Electronic Prescribing: Criteria for Evaluating Handheld Prescribing Systems and an Evaluation of a New, Handheld, Wireless Wide Area Network (WWAN) Prescribing System

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Abstract

Background. Handheld computer use among physicians is growing. Palm-sized personal computers are expected to become more important in healthcare. These units have the ability to send prescriptions to pharmacies via wireless transmission. The complexities of designing electronic prescribing systems and their ideal features have been outlined, however, in the peer-reviewed literature, only one critical evaluation of an electronic prescribing system has appeared. The purposes of this study were: 1) to develop a comprehensive set of criteria for evaluating handheld computerized prescribing systems, and 2) using these criteria, to evaluate out-of-box performance and features of a new, Palm Operating System (OS)-based, wireless, handheld electronic prescribing system. A dermatologist familiar with healthcare information technology conducted an evaluation of the performance and features of a new, handheld, wireless wide area network (WWAN) electronic prescribing system in an office-based practice during a three-month period in 2000.

Innovation. The system consisted of a Palm Vx handheld organizer, a Novatel Minstrel V wireless modem, OmniSky wireless internet access and ePhysician ePad 1.1, the Palm OS electronic prescribing software program. System performance, defined as transmission success rate, was determined from data collected during the three-month trial. Evaluation criteria consisted of an analysis of features found in electronic prescribing systems. All prescriptions written for all patients seen during a three-month period (August—November, 2000) were eligible for inclusion. The performance of the system was evaluated using data collected during the study. Criteria for evaluating features of electronic prescribing systems were developed and used to analyze the system employed in this study.

Lessons Learned. During this three-month trial, 200 electronic prescriptions were generated for 132 patients

included in the study. Of these prescriptions, 92.5 percent were successfully transmitted to pharmacies. Transmission failures resulted from incorrect facsimile numbers and non-functioning facsimile machines. Criteria established for evaluation of electronic prescribing systems included System (Hardware & Software), Costs, System Features, Printing & Transmission, Formulary & Insurance, Customization, Drug Safety and Security. This study is the first effort to establish comprehensive criteria for evaluating handheld prescribing systems and to evaluate the performance and features of a handheld, electronic prescribing system. The results demonstrated that the evaluated system: 1) was simple to implement; 2) successfully interfaced with a commonly-used practice management system; 3) was user-friendly and easy to operate; 4) offered a robust variety of standard features; and, 5) resulted in a high rate of success for transmitting electronic prescriptions. The criteria established for the evaluation of features of an electronic prescribing system can be used to critically evaluate the performance and features of other handheld and personal computer-based electronic prescribing systems.

Background

- More than 7,000 U.S. deaths occur each year because of medication errors.¹
- Electronic prescribing can reduce medication errors² and improve prescribing practices.³
- With new drugs being introduced at an increasing rate, physicians are continually challenged by the complexitie of recalling new and changing indications, dosing regimens, adverse effects and drug interactions.
- Only a portion of medical knowledge is retained by professionals.⁴
- Medication safety experts, public health groups and pharmacy organizations have advocated the development and adoption of electronic prescribing practices. 5-7
- Various electronic prescribing and physician order entry systems have been described.^{2,8-10}
- Previously described electronic prescribing systems have not used handheld computers or wireless transmission.
- The use of handheld computers by physicians is growing.
- A prediction is that by 2004, twenty percent of US physicians will be using handheld devices for transactional purposes, among them prescription writing.11
- Handheld units have the ability to send prescriptions to pharmacies via wireless transmission. 12,13
- In the peer-reviewed literature, only one critical evaluation of an electronic prescribing system has appeared.9
- A critical evaluation of a handheld, wireless electronic prescribing system has not previously been published in a peer-reviewed scientific journal.

Objectives

The two purposes of this study were:

1) to develop a comprehensive set of criteria for evaluating handheld computerized prescribing systems; and, 2) using these criteria, to evaluate out-of-box performance and features of a new. Palm OS-based. wireless. handheld electronic prescribing system.

Methods (Innovation)

- -ePhysician ePad 1.1 (ePhysician, Mountain View, CA)
- -Palm OS 3.5 (Palm, Santa Clara, CA)
- -OmniSky 1.0 wireless internet access (OmniSky, Palo Alto, CA)—WWAN provider
- Personal Computer (PC)
- -ePhysician ePad web-enabled PC application
- -Microsoft Windows 98 OSR2 (Microsoft, Redmond, WA)
- -Palm OS Emulator 3.0a6—screen captures of ePad and eDR 150 handheld applications
- -Power Link two-way cable modem internet access (Adelphia, Coudersport, PA)
- -Lytec Medical 98 (Lytec Systems, Mesa, AZ)—practice management system (PMS)

- Palm Vx handheld organizer
- -Novatel Minstrel V wireless modem (Novatel Wireless, San Diego, CA)

-450-MHz Intel Celeron processor (Intel, Santa Clara, CA); 160 MB random access memory -LANCity LCPET-2 cable modem (Bay Networks, Santa Clara, CA)

■ Patients were selected from a private dermatology practice between August and November 2000.

