

Editor's Note: This online data supplement contains an exhibit that was not included with the published article by Douglas S. Bell et al., "Recommendations for Comparing Electronic Prescribing Systems: Results of an Expert Consensus Process," *Health Affairs*, 25 May 2004, found online at content.healthaffairs.org/cgi/content/full/hlthaff.w4.284

Rationale and median expert panel ratings for the complete set of electronic prescribing recommendations

#	Recommendation	Rationale	Patient Safety & Health Outcomes	Helping Patients Manage Costs	Patient Privacy	Clinician Acceptance	Achievable within 3 years
Patient Identification							
1	A minimal set of patient identifying information (name, gender, and date of birth or age) should be visible in the user interface throughout the process of creating a prescription. *	If prescribers select the wrong patient, displaying the identity throughout later steps maximizes opportunities to correct this slip.	7	0	0	2	Yes
2	The system should have the capability of importing patient identification and demographic data from an electronic medical record (EMR) or practice management system (PMS) used by the health care organization. *	Coordination of patient data across systems should improve the accuracy of patient identification and the completeness of historical information available for decision support.	6	0	-1	4	Yes
3	The system should provide a method for manual entry of patient identification and demographic data when importing this information from an EMR or PMS is not possible. *	Prescriptions may sometimes be needed when access to electronic records is not available.	5	0	0	5	Yes
4	The system should permit records created under separate identities for the same patient to be merged or treated as one patient by a system administrator.	Two or more identities are sometimes created for the same patient. Merging these identities should provide more complete data for decision-making.	5	1	-1	5	No
Access to Patient Historical Data							
5	The system should be capable of extracting patient data for decision support from external sources including pharmacy, hospital, laboratory, and EMR systems.	Prescribing decision support often depends on data available only in external systems.	6	4	0	4	No
6	The system should indicate when an external interface that provides data for decision support is not operational.*	Interfaces among information systems often fail. Prescribers need to know when decision support they may rely on is not functioning.	5	0	0	4	Yes
7	Prescribers with care responsibility for the patient should be able to review the patient's complete current medication list, based on open prescriptions from all other clinicians. *	An accurate current medication list is required for clinical decision-making. Achieving this capability may depend on criteria 5, 9 and 12, among others.	7	3	-2	6	Yes
8	Prescribers should be able to review all non-prescription medications the patient is currently taking, including over-the-counter and alternative medications	Over-the-counter and alternative medications may impact on clinical decision-making.	6	3	-1	5	No
9	The system should provide a means for entering medications the patient is currently taking that have not been prescribed through the system and are not available through external interfaces. *	Even highly integrated systems may not capture all of a patient's medications, particularly non-prescription medications.	6	2	-1	5	Yes
10	Prescribers should be able to review a summary by drug class of the patient's medication history including drug names, dosages, start and end dates, and adherence gaps.	Making available the patient's prior experience with medications could prevent adverse events and repeat trials of ineffective medications. Including adherence data could improve the interpretation of medication history data and could permit early identification of non-adherence.	5	3	-1	4	No
11	Prescribers should be able to retrieve details of individual past prescriptions including dosages, prescribing dates, and dispensing dates.		5	2	-1	3	No
12	The system should support orders to discontinue currently open prescriptions with a message sent to notify the original prescriber of the discontinuation.	Constructing a current medication list and monitoring adherence both depend on information regarding when medications are discontinued.	5	2	-1	4	No

