Investigating Physician Order Entry in the Field: Lessons Learned in a Multi-Center Study

Joan Ash\textsuperscript{a}, Paul Gorman\textsuperscript{a}, Mary Lavelle\textsuperscript{a}, Jason Lyman\textsuperscript{b}, Lara Fournier\textsuperscript{a}

\textsuperscript{a} Oregon Health Sciences University, Portland, OR, USA
\textsuperscript{b} University of Virginia, Charlottesville, VA, USA

Abstract

The progress of studies by this team of researchers concerning computerized physician order entry (POE), beginning with a mail survey and moving to qualitative multi-center studies, is reviewed, with emphases on lessons learned and future directions. While mail surveys were appropriate to answer initial research questions about diffusion of POE in the U.S., multiple qualitative methods became the methods of choice for answering more complex questions. Results of the latter include articulation of multiple perspectives on both positive and negative aspects of POE and a description of what may be important for successful implementation of POE in the future. The present economic environment of hospitals may be inhibiting widespread diffusion of POE, not only because of the direct cost, but also indirectly by affecting relations with practitioners. Analysis of successful past implementations can provide guidance when the time is right.

Keywords:
Attitude to computers; Hospital information systems; User-computer interface; Physician order entry

Introduction

Computerized physician order entry (POE), defined as a process which allows a physician to use a computer to directly enter medical orders, holds the potential for improving the order communication process and ultimately improving patient outcomes [1-6]. However, as recently as 1997, the number of hospitals in the U.S. which made POE available was unknown. A team of researchers at Oregon Health Sciences University, now called the Physician Order Entry Team (POET), began a simple study to discover what percent of hospitals have POE and to answer several related questions. The results of a mail survey indicated that in the U.S., less than one third of hospitals have POE and those that have it report low usage [7]. The POET, intrigued by these results, endeavored next to find out how some hospitals had successfully implemented POE. The initial idea was that by describing successes, we could guide others who wanted to take the same path. Another mail survey was developed and mailed to a random sample of faculty members at five academic health sciences centers known to have POE. The results were of little use, both because the response rate was low and because many respondents replied that they were not the real users: interns and residents did all of the order entry. The next step might have been a survey of house officers at these five centers, but contacts at those sites were pessimistic about the potential response rate from this group.

The POET changed direction methodologically. If house officers would not respond to surveys, perhaps they would consent to being watched as they went about their daily work routine. A new study design included the use of focus groups, oral history interviews, and observation, to be accomplished by an interdisciplinary team. After successfully using these methods at the University of Virginia, the team designed a multi-center study. The data gathering and analysis process is iterative and ongoing. Results from each phase build on one another and provide a clearer picture after each iteration. The following offers a summary of the methods and results of the mail survey, of the first phase of the qualitative study, which included teaching hospitals, and of the second and third phases, which added a community hospital.

Preliminary Work: Mail Survey

A random sample of 1,000 of the 6,000 hospitals listed in the American Hospital Association Guide [8], which lists all accredited hospitals in the U.S., was selected. A survey instrument was developed to fit on a postcard asking four questions to be answered on Likert scales. The usual contact person listed in the Guide was the Chief Executive Officer, but instructions were given asking the receiver to forward the survey to the most appropriate person.

The mailing included a cover letter outlining the purpose of the study and the self-addressed stamped postcard survey. A follow-up mailing was sent to those not responding to the first mailing. To verify that respondents were not
significantly different from non-respondents, a random sample of 42 non-respondents was phoned.

The final response rate to the survey was 37% and on the whole respondents did not differ significantly from non-respondents. Chi-square and analysis of variance (ANOVA) tests were used to verify whether respondents differed from non-respondents. Frequencies and percents were tabulated for each of the four questions.

