Change

THE CHALLENGE OF CPOE

HQ Fonds

Best Practices.

Editorial

T he Institute of Medicine's (IOM) report, *To Err Is Human*, published in 1999, revealed how tens of thousands of Americans needlessly die each year as a result of medical errors. "The Canadian Adverse Events Study," published in the *Canadian Medical Association Journal* in 2004, suggested that 9,000–23,000 Canadians die each year as a result of preventable adverse events. These and other studies have brought tremendous attention to turning the tide on this patient safety epidemic. One promising approach to addressing this medical error crisis – beyond laudable attempts to create "blameless cultures" in healthcare organizations – is the migration toward computerized physician order entry (CPOE).

This approach is further endorsed by the IOM's 2006 report that adverse drug events in the U.S. occur at a rate of 1.5 million per year. The report's authors argue that the promise of CPOE will only be fully realized if pharmacists, nurses and physicians are prepared to change how they work, they are able to work collaboratively in the design and implementation of CPOE, and healthcare executives are willing to make substantial financial investments in these systems. As experienced healthcare executives and clinicians know, having all of these conditions come together at one time is challenging, possibly explaining why only about 2% of hospitals in North America have a CPOE rate of greater than 50%. Toronto's University Health Network (UHN), featured in this special issue, has a CPOE rate of over 85%. There is much to learn from the UHN experience.

With this in mind, this issue of *Healthcare Quarterly* is devoted to the subject of how to implement major change in healthcare organizations, and specifically, the implementation of CPOE. It originated from conversations among UHN's Lydia Lee, Stephanie Saull-McCaig and Joe Nguyen, all of whom were frustrated by the dearth of published advice on CPOE implementation. Lee, Saull-McCaig and Nguyen proposed this special issue to the editors of *Healthcare Quarterly*, and for this, and their tireless efforts throughout this issue's production, they deserve a special acknowledgment.

This issue documents a five-year planning and implementation initiative at UHN. It is written for all healthcare leaders charged with major organization change, in general, and the implementation of CPOE, in particular. We have taken an unusual approach here, attempting to present this initiative from the various perspectives of the management and clinician groups involved. UHN's senior leadership, project managers, pharmacists, nurses, physicians, information technology (IT) professionals and program evaluation experts have written papers for this issue of *HQ*. This "story" moves from the UHN's leaders' decision of whether or not to invest $5 million in UHN's version of CPOE – Medication Order

Entry/Medication Administration Record (MOE/MAR) – to the process of implementation as seen by different stakeholder groups, to an assessment of benefits to date. Each paper, with the exception of the introductory paper, concludes with a summary of "Lessons Learned" and is followed by a commentary from an industry leader.

The first paper, written by me, is intended to interest all healthcare leaders responsible for implementing complex, politically charged change. The paper is written as a "how-to" guide for change leaders in healthcare; it is tactical, and is based on my prior research and consulting experiences in healthcare organizations, on the vast literature on change management in public and private sector organizations and on the experiences (both positive and sometimes less than positive) of UHN's MOE/MAR implementers. While the change framework is brought to life with illustrations from UHN, I have written it to guide various types of change in healthcare organizations.

"The Executive Perspective: The Business Case for Patient Safety," by Matthew Anderson, Dr. Michael Baker, Dr. Robert Bell (UHN's President and Chief Executive Officer), Mary Ferguson-Paré, Lydia Lee, Emily Musing and Dr. Bryce Taylor, reveals how UHN's Executive Team made the decision to invest in MOE/MAR. Despite the IOM's call for CPOE, the decision to invest in such a decision is far from simple. UHN, regardless of its size, like all healthcare organizations, faces numerous demands on its scarce financial and human resources. This paper reports on how, in the face of several opportunities to improve clinical and operational performance, UHN's leadership determined that MOE/MAR would be the most effective way to support its patient safety mandate. Specifically, the authors address why MOE/MAR was needed at UHN; they consider the capabilities, finances and interest required to maintain and support the project and how they would sell the idea to their Board and staff. David Collins of the Healthcare Information Management and Systems Society (HIMSS), and an expert on the *return on investment* from information technology, provides a commentary on this paper.

The second paper, by Stephanie Saull-McCaig, RoseAnn Pacheco, Pakizah Kozak, Susan Gauthier and Rebecca Hahn, provides a project management perspective on the MOE/MAR implementation. While all the clinician groups were undoubtedly critical to UHN's successful implementation of MOE/MAR, the Project Management leaders were, to my mind, the unsung heroes in this story. The discipline that they and their colleagues provided to this multi-year project substantially contributed to the project's completion on-time and on-budget. Change leaders throughout healthcare can benefit from a description of the methodology they employed to keep the various MOE/MAR plates spinning in

the air (with only one, instructive, crash!). Denise Zarn provides additional thoughts on the importance of project management when implementing CPOE. Zarn is a partner in the Health and Life Sciences Practice at Accenture, Inc.

The paper by pharmacists Monique Pitre, Karen Ong, Jin-Hyeun Huh and Olavo Fernandes delves into many of the most fundamental issues of developing a medication order and administration system. Among its many important contributions, this paper raises issues about how to allocate clinician staff to the development process, the clinical challenges of system design and the profound impact MOE/MAR has on the work processes of pharmacists.

Nurses represent the largest group of employees and clinicians at UHN, and the paper by Brenda Laurie-Shaw, Wendy Taylor and Carol Roach reveals the challenges that MOE/MAR posed for this group. As with other professional groups, MOE/MAR represented substantial change in how clinical care would be provided. Yet, nurses experienced some unique challenges relating to training and education, staff shortages at a time when MOE/MAR development required extra staffing and nurses' concerns that they would be seen as less efficient during the transition from a paper-based medication system. Dr. Lynn Nagle, a Health Informatics Consultant, provides commentary.

As readers familiar with the disastrous effort to implement CPOE at Los Angeles' Cedars-Sinai Medical Center know, the support of physicians will make or break CPOE implementation. For this reason, the paper by Drs. Peter Rossos, Howard Abrams, Robert Wu and Peter Bray is a must read. These UHN physicians, all strong supporters of MOE/MAR from the start, were instrumental in ensuring that the system met the requirements of their physician colleagues. Among the questions they address are, "How can one capture the attention of already stretched physicians?" "Why would/should physicians support a change to their practice?" "Which physicians should be pursued initially?" "How can physician expectations be managed?" "How can physician support be sustained?" These authors quite rightly reveal that the process of enlisting physicians is as much a political challenge as it is a technical/clinical challenge. All change leaders will be well served by understanding how physicians are likely to see the introduction of CPOE. Two commentaries accompany this paper, one by Dr. Ben Davoren, Director of Clinical Informatics at the San Francisco Veterans Administration Hospital, the second by Dr. William Fera, Medical Director of the Wellness Center and Quality Liaison at St. Margaret Hospital, in Pittsburgh.

The final paper by a distinct professional group is written by Penny Hackenbrook-Rogers, Trevor Godfrey, David Eagan, Monique Pitre and Anna Barbosa. While especially instructive for IT professionals, this paper gets at the heart (some would say "guts") of what UHN attempted to design and implement. These authors portray the extreme complexity of adapting two commercial vendor systems to meet the requirements of clinicians. In addition, they describe – in a style accessible to non-IT professionals – issues such as mapping paper-based processes into a computerized system, the development of thousands of medication order screens, data warehousing, the implementation of point-of-care device strategies and the challenges of balancing the varied interests of pharmacists, nurses and physicians. Denni McColm, Chief Information Officer of Citizens Memorial Healthcare in Bolivar, Missouri, a winner of the prestigious HIMSS Davies Organizational Award, provides commentary.

Readers will naturally wonder whether the seemingly Herculean efforts and vast expenses incurred by UHN were worth it. The paper by Nick Zamora, Michael Carter, Stephanie Saull-McCaig and Joe Nguyen addresses this question. The authors quantify the benefits to UHN attributable to MOE/MAR, focusing on such metrics as order and transcription errors, medication incident reporting, clinical decision support utilization and medication order processing cycle time. Not only does this paper suggest that MOE/MAR has begun to live up to its patient-safety promise at UHN, providing greater confidence to other organizations as they consider a similar initiative, but it also provides a useful methodology for measuring performance effects. Professor Denis Protti, founding Director of the University of Victoria's School of Health Information Science, comments on UHN's successes as well as on experiences beyond Toronto.

The final paper in this series by Dr. Robert Bell, Brian Golden and Lydia Lee takes a look back on the five-year initiative, from all perspectives, in order to provide a final set of observations for organizations considering the implementation of a MOE/MAR-type initiative. In that paper, we attempt to pull together a set of "Lessons Learned" that could only be gleaned by simultaneously examining the UHN change from *all* perspectives.