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Medication Selection							
13	The system should allow for viewing a list of medications appropriate to the diagnosis when a diagnosis is entered. *	Displaying medication options for a diagnosis could increase the appropriateness of prescribing ⁷ and assist in managing the patient's costs.	5	3	0	4	Yes
14	The system should allow efficient prescribing without the entry of a diagnosis and with the entry of speculative or tentative diagnoses. *	For many patient encounters, no firm diagnosis is established. Physicians may assign inaccurate diagnoses if forced to select one.	5	1	0	6	Yes
15	The system should provide a method for prescribers to create customized menus of medication options. §	Providers may be most experienced and most comfortable with one or a few medications within a class.	2	1	0	5	Yes
16	The display of medication options should not be influenced by promotional considerations . *	Promotional considerations would create conflicts of interest by introducing factors into the prescribing decision other than the patient's best interests.	7	6	0	6	Yes
17	The meaning of any symbols or special fonts should be immediately available during the prescribing process. *	Symbols that indicate favored or disfavored medications could cause safety and cost considerations to be confused.	6	4	0	5	Yes
18	Prescribers should have immediate access to the rationale for any medication choice that the system displays as being recommended or preferred for the current patient. *	Making clear the reasons that a medication is recommended should help to avoid any appearance of conflicts of interest.	6	3	0	6	Yes
19	The system should omit from suggested-medication menus options that would be medically contraindicated for the patient. *	Tailoring menus to individual patient characteristics should prevent adverse drug events.	6	3	0	4	Yes
20	The system should allow prescribing by name search from a complete list of medications, bypassing any restricted medication menus. *	Menu restrictions could be based on poor-quality drug information or influenced by conflicts of interest.	3	0	0	5	Yes
21	The system should enable providers to determine the accurate formulary status and the actual cost to the patient for each medication option based on the patient's prescription insurance coverage.	Providing access to accurate costs should enable negotiation of adherence at the time of prescribing. This would prevent patients from having to later make uninformed decisions about adherence when they learn their actual costs. This should also reduce call-backs.	2	7	0	3	No
22	The system should provide access to the current amount remaining on the patient's prescription drug benefit cap, if one exists.		1	6	0	2	No
23	Prescribers should be able to access brief summaries of medication effectiveness and potential harms based on the evidence used for FDA actions and on evidence from peer-reviewed randomized clinical trials or peer-reviewed meta-analyses.	Providing effectiveness and potential harm information should enable prescribers to make more effective choices.	5	2	0	4	No
24	The system should provide for selection from the dosages and forms that are available and appropriate for a given medication. *	Selection of dosage and form from controlled menus (as opposed to being entered as text) should prevent prescribing errors, specifically wrong-dose and wrong-form errors. ^{2,8}	5	1	0	5	Yes
25	The system should provide prescribers with access to assistance with dosing calculations based on body size and age, when such adjustments are indicated. *	Computer-assisted dosage calculations can reduce medication dosage errors. ^{3,5} The patient's age is used in some pediatric dosage calculations.	6	0	0	5	Yes
26	The system should provide prescribers with access to assistance with dosing calculations based on kidney and liver function, when such adjustments are indicated. *	Automated renal and hepatic dosing can also reduce errors. ⁵ Since this may require laboratory data, #26 is separate from #25.	5	0	0	5	Yes

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Alerts and Other Messages to Prescribers							
27	The system should alert the prescriber when a medication is selected that has a contraindication or significant precaution based on the patient's allergies, current medications, medical conditions, and laboratory findings. *	Adequately sensitive and specific alerts should reduce adverse drug events. ²	7	2	0	5	Yes
28	The system should remind the prescriber when a prescription for a new medication might be indicated based on patient data (e.g., medical history, labs) in conjunction with rules from practice criteria that are based on thorough analyses of the peer-reviewed literature.	Reminders should prevent errors of omission and enhance prescribers' adherence to best practices. ⁵ For example, reminders to consider a beta-blocker might be triggered for patients with recent myocardial infarction.	6	1	0	4	No
29	For every message , the system should provide immediate access to an explanation of its rationale, including disclosure of all criteria and financial support used in its development.*	The rationale for messages should be transparent to the user. Prescribers may be inappropriately influenced if criteria based on cost versus health are confused.	4	1	0	5	Yes
30	Prescribers should be able to clearly distinguish alerts and messages based on patient safety and health outcome concerns from those based on formulary adherence and other considerations.*		5	2	0	5	Yes
31	The system should prioritize safety alerts based on clinical importance (e.g., the frequency, severity, and certainty of the possible adverse consequences).*	Prioritization is required to avoid overwhelming the prescriber with inconsequential information.	6	1	0	6	Yes
32	The system should allow low-priority safety alerts to be suppressed either by the prescriber or at the time of installation.*	Frequent low-priority alerts could desensitize clinicians. ¹ Suppression at installation-time may be necessary if individual prescribers do not feel comfortable authorizing suppression by themselves.	4	0	0	3	Yes
33	The system should allow the prescriber to suppress alerts and messages that are not based on patient safety. §	Allowing other classes of alerts and messages to be suppressed would further reduce potential distractions.	1	-1	0	4	Yes
34	Any sponsorship of a message to prescribers should be indicated in the message.	Disclosure of sponsorship allows the prescriber to evaluate potential conflicts of interest.	2	3	0	4	Yes
35	Prescribers should be able to proceed with their intended order, overriding any alert, with clinical justification required for the most severe potential adverse events. §	Prescribers need to be able to exercise judgment in overriding alerts.	1 [†]	0	0	5	Yes
36	Alerts and messages should display the date that the underlying decision support rules were last updated.*	Prescribers need to be able to judge whether decision support tools reflect the most current available information.	4	0	0	4	Yes
37	Prescribers should have access to patient data that was used to trigger alerts or tailor medication menus.	Patient abnormalities that trigger alerts may be interpreted differently by the provider.	4	0	0	4	No
38	Prescribers should be able to correct or flag patient information that they believe to be erroneous.*	Erroneous patient information may trigger nuisance alerts. However, prescribers should not delete this information, since their judgement of the error may also be wrong.	5	0	0	3	Yes