### Table 1. Availability of POE in the U.S.

<table>
<thead>
<tr>
<th>Extent</th>
<th>Responses</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td>54</td>
<td>14.8%</td>
</tr>
<tr>
<td>Partial</td>
<td>63</td>
<td>17.3%</td>
</tr>
<tr>
<td>Not available</td>
<td>241</td>
<td>66.0%</td>
</tr>
<tr>
<td>Unknown</td>
<td>7</td>
<td>0.19%</td>
</tr>
</tbody>
</table>

### Table 2. Inducement for using POE

<table>
<thead>
<tr>
<th>Extent</th>
<th>Responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>18</td>
<td>13.7%</td>
</tr>
<tr>
<td>Encouraged</td>
<td>31</td>
<td>23.7%</td>
</tr>
<tr>
<td>Optional</td>
<td>82</td>
<td>62.6%</td>
</tr>
</tbody>
</table>

### Table 3. Participation by Medical Staff

<table>
<thead>
<tr>
<th>Extent</th>
<th>Responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% or less</td>
<td>58</td>
<td>52.2%</td>
</tr>
<tr>
<td>11-50%</td>
<td>31</td>
<td>28%</td>
</tr>
<tr>
<td>51-90%</td>
<td>9</td>
<td>8.1%</td>
</tr>
<tr>
<td>Over 90%</td>
<td>13</td>
<td>11.7%</td>
</tr>
</tbody>
</table>

### Table 4. Saturation, Percent Entered This Way

<table>
<thead>
<tr>
<th>Extent</th>
<th>Responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% or less</td>
<td>64</td>
<td>57.7%</td>
</tr>
<tr>
<td>11-50%</td>
<td>25</td>
<td>22.5%</td>
</tr>
<tr>
<td>51-90%</td>
<td>12</td>
<td>10.8%</td>
</tr>
<tr>
<td>Over 90%</td>
<td>10</td>
<td>9.0%</td>
</tr>
</tbody>
</table>

Answers to an open ended request for comments were grouped by topic.

Question 1 asked about availability and results are given in Table 1. Question 2 asked about inducement: of the hospitals that have POE, how are physicians encouraged to use it? Results are in Table 2. Note that several respondents who replied “unknown” to Question 1 nevertheless answered Question 2. The next question was about the percent of medical staff using it at places where it is available; results are in Table 3. Finally, Question 4 asked what percent of orders are entered this way, with results in Table 4. The written comments indicated that many hospitals have order entry systems available, but not for physician use. Others are considering purchase of systems. The majority of respondents listed themselves as chief executive officers or presidents. Since over two-thirds of respondents requested copies of the results of the survey, it is clear that interest among those in decision making roles in hospitals is high.

### Methods

#### Sample selection

Criteria for site selection for the multi-center qualitative study included geography, type of hospital, and length of experience with POE: a range across each was desired. The University of Virginia was selected first because its early experience during implementation is well known [9,10]. It is on the East coast, has had POE since 1989, and is a teaching hospital. The Veterans Affairs Puget Sound Health Care System campuses in Seattle and American Lake, WA were chosen because the installation was new yet well documented [11], they are on the West coast, and one is teaching and the other is not. El Camino Community Hospital in Mountain View, CA was selected because not only is it a non-teaching hospital, but it also is well known, having been the development site for Lockheed’s building the first integrated hospital information system [12]. It has had POE since 1972 and therefore has more experience with it than any other hospital in the world.

#### Data Collection

A multidisciplinary team of researchers visited each site after contact people helped with arrangements. Oral history interviews, which are semi-structured tape recorded interviews which focus on past events as seen through the eyes of the interviewee, were primarily conducted by the librarian researcher. The focus groups were moderated by the qualitative methods consultant. Observation was done by physicians, the librarian, nurses, and graduate students. Because we wanted to study multiple perspectives, we interviewed and shadowed not only physicians, but nurses, pharmacists, information technology staff, administrators, and others. One week visits were made to Virginia and Seattle and two week-long visits were made to California.

#### The Data

Approximately 184 hours of observation, 32 one hour oral history interviews, and 3 focus groups were conducted. Field notes from observation periods and typed transcripts of the interviews and focus groups, approximately 500 pages, were entered into a qualitative analysis software package (QSR NUD*IST).
Data Analysis

A grounded theory approach was used to identify emergent themes in the transcripts. Two to three researchers independently coded all of the documents and two others reviewed the documents and coding. The team of four to five met 12 times to reach consensus on results.

Results

After we had visited both the University of Virginia and the VA Puget Sound site in Seattle, we completed the first iteration of analysis dealing with house staff perceptions of POE. Six themes emerged from the data: educational issues; the benefits of POE for house staff; problems with POE; their feelings about POE; implementation strategies; and the future of POE [13].