As will no doubt be clear from the papers in this issue, leading effective change requires not only a mastering of one's own professional domain (e.g., project managers must understand project management methodologies), but also putting oneself in the shoes of those who are being asked to change. Thus, while each paper in this issue of *HQ* was written as a stand-alone piece, and physicians will no doubt have a special interest in the article written by physician authors, pharmacists by pharmacist authors, etc., we encourage readers to explore all papers in this issue. Only then will they grasp the true complexity of the change process and draw useful lessons for their own organizations.

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Transforming Healthcare Organizations

Brian Golden

Imagine you are a member of a hospital's executive team, having just left a meeting in which you and other members discussed the possible introduction of an ambitious Computerized Physician Order Entry (CPOE) system. Around the conference table you and others questioned whether CPOE would be the most effective way to realize your hospital's commitment to patient safety. Other issues that were raised included whether clinicians would support or resist the change, whether staff would have sufficient skills, where to begin, affordability and whether to proceed incrementally or with a "big bang." While there was much disagreement with respect to each of the issues, there was near unanimity around two important decisions – CPOE would be implemented and you would be the executive responsible for the system's design and implementation. This article, based on the experiences of a multi-site hospital, and drawing on past research on organizational change, provides a Four-Stage model to help change leaders in healthcare. Although relying on Toronto's University Health Network to illustrate the change model, the model is intended to speak to change leaders implementing various types of complex changes in all healthcare organizations.

Introduction: Leading Transformative Change

However much healthcare organizations may resemble – at least on the surface – other large, complex organizations, thoughtful analysis reveals that healthcare organizations are considerably more than mere businesses. Peter Drucker (1993) tells us that healthcare organizations are the most complex form of human organization we have ever attempted to manage. This complexity derives from, among other things, the confluence of professions (e.g., physicians, nurses, pharmacists and administrators) and other stakeholders (e.g., patients and government) often with seemingly incompatible interests, perspectives and time horizons. Exacerbating the challenges for healthcare leaders is the well-known need to satisfy what appears to be the insatiable demand for healthcare – without unlimited financial support.

With these challenges in mind, this article attempts to lay out a research-based model of how to lead change in healthcare organizations. It uses the implementation of a CPOE system – specifically, Medication Order Entry/Medication Administration Record (MOE/MAR) at Toronto's University Health Network (UHN) – as an ongoing case. In addition to the UHN case, which was largely successful but not without some bumps along the road, additional evidence is drawn from the vast literature on change management.[1] Though this article will use the change at UHN for illustrative purposes, its intended audience includes all healthcare managers, from the most junior to the most senior, in search of a systematic approach to creating order during complex change.

Four Stages of Change

As in all industries, change management is complex (i.e., there are many interdependent processes and variables); it is difficult to fully lay out a comprehensive change program in advance; the organization must be prepared for unanticipated events; employees are likely to be unnerved; and rarely does there seem to be sufficient time and resources to bring about the needed change. In my view, this description of organizational change in "generic organizations" understates the difficulty of managing change in healthcare organizations. Healthcare managers frequently face additional challenges because (1) they face disparate stakeholder groups, (2) healthcare organizations have multiple missions (e.g., provide healthcare to their communities, remain fiscally solvent and – frequently – be a primary employer in the community), (3) professionals such as physicians and nurses value professional autonomy, and their decisions influence a major portion of healthcare expenditures and (4) the information necessary to manage the change process is often sorely lacking in healthcare organizations.

> … healthcare organizations are the most complex form of human organization …

Recognizing important similarities and differences between healthcare organizations and other organizations, I began the development of this four-stage healthcare change framework with a study of change in other industries (cf., Kotter 1996; Tushman and O'Reilly 1997). The goal was to build upon previous observations about managing change – but only to the extent that these observations were appropriate for the healthcare setting. In many cases, fine-tuning, customization and elaboration of these models was necessary so that this paper's four-stage process would be of the greatest value to healthcare managers.

This process is described in great detail as a "how-to" manual for change leaders, and is brought to life with illustrations from UHN's implementation of MOE/MAR – one of the most ambitious change initiatives at UHN in years (see sidebar for MOE/MAR description).

Stage One: Determine Desired End State

I take as a given in this article that a leader's initial thoughts about change derive from his or her recognition of a performance gap – the difference between how well the organization is performing and how well the leader wishes it to perform; in short, a performance gap represents the space between current reality and future aspirations. In many cases this gap exists not due to mismanagement, but rather, because strategic or technical opportunities have emerged that allow the organization to do better. Such was the case with MOE/MAR, offering the real opportunity to substantially decrease medication errors and increase patient safety. This opportunity was recognized by UHN's well-regarded Chief Information Officer. Importantly – so that MOE/MAR would be viewed as a safety imperative rather than merely as an interesting Information Technology (IT) project – the opportunity to implement MOE/MAR was also supported by UHN's systems-thinking CEO and by the Board Chair. Both had for years publicly expressed their frustration with the health sector's failure to employ IT to improve performance.

Getting to a new desired end state is often appropriately described as a journey, but in large, complex healthcare organizations, the kind of journey during which the weather may

Figure 1. Transforming healthcare organizations

Stage One	Stage Two	Stage Three	Stage Four
• Goals • New behaviours • Organization architecture • Systems	• Situational analysis (past and present) • Top management support • Key player/stakeholder analysis • Change leader selection	• Communicate need for change • Show benefit to employees • Build coalitions	• Monitor and re-evaluate • Recognize/reward • Support • Showcase success • Fine-tune systems
Determine Desired End State →	**Assess Readiness for Change** →	**Broaden Support** **Organizational Redesign** →	**Reinforce and Sustain Change**
		• Goals & tasks • Structures • People/HRM • Rewards • Cultures & values • Information & decision support	

change unexpectedly, pot-holes line the route and detours or the occasional road-blocks are confronted. The experienced change leader prepares for this and recognizes that while departures from plan may be necessary, the desired end state is always kept in sight and is clear to all. Many writers refer to this as a vision or "where will we be when we get there," and beginning with the end in mind is critical. However, "vision" can be a nebulous concept without sufficient specificity to be actionable.

In the case of UHN's vision for a fully implemented MOE/MAR initiative, it was necessary to specify measurable goals that would allow it to chart progress and determine success or failure. In my experience, the discipline of developing and monitoring performance measures is critical to focusing the attention of change leaders and those who will be asked (or required) to change. The initial supporters of MOE/MAR, as discussed in "The Benefits of the MOE/MAR Implementation: A Quantitative Approach" (see p. 77 in this issue), had very clear and measurable goals in mind from the start (e.g., reduction in both transcription errors and cycle time from medication order to administration). Also part of their visioning process were initial thoughts about the systems and activities required to measure these outcomes (e.g., chart audits, time and motion studies, electronic reporting from the data warehouse).

In addition to specifying measurable goals, other necessary sub-components of vision had to be considered from the onset. For example, what new behaviours, such as navigating a computerized patient record, would clinicians have to perform? What changes to organizational structure and systems would be necessary to support the implementation of MOE/MAR? Answers to these questions about vision can act as touchstones as change leaders confront the numerous decision points that will invariably emerge in the change process. While the specifics of changing behaviours, capabilities, organizational structure and systems are discussed in a later section, for now it is sufficient to emphasize that the outcomes of the visioning process are the building blocks of effective change.

Stage Two: Assessing Readiness for Change

Once supporters of a change have come to a reasonably clear understanding of their objectives, it is time to assess the organization's readiness for change. This begins with a broad situational analysis, which includes determining whether

- the need for change is recognized by those whose work will be affected
- other change programs are vying for executive attention and resources
- the organization will have to develop new capabilities to close the performance gap
- there is something in the organization's history (e.g., a prior

failed IT initiative) that either predisposes staff for or against the change or, more generally, from which the change leaders must learn

At UHN the executive team decided that MOE/MAR would be a priority and that they would support all efforts to ensure it was recognized by those whose daily work would change. Ensuring broad support for this initiative required UHN leaders to conduct a Key-Player (Stakeholder) Analysis. A Key-Player Analysis involves asking the following kinds of questions: Who are the various individuals, clinicians or professional groups and departments likely to be affected by MOE/MAR? Are they likely to be supporters or opponents? What would they want to see MOE/MAR do or not do (i.e., what are their *interests*)? What will they say they want MOE/MAR to do or not do (i.e., what are their *positions*)? Who are most able and powerful to enable or scuttle the change?

