

What s So Special About Medications: A Pharmacist s Observations from the POE Study

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Abstract: Observations from a qualitative, multi-site study of physician order entry (POE) confirm that implementing POE is problematic, and suggest that there is particular difficulty in implementing medication order entry. A pharmacist participating in the study group sought to answer the question: What makes medications different? Analysis of themes specific to medication POE in this study s large data set was undertaken using a grounded theory approach. Emerging themes in the data are explored and include: (1) medication order complexity and potential consequences of error (2) impacts on professional roles, (3) prescribing needs in different settings, and (4) impacts of technology on medication administration. Awareness of potential roadblocks and lessons learned from previous implementation attempts should help organizations considering medication POE to optimize their own strategies.

INTRODUCTION

The rationale for and potential benefits of physician order entry (POE) have been well described. They include decreased medication errors [1], especially errors of omission [2], immediate feedback by automated decision support [3,4], improved legibility of orders, opportunities for remote order entry, more rapid entry through the use of order sets [5], integrated access to guidelines and reference information, more timely drug delivery and administration, reduced ambiguity of orders, and better cost control [6]. Despite these reported benefits of POE, it has not yet become widely available, and where it is available it is not heavily used [7]. Attention drawn to medication error by the recent Institute of Medicine (IOM) report, *To Err is Human* [8], and increasing regulatory scrutiny of medication use may cause hospitals already considering POE implementation to expedite this process. In fact, a subsequent IOM report, *Crossing the Quality Chasm* [9], recommends a commitment be made to integrate and improve the health information infrastructure and that this commitment should eliminate most handwritten clinical data by the end of the decade.

POE encompasses many aspects of patient care, including orders for laboratory and ancillary tests, diet and activity regimes, professional and paraprofessional services, medications and other treatments, and various miscellaneous instructions. Observations from a qualitative, multi-site study of POE confirm that implementing POE is problematic because of a host of organizational, professional, and technical issues [10]. In the course of this work it became apparent that implementation of medication POE is particularly difficult. One informant in this study confided: A couple of things came on line early on that were again, very simple: things like dietary orders and radiology things that are really pretty simple compared to pharmacy ordering, which is where the major problem is while another called the stage at which medication POE was implemented an outrage.

METHODS

The goal of the Physician Order Entry Team (POET), lead by Dr. Joan Ash at Oregon Health Sciences University, is to elucidate success factors and barriers to POE implementation. Site selection criteria, data collection techniques, and analyses performed on the data by the research group have been described in previous publications [10,11].

In an effort to discover why medication order entry differs from other components of POE, a pharmacist participating in the POET group read and coded 447 pages of transcript data from field observations and 16 interviews. A grounded theory approach was used to identify emergent themes specific only to medication POE implementation in this large data set [12]. Organizational, professional, and technical issues not directly implicated in problems of medication prescribing and administration were excluded from analysis. Informant s utterances and experiences were used exclusively to develop the taxonomy of themes.

RESULTS

Four primary themes were identified as making medication POE problematic: the complexity of medication orders and consequences of error, changes in professional relationships and roles, difficulties imposed by prescribing in different settings, and considerations of current and future technologies.

Complexity of Medication Orders

Compared with other orders, medication orders require consideration of a myriad of variables. Completion of an order requires choosing appropriate drug, dose, route, frequency, duration, and, in the case of intravenous medications, diluent, volume, and administration rate. Ordering may require navigating numerous screens, and some input variables may be outside the physician's traditional domain. We put the resident in front of a terminal and said, Pick a solution. Do you want saline, or do you want glucose? Do you want 50, or do you want 100? Now pick a rate, and he's going Wait, I don't know this. Even after streamlining efforts are made so that order entry requires navigating fewer screens, the medication ordering process remains complex and lengthy.

Informants agree that medication order entry is smooth when doing standard tasks but that unusual orders require an ability to quickly recover from unexpected snags. Physicians encounter difficulty with atypical uses (topical use of mineral oil, otic use of docusate sodium), and administration at non-standard times. Peritoneal dialysis, total parenteral nutrition, chemotherapy, and pediatric patient orders can prove especially difficult. One informant noted an intern taking over an hour to complete a peritoneal dialysis fluid order. Inadequate training and onsite support during implementation can be crippling.

Additionally, compared to other orders, drug orders may require more frequent modification. Changes may be necessary on an hourly or even moment-to-moment basis. Systems that require discontinuation and complete order re-entry for simple changes in dose or schedule can increase frustration and the possibility of error.