1. Educational issues include the fact that usually house staff rather than attending physicians enter orders at teaching hospitals. Users are proud of being facile with POE on the one hand, but resentful of the additional time it takes on the other. Some believe it may be undermining the educational process by reducing the need to think through each order when using order sets.

2. The benefits of POE include personal electronic order sets and legibility. Drug interaction alerts were viewed as helpful, along with the fast delivery of medications to the patient. Entering orders from any location, ready access to results, and having everyone reading off the same page were considered benefits.

3. Problems were legion and those described in focus groups were later observed firsthand. There were hardware problems, service and support issues, an increase in paper usage, usability issues, an excessive number of screens to scroll through, and delays switching between systems.

4. Feelings about POE were strongly expressed. Informants were frustrated with the additional time it took and with the need to learn workarounds, ways to use the system in unintended ways to accomplish needed tasks.

5. Implementation strategies that include house officers, that integrate POE into the workflow, and that provide training and support would please house staff.

6. House officers cannot picture a future without POE and they want comprehensive integrated systems available in all hospitals but hope the systems can be tailored to meet specialty-specific needs. They look forward to systems that will bridge both inpatient and outpatient care and will fit the workflow.

A second iteration of analysis included data from our first visit to El Camino Hospital, with a focus on finding out more about the multiple perspectives of different groups of staff members on POE. We used a general framework developed by Linstone termed the Multiple Perspectives approach: the views of clinicians, administrators, and information technology personnel were analyzed with respect to three aspects of POE: the Technical, the Organizational, and the Personal aspects [14].

1. As far as the Technical system goes, some clinicians believe that POE is more advantageous to the hospital administrators than it is to them. If the response time and the total time spent dealing with order entry is longer than manual systems, there is little tolerance. Administrators view the technical system differently. They see POE as a quality assurance tool and an aid in accreditation success. Information technology professionals are somewhat frustrated with the POE technology available from vendors but are committed to helping clinicians accept POE.

2. The Organizational system is viewed by clinicians with distrust, at least when speaking of the hospital in general. Interns spoke of POE being crammed down their throats. The social aspects of developing order sets or pathways or even of helping to modify the system are positive, however. Administrators, on the other hand, were proud when they succeeded in getting clinicians to use POE. They are also proud that their organizations are on the cutting edge. The information technology staff feels that it has to bend over backwards to get clinicians involved.

3. The Personal aspect for clinicians focuses on the additional time spent using POE which eats into their personal time. Remote access to order entry is a plus, however.

A third iteration of analysis included data from a second visit to El Camino during which the focus was on how community hospitals may differ from teaching hospitals. The analysis is not yet complete, but the following are initial results. The framework of describing multiple perspectives on the Technical, Organizational and Personal systems will be followed here for consistency.

1. It is somewhat surprising from the Technical view that the appearance of the screen has not mattered to the users as much as the match between the user’s task and the system’s capabilities. If a system is functional because it is fast and logically organized, clinicians will get used to it. Even screens that do not possess qualities most of us consider user friendly such as windows, menus, icons, color, upper and lower case letters, etc., can be useful and well accepted. Another theme related to the Technical aspects of POE is integration of systems. In a broad sense, this can mean integration of the computer and the task, and how well they fit one another. In another sense, this means not having to switch among many different systems and write separate logins. Also, it appears that the technology will be more readily accepted if information
2. A number of themes have arisen from the Organizational view. First, communication throughout the organization is a factor, but especially the level of communication among clinicians. The order communication process involves many more people than physicians. There is often discussion prior to a decision about an order. There are always verbal orders, orders which the physician may give face to face with a nurse or other health care worker, or which may be communicated via phone or initiated by a student or non-physician. There are also changes made to orders later in the ordering process, not necessarily by physicians. POE can undermine the order communication process because rather than allowing free interchange and interaction among different clinicians, it forces a one way communication.