How these questions are answered is critical to the next set of Stage-Two activities – enlisting the most appropriate change leaders. These change leaders are often not, and should not be, the organization's most senior executives. While senior leadership must bless and resource large change programs, they rarely have the time or intimate knowledge of the change to be the actual change leaders. Instead, the change leaders should be selected because they share common qualities that have been revealed as important in past research

- influential: They are influential, either because of their formal position in the organization's hierarchy, the resources they control or due to the respect they have earned.
- connected: They have strong relationships throughout the organization (not only in a single program, department or professional group) that allow them to efficiently and quickly use their influence.
- skilled: They have technical, substantive expertise relevant to the change program (e.g., pharmacists who understand how MOE/MAR must function) and are not merely "process people."

The change leaders should also have

- personal conviction and motivation: They have a strong personal interest in the change program's success. This motivation could be selfish (e.g., MOE/MAR allows physicians to easily take advantage of evidence-based guideline information) and/or selfless (e.g., MOE/MAR promises to reduce medication errors). The source of their motivation is irrelevant.
- a broad range of perspectives: They understand the broad range of technical issues that may arise during the change process and can empathize with the concerns of the different

stakeholder groups.
- high self-confidence: They have the strength to persevere in the face of opposition frequently targeted at change leaders.

The attempt to find someone with all of these qualities will no doubt be daunting, but that should not deter the executive team sponsors of the change. While past research suggests how important these qualities are, it does not suggest that there must be a single change leader. Indeed, in the successful implementation of UHN's MOE/MAR initiative, that change was led by multiple change leaders who enlisted an ever-increasing group of supporters. As the articles in this issue show, UHN established a Steering Committee comprised of well-regarded clinical (e.g., physician, nursing and pharmacy) and administrative (e.g., IT, Project Management) leaders, each of whom was well regarded across the organization and respected by his or her most immediate colleagues. This respect had to have been earned previously and maintained throughout the implementation of MOE/MAR.

At UHN the case of one Steering Committee member, the Physician-in-Chief, is noteworthy. Everyone involved with MOE/MAR in the early stages recognized that this Chief, as an Executive Team physician leader, had to be seen as a supporter. Unfortunately, he was also renowned for being a computer neophyte (he did not own a computer prior to MOE/MAR). He used this reputation to his advantage, telling his physician colleagues that "if I can do it, so can you." His support was further demonstrated by the role he took introducing members of the MOE/MAR implementation team (e.g., Project Management and IT staff) to physicians across the targeted divisions and asking these physicians to support these team members.

Despite supporting MOE/MAR, he also recognized the need to maintain his credibility with physicians. This required showing an appreciation for physician concerns and a willingness to put the brakes on MOE/MAR if necessary. For instance, in a dramatic event, the Chief Medical Resident came to the Physician-in-Chief approximately 10 days into the pilot. The resident convinced him that the pilot was slow, clumsy and had too high an error rate and therefore needed to be shut down. The medical resident warned the Chief that the other physicians in the pilot division (General Internal Medicine) were "fed up with the project and would soon refuse to use it." The Chief, in a bid to maintain his *credible* support of MOE/MAR and also to avoid the use of a poorly performing system, immediately met with UHN's Chief Information Officer and had the system shut down. As the Chief recalled, the CIO "gulped hard, picked up the phone, and shut the project down." The system remained idle until more redesign and additional testing satisfied the Steering Committee and the medical staff.

In a less dramatic case, a group of sceptical users of MOE/MAR became credible supporters. As seen in "Nursing Perspective:

Focus on Clinical Best Practices, Patient Safety and Operational Efficiency" (see p. 50 of this issue), many nursing staff members were initially hesitant to alter their tried and true work habits. However, there was a small group of early supporters among the nursing staff who were not only eager to use MOE/MAR, but who also became MOE/MAR "ambassadors" – selling the vision to their peers. These respected colleagues, though not formally designated change leaders, were instrumental to MOE/MAR's success.

In both of these illustrations we see that no single member of the Steering Committee, including the influential Physician-in-Chief, could have successfully led the MOE/MAR initiative. Rather, the Steering Committee members together, and those they later enlisted, met the change leader criteria listed above and worked to maintain their credibility and influence throughout the implementation.

Stage Three: Broaden Support and Organizational Redesign

Prior to Stage Three, relatively few in the organization may have been affected by, or even been aware of, the change initiative. Up until this point, much of the change work has been behind the scenes, both enlisting the support of important allies and sizing up the challenge. It is now time for the change to affect others in the organization, and this will occur on two fronts *simultaneously* – broadening support and organizational redesign.

Broadening Support

Broadening support is where the change program moves into high gear. While much of the work thus far has been done behind the scenes and often behind a desk, broadening support for a change requires much greater interaction between change leaders and the staff who will be affected.

The communication process is central to broadening support. Researchers in healthcare (Shamian-Ellen and Leatt 2002; Shortell 2006) and commercial enterprises (Kotter 1996; Tushman and O'Reilly 1997) have regularly noted the importance of a communication strategy. And, in those organizations where change is most effective, the communication strategy of the change leaders has several common features. First, the change leaders, supported by the Chief Executive, must articulate a consistent message about the change objectives and means. Second, the message is often best communicated using multiple media (e.g., formal presentations, casual conversation, technology demonstrations, e-mail, newsletters). The effective-

ness of multiple media to communicate a message has been well documented in other industries, and it may be particularly important in those healthcare organizations operating "24/7," in which it is difficult, if not impossible, to bring all potentially affected staff together at one time.

Change leaders must also ensure that the message is tailored to its particular audience and delivered by a credible source. At UHN the Steering Committee members used their networks of relationships to form coalitions of supporters. For example, the Chiefs of Medicine and Surgery were the Steering Committee members charged with introducing the MOE/MAR concept to physicians. The same was done in Nursing by the Chief Nursing Executive. In these cases and numerous others, Steering Committee members were able to anticipate and address the kinds of questions that regularly emerge during a change program:

- What is the change (e.g., what is MOE/MAR, and how is it similar or different to similar IT initiatives)?
- Why this change rather than another change or none at all?
- Why now?
- How will the change affect the work I do?
- How will it change my relationships and interactions with others?
- Do I have the skills to do this work, and if not, how will I develop them?
- Why would I want to support this change (or, why shouldn't I oppose it)?

Unlike many failed change efforts in other organizations, communication at UHN was not unidirectional, nor did it always involve presenting an idea as a *fait accompli*. Rather, communications often took the form of posing questions and joint diagnosis, in which broad objectives were stated by leadership, but plans to operationalize these were open for discussion. This was seen, for example, in the nursing staff's recommendation to create an "electronic whiteboard" (see "Nursing Perspective: Focus on Clinical Best Practices, Patient Safety and Operational Efficiency" at p. 50 in this issue).

Of course, management is faced with a dilemma when anxious employees seek answers that management is not yet able to provide. In an earlier study of hospital downsizing during restructuring in the 1990s, I observed two managerial responses to this challenge, but only one that was effective (Change Foundation 1997). In several hospitals, managers themselves did not yet know the specifics of the downsizing process (e.g., "Will 40 or 80 nurses have to be laid off?"). Those managers added to their difficulties by refusing to speak about an issue until they had all of the answers. This often led to increased rumours, thwarting the change leader's efforts to control information about proposed changes. Silence also affected the credibility of

change leaders who were thought to be keeping secrets from those individuals who would soon be affected by the changes.

A more successful approach to managing the unknown was simply to be honest with employees about the unknowns. For example, in that earlier study one CEO was unable to determine how many nurses were going to be laid off, but he was able to say how the layoffs would be managed once more information about budgets was available to him and his staff. Although affected staff have a great need for information, most will understand that not everything is knowable by senior management. Honesty about the unknown, married with a plan to lessen the uncertainty, can go a long way toward protecting management's credibility. In contrast, those managers who had not yet earned the credibility of their employees exacerbated this problem by not being honest about the unknowns, providing added grist for the rumour mill.

> **Honesty about the unknown, married with a plan to lessen the uncertainty, can go a long way toward protecting management's credibility.**

Finally, it serves no one to sugar-coat the truth. In the case of MOE/MAR at UHN, the Clinician Informatics staff who supported the project told their clinical colleagues that they would hate MOE/MAR initially, but that their appreciation for what MOE/MAR could do would grow over time.

As part of the attempt to broaden support – or lessen opposition – it is useful to recognize the most "saleable qualities" in change initiatives. Changes are more likely to be accepted to the extent that they are *seen to be*

- "trialable" and revisable: Changes can be revised and adjusted.
- divisible: Changes can be implemented in phases.
- concrete: Changes involve tangible ideas (e.g., a new IT system) rather than abstract ones (e.g., a safety culture).
- familiar: Changes resemble past, positive experiences (e.g., the implementation of a second-generation IT system)
- congruent: Changes fit with other initiatives at the organization.
- marginal: Changes slip in unnoticed.

It is difficult to imagine a change initiative characterized by all of these qualities, nor is it necessary that it be so. In the case of MOE/MAR at UHN, and described in later articles in this issue, the Project Management Team piloted MOE/MAR and revised it based on the pilot experience.