The sheer number of drugs available, introduction of new drugs, and their availability in multiple forms (oral, intravenous, topical, etc.) combine to make the medication POE interface a critical issue. The search process can be very

cumbersome. It's hard to find the right med, you can't just type in the name you want, you have to search through the alpha list which is many screens. Drug database browsing is often difficult, and text search capability, a desirable feature, is not always available. The interface may not provide helpful cues as to usual dose, frequency, and, for IVs, diluent and rate. Systems that don't permit searches using both brand and generic names, and don't consider misspellings, synonymy, and problems with look- and sound-alike drug names, may handicap ordering clinicians. Formularies in multi-hospital systems that are not reconciled and permit choosing formulations and strengths that are institutionally unavailable will increase the need for order re-entry, error, and drug delivery time. Design decisions as to how drug choices will be listed (by type - IV piggybacks, chemotherapy, oral meds, dialysis, etc. - or alphabetical by generic or brand name, or some combination thereof) will be non-trivial.

The patient medication profile design is also important. Medication profile listings that are not logically organized either temporally, alphabetically, by drug class, by prescriber, by route, by schedule (e.g. as needed vs. scheduled), or in some predictable combination will be difficult to interpret.

The fluidity of institutional drug use policy can also be problematic. POE tends to accentuate built-in inflexibility due to policy [13]. Medication POE will likely cause a more rigid adherence to formulary and use restrictions that may have historically been only loosely followed. Ordering processes that provide no cues to drug use restrictions and formulary alternatives make pharmacist callbacks for order changes more likely.

Order entry on an unintended patient is an insidious and consistent problem, and can be a significant risk to patient safety. Visual cues formerly provided by the paper chart, such as thickness, location, and handwriting, are removed with POE. The problem can be especially dangerous with drug interventions and can have a deleterious effect on clinician opinions of POE's value. After one patient received a drug intended for another patient and the mistake resulted in an adverse event, a clinician commented that this event became lore and myth about [POE] being bad for patient care.

Changes in Relationships and Roles

A variety of health professionals cooperate as stewards of the medication use process, and help to assure patient safety. Physicians, physician assistants, nurses, nurse practitioners, pharmacists, and ward clerks all function with varying degrees of autonomy, prescribing privilege, and task focus. A disruption of customary work patterns and roles should be expected with POE implementation. Nurse and pharmacist roles and responsibilities are particularly impacted.

Nurses: While nurses may perceive fewer errors, more time with patients, and improved relations with physicians after POE implementation, they may also feel a decreased amount of control and greater dependency [14]. Informants in this analysis report a decrease in physician-nursing interactions, especially rich interactions formerly precipitated simply by the need to clarify an order: [Before POE] when the physicians would write an order, if it wasn't complete, nursing did all the right things to make that order complete. We took the nurse out of that loop.

An unexpected elimination of traditional nursing double-checks may also result with POE implementation. Nurses working in POE environments have noted feeling unclear as to whether or not order entry checking was in their professional duty. A physician informant echoed these concerns: [Before POE] the clerical staff would transcribe the [written] orders and the nurse would come and double check it. So there were a lot of levels of safety in that to make sure everything went right, whereas now, the intern can be in the clinic, and enter something. It goes automatically to the pharmacy. The med comes up into the drawer, and the nurse gets it. So nobody else double checks it. Nurses may also feel unclear about their role in verifying pharmacist's order edits.

The need to make nurses aware of new medication orders is a recurring theme in the data. One physician confided: What you would do before [POE] is, you would write [the order] in the chart, you would also actually go and find the nurse and tell them, too. That's done less frequently now, I think, because you know, the nurse is somewhere else, you're at the computer and you just kind of enter and then go somewhere else.

The problem of verbal orders is also pervasive. Will verbal orders be accepted? Under what circumstances? How will verbal orders be verified? This issue is especially problematic when the clinician is in an outpatient clinic or off-site and lacks system access. A physician trying to communicate a STAT verbal medication order from an outpatient clinic reported being told by a nurse: you'll have to get a colleague to put [the order] in for you. When verbal orders are accepted, inaccurate selection of the ordering physician is also an issue, especially for junior and agency nurses.

Pharmacists: Ready availability of online patient data may allow pharmacists to take a more active role in critiquing orders. Their roles in patient and staff education, monitoring, and gathering and recording reliable allergy and medication histories may be expanded in POE environments.

