

Research Paper ■

Emotional Aspects of Computer-based Provider Order Entry: A Qualitative Study

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Abstract Objectives: Computer-based provider order entry (CPOE) systems are implemented to increase both efficiency and accuracy in health care, but these systems often cause a myriad of emotions to arise. This qualitative research investigates the emotions surrounding CPOE implementation and use.

Methods: We performed a secondary analysis of several previously collected qualitative data sets from interviews and observations of over 50 individuals. Three researchers worked in parallel to identify themes that expressed emotional responses to CPOE. We then reviewed and classified these quotes using a validated hierarchical taxonomy of semantically homogeneous terms associated with specific emotions.

Results: The implementation and use of CPOE systems provoked examples of positive, negative, and neutral emotions. Negative emotional responses were the most prevalent, by far, in all the observations.

Conclusion: Designing and implementing CPOE systems is difficult. These systems and the implementation process itself often inspire intense emotions. If designers and implementers fail to recognize that various CPOE features and implementation strategies can increase clinicians' negative emotions, then the systems may fail to become a routine part of the clinical care delivery process. We might alleviate some of these problems by designing positive feedback mechanisms for both the systems and the organizations.

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For over 30 years, medical informaticians and quality improvement experts have said that computer-based provider order entry (CPOE) with real-time, point-of-care clinical decision support could potentially solve many inefficiencies and inaccuracies within the healthcare system.¹ An extensive review of the literature in 1994 concluded that, in addition to institutions pioneering CPOE, other institutions should consider CPOE implementations.² More recently, the Institute of Medicine's reports on errors in medicine,^{3,4} the LeapFrog Group's efforts,⁵ and at least one state legislature⁶ have increased their emphasis on CPOE. In the limited number of institutions that have survived the difficult implementation period,^{7,8} CPOE has proven to be effective at increasing both efficiency and accuracy. Yet no one familiar with the history of CPOE would argue that a CPOE implementation, or its subsequent use by clinicians in routine clinical practice, will definitely succeed, let alone be easy, straightforward, or even result in an error-free medication prescribing process.^{9–11}

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Over the past five years, the Provider Order Entry Team (POET) led by Dr. Joan Ash from the Oregon Health and Science University in Portland, OR, has been studying various institutions that have successfully implemented CPOE. When we asked individuals involved in these projects to "tell us what happened," we have been continually surprised by the strong emotions expressed. This retrospective, qualitative research investigation describes the myriad emotions that we have documented during our study of these CPOE implementations and their subsequent use by clinicians in routine clinical practice.

Background

Computer-based Provider Order Entry

Computer-based provider order entry is the portion of a clinical information system that enables a patient's care provider to enter an order for a medication, clinical laboratory or radiology test, or procedure. The care provider is most often a physician, but we would also consider it CPOE when a physician assistant (PA) or nurse practitioner (NP) with medication-ordering privileges uses the computer to enter orders.¹² The system then transmits the order to the appropriate department or individuals, so it can be carried out. The most advanced implementations of such systems also provide real-time clinical decision support such as dosage and alternative medication suggestions, duplicate therapy warnings, and drug-drug and drug-allergy interaction checking.¹³

In this article, we use the generic term CPOE to refer to use of these systems by clinicians in their routine clinical practice. We use the phrase CPOE implementation to refer to the initial process of introducing the CPOE system into the clinicians'

routine clinical workflow. Finally, we recognize that these CPOE systems are continually being modified, both to fix problems that are identified by those using the systems as well as to increase the capabilities of the applications. So, from the clinicians' perspective, it often appears as if the CPOE systems are in a state of perpetual implementation or reimplementation.

Emotions

Emotions are mental states that arise spontaneously rather than through conscious effort (see Morelos-Borja, 1998¹⁴ for an overview of emotions and their relation to technology). Changes in underlying physiology, facial expression, or even actions often accompany emotions. A specific event or series of events that either cause the person to succeed or fail in reaching his or her goal(s) triggers most emotions. One's emotions and resulting moods reflect on a person's ability to attend to complex physical and cognitive tasks.¹⁵

While emotions of all types are interesting to study, we are interested in those emotions that are associated with either or both decreases in cognitive and physical abilities. CPOE seems to elicit such emotions. For example, Ash et al.¹⁶ identified many examples of emotionally loaded words related to CPOE either uttered by housestaff or to describe housestaff, such as "The surgeons have always used it and the internists have sort of been laggards." Or "They just are pretty intolerant if anything isn't just the way they want it."