In addition, MOE/MAR's Steering Committee and Project Management Team translated the abstract, yet familiar concept of improving patient safety to a very concrete IT system. The objectives of MOE/MAR were also congruent with Nursing's patient-centred-care initiative.

Organizational Redesign

Inextricably linked to the task of gaining support, which is largely an education and communication strategy, is ensuring that affected staff appreciate the *benefits of change* and operate in an organizational environment supportive of it. Thus, it is necessary for change leaders to focus on organizational redesign, that is, ensuring that the organization is sufficiently aligned to support the change.

As discussed in a previous article in *Healthcare Quarterly* (Golden and Martin 2004), change leaders may find some utility in the Star Model presented in Figure 2 (see also Galbraith 2001 and Lawler 1996). The Star Model encourages managers to think of the organizational environment in which change occurs as a set of subsystems, or "points" of the star:

- goals and tasks: What are we trying to achieve and what new behaviours will staff have to perform?
- structure: How do we need to be organized?
- people and human resource management policies: What kinds of staff do we need and what skill set will they need to have?

Figure 2. Organizational redesign

- rewards: What do staff value and get from their work?
- information and decision support: Do staff have sufficient access to information to do their work and make necessary decisions?

There are five important ideas implicit in the Star Model. These are described here, and then illustrated by UHN's efforts to implement MOE/MAR.

The first idea, based on substantial evidence, is that the root cause of organizational performance problems – or resistance to change – is rarely "dumb, stupid, incompetent, evil and lazy" staff. It is necessary to state this explicitly since resistance to change is too often, and wrongly, attributed to a "natural resistance to change." Resistance to change is not some inviolable rule of nature; *resistance to change occurs because individuals do not see the benefit of changing or a high likelihood of being able to do so successfully.* This is where organizational redesign comes in. (I refer to this as redesign rather than design, because all existing organizations already have some design features, whether functional or not.)

Second is the proposition that there is no one best way to design a system. Thus, we should avoid asking questions such as "What is *the* right reward system?" or "What is *the* right human resource mix?" The answer to these questions is always the same – "it depends." Specifically, it depends on what were the previous subsystem design decisions relating to goals, human resources, structure, etc. For example, in response to a failure to recruit sufficient numbers of anesthesiologists (a human resource issue), a hospital may need to organize around nurse anesthetists (a structure decision), regulations permitting.

A third key feature in the Star Model is its dynamism, and specifically, the notion that *change* to any one of the points on the star *may* create the need to alter other systems (e.g., reward systems) in order to regain alignment. For example, the structural change from program based to disease-management based may create the need to alter information and decision support systems so that performance can be validly evaluated and rewarded (i.e., so that clinical leaders and administrators can be held accountable). The enhanced information and decision support systems may require better skilled staff (i.e., a change in human resources) who can manipulate and use newly available data.

A fourth idea embedded in the Star Model is that there are no levers available to healthcare leaders that, when pulled, directly affect a system's culture and values. Rather, a system's culture and values can only be changed *indirectly*, and only through the decisions we make about the points on the star. For example, the recently enacted Accountability Agreements between Ontario hospitals and the provincial government are intended to change the rewards to hospitals and their leaders. Although less explicit, they are also intended to change the

culture of healthcare in the province to a culture of collaboration, performance and integration.

Fifth, and related, is the more subtle message that culture and values can either impede change or support it. Thus, when we hear such statements as "We can't do that" (e.g., pay for performance; dismiss low performing staff), there is a very real chance that what is actually being said is "We don't want to do that" or "That's not the way we do things here." On the other hand, the case of MOE/MAR at UHN reveals how organizational culture, namely, a shared commitment to enhancing patient safety, can support change.

> **With respect to *goals and tasks*, the objective was clear: The supra-goal was greater patient safety at UHN, and this would be operationalized by way of 100% utilization of the MOE/ MAR system in the targeted units.**

The Star Model simultaneously captures what Ghoshal and Bartlett (1997) refer to as the anatomy (structure), the physiology (systems) and the psychology (culture) of the organization. Now, having described the Star Model at a high level, we can see how some organizational redesign was necessary in order to implement MOE/MAR at UHN. With respect to *goals and tasks*, the objective was clear: The supra-goal was greater patient safety at UHN, and this would be operationalized by way of 100% utilization of the MOE/MAR system in the targeted units.

Structural changes have included the creation of temporary or more permanent teams, new departments or integrating mechanisms (e.g., boundary-spanning individuals charged with linking different functions or units within the organization). As mentioned above, UHN established a temporary Steering Committee to oversee MOE/MAR. In addition, the Pharmacy Informatics Team was created in recognition of the increased demands placed upon Pharmacy as a result of MOE/MAR. MOE/MAR has also created the need for other standing multidisciplinary corporate committees. Given the goal of implementing a system that cuts across clinician groups, such structural changes were necessary.

People and human resource management required numerous changes. Most basic was the selection of appropriate change leaders to support the teams and committees just discussed. In addition, substantial training and skill development were required to work in a MOE/MAR environment (i.e., to be aligned with the tasks). As "Nursing Perspective: Focus on Clinical Best Practices, Patient Safety and Operational Efficiency" reports (see p. 50 in this issue), the demographic

profile of UHN nurses is such that many had little experience (and comfort) with computers; substantial training was required to address this skill-gap.

With one exception, little more likely needs to be said about the *information and decision support dimension*; MOE/MAR, by its very nature, represents a change to this organizational design element. However, in addition to the introduction of the MOE/MAR system, UHN also developed clear metrics and measurement systems to monitor the use of MOE/MAR and the impact it had on the organization (e.g., reduction in medication administration errors). These are discussed extensively in "The Benefits of the MOE/MAR Implementation: A Quantitative Approach" (see p. 77 in this issue).

Perhaps the most challenging redesign issue in change initiatives such as UHN's introduction of MOE/MAR concerns *rewards*, and for this reason, extra attention is devoted here to this challenge. As experienced managers well know, in any change effort there is a very real risk that intended change recipients will become change resistors. Thus, once staff are confident that they will be able to implement the change (e.g., they receive appropriate training, sufficient resources and necessary information), they must also be motivated to change. This requires change leaders to address the issue of *benefit* – benefit to patients, to the organization, to the health system and to clinicians and administrators.

Experienced managers know they can ask their staff to accept personal sacrifices for the good of the organization for only so long. Ultimately, what is good for the organization (e.g., the implementation of MOE/MAR) must also have either a neutral or a positive effect on those who must change. It would be naïve to think otherwise. Yet, this does not present an insurmountable problem. In one sense, healthcare leaders are more fortunate than leaders in commercial enterprises; the core mission of non-profit healthcare organizations is universally regarded as worthy. Thus, leaders must design a change plan – and communicate it clearly – so that the targeted staff will understand that they will be better off (or at least not worse off) if they support the change; alternatively, the staff must realize that they will be worse off if they oppose it.

In some cases, the message is a simple one; for example: "As clinicians, you care about the safety of your patients, and MOE/MAR is a safety measure you can use with only little inconvenience." The support for such a claim may come from a variety of sources such as published articles, testimonials from respected clinical colleagues at other organizations or vendors. Critical here is providing support for staff to learn themselves about the benefits of the change, if they wish, rather than simply accepting the word of the change leaders.

In other cases, those targeted to change will not be better off with the change; the benefits may flow entirely to the organization (e.g., greater efficiency) or to patients (e.g., more convenience). What are change leaders to do in such cases? Unfortunately, these instances require the judicious use of power. At some point, clinical leaders may need to say "If you want to practise in our hospital, you *will* use the MOE/MAR system." Such was the case at UHN when a physician leader, who had been asked by his Chief to support MOE/MAR implementation in his division, was instead thought to have organized his colleagues against it. The division head was told that he would be removed from his position if there were any evidence that he was not supporting MOE/MAR. In this case, the respected Chief needed to use his formal power to change the benefit equation for the division head. Change by fiat is never desirable and is frequently unsustainable, as some clever clinicians and administrators will do all they can to resist the change when it is contrary to their interests. Thus, it is critical that change leaders (1) have the ability to reward those who support the change initiative and to punish (or withhold rewards from) resistors or (2) are able to communicate to those impacted by the change how both they and the organization (or patients) will be better off after the change.

Obviously, the work behind Stage Three activities can be enormous. In the case of UHN and MOE/MAR, for example, substantial time and resource commitments of senior and mid-level managers were made over four years. These activities are documented in great detail throughout this issue. As will become apparent, these activities and commitments were instrumental in ensuring that (1) there was a broad-based will (deep and wide) throughout the UHN to implement MOE/MAR, and that (2) the organization was appropriately aligned to allow the motivated to accomplish their objectives. Stage Four activities, discussed next, are necessary to take a change program from an experiment to a more permanent way of working.