Physicians entering orders report a perceived decreased volume of calls for clarification from pharmacists: It's not like you're going to put in [a dose of] 70 milligrams which isn't available or something like that, because it's not on the screen. However, physicians desire a continued presence of pharmacists in order entry verification, and, as with nursing, value knowing that if a mistake is made, that pharmacy double-checks exist. One intern remarked: If you make a mistake and put in a wrong order the pharmacy calls in about 30 seconds. We're always interacting with pharmacists.

Orders may need to be corrected or reentered by pharmacists because of order entry mistakes, incompatibility with automated dispensing devices, or product availability issues. Preferred systems allow identification of the clinician and their location so that double checks can be expedited [15]. Communicating a need for changes long after the moment of order entry risks either not reaching the physician when recollection is easy, or the physician's being unavailable. There is concern that pharmacist order edits have the potential to elicit changes in order meaning, so the need for physician verification of pharmacist edits will have to be explored [15].

There is a consistent reliance on pharmacists for unusual orders. A text entry option, especially during transition to POE and with complex orders, is desirable but not without risk. We gave them a type-in option so that if they

couldn't find a drug and they didn't know, they would just type the name of it, hit send, it would go to the pharmacy and the pharmacy would re-enter it in the proper format so it could be processed. Clinicians find text entry of orders useful when a new medication exists and they either don't know how to find it, or it does not yet exist in the medication database: The one place where [medication POE] falls down is anything that is not standard then it becomes almost impossible to order unless you type it in. And one of the parts of the learning curve is you learn that it's easier just to type it in and let the pharmacist deal with it. Obviously, text order entry can be subject to abuse, and was actually used as a subtle method of protest in one difficult implementation. Text-entered orders will not interface with automated dispensing modalities, and can introduce potential misinterpretation with pharmacist re-entry.

Integrated decision support systems are hailed as a powerful advantage of POE, especially for drug orders. Alerts and reminders have the potential to circumvent errors of therapeutic duplication, interactions, and drug-allergy conflicts, among others. But their use can be problematic. The timing of and manner in which the system communicates alerts may be ill conceived. Frustrations with annoying, inaccurate, or disruptive alerts can be significant. Some choose to use the pharmacist as intermediary for all drug alerts. When this is the case, the level of pharmacist autonomy in deciding the alert's clinical significance may be unclear. Both physician and pharmacist acknowledgment is required in some systems. Additionally, responsibilities regarding automatic stop orders and expiring orders will have to be addressed.

Setting

Both admission to and discharge from the inpatient setting may necessitate complete reentry of all patient medications. Reentry of a patient medication profile on admission (from sources of varying reliability) is time consuming and potentially fraught with error. Where simple order renewal is not possible, users have mentioned the use of cutting and pasting medication lists from previous admissions or outpatient systems into the current inpatient account. In other systems, orders from prior admissions may be retrievable, but still have to be retyped entirely into the current admission account. This is sometimes accomplished by

opening simultaneous sessions on the same or adjacent terminals. Transition into and out of intensive care units and surgery may also necessitate manual reentry of all orders.

Similarly, reconciling medications with the discharge process can also be time consuming and subject to error. Communication of inpatient and outpatient medication systems is not common, even within health systems. Physicians complain of the need to re-enter discharge medications and there being tremendous potential for mistakes: Instead of being able to go through the screen when doing your discharge orders and go back and go through and pick the ones you want, you have to totally re-enter all this medication. You spend hours. Systems that clinicians use in inpatient and outpatient settings may not even be the same: our physicians practice in both arenas and I think it's ludicrous to think that they're going to use one [system] when they're in the inpatient [setting] and then go to ambulatory care and have to use an entirely different system with a different look and feel. That's crazy.

Some physicians feel the eventual transition to POE for outpatient prescribing is obvious: There's nothing inherently different from my standpoint as a physician about ordering a medicine on the inpatient unit than writing a prescription in an outpatient clinic. The steps are the same. Others remain skeptical, see it as disruptive to the encounter, and insist on using traditional written prescriptions. The handling of outpatient prescriptions for DEA Schedule II narcotics can also be an issue. While electronic signatures are sufficient for inpatient narcotic use, outpatient narcotic prescriptions require a paper copy signed by the prescriber.

There are areas that offer unique challenges for medication POE deployment even within the inpatient setting. Operating suites, emergency departments, and intensive care units are dynamic environments where patient treatment needs may be immediate. One physician commented: If you have to [enter] an order for dopamine at two in the morning for somebody whose blood pressure is 60, you don't have much patience if the order entry application doesn't work. A re-examination of policies regarding verbal order acceptance and intermediary order entry may be required in these environments.