Another theme is leadership. This is a matter of style. When POE was implemented at the University of Virginia, the leaders held fast during the house staff rebellion by insisting that the system would not be eliminated, but they also made it clear that they wanted to work with the residents to make POE more palatable. Leaders devoted countless hours to the effort, thus indicating how important POE was but also how important the house staff was. At El Camino, the leadership in place during the initial implementation was legendary. The leader was known by everyone personally, was visible on the floors and in the lounges, and was universally respected. A related issue is trust, the level of trust between the management and the clinicians at El Camino was high when the decision was made to implement POE as one of the first pieces of the hospital information system. Finally, a theme of interdisciplinary teamwork has been evident at all sites. Nurses, pharmacists, dietitians, and other health care personnel work with physicians: “they have a strong history of being part of a team more than just a care team, that they’re part of decision-making.”

3. From the Personal view, we have identified a theme we call “us and them”. At times it was hard for one professional group to understand the needs or views of members of other groups even though they believed they understood.

4. We now believe the perspectives should also involve a good look at the outside environment and how it impacts the organization, so we are adding Environment to the list of “what is viewed.” We consistently heard at Virginia and El Camino that things were different “back then” when the system was implemented. The entire health care system was different. While everyone believes implementing systems should be easier now that those entering medicine are computer literate, the situation is much more complex. Of physicians, one informant said “they seem to react to lots of things one wouldn’t expect these days. So I think it’s an issue of control, how much control they think they have over what’s going on.” Another said “It’s a tough environment right now, and that’s causing some of the frictions we’re seeing.” The economic, political, and social systems that impact medical practice may be greater barriers to implementing POE than the Technical, Organizational, or Personal issues. In addition, when these systems were implemented, they were cutting edge technologies. “If you focus on a group of people and you say Gee, we’re doing something special here” it creates an excitement that can overcome some of the barriers. Today’s hospital administrators would find it difficult to convince physicians that POE is terribly cutting edge. Another consideration for places that already have POE is that decisions will need to be made about replacing older systems: re-implementation raises a new set of issues.

Discussion

The results of the mail survey led us to believe that POE is a topic of interest to many but that the majority of hospitals did not have it. We read in the informatics literature about outstanding systems, but these are few. Community hospitals in particular may be able to benefit from POE, but successful implementations in non-teaching hospitals are rare. To answer the complex questions about success factors for implementing POE in both teaching and non-teaching hospitals, we decided to expand our study.

Physician-nurse communication and the complexity of the order communication process as they relate to information technology have been the subjects of others’ work [15,16], but they have arisen as major themes in our observations as well. Further study and focus on these themes as they pertain to POE would be fruitful.

The organizational themes revolve around management styles. Trust between administrators and clinicians seems to be a necessary ingredient to successful implementation but there is no recipe for building this kind of trust.

The influence of environment is out of the control of anyone implementing a POE system. However, times do change and indeed they seem to be changing for health care. It may be that because of today’s economic environment and the pressures on both physicians and hospitals, the times are not conducive to building trust between the clinicians and hospital administrators. When times change, the barriers may lessen.

Conclusions

The multi-center study is an initial study done at four hospitals. The Puget Sound VA hospitals have made strides in further implementing POE since we were there, so further observation is needed. Because our results still do not clarify whether there are great differences between teaching and non-teaching hospitals with respect to POE, and
because El Camino is a somewhat unique community hospital because it has the first system ever developed, there is a need to study other community hospitals with successful implementations. In addition, studies of outpatient POE implementation are needed.

**Recommendations**

Because, as one informant stated, “you’re getting down to survival mode for a lot of hospitals nowadays,” the time might not be right for implementing POE. However, those who are optimistic about the economic and social climate should be building trust with users so that implementation will proceed more smoothly when it inevitably occurs.

**Acknowledgments**

This work was supported by Mr. Paul Mongerson and grant DE-FG03-94ER61918 from the U.S. Department of Energy and grant LM06942-01 from the U.S. National Library of Medicine. Special thanks go to Tom Massaro and Gerri Frantz at the University of Virginia, Tom Payne at the VA Puget Sound Health Care System, and Bart Lally and Lynda Winterberg at El Camino Hospital for their assistance with the study.

**References**


**Address for correspondence**

Joan Ash, Ph.D., Assistant Professor Email: ash@ohsu.edu Oregon Health Sciences University BICC Division of Medical Informatics & Outcomes Research 3181 SW Sam Jackson Park Road Portland OR 97201-3098 USA