Stage Four: Reinforce and Sustain Change

Even the most successful change leaders must be wary of calling their work a success at the end of Stage Three. Change programs must move to Stage Four if they are to be sustainable. This stage involves efforts to

- monitor performance
- showcase successes
- reward supporters
- recognize and support losses associated with the change
- reconsider goals in light of new information and new opportunities
- fine-tune realigned systems
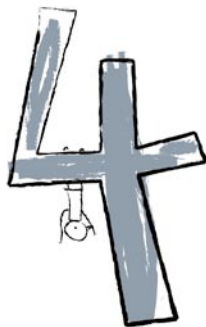
As seen in "The Benefits of the MOE/MAR Implementation: A Quantitative Approach" (see p. 77 in this issue), UHN devoted considerable attention to determining whether MOE/MAR has been living up to its promise. Among other things, UHN currently measures transcription errors (reduced), medication incident reporting (increased) and medication processing time (reduced). In addition, division leaders must ensure that their staff are using MOE/MAR as intended. Performance monitoring allows the organization to make technical adjustments to the system and also to identify where some additional organizational realignment may be necessary (e.g., additional training). In addition, this is the time when the promised benefits of MOE/MAR (e.g., error reduction) must be revealed to those who have thus far borne the cost of change. That is, this is the time to ensure that those who supported the change have been appropriately rewarded for their support.

In the case of UHN, the hospital made certain to showcase and celebrate its successes, provide credit where credit was due and acknowledge the sacrifices that staff made. For instance, UHN clinicians and administrators have regularly spoken about MOE/MAR at professional conferences and other organizations. Internally, shortly after the successful implementation of MOE/MAR at each hospital site (UHN is made up of three hospitals), UHN threw a celebration party for front-line clinicians, project team members and senior executives, thanking staff for their support (see sidebar for MOE/MAR-TINI recipe). The cost of such celebrations pales in comparison to the costs UHN would have paid had MOE/MAR been unsuccessful. By doing so, this appreciation not only reinforces ongoing staff behaviours but also further establishes UHN's leadership's credibility – critical to the *next* change UHN will ask of its staff.

Stage Four is also the time to reflect on both the change process (e.g., Should we have implemented MOE/MAR differently? More quickly? With fewer or greater resources?) and the change itself (e.g., Was MOE/MAR the right change for us to reduce errors? Have new technologies or systems emerged that would have allowed us to better achieve our goals?). This opportunity to reflect should not be lost, despite how eager staff may be to regain some normalcy in their work. Indeed, one of the motivations for each of the articles in this issue was the opportunity to systematically reflect about MOE/MAR and the implementation process. Lessons that emerge from this, concerning both what was done well *and* poorly, are intended to inform future changes at UHN and other interested healthcare organizations.

Conclusion

Ambrose (1987) presents a slightly different, but certainly complementary perspective on managing the kind of complex change seen in the case of UHN's MOE/MAR implementation (see Figure 3). His *recipe for successful change* identifies five

Recipe for Moe-Martini

martini glass
1/2 oz raspberry syrup
2 oz pineapple juice

In martini mixer add ice, syrup and pineapple juice. Shake and serve. Garnish with a single raspberry in the bottom of the glass.

Figure 3. Recipe for successful change

		Skills	+	Incentive	+	Resources	+	Action Plan	= **Confusion**
Vision			+	Incentive	+	Resources	+	Action Plan	= **Anxiety**
Vision	+	Skills			+	Resources	+	Action Plan	= **Gradual Change**
Vision	+	Skills	+	Incentive			+	Action Plan	= **Frustration**
Vision	+	Skills	+	Incentive	+	Resources			= **False Start**
Vision	+	Skills	+	Incentive	+	Resources	+	Action Plan	= **Change**
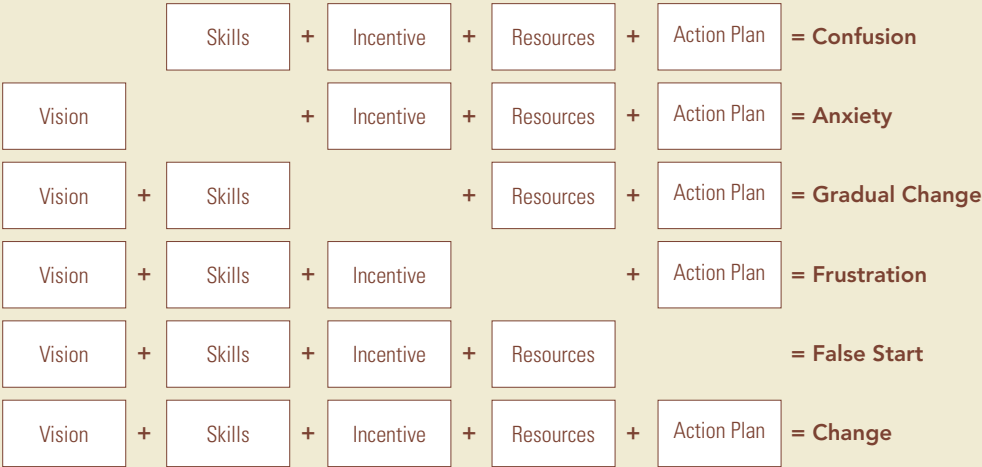
Figure 4. Action planning matrix

Actions	Needed Support	Responsibility	Timetable	Required Resource	Success Criteria	Monitoring Mechanisms	Possible Modifications
1.							
2.							
3.							
4.							
etc.							

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critical elements to the change process (vision, skills, incentives, resources, action plan), each of which has been addressed in the Four-Stage model described in this article. In addition, his framework – by revealing predictable outcomes when ingredients are missing – is a helpful diagnostic tool to determine why the change process has not yet been successful.

One of Ambrose's requirements for successful change is action planning – the primary focus of this article. To assist readers, Figure 4 provides a template for finding order among the clutter of organizational change. This template comes with a warning, however. Paradoxically, the most effective change leaders do not "overplan," recognizing that many unanticipated events await them. Effective action planning involves laying out the likely sequencing of events, attempting to stick to a timeline and doing so to the best of one's ability. As Kotter (1996) has argued, change leaders must accept that the sequencing of events and completion of all stages in the change process may be far more important that sticking to a preset timeline.

Finally, as readers will see either by on their own change management experiences or by reading the articles in this issue, successful change programs are much like icebergs. As the passengers on the *Titanic* unfortunately discovered, it is the 90% of the iceberg below the surface of the sea that sinks the ship. To avoid the sinking of a change program as complex as UHN's MOE/MAR program, change leaders must give the needed attention to all those activities that are seen by few, but which are critical to smooth sailing.

Endnotes

1. Parts of this article draw on the report "Leading the Management of Change: A Study of 12 Ontario Hospitals," which I authored with Murray Bryant, Ann Frost, Ken Hardy and Peter Newson for The Change Foundation (Change Foundation 1997).

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The **Business Case**
for Patient Safety

Matthew Anderson, Michael Baker, Robert Bell, Mary Ferguson-Paré,
Lydia Lee, Emily Musing and Bryce Taylor

C onventional wisdom dictates that hospitals are institutions in which ailing or injured people go for a temporary visit, their discharge ultimately dependent upon either a partial or complete recovery. Unfortunately, the most well-intended acts sometimes result in tragedy. Depending upon the severity of a patient's condition, sometimes a visit to the hospital is a one-way excursion. And in some cases (most would argue in too many cases), the reason a patient dies within the confines of a hospital is due to the lack of a systems approach to patient safety.

With this in mind, the leadership team at University Health Network decided to pursue a new information technology initiative to substantially reduce human and system errors and omissions as it pertains to medication management and patient safety. As the leadership team, we collectively decided that, since the technology was now available, and had been shown to be proven but underutilized within our industry, the time had come for our organization to apply it.

In particular, what caught our attention in recent years was a pair of groundbreaking studies. These studies confirmed that patient safety in a hospital setting can be sometimes seriously compromised due to medical error. In the report, *To Err Is Human: Building a Safer Health System*, published by the U.S.-based Institute of Medicine of the National Academies (IMNA) in 1999, IMNA found that nearly 100,000 patients per year were dying in U.S. hospitals due to adverse complications stemming from medical errors (Kohn and Corrigan 2000).