Criteria for Inclusion

- All patients for whom prescriptions were written were eligible for inclusion.
- Patients using pharmacies without facsimile machines physically located within the pharmacy were excluded.
- Patients indicated pharmacy preferences either upon registration or at the time a prescription was written.
- Prescriptions were not transmitted to two pharmacy chains that did not have a uniform corporate policy for receiving electronically transmitted prescriptions.

Procedure

Length of Agreemen

- All prescriptions were written and transmitted electronically at the point-of-care by one physician.
- Multiple prescriptions for a patient could be sent with a single transmission.
- Failed transmissions were re-transmitted once.

Prescription Data and System Performance

■ At the conclusion of the study, data was downloaded and analyzed.

Non-wireless

Wireless Modem

Direct Facsimile

Transmission Status

■ Transmission success = (Successful transmissions/Total electronic prescriptions) x 100.

System Evaluation

- A list of features commonly found in electronic prescribing systems was developed (Table 1).
- Using this list, individual features of the ePhysician ePad system were analyzed.

lable if reatures of Liectronic Prescribing Systems						
System	System Features	Formulary & Insurance	Drug Safety			
Product	Appointment Scheduling	Formulary Verification	Allergies			
Company	Controlled Substance Prescribing	Prescription Insurance Verification	Adverse Event Reporting			
Type (Handheld, Web-enabled or Both)	Customer Support		Current Medication Input			
Hardware Requirements	Drug Pricing Information		Disease Input			
Handheld	Drug Reference Database		Laboratory Input			
PC	Handheld Patient Input		Dose Calculation			
Software Requirements	Pharmacy & Drug Lists		Dose Verification			
Handheld	PMS Integration		Drug-Age Screening			
PC	Prescription Writing/Storage/Retrieval		Drug-Allergy Screening			
Additional Requirements	Reorder Capabilities		Drug-Disease Interaction Screening			
Additional Options			Drug-Drug Interaction Screening			
			Drug-Lab Interaction Screening			
Costs	Printing & Transmission	Customization	Security			
Cost of System	Printing	Amount Dispensed	Electronic Signature			
Additional Costs	Infrared	Custom Sig	Encryption			

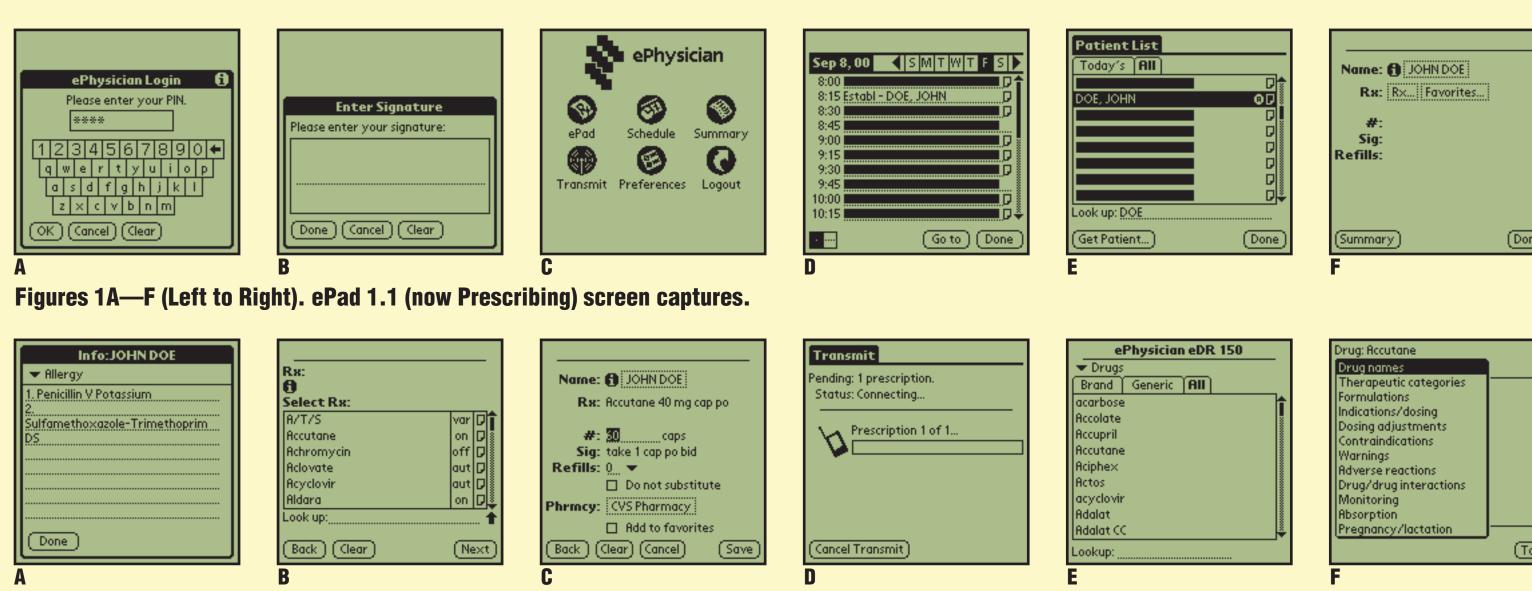
Table 1. Features of Electronic Prescribing Systems