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Patient Education							
39	The system should provide information for patients on how to take the medications prescribed and why they should be taken.*	Education from the provider (in addition to the pharmacist) should improve physician-patient communication and enhance adherence.	5	3	0	3	Yes
40	The system should print a complete current medication list for patients.*	Providing patients with a complete current medication list should enhance adherence and the accuracy of medication data.	5	3	-1	3	Yes
Data Transmission and Storage							
41	The prescriber should be able to transmit prescriptions electronically to the patient's pharmacy of choice (mail-order or retail). *	Allowing patients to choose their fulfillment venue should aid patients in starting new prescriptions on time and in establishing continuity among pharmacies.	4	2	0	3	Yes
42	Transmission of prescription data between systems should conform to the most recent versions of criteria from Health Level 7 (HL7) and/or the National Council for Prescription Drug Programs (NCPDP); transmission of other clinical data should conform to the most recent version of HL7. *	Standardized data exchange should increase the chances of having data relevant to prescribing decisions, decrease costs from redundant testing, and increase acceptance to the extent that it decreases clinicians' work. NCPDP covers Rx Data, HL7 covers Rx and other clinical data.	6	2	0	5	Yes
43	The system should use National Provider Identifiers ⁹ when they become available. *	A provider ID would permit aggregation of prescribing data for a single provider operating in different sites.	4	0	0	2	Yes
44	The system should use universal patient identifiers if they become available.	A universal patient identifier would enable linking patients across providers and insurers where legally possible	5	2	-1	3	No
45	The system should disclose any promotional considerations that have influenced the display of pharmacy fulfillment options. *	Promotional considerations could bias the selection of pharmacies toward those that may be in the best interest of a sponsor rather than the patient.	3	4	0	4	Yes
46	Prescribers should be notified of transmission failure of a prescription to a pharmacy. *	Transmission failures could delay or block patients' receiving medications, cause extra work for providers and lead to errors when prescriptions are manually re-entered at the pharmacy.	6	1	0	5	Yes
47	The system should be able to receive and store notification from the pharmacy when each prescription is delivered to the patient.	Provides a basis for informing providers of patient non-adherence, which in turn would enable their negotiation of better adherence.	4	0	-2	3	No
Monitoring and Renewals							
48	The system should notify the prescriber when a prescription or prescription refill is not dispensed and delivered to the patient within a time interval specified by the provider.	Non-adherence is a frequent cause of outpatient adverse drug events. ⁴ Alerting providers to potential non-adherence gives them a chance to negotiate improved adherence and avert patient injury.	6	2	-2	4	No
49	The system should remind the clinician to place orders for follow up laboratory tests recommended by the manufacturer for monitoring.	Automated reminders to order monitoring laboratory tests decreased errors of omission in monitoring. ⁶	5	2	0	3	No
50	The system should alert the prescriber when the results of laboratory monitoring tests require action.	Alerts for abnormal monitoring test results should help clinicians act more quickly on potential adverse events.	6	2	0	5	No