There is no widely accepted taxonomy of emotions.¹⁷ In an effort to better study emotions by analyzing textual documents, Storm and Storm¹⁸ developed a hierarchical taxonomy of semantically homogeneous terms that are associated with specific emotions. They further grouped these terms into negative, positive, and neutral emotions. After careful review, we believe that their taxonomy is sufficient to begin illustrating the concepts that we are after (see Table 2 in Methods section that illustrates this hierarchy).

Methods

Overview

We performed a secondary analysis of three previously collected qualitative data sets. The first set contained data from several one-on-one interviews with key individuals involved in various CPOE implementation efforts.¹⁹ For the

second set, researchers recorded field notes while accompanying clinicians through typical daily tasks, which were performed in the hospital and outpatient clinics associated with the data set one interviewees. The third set contained data from several multiperson focus groups of clinicians from a large health maintenance organization. These groups focused on asking experienced clinicians about their views on clinical alerts and reminders.²⁰ These alerts and reminders are most often associated with the medication order entry process within an electronic medical record. Three researchers reviewed all data from the three data sets, identifying quotes that expressed emotional responses to CPOE. One of those researchers (DFS) then further reviewed and classified these quotes using the validated taxonomy of emotions.

Site Selection for Data Sets One and Two

We selected sites with differing lengths of experience with CPOE, geographic locations, and types based on nominations by a panel of experts. The sites included an academic institution on the east coast with a ten-year history of using CPOE (University of Virginia), a west coast Veterans' Administration (VA) hospital with a recent CPOE installation across two campuses, and a nonteaching, community hospital on the west coast with the longest history of CPOE use in the country (EC).²¹⁻²³ Table 1 synthesizes the sites, methods, and participant characteristics of each institution that we selected.

Data Collection Methods for Data Sets One and Two

These studies used three data collection methods: participant observation, one-on-one oral history interviews, and focus groups. Participant observation "produces detailed descriptive accounts of what [is] going on,"²⁴ and has been used effectively in prior informatics studies.^{25,26} Briefly, researchers accompanied clinicians in the course of typical daily tasks in the hospital. We generally followed such shadowing sessions with informal interviews. We also collected data using focus groups, which provide an efficient way to gather information from a group with the benefit of synergy among participants.²⁷ Finally, formal tape-recorded, one-on-one oral history interviews provided the opportunity to ask open-ended questions, elicit memories to gain a historical perspective, and probe for more specific answers.²⁸ To gain

Table 1 ■ Sites, Methods, and Participant Groups Studied for Data Sets One and Two

Site	Methods	No. of Clinicians or Units Studied	No. of IT Professionals Studied	No. of Administrators Studied
University of Virginia	Observation*	6		
	Interview	5		
	Formal interview	5	2	2
	Focus group	2		
U.S. Veterans' Administration	Observation*	7		
	Interview	7		
	Formal interview	1	1	
	Focus group	1		
El Camino	Observation*	6	1	
	Informal interview	7		
	Formal interview	2	1	2

Adapted from Mozziconacci.¹⁷

*Sum of the number of individual clinicians shadowed for periods of at least four hours and the number of units (e.g., nursing stations) observed for at least that period of time (when the observer was watching all activities rather than one individual).

insight about the perspectives of administrators and information technology staff such as chief medical information officers and clinical application support staff, we interviewed representatives of each group. In all, we did a total of 160 person-hours of observation and informal interviewing and 36 hours of formal interviewing.

Data Collection Methods for Data Set Three

Data set three consisted of the transcripts from three focus groups, with four to seven clinicians (i.e., physicians, PAs, and NPs) per group.²⁰ The subjects were experienced Kaiser Permanent primary care clinicians in the internal medicine, family medicine, and pediatrics departments. The subjects all used a comprehensive outpatient electronic medical record system with CPOE,²⁹ and they all had computers in their examination rooms. We selected clinicians with the intent of balancing groups according to specialty, physicians and non-physicians, and gender.

During focus group sessions, the facilitator asked 14 questions focusing on both positive and negative aspects of the system. A sample question was "Now, we have already heard expressed a number of different views and feelings about alerts and reminders. Let's focus for a few minutes on the circumstances where electronic alerts or reminders are *helpful* in your work. Can anyone think back to a recent example where an alert or reminder was helpful? What made it helpful?"

Data Analysis

The investigators transcribed the field notes from their handwritten notes themselves. Professional transcriptionists transcribed the audiotapes of interview and focus group sessions. When put into a format suitable for analysis, they totaled 1,280 pages. Rather than using a grounded approach to identify emergent themes,³⁰ we started with a predetermined taxonomy of emotion-related code words (Table 2). We used qualitative data analysis software (QSR NUD*IST 4, Sage Publications, Berkeley, CA) to help identify and code patterns and themes.