> **"The Canadian Adverse Events Study" determined that errors were occurring in 7.5% of annual hospital admissions. More unsettling was the fact that more than one-third of these mistakes (36.9%) were entirely preventable.**

Closer to home, we were apprised of some equally disturbing statistics reported in "The Canadian Adverse Events Study: The Incidence of Adverse Events Among Hospitals in Canada" (Baker et al. 2004). This study was developed by the Harvard Medical Practice Study and based on a protocol similar to that used by the authors of the IMNA paper. It examined chart audits at a teaching hospital, a large community hospital and two small community hospitals. The hospitals were situated in five provinces (British Columbia, Alberta, Ontario, Quebec and Nova Scotia), and the data were amassed during the 2000 fiscal year. The findings were subsequently published in the May 2004 issue of the *Canadian Medical Association Journal*. In a

nutshell, "The Canadian Adverse Events Study" determined that errors were occurring in 7.5% of annual hospital admissions. More unsettling was the fact that more than one-third of these mistakes (36.9%) were entirely preventable and that 20.8% of these mishaps actually resulted in the death of a patient.

By extrapolating the data, an unsettling picture eventually emerged: Of the almost 2.5 million annual hospital admissions in Canada during the time of the study, roughly 185,000 were associated with an adverse event. Ultimately, these adverse events resulted in between 9,250 and 23,750 preventable deaths.

What was the leading cause of these sometimes-fatal errors?

"Based on the literature, there was strong consensus that errors around the administration of drugs were the most critical problem contributing to adverse events," says the Chief of Surgery at UHN. "This [incidence of adverse events] could result from any mix of incorrect writing of prescriptions by physicians, illegibility of the written orders, the prescribing of inappropriate meds, the incorrect interpretation/transcription of written orders by nurses, or the incorrect administration and documentation of the meds."

If anything, the studies indicated that there is an urgent need to improve patient safety in acute care hospitals. As well, the studies suggested that when it came to administration of medications in hospitals, changes were required to reduce the frequency of errors and adverse events.

In fact, part of the reason why mistakes are typically made vis-à-vis the administration of medications is due to the archaic nature of paper-based medication management in an increasingly digital world.

Thus, in 2001, we at UHN undertook one of the largest patient safety initiatives in Canada by requiring all medications to be ordered, administered and documented electronically. The system became known as the Medication Order Entry/ Medication Administration Record project (MOE/MAR).

While not necessarily followed in a systematic fashion, we took the following key steps in making our decision to pursue MOE/MAR:

- articulating the problem that the organization was trying to solve
- identifying a credible and feasible solution
- determining the true costs and risks of the project
- defining the benefits to get support for the project
- ensuring commitment to mitigate inevitable challenges

The process of transforming clinical practice for medical, nursing and pharmacy staff across three campuses of the nearly $1 billion (annually) hospital organization was not without its challenges. First, MOE/MAR came with a lofty price tag, ultimately costing more than $5 million. It was also a time-intensive project, requiring nearly five years in which to imple-

ment from investigation to complete implementation. This paper documents our decision-making process undertaken by the Executive Management team at UHN that ultimately led to the implementation of MOE/MAR.

Background on UHN

UHN, the eighth-largest acute care institution in Canada, encompasses three hospitals located in downtown Toronto: Toronto General Hospital, Toronto Western Hospital and Princess Margaret Hospital. It also encompasses Toronto Medical Laboratories. As well, UHN is a major teaching hospital for the University of Toronto with care delivered through seven program groupings: Advanced Medicine & Surgery, Community & Population Health, Heart & Circulation, Musculoskeletal Health & Arthritis, Neural & Sensory Science, Oncology & Blood Disorders, and Transplantation.

The oldest site in the UHN group is Toronto General Hospital, which has provided services to the community for more than 165 years. UHN has approximately 11,000 affiliated staff, more than 1,200 physicians, an operating budget of nearly $1 billion, 30,000 annual inpatient cases and 950,000 annual outpatient visits.

Articulating the Problem the Organization Was Seeking to Solve

In 2001, UHN completed a 10-year corporate strategic plan in which "improving the patient experience" was a key organizational strategy. As a result, moves were undertaken to implement new processes and structures within UHN to support improvements in patient safety. Senior management observed a strong movement toward improving patient safety (particularly in the hospital setting) throughout the entire healthcare industry in the early 2000s.

Meanwhile, the federal government had established the Canadian Patient Safety Institute (CPSI). CPSI acts as an independent, not-for-profit corporation dedicated to achieving measurable improvement in the incidence of patients experiencing adverse events while in the care of the Canadian health system. These activities, which were all taking place two or three years ago, served to galvanize the industry – and UHN – into looking closer at patient safety in the context of quality improvement.

Further examination of the literature indicated that MOE/MAR-type systems were seen as being highly effective in helping hospitals track and mitigate adverse drug events. An analysis by the U.S.-based Leapfrog Group in 2003, for example, indicated that the full implementation of a Computer Physician Order Entry (CPOE) system decreased serious medication errors by 55% (Birkmeyer and Dimick 2004). As well, a more recent study by Grandville et al. (2006) pointed to a significant 62% error reduction rate.

These findings led the Leapfrog Group to include CPOE in its list of the three recommended quality and safety practices that have the most potential to prevent medication errors and save lives. The studies also indicated that CPOE reduces the length of stay, reduces repeat tests and reduces turnaround times for laboratory, pharmacy and radiology requests. As an added benefit in this day of fiscal restraint, CPOE also delivers cost savings (Birkmeyer and Dimick 2004).

While this groundswell of concern for patient safety was occurring throughout the industry, UHN independently initiated several major organizational patient safety efforts. For example, UHN launched a Quality Clinical Risk Management and Incident Reporting Committee chaired by the then Chief Operating Officer of the Princess Margaret Hospital site (who would go on to become UHN's Chief Executive Officer in 2005). To support this committee, UHN leadership formed a Patient Safety Council. This council was given the mandate to address specific patient safety risks resulting in reported adverse events.

University Health Network (UHN)
Network of three sites in Toronto, Ontario: Toronto General Hospital, Princess Margaret Hospital, Toronto Western Hospital

As well, a major corporate culture renewal initiative was also underway led by Nursing. This initiative included training for all nurses and others to emphasize patient-centred care in all aspects of the care process. A key component of this training focused on patient safety.

"By the time our council was formed, however, we felt we were already behind by both Canadian and North American standards," says UHN's Medicine Physician-in-Chief. "Our hospital likes to be at the leading edge, so we created a strategic plan to jump into the lead on patient safety, at least on the national level."

UHN had already implemented CPOE for labs and medical imaging since the late 1980s. However, it had not yet implemented medication order entry or electronic medication administration. As a result of this increased attention in the industry, coupled with the organization's commitment to step up its own patient safety efforts, UHN's senior management increasingly felt compelled to consider electronic medication order entry and medication administration systems.

Identifying a Credible and Feasible Solution

Although there was not much information in the literature regarding the actual implementation efforts for CPOE initiatives in other hospitals, UHN realized that implementing medica-tion order entry and medication administration on-line would make for a highly complex project and would impact every clinical program in the organization. Successful implementation would require proper scoping up front, adequate staff training and change management throughout all stages of the project.

There would also have to be a demonstration of patient safety and other benefits in order to justify the organization's efforts and investment.

The hospital's Information Management and Information Technology department, known as "SIMS" (Shared Information Management Services), had already been experimenting with clinical decision support software. SIMS was developing an understanding of how automated alerting (for drug-drug and drug-allergy incompatibilities as well as for duplicate orders or orders that might show a contrary indication based on lab results) could be introduced with medication order entry.

The scope of the MOE/MAR project was defined to include all inpatient units across all seven of the hospital's clinical programs. A physician order entry system would be required, as would a nursing medication administration on-line system and on-line pharmacy verification. And although not yet fully contemplated at this juncture, it was assumed there would be a need to redesign some of the clinical workflows supporting medication administration.

Finally, the scope of the MOE/MAR project would have to include implementation of wireless computer devices to support portability of the physician and nursing staffs.

Before the project received the green light, however, there was considerable debate among members of the executive team. The point of contention: Was the MOE/MAR project truly the best use of time and money in comparison to other much-needed and much-requested initiatives? Other initiatives that were considered included clinical documentation, clinical

decision support alerting for lab and diagnostic orders and incident reporting electronic system changes.

Ultimately, it was decided that attempting to manage multiple patient safety projects would be too much of a drain on financial and people resources. As well, implementing multiple initiatives simultaneously would likely be too much change for the organization to handle. Based on the expected relative impact on patient safety, compared with these other initiatives, the choice was made to support MOE/MAR.

Table 1. Costs per project activity area

MOE/MAR Project Activities	% of Total Project Costs
Project management resources & support	30%
External consultant support	15%
Technical design and development	25%
Point of care devices & set-up	20%
User training	10%
TOTAL	100%

Source: Shared Information Management Services

Determining the True Costs and Risks of the Project

The expected capital costs of the MOE/MAR project to UHN were estimated at $4 million over the duration of the implementation. This investment would cover project management, an information technology system build and testing activity, staff training, Medical, Nursing and Pharmacy Informatics support and evaluation. As well, an additional $1 million to $2 million in other staff resources from Medical Informatics, Nursing Informatics, Clinical Pharmacy and SIMS was required to further supplement the capital-funded project team and technical development. These costs did not include nursing or physician replacement costs while they would be receiving training to use MOE/MAR; rather, these costs were covered by the clinical program budgets.