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51	The system should provide access to the results of laboratory monitoring tests.	Access to monitoring test results should facilitate more timely assessments.	6	0	-1	5	No
52	Prescription renewals entered by non-prescribing office staff should be clearly attributable to both an individual staff person and an authorizing prescriber. *	Allowing office staff to assist with renewals may improve office efficiency, but both the staff person and the prescriber involved should be accountable to ensure that renewals are adequately reviewed.	5	0	0	3	Yes
Transparency and Accountability							
53	The system should display notification of corporate sponsorships and critical business relationships that could represent conflicts of interest, and vendors should completely and transparently disclose details of these relationships in publicly available documents. *	Making users and the public aware of any <i>potential</i> conflicts of interest should help them remain alert for biases that could arise from these relationships.	3	4	0	5	Yes
54	Prescribing system vendors should provide access to complete and transparent disclosure of the sources and methods used to develop clinical decision support rules, including the triggers for alerts and other messages. *	Prescribers would not routinely access this level of detail, but its availability would provide a way to evaluate whether potential conflicts of interest resulted in actual biases.	4	3	0	6	Yes
Prescriber-level Feedback							
55	Prescribers should be able to review profiles of their own prescribing patterns. *	This should promote practice-based learning for clinicians.	5	4	0	3	Yes
56	The system should be able to profile prescribers' history of overriding alerts. *	This should enable the detection of useless, potentially distracting alerts and of prescribers who may ignore all alerts.	4	0	0	-2 [†]	Yes
Security and Confidentiality							
57	The system should support compliance with the most current Health Insurance Portability and Accountability Act (HIPAA) criteria for privacy and security. ¶	Widely accepted privacy and security criteria should enhance patients' and clinicians' trust in health data systems.	0	0	6	3	Yes
58	User activities should be recorded in a reliable audit trail that is accessible only to authorized personnel responsible for enforcing data privacy and security. ¶	Promote privacy and security by making users accountable for all data they view or manipulate.	2	0	6	2	Yes
59	Each user should be individually identified in the system and have role-based access privileges. *	Promote privacy by limiting access to patient data based on the user's clinical or administrative job role.	3	0	6	3	Yes
60	The system should support a method for checking the integrity of stored or transmitted data. *	Data integrity checks, such as "check sum" or electronic signature algorithms, would reveal unauthorized alterations of data in transmission or storage.	5	0	3	3	Yes

Source: Authors' analysis of expert panel ratings. Rating scales ranged from -7 to +7, where -7 represented the largest negative impact on the dimension and +7 represented the largest positive impact. Panelists were instructed to use the lowest third of the scale (-7 to -3) to indicate clearly negative effects and the highest third of the scale (+3 to +7) to indicate clearly positive effects.

Definitions of key terms – **Promotional considerations:** Payments or in-kind support to vendors, providers, or any other third party, in exchange for their promoting a medication or group of medications. **Message:** Any communication targeted to an individual prescriber. Messages may be delivered at the point-of-care or asynchronously, e.g. via e-mail. Messages are often, but not always, intended to influence prescriber's actions. **Alert:** A message intended for immediate review by the prescriber, generally interrupting the usual workflow, and often demanding an acknowledgement. A complete glossary of terms used by the panel is available at www.rand.org/health/erx/eRx_glossary.pdf.

Symbols:

- * Recommendations judged to be achievable within 3 years and rated as having clearly positive effects on patient safety and health outcomes. Thirty-seven criteria fell in this category.
- † Ratings that met the *a priori* criterion for disagreement (at least two ratings clearly negative and at least two other ratings clearly positive).
- ¶ Recommendations rated as having clearly positive effects only on the patient privacy dimension.
- § Recommendations rated as having clearly positive effects only on the clinician acceptance dimension.

Notes:

1. S.A. Abookire et al., "Improving Allergy Alerting in a Computerized Physician Order Entry System," Proc AMIA Symp (2000): 2-6.
2. D.W. Bates et al., "The Impact of Computerized Physician Order Entry on Medication Error Prevention," Journal of the American Medical Informatics Association 6 , no 4 (1999): 313-21.
3. R.S. Evans et al., "Evaluation of a Computer-Assisted Antibiotic-Dose Monitor," Ann Pharmacother 33, no 10 (1999): 1026-31 .
4. J.H. Gurwitz et al., "Incidence and Preventability of Adverse Drug Events Among Older Persons in the Ambulatory Setting," JAMA 289, no 9 (2003): 1107-16.
5. D.L. Hunt et al., "Effects of Computer-Based Clinical Decision Support Systems on Physician Performance and Patient Outcomes: a Systematic Review," JAMA 280, no 15 (1998): 1339-46.
6. J.M. Overhage et al., "A Randomized Trial of "Corollary Orders" to Prevent Errors of Omission.," J Am Med Inform Assoc 4, no 5 (1997): 364-75.
7. I.N. Purves, "PRODIGY: Implementing Clinical Guidance Using Computers," Br J Gen Pract 48, no 434 (1998): 1552-3.
8. J.M. Teich et al., "Effects of Computerized Physician Order Entry on Prescribing Practices," Archives of Internal Medicine 160, no 18 (2000): 2741-7.
9. U.S. Department of Health and Human Services Office of the Secretary, "45 CFR Part 162. Standard Unique Health Identifier for Health Care Providers," Federal Register 69, no 15 (2004): 3434-3469.

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