Results

The analysis identified all of the emotions listed in Table 2. Negative emotional responses to the CPOE systems were by far the most prevalent in all the observations. While we interviewed or observed more than 50 people, the number of instances of any positive emotion resulting from the CPOE system was very small. Based on our analysis, the most one can expect from a group of overworked employees asked to undergo a major change is that they develop some level of understanding or tolerance for the system. These "neutral" emotions were much more common than positive ones but far less common than the negative emotions (i.e., negative emotions >> neutral emotions >> positive emotions).

In order to provide a sense of the emotions exhibited by the clinicians, we provide a brief introduction that attempts to place each exemplary quote in perspective, and then place the actual words that the clinicians used to convey each of the identified emotions in *italics*. The goal of each of these examples is not to "prove" that CPOE results in negative emotions on the part of clinicians, but rather to illustrate the broad range of emotion that various aspects of CPOE and the implementation process can elicit from clinicians.

Table 2 ■ The Taxonomy of Emotionally Related Terms Used to Classify the CPOE-related Quotes

Positive Terms	Neutral Terms	Negative Terms
Love: lust, attraction, adoration	Sleepy: drowsy, listless	Shame: humiliated, embarrassment, shy
Liking: admiration, friendly, affection, excellent	Apathetic: apathy, boredom	Sadness: melancholy, wistful, guilt, sorrow
Contentment: harmony, peaceful	Contemplative: calm, dreamy, strange	Pain: agony
Happiness: amusement, hope, gaiety, joy	Arousal: electric	Anxiety: worried, nervous, tension, upset
Pride: satisfaction, smug	Interest: alert, fascination, curious	Fear: afraid, dread, terror, shock
	Surprise: amazement	Anger: mad, annoyed, indignant, cross
	Understanding: confusion, uncertain, confidence	Hostility: hatred, revenge, defiant, spite, dislike, distrust, bitterness
		Disgust: contempt, distaste

The first section describes the positively focused emotions that the CPOE systems provoked. The second section describes those emotions that are more neutral, and the final section illustrates the myriad of negative emotions that these systems may generate.

Positive Emotions

Our analysis found very few instances in which people interviewed or observed mentioned or expressed any sort of positive emotion resulting from the CPOE system. In this particular case, the "positive" emotion is more a lack of a negative emotion than a true positive experience, for example, "I would look positively on that (medication interaction alerts) because there are more and more (medication) interactions and so many choices of medications now, that I think it doesn't hurt to have reminders like that."

Happiness/Enjoyment

Interestingly, the aspects of the systems that tended to provoke these "good feelings" were, for the most part, unintentional or serendipitous, on the part of system designers. For example, in one particular system, health maintenance reminders are indicated by a small textbox in the upper right-hand corner of the screen that is highlighted if a reminder exists. Once the user has satisfied the alert by ordering the appropriate test or documenting an extenuating circumstance, the highlighted text returns to normal. One user said, "It's a big deal for me to have those lights unlit. It is a reward for me to have that light unlit. It's like guessing what the health maintenance is. I mean, you have to have like these little games you play all day. It's like, guess what the health maintenance thing is? Pop it off. Your patient calls, pop it off your messages. It's like a little reward system." Along those same lines, another user chimed in, "I do miss the little alert when you empty it (the in-basket). There used to be a little box that would pop up that would say, 'Your in-box is empty,' and a little sound went off. I used to like that because it was such a victory. You guys took that one away [Group laughter]."

Liking/Attachment

While not a unique attribute of CPOE, clinicians like the fact that it is no longer necessary for them to have the patient's chart in their possession to write an order; for example, "One of the beauties of not having a paper chart is you can do it anywhere, and you can do it on the fly. And so that's actually one of the great bonuses of this process."

Pride/Honor

Recognition by one's peers is one of the greatest honors that a person can achieve. By creating useful order sets, a clinician in an organization where personal order sets are shared can make a name for him- or herself within the organization. As one clinician stated, "So efficiency was the first thing, but in fact, I think one of the things that happened, that was a side benefit, is that, the ownership (of the order sets) became an issue and so now you can construct your own personal order set. And that became yours and you could mold it however you wanted and it would be, you know, your hallmark."

Contentment/Satisfaction

No one familiar with the current state of the art for clinical computing systems and the difficult CPOE implementation process would ever expect the initial version of a system to be perfect. On the other hand, by responding to user criticisms, system administrators have an excellent opportunity to win over clinicians. "Oh yeah, oh yeah. It's much improved now. And there's aspects to it that actually make things easier than they used to be."