Technology

Medication administration is being transformed by new technologies that will also impact POE. Automated Medication Dispensing Machines (AMDMs) and robot dispensing are becoming more common. Communication problems will result if medications ordered don't align with cabinet and robot inventories. AMDMs may permit an override function, where nurses may remove drugs prior to the order's entry into the pharmacy system in emergency situations. Careful pre-definition of what drug classes will be available for this over-ride access will be needed, as alert mechanisms may be circumvented. If Bar Code Medication Administration is used, completed orders will have to be in a format compatible with the way this technology is designed to conduct medication transactions.

The automated Medication Administration Record (MAR) will also play an important role: The MAR is the way the order is executed down the line. [When] nurses are comfortable with the steps involved in getting that medication order to that point then it will work. If they're not, it'll go down in flames. We tend to concentrate on the ordering practitioners side of this. We need to keep in mind that that's only half the cycle. The rest of it is in how the order is interpreted and carried out.

DISCUSSION

Though the advantages of implementing medication POE are clear, this analysis suggests that medication POE implementation may be more difficult than other elements of POE. Medication order complexity puts a premium on the order entry interface to simplify drug selection, modification, and assist clinician's compliance with drug use policy. Nurses and physicians express concern about a decrease in interaction, elimination of nursing double checks, and verbal order communication problems. Pharmacist's roles with order verification, editing, order entry support, and alerts and reminders will have to be clarified. Problems with patient transitions both within and between settings should be anticipated. Finally, POE deployment will likely be impacted by emerging technologies. Awareness of potential roadblocks and lessons learned from previous implementation attempts should help organizations considering medication POE to optimize their own strategies.

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REFERENCES

1. Bates DW, Leape LL, Cullen DJ, et al. Effect of computerized physician order-entry and a team intervention on prevention of serious medication errors. *JAMA* 1998;280:1311-6.
2. Overhage JM, Tierney WM, Zhou XH, McDonald CJ. A randomized trial of corollary orders to prevent errors of omission. *JAMIA* 1997;4:364-75.
3. Robert A. Raschke, MD, MS; Bea Gollihare, MS, RN; Thomas A. Wunderlich, RPh, et al. A Computer Alert System to Prevent Injury from Adverse Drug Events. *JAMA* 1998;280:1317-20.
4. David M. Rind, MD, Charles Safran, MD, Russell S. Phillips, MD, et al. Effect of Computer-Based Alerts on the Treatment and Outcomes of Hospitalized Patients. *Arch Intern Med* 1994;154:1511-17.
5. Teich JM, Hurley JF, Beckley RF, Aranow M. Design of an easy-to use physician order entry system with support for nursing and ancillary departments. *Proc Annu Symp Comput Appl Med Care*. 1992; 16:99-103.
6. Sittig DF, Stead WW. Computer-based physician order entry: the state of the art. *JAMIA* 1994;1:103-123.
7. Ash JS, Gorman PN, Hersh WR. Physician Order Entry in U.S. Hospitals. *J Am Med Informatics Assoc Symposium Supp* 1998;235-239.
8. Institute of Medicine. *To Err is Human: Building a Safer Health System*. Washington, D.C.: National Academy Press, 2000.
9. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, D.C.: National Academy Press, (forthcoming).
10. Ash JS, Lyman J, Carpenter J, and Fournier L. A Diffusion of Innovations Model of Physician Order Entry. *J Am Med Informatics Assoc Symposium Supp* 2001 (submitted)
11. Ash JS, Gorman PN, Lavelle M, Lyman J. Multiple Perspectives on Physician Order Entry. *J Am Med Informatics Assoc Symposium Supp*, 2000:27-31.
12. Crabtree BF, Miller WL. *Doing Qualitative Research*. Newbury Park, Sage, 1992.
13. Massaro TA. Introducing Physician Order Entry at a Major Academic Medical Center: I. Impact on Organizational Culture and Behavior. *Acad Med* 1993;68:20-25.
14. Weir C, Johnsen V, Roscoe D, Cribbs A. The impact of Physician Order Entry on Nursing Roles. *J Am Med Informatics Assoc Symposium Supp* 1996:714-7
15. Payne TH. The Transition to Direct Practitioner Order Entry in a Teaching Hospital: The VA Puget Sound Experience. *J Am Med Informatics Assoc Symposium Supp*.1999:589-9.