SIMS developed a multi-year detailed project budget to examine the business case. The breakdown of the costs per project activity area as a percentage of the total project costs is shown in Table 1.

In addition, incremental, one-time resources would also be provided to Nursing Informatics to recruit seven clinical support analysts and to Pharmacy Informatics to support five full-time

and three part-time staff to further support the implementation outside of their departments' operating budgets. However, these were not part of the original business case, as they were unanticipated.

We knew that there were many risks associated with a project of this magnitude. Notably, a change management and information technology implementation of this size was unprecedented at UHN. While the technology certainly was not new, few other North American hospitals had successfully implemented MOE/MAR due to the clinical workflow complexities and costs. For example, the termination of the Cedars-Sinai Medical Center CPOE initiative in the United States (Wachter 2006) created uncertainty among some of the physician leaders that the lofty goals of MOE/MAR might not be achievable.

Even so, against these risks, the team always believed MOE/MAR could be successfully implemented. And management, it should be noted, was motivated by something other than blind faith. For example, the hospital's existing electronic patient record and pharmacy system vendors had very robust solutions. As well, clinicians at the Toronto General Hospital and Toronto Western Hospital sites had been using the electronic patient record for more than two decades, with order entry available for labs and medical imaging for the past decade. In other words, these various stakeholders were used to working with electronic systems.

Moreover, we looked upon MOE/MAR as a way to introduce additional functionality (i.e., drug order entry) to an existing system's environment with which staff were already familiar. The fact that the Medicine Physician-in-Chief was willing to step forward as project sponsor gave further credibility to the organization's commitment to MOE/MAR. SIMS was known throughout the hospital for having strong IM/IT project management capabilities; SIMS was also perceived by management to have a strong ability to effectively work with a broad set of stakeholders across the organization to ensure change management. The organization's Director of Medical Informatics, Director of Nursing Informatics, Manager of Pharmacy Clinical Informatics and all of their respective teams further rounded out UHN's support for MOE/MAR.

"Just by looking at who the project leadership would encompass – Nursing, Medical, Surgery, Pharmacy, SIMS – it was clear that this was absolutely not just an IT project," says UHN's Vice-President and Chief Information Officer. "Our technical people would have to be the least visible amongst the participating groups. If this had been just an IT project, it would have gone nowhere."

Even so, the senior management team acknowledged that the organization would need to depend on SIMS to pull off a project like MOE/MAR, orchestrating activity on the ground and getting people to meet, discuss, make decisions and change the way they do things.

"Although decent compared to other hospitals, we have

a relatively small budget for information systems initiatives compared to other industries – 4% versus the 10–12% often found in financial services, transportation and so on," notes UHN's Chief of Surgery. "And we knew that this would be all-consuming for our IS budget for at least two to three years. But we knew we had to get into this, so we simply bit the bullet and said this was important enough that we would commit what it took to make MOE/MAR happen at UHN."

Approval for MOE/MAR's implementation finally came during a UHN board of trustees meeting in the winter of 2003. The then chairman of UHN's board of trustees (a senior executive with a major Canadian bank) challenged the Medicine Physician-in-Chief and the Chief Information Officer to catch up with the financial industry in terms of information management. Both hospital executives accepted the challenge, responding that UHN would indeed proceed with MOE/MAR.

Defining the Benefits to Get Support for the Project

Although it was acknowledged that the project would ultimately yield many additional short- and long-term benefits, the decision to implement MOE/MAR at UHN was driven almost singularly by our commitment to improve patient safety. With less than 2% of North American hospitals having substantial CPOE implementations (Gale 2005), hospital executives saw this groundbreaking project as an opportunity for UHN to distinguish itself. There was a general consensus that if we could succeed with the MOE/MAR project, not only would it be an important victory for us in terms of patient safety, but also it would significantly strengthen UHN's position as a leader in the adoption of the Electronic Patient Record (EPR).

As such, benefits to the organization were the key factor in the business case for MOE/MAR. "We had to assess both short- and longer-term benefits relative to the expected costs to get executive commitment to the project," noted the Executive Director Information Management of SIMS. "While there was no denying that a reduction in transcription errors and a more efficient order-to-administration turnaround time would serve as key patient safety benefits, we also knew that clinical decision support alerts could further improve the quality of patient care by identifying drug-drug, drug-lab and drug-allergy interactions at the time a drug was ordered."

Enhancing communications within clinical teams – thanks to reducing verbal and telephone orders and extending EPR usage to a broader base of UHN physicians – was also considered to be paramount. UHN's Chief Nursing Executive had wanted to address the "no verbal order" goal for a long time. The reason: Nursing realized the potential errors and patient safety risks that were inherent in verbal miscommunications. By taking laptops to the bedside and using MOE/MAR to help with patient education, nurses would be in a far better position

to deliver patient-centred care. And because MOE/MAR would only allow medications to be ordered by physicians, verbal orders would no longer be accepted as part of the medication order workflow at UHN.

Although not decision-drivers for senior management, other benefits in pursuing MOE/MAR included efficiencies from updated order sets and better compliance with drug formulary. Finally, with UHN's vision statement of "achieving global impact," the opportunity to demonstrate CPOE leadership in Canada was certainly a key factor for UHN's board.

Finally, UHN extrapolated its adverse event rates and medication errors from the findings in Baker et al. (2004) in order to assess the opportunity for improvement in patient safety. While the project team would have preferred to complete a chart audit to gather actual baseline data, this approach was turned down due to the costs and time it would have taken to complete. Nevertheless, this baseline information – coupled with plans for how ongoing metrics would be reported to show improvement – compelled the senior management team to enthusiastically move forward with MOE/MAR.

Ensure Commitment to Mitigate Inevitable Challenges

As part of the decision to proceed with MOE/MAR, the senior management team had numerous discussions about the inevitable challenges this project would have as well as mitigating strategies. The primary concern was to ensure Physician, Nursing and Pharmacy engagement throughout the duration. The Medicine Physician-in-Chief committed to being executive sponsor for MOE/MAR. The Pharmacy department reported to him, which would help ensure alignment of that team with the project priorities. Further, a MOE/MAR steering team would be established that would encompass key Physician, Nursing and Pharmacy clinical leaders from across the three hospital campuses and SIMS.

Meanwhile, the steering committee would be accountable to senior management, including UHN's CEO, for directing the project and to serve as the point of escalation for any challenges that could not be addressed by the project team including clinical resistance to change.

"Perhaps most important of all, however, is that there was already a good relationship between the medical staff, Nursing, Pharmacy and our SIMS group that allowed them all to work closely as a multidisciplinary team," says UHN's Pharmacy Director.

A related challenge raised by the Pharmacy department: With new drug protocols being introduced on a daily basis, new drugs coming onto the market and changes in the way physicians, nurses and pharmacists act and work with respect to patient care, the hospital was a highly dynamic environment. With the hospital landscape in a continual state of flux, imple-

menting new MOE/MAR functionality meant that implementing change would become a continuous process, both from a clinical and technical perspective. The departments involved would require sufficient staff to handle these changes on an ongoing basis, and the electronic systems would have to be flexible enough to incorporate those changes in real time as they occurred. In light of this concern, the senior management team approved one-time staffing increases within Pharmacy, Nursing Informatics and SIMS. This increase in funding would address the initial effort but would not commit to increasing operating budgets until after the project was completed. By embracing such a strategy, it was hoped that the ongoing effort would be better understood.

Critical Factors in the Decision to Undertake MOE/MAR

1. The strong movement already afoot in the healthcare industry to improve patient safety in the acute care hospital setting provided considerable external impetus.
2. Existing UHN initiatives around patient safety and patient-centred care created an internal environment and momentum conducive to the advent of MOE/MAR.
3. Studies and work by various patient safety groups had already identified medication errors as the most critical problem contributing to adverse events, and CPOE as the most effective way to reduce those errors.
4. Executives saw MOE/MAR as an opportunity to distinguish UHN on the patient safety front and as a leader in the adoption of the Electronic Patient Record (EPR).
5. The Executive team was willing to embrace the MOE/MAR vision, commit hospital resources and take the necessary actions to see it through to completion.
6. UHN invested in Physician, Pharmacist and Nurse Informatics professionals to work cooperatively in guiding their respective colleagues through the clinical transformation.
7. Rigorous, proven project management skills orchestrated all the project logistics to ensure appropriate change management support across the organization.