Neutral Emotions

Apathetic/Indifferent

Computer-based provided order entry systems are not as complex as the human emotions and interactions that surround them in health care institutions. While these systems often provoke negative emotions in junior members of the academic health care team, senior members of the team often show indifference. Whether feigned or real, this indifference may increase the negative feelings of the junior members of the team because the senior members often are not required to use the system. For example, a senior clinician said, "I think the decisions are, you know, the actual entry of orders is not really as important in my mind as the thought process of what the plan is and what we want to do. And if we all, in a teaching environment, we all make that decision together, I don't care who the h#\$% puts the orders in."

Contemplative/Reflective

While stress of any kind can bring out the worst in some individuals, others often rise to the occasion. These extraordinary individuals' efforts are often only recognized long afterward. "But there were several individuals who devoted, as I said, hours of their time, days, months of their time trying to work within their specialty. And these people sort of rose to the top, became identified by [Joe], [George], me, others as being interested in trying to work through the problem and they sort of ended up shouldering the burden simply because they're that type of person in trying to work through this with their colleagues, now what do we want, here's how our order sets are gonna look and that sort of thing."

Interest/Curiosity

Computer-based provided order entry implementations often inspire intense emotions in members of the health care team.

The following quote illustrates how one clinician described the three groups of clinicians (interested, apathetic, and saboteurs) at his institution. "And probably people fell into three groups: ones that realized and admitted to themselves that this was gonna happen regardless of what they did [i.e., were interested and helped out with the process]; those that were ambivalent either way and knew that it was a real pain in their life but didn't care enough to take action one way or the other; and then the group who were reactive and wanted to try to dump the system as the solution rather than work through it."

Understanding/Tolerance

Often the most one can expect from a group of disgruntled employees is that they develop some level of understanding, or tolerance, of the system. Luckily, in one particular instance, that is just what the administration received. "And then, with time, everybody worked it out [clinicians and administration agreed to continue with CPOE implementation], that it [a strike] would never be perceived as a positive sort of thing from a public relations point of view and that the administration wouldn't [budge] if you have it on that issue [patient safety] and that things would be worse rather than better [if they struck rather than fixed the CPOE system]."

Negative Emotions

Negative emotional responses to the CPOE systems were by far the most prevalent in all of the observations.

Shame/Guilt

Many times users are upset by the position in the workflow in which alerts arise. For example, one respondent said, "I feel guilty if I click it no [when asked, "do you want to document your actions to satisfy this alert?"], because it's almost as though I haven't dealt with it, but I always do deal with it." Another stated, "We take these alerts personally, and they're like a slam. It's like, "Well, they [the patient] just got here and I haven't even had a chance to do anything [e.g., enter an order for a specific preventive screening procedure], and I'm getting the ALERTS!"

Anger/Annoyance

Computer-based provided order entry system designers think they are helping clinicians take the correct actions and hope that the alerts and reminders that pop up to interrupt the clinician's workflow will help them "learn" to perform the correct action. Unfortunately, these little "learning opportunities" do not always have the intended effect as McDonald³¹ showed over 25 years ago. As one clinician said, "It just makes you angry. Because even if you order. ... One of the things that's nice, even if you are ordering what it recommends, you still get the little message. Yeah, that's maybe the most annoying."

Sadness/Melancholy

Some respondents reflected that life is short and that their time could have been spent more productively; in this case, a sense of sadness often ensues. "Well, for me personally, I gave up a tremendous amount of personal time for my family [to work on the CPOE system]. I gave up a lot of my time that I probably should have been devoting to my research program to deal with the [CPOE] issues. And you know, also a lot of educational time, going to meetings, going to seminars, that sort of thing. So from a personal sense, there was a quite a bit of sacrifice in that sense."

