuable tools for clinicians. The rational and effective use of e-prescribing requires that administrators, developers and clinicians pay careful attention to potential problems through a continuous quality-improvement process after implementation [19]. E-prescribing solutions often require the customization of systems for diverse health care institutions in academic, urban or rural locales. They must adapt to specific settings of care such as outpatient, inpatient, medical-surgical services, intensive care or emergency departments. The computer applications are also asked to account for the various patient populations—children, adult, elderly—served by those institutions [11, 19]. But the interactions between humans and computers are often unpredictable [19]. The ultimate goal should be the implementation of e-prescribing systems as part of a more comprehensive electronic medical record system, as proposed by the federal government and others [20].

The role of e-learning in better physician prescribing
If e-prescribing's main purported advantage is the improvement of physician prescribing and reduction of medical errors, it may be particularly useful for busy clinicians caring for a growing number of patients. Physicians do face tremendous challenges in trying to follow up on answers to a multitude of relevant drug-prescribing questions within serious time constraints [21]. This problem is further complicated by the expansion of the body of evidence-based medical knowledge and the increasing number of available medications and potential adverse drug reactions [21]. Continuing medical education (CME), the usual approach clinicians use to deal with these challenges, is nonetheless rather ineffective and inefficient for this purpose in its traditional form [22]. Internet-based CME shows signs of being more effective [23].

E-prescribing offers to improve physicians' prescribing practices at the point of care through the use of information technology and e-learning interventions. E-prescribing systems with computerized decision support systems may allow clinicians to receive just-in-time training that is cued by patient care activities and made feasible by the ubiquity of computers in the clinical environment and the expansion of mobile wireless technologies. The linkage of e-prescribing and computerized physician order entry systems with e-learning can promote this process through the use of Internet-based technologies to enhance education and training [24]. E-learning materials integrated into an e-prescribing CDSS may consist of a range of electronic resources [21], including:

- access to medical databases (e.g., PubMed, Cochrane Library, EMBASE)
- electronic books and journals
- e-learning tutorials and simulations
- scientific drug information (e.g., Micromedex, Physicians' Desk Reference, FDA)
- patient education resources (e.g., Medline Plus)

One of the key features of this integration is the simultaneous access to individual patient information including medication history and relevant drug information in e-learning databases, thereby ensuring safe and effective prescribing without forced disruptions to the clinicians' workflow [21, 25]. The seamless integration of these e-learning materials into clinical decision support systems and e-prescribing fosters evidence-based, rational and individualized prescribing. It is also conceivable that physicians at the point of care may receive CME credits for some of these activities, which would further encourage the use of evidence-based interventions. The AMA is already conducting pilot projects on the assignment of credit hours for physician office-based patient care quality-improvement activities [26].

Current e-prescribing systems cannot algorithmically recognize specific clinician knowledge gaps or intelligently ascertain when educational content is relevant to individual patients [21]. These limitations pose important challenges for the design and implementation of e-learning tools as part of e-prescribing systems. The critical step in integrating e-learning technologies into clinical decision support systems is achieving an adequate balance that ensures concise, context-appropriate information. Too much data or inappropriate information may discourage users. Context-sensitive e-learning materials and patient information, if available through hyperlinks, are more likely to be useful than drug information alone [21].

The other big challenge we face is ensuring physicians' competency in the use of the systems. Familiarity with e-prescribing and e-learning systems is not enough. Training and assessment are imperative, with simulated patients as a first step followed by demonstration of competency in using the system with actual patients.

In sum, e-prescribing enhanced by e-learning technologies can potentially assist clinicians by offering needed, just-in-time information at the point of care and guiding them through the individualization of drug-prescribing for their patients.

References
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Additional resources
The Leapfrog Group: http://www.leapfroggroup.org/

The eHealth Initiative: http://www.ehealthinitiative.org/

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