Results

ePhysician ePad (now Prescribing

- ePad 1.1 is a combination electronic prescribing system offering the ability to generate and transmit electronic prescriptions from both handheld and web-enabled PC applications.
- Screen captures of this application are shown in Figs. 1A—F and 2A—D.
- -Fig. 1A shows the *Login* screen. A personal identification number *(PIN)* is entered to access the application.
- -Fig. 1B shows the *Enter Signature* screen. The signature is stored and transmitted with each prescription. -Fig. 1C shows the ePhysician applications screen.
- -Fig. 1D shows the daily schedule screen, accesible by tapping the *Schedule* icon in Fig. 1C. A prescription is generated by tapping a patient's name.
- -Fig. 1E shows the searchable *Patient List* screen, accessible by tapping the *ePad* icon in Fig. 1C.
- -Fig. 1F shows the ePad prescription screen. Favorite prescriptions can be selected by tapping *Favorites*.
- -Fig. 2A shows the *Allergy* information for the selected patient, accessible by tapping the ☐ icon (Fig. 1E) or the dicon (Fig. 1F).
- -Fig. 2B shows the searchable *Select Rx* screen. The second column lists formulary status abbreviations.
- -Fig. 2C shows the completed prescription, including *Name*, *Rx*, #, *Sig*, *Refills* and *Phrmcy*.
- -Fig. 2D shows the *Transmit* screen, indicating the number of *Pending* prescriptions and transmission *Status*. ePhysician eDR 150 (now Drug Reference)
- eDR 150 is a drug reference database for the Palm OS.
- Screen captures of this application are shown in Figs. 2E—F.
- -Fig. 2E shows an alphabetical list of *All* drugs in the database. *Brand* and *Generic* lists may also be viewed.
- -Fig. 2F shows the twelve categories of information available for each drug in the database.

Figures 1A—F & 2A—F. ePad & eDR 150 Screen Captures



Figures 2A—F (Left to Right), ePad 1.1 (now Prescribing) screen captures (A—D); eDR 150 (now Drug Reference) screen captures (E—F).

Prescription Data and System Performance

- Demographic data are show in Table 2. A total of 132 patients participated.
- Prescription data are shown in Table 3. A total of 200 electronic prescriptions were written.
- Performance data is shown in Table 4. The success rate of prescription transmission was 92.5 percent. ■ Transmission failures resulted from two different causes:
- 1) non-functioning facsimile machines; and,
- 2) incorrect facsimile phone numbers.
- Although not measured, overall this system appeared to lead to fewer telephone calls from pharmacies for prescription verification, amount dispensed and instructions.

Table 2. Demographic Data		Table 3. Prescription Data		Table 4. Performance Data	
Dates of study	8/9/2000 - 10/27/2000	Electronic prescriptions	200	Successful transmissions§	185
Physicians	1	Prescriptions per visit		Unsuccessful transmissions	15
Patients	132	1	88	Transmission success (%)	92.5
Male:Female ratio	0.81:1	2	43	§Verified successful transmissions	
Mean patient age	42	3	6		
Median patient age	38.5	4	2		
Office visits [†]	139	Mean prescriptions per visit	1.44		
[†] 5 patients seen on 2 visits; 1 patient seen on 3 visits		Median prescriptions per visit	1		
		Drugs prescribed [‡]	70		
		Pharmacies	49		
		[‡] Different formulations counted as separate drug	as		

- Categories evaluated included *System, Costs* and *System Features* (Table 5A) and *Printing & Transmissic* Formulary & Insurance, Customization, Drug Safety and Security (Table 5B).
- The system is a combination type, allowing prescriptions to be written and sent from both a handheld unit and from a web-enabled PC application.
- It is compatible only with Palm OS-based handheld units and with PCs.
- An Internet Service Provider (ISP) is required.
- Wireless transmission, an option, requires a wireless modem and a wireless ISP.
- Costs are based on a yearly subscription agreement, with no prescription limits and no transaction fees.
- Appointment scheduling can be performed with the web-based scheduler or imported from a PMS.
- Most PMS interfaces are supported, although a PMS is not required.
- Free customer support is available on weekdays via toll-free telephone number.

ePhysician ePad 1.1 (now ePhysician Practice

- Drug pricing information is not currently available.
- A handheld drug reference database, eDR 150 (now Drug Reference) is available at no cost.