Hostility/Animosity

Hostility was one of the most commonly expressed emotions throughout all these interviews and focus groups. A work stoppage, even if only threatened, represents a level of hostility rarely seen in, or even around, health care institutions, *"but they...happened like a hurricane [i.e., rallies of hostile residents] within the space of two or three days, all of a sudden something would happen, stir the pot, everybody would decide okay, we've had enough and this is the time [to strike]."*

Disgust/Loathing

Disgust often results from situations in which the person has little or no control over the situation at hand. These feelings of disempowerment were widespread throughout the data sets. *"Everybody felt like the university had gotten the short end of the stick, they'd...got a bad product. And then to make it [worse], we couldn't dump it and it [was a] 6 million dollar investment whatever it was, I don't know how much the investment was, it was a lot of money and you couldn't just dump it into a different vendor."*

Discussion

The practice of medicine is filled with enormous stressors including an incredible workload³² that is often accompanied by a lack of sleep,³³ the threat of lawsuits, feelings of loss of control over the workload and/or schedule,³⁴ task interruptions,³⁵ and patients with complex medical problems.³⁶ With all these stressors capable of causing negative emotions, CPOE system designers and implementers must be especially careful not to be the ones to cause a nonlinear negative effect on performance (e.g., failure to complete a task or an erroneous action)³⁷ by popping up yet another irrelevant alert³⁸ or implementing a new CPOE system³⁹ on an underpowered and slow computer system.⁴⁰ Likewise, clinical system designers and health care administrators should be careful to listen and respond in a positive manner to clinical users' concerns. At the same time, clinicians need to be educated about the potential long-term benefits of CPOE and remain open to the possibility of changes in their workflow.

CPOE systems with clinical decision support capabilities focus frequently on alerting or reminding clinicians when they have forgotten to do something or when they have done something wrong rather than trying to educate or help them to do a better job, by making "the right thing to do the easiest thing to do." It is little wonder that so many of the emotions exhibited by clinicians involved with CPOE implementation, or any clinical information system, are negative.^{41,42} Interestingly, many of the positive emotional responses that we observed resulted directly from

1. Positive feedback from other users (e.g., order set becomes "hallmark")
2. Evidence that either system designers or health care administrators listened to their concerns and made positive changes (e.g., "system much improved now" or "clinicians and administrators worked it out")
3. Aspects of the systems that provided some sort of positive feedback to clinicians (e.g., "lights unlit" or "little sound")

Likewise, many of the negative emotions that we recorded resulted from either negative feedback from the system or from health care or information technology administration personnel. Based on these findings and the recognition that clinical information systems users already lead stressful lives, system

designers might consider designing systems that provide more positive, rather than punitive, feedback.⁴³

An Idea for Improving Clinical Information Systems by Providing Positive Feedback

While CPOE system designers and implementers can never hope to remove the myriad of stressors routinely faced by clinicians, it might be possible for them to develop new system features that provide positive feedback to clinicians, although we must be careful not to further disrupt the clinicians while doing this. For example, the ability for each clinician to select first whether he or she would like to receive positive feedback and then, if so, to what degree, might be helpful. If a clinician chose to participate in the positive feedback program, might receive something like the following examples.

- A system might pop up a small congratulatory reminder whenever a clinician enters 100 medication orders in a row that are on the formulary.
- We could place a small geometric figure in an unobtrusive location on the screen that had pieces added to it, or it was colored in, as the clinicians worked with the system as designed.
- A congratulatory message could be sent to clinicians by the system when they have completed all their patient encounters within three days of the event over a one-month period.
- We could generate a pleasant audio sound when clinicians performed a series of correct tasks.
- Clinicians could get a \$50 gift certificate whenever 90% of their patients meet their health maintenance targets in any given month.
- Clinicians who have overridden a particular alert more than 90% of the time and more than ten times in the past three months could be presented with an option to: Stop receiving this alert because...(enter reason here!) or Continue receiving this alert.
- We could allow physicians to adjust the level of positive feedback that they receive so that they would not receive more disruptions than they want.

If clinicians received such positive reinforcements or simply felt more in control of their workflow, they might react differently to the various alerts and reminders that are currently in place. For example, rather than feeling as if the alerts were "punishing" them, they might begin to feel that these alerts were "helping" them reach their objectives.

Study Limitations

The data sets used in this secondary analysis were chosen because the organizations, as well as the clinical and information technology personnel, represented a cross section of types, geography, backgrounds, and experience with CPOE. The selection was purposive rather than random, according to qualitative research conventions. It is possible that informants expressed negative emotions because they hoped that the researchers would take complaints to those who manage the systems. However, the researchers did explain the purpose of each study. It is also possible that informants enjoyed the opportunity to vent, which would also increase the number and intensity of negative emotions.

Conclusion

Designing, implementing, and maintaining CPOE systems is difficult. The implementation and subsequent use of these

systems inspires intense emotions in nearly everyone involved. If system designers fail to recognize that various CPOE features and implementation strategies can increase clinicians' negative emotions, then this may increase the likelihood that the system implementation will fail or that the system will never be routinely used by clinicians. Increasing the positive feedback associated with these systems might alleviate some of these problems, although this is a hypothesis that should be tested.

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