■ Direct patient input on the handheld is not available. (Version 1.3 allows direct patient input.)

- The web-enabled browser allows pharmacy and drug list customization, access to prescription data, reorders, printing and transmission status.
- Prescriptions are transmitted via synchronization (standard) or via a wireless (WWAN) modem (optional).
- Formulary verification is accomplished manually on the handheld unit. Amount dispensed, sig, favorites and notes may be customized on the handheld unit.
- Allergy information entered on the browser is available on the handheld unit. Drug-allergy screening is performed
- The following features are not available: adverse event reporting, current medication input, disease input, laboratory input, dose calculation, dose verification, drug-age screening, drug-disease interaction screening and druglab interaction screening.
- Security features include electronic signatures, transmission encryption and password protection of both the handheld unit and desktop applications.

Table 5A. ePhysican ePad Features Table 5B. ePhysician ePad Features

Not currently available ePhysician, Inc. (Mountain View, CA) Combination (Handheld & Web-enabled) Palm OS-compatible handheld Pentium II 233 MHz: 64 MB RAM; 99 MB hard disk space: 56K modem; CD-ROM; Printer; 15" monitor Direct Facsimile Not currently available Palm V: Palm OS 3.0: Palm Vx: Palm OS 3.5: Windows 95/98/NT 4.0 (Service Pack 4 or better Prescription Insurance Verification Not currently available Internet Service Provider (ISP) **Amount Dispensed** 1. Use with PMS may require cable/software 2. Wireless ISP/Minstrel V wireless modem Originally \$20 per month (ePad); now \$39.95 (ePhysician Practice); Advance payment discount; \$40 per month (wireless mode): No limits on number of prescriptions: No transaction fees Adverse Event Reporting Not available HotSync updates handheld schedule **Current Medication Inp** Not available Varies depending on state laws Not available Available Monday through Friday; Toll-free Not available

Appointment Scheduling Web-enabled scheduler or import from PMS; telephone number; No support charge

g Pricing Information	Not currently available
g Reference Database	eDR 150 (150 most commonly prescribed of
	Now called Drug Reference
dheld Patient Input	No direct input (available in version 1.3)
rmacy & Drug Lists	Customized via browser; Updated on HotSy
S Integration	Most PMS interfaces supported
scription Writing/	Writing via handheld or browser; Storage ar
age/Retrieval	retrieval via browser only

Not available Drug-Drug Interaction Screening Via eDR 150 (now Drug Reference) Drug-Lab Interaction Screening Not available

Password Protection

Conclusions (Lessons Learned)

- The performance and features of a wireless, handheld electronic prescribing system were evaluated.
- Advantages included manual formulary checking, manual drug interaction checking, time savings, excellent vendor support, easy record display and increased patient satisfaction.
- Disadvantages of this system were minimal. It was easily installed, generated no staff reluctance, can be installed on more than one workstation and interfaced well with the PMS used. Transmission delays were not encountered.
- The practical implications of the current study are important in two regards:
- 1) First, this is the first study that has evaluated the performance and features of a wireless, handheld electronic prescribing system. The results of this study are potentially valuable to physicians and healthcare systems considering the adoption of this new technology.
- 2) Second, a comprehensive set of product features has been developed, which can be used to evaluate similar handheld and PC-based electronic prescribing systems.
- This study demonstrated that the handheld, WWAN prescribing system evaluated, ePhysician ePad 1.1:
- 1) was simple to install;
- 2) successfully interfaced with a popular practice management system;
- B) was user-friendly and easy to operate;
- 4) offered a robust set of standard features; and,

5) resulted in a 92.5 percent success rate for transmitting electronic prescriptions.

- The criteria developed in this study for evaluating the performance and features of an electronic prescribing system can be used to evaluate other handheld and PC-based electronic prescribing systems.
- Future studies should evaluate the performance of these systems so that potential users will have a factual basis for product comparison.
- In addition, as new features are added, future investigations should examine these features in detail to determine if they are useful and cost-effective.

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