The final major challenge identified by medical leadership was the need to ensure adequate training for the July and January intake of new residents every year. As the largest teaching hospital in Canada, UHN typically receives approximately 150–200 residents and 200–250 clinical fellows every 12 months. MOE/MAR would add significant additional training to the residents' UHN orientation requirements – especially since none of the other teaching hospitals in Toronto had MOE/MAR in place yet. Thus, ongoing resources were added to the SIMS Education budget to address the continual training requirements into the future as well as the development of multiple training modalities to accommodate flexibility in training residents.

It was expected that implementing MOE/MAR would be a Herculean effort, given the amount of time, effort and money required. But considering MOE/MAR was focused on reducing medication errors and adverse events – and thereby reducing unnecessary patient morbidity and mortality – the project was more than merely a way to increase efficiencies. Rather, in the final analysis, the choice as to whether to implement MOE/MAR was no choice at all. If UHN was serious about enhancing patient safety, MOE/MAR had to be developed and adopted.

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Commentary
They Must Embrace the Vision

David A. Collins

Justifying the expense of health information technology undergoes unparalleled scrutiny. Competing priorities for expenses must be balanced by revenue, all within the confines of the "service" industry. Whether for profit or non-profit, healthcare is ultimately a business.

Technology in healthcare is not always viewed as a tool to increase efficiencies, unlike other industries where technology is pivotal to competitive advantage. The absence of even simple, day-to-day technology in the healthcare environment – the dead battery in the physician's pager or the inconvenience of only one functioning elevator – and, suddenly, technology finds it relevance! Technology enables workflow efficiencies: "Implementing an EMR is a strategic undertaking – not simply an operational endeavour. In addition to understanding this distinction, they must embrace the vision and be proactive in advancing it at all levels of the organization" (2006 HIMSS Davies recipient, Cardiology of Tulsa, www.himss.org/ASP/davies_organizational.asp).

UHN's MOE/MAR implementation was leveraged by embracing it as the "right thing to do" rather than just jockeying for a competitive advantage in the marketplace. Even with the obvious overall benefit, however, UHN was scrupulous with its business decision:

> Before the project received the green light, however, there was considerable debate among members of the executive team. The point of contention: Was the MOE/MAR project truly the best use of time and money in comparison to other much-needed and much-requested initiatives? Other initiatives that were considered included clinical documentation, clinical decision support alerting for lab and diagnostic orders and incident reporting electronic system changes.
>
> Ultimately, it was decided that attempting to manage multiple patient safety projects would be too much of a drain on financial and people resources. As well, implementing multiple initiatives simultaneously would likely be too much change for the organization to handle. Based on the expected relative impact on patient safety, compared with these other initiatives, the choice was made to support MOE/MAR. (Excerpt from "Executive Perspective: The Business Case for Patient Safety," by Anderson et al., at p. 20 in this issue of *Healthcare Quarterly*.)

UHN's business decision can be supported by organizations recognized for their excellence in implementation and use of electronic health record systems, such as those receiving the HIMSS Nicholas E. Davies Award of Excellence. Two past Davies award recipients cite a number of patient safety improvements in several areas in addition to improving prescription practices:

Maimonides Medical Center (Davies 2002, www.himss.org/content/files/davies_2002_maimonides.pdf), a 705-bed hospital, saw problem medication orders drop by 58% and medication discrepancies by 55% in 2001 after its EMR-EHR implementation. That same year, the decision support feature identified 164,250 alerts, resulting in 82,125 prescription changes. The provider's EMR-EHR addressed "high alert medications," confusing look-alike and sound-alike drug names, as well as patients with similar names that could potentially cause the pharmacy confusion.

> **Technology in healthcare is not always viewed as a tool to increase efficiencies, unlike other industries where technology is pivotal to competitive advantage.**

On-line medication charting saw errors in transcription drop to zero for departments in which EMR-EHRs were in full use at Ohio State University Health System (Davies 2001, www.himss.org/content/files/davies_2001_osuhs.pdf). In areas where the EMR-EHR had not been implemented, transcription errors ran as high as 26% in its system. Other healthcare providers also saw transcription errors drop to zero.

Although healthcare is ultimately a business, the patient must stay anchored at the core. UHN's decision to improve patient care through its MOE/MAR implementation is an example of industry leadership for others to embrace.

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Implementing MOE/MAR:
Balancing Project Management with Change Management

Stephanie Saull-McCaig, RoseAnn Pacheco, Pakizah Kozak,
Susan Gauthier and Rebecca Hahn

Introduction

When Toronto-based University Health Network (UHN) initiated its Medication Order Entry/Medication Administration Record project (MOE/MAR) in 2001, it was well understood by the organization that this would be one of the largest change management initiatives undertaken. Being the largest academic hospital in Ontario and the eighth largest healthcare organization in Canada, a successfully implemented computerized physician order entry (CPOE) project in this complex environment would require rigorous project management, significant clinical involvement and a well-developed change management program.

The extensive project management approach employed by UHN to support the MOE/MAR implementation will be discussed in this paper. The major phases of the MOE/MAR project are described from the perspective of the project team to highlight key activities undertaken, decisions made and challenges faced. Next, an analysis of the project management process is provided along with reflections of the approach taken and challenges encountered. Consistent with UHN's methodology to incorporate knowledge gained from the early phases of the MOE/MAR project into future

> **The pilot really opened our eyes about the extent to which the system needed to be tested prior to going into the live environment.**

implementations, we hope to provide insight to other organizations considering CPOE initiatives.

The Complexity of MOE/MAR Requires Years to Complete

The UHN Project Management Team (hereafter the "Project Team") was comprised of dedicated project management, information technology and Medical Informatics staff from the hospital's Shared Information Management Services (SIMS) department. Collaborating extensively with the hospital's Nursing and Pharmacy Informatics departments, these people were collectively responsible for delivery of the MOE/MAR implementation.

The MOE/MAR project phases required over five years to complete, from the initial exploration phase to the end of the enterprise rollout. The majority of this time was invested up front on the System Design/Build phase and subsequent Pilot implementation to address numerous technical complexities. The majority of the clinical workflow implications of the MOE/MAR project were revealed in preparation for "go-lives" of each of the clusters (i.e.,

Figure 1. MOE/MAR major project phases

Initial exploration	System design/build	Pilot	1st. Go-Live Part A (Cluster #1)	1st. Go-Live (Cluster #1)	Enterprise Rollout
Begin evaluation of project requirements & engage vendors	System build & rollout plan Internal & vendor collaboration Interface development between HIS* & RxS**	One general internal medicine ward In parallel with existing paper-based system	All GIM*** & emergency admitted patients Conducted extensive testing in controlled production environment prior to go-live Order entry only to focus solely on physicians	All GIM & emergency admitted patients eMar only to focus solely on nurses	7 additional clusters MOE/MAR simultaneously Overlapped rollouts & planning for optimum timing & resource utilization

*HIS: Hospital Information System
** RxS: Pharmacy Information System
*** GIM: General Internal Medicine

a grouping of clinically similar or closely related Nursing Units where MOE/MAR was implemented together). The major project phases are depicted in Figure 1.

Investigation and System Build Require Longer-Than-Planned Early Phase

The Project Team spent two years working with its Hospital Information System (HIS) and pharmacy (Rx) system vendors to prepare for the first pilot of the new combined MOE/MAR system. A considerable amount of effort and time was spent customizing the medication order entry functionality within the HIS and developing the technical Health Level 7 (HL7) interfaces to the Rx system to meet the needs of these stakeholder groups. Although UHN had extensive experience with building the interface between its HIS and other departmental applications, this particular phase of work proved more complex than any other interface project in the past, thus requiring longer time than originally anticipated.

Although considerable effort and investment had already gone into the technical design and build work, it was not until the final "green light" was received from UHN's Executive Management in 2003 that the subsequent steps of implementation planning could proceed.

Pilot Test Marks First Project Milestone with Clinicians

An initial pilot was conducted in February 2003. The test was confined to one General Internal Medicine (GIM) ward at the Toronto General Hospital (TGH). Electronic MOE and MAR capabilities were activated for physicians and nurses within that group. The pilot was designed to test whether the new system

would allow physicians to order medications electronically. As a precaution against unforeseen problems, it was decided that both systems – the existing paper-based process and the new on-line system – would run simultaneously. Although this doubled workload for clinicians – physicians not only had to enter orders on-line, for example, but also had to write them out on paper – this approach helped with problem identification, and eliminated risks to patients.

Unfortunately, the pilot test had to be terminated earlier than expected due to significant technical performance problems not encountered during the system-build phase of the project. Although the system had worked well in a development environment, system delays emerged when MOE/MAR was subjected to far greater usage than originally anticipated. When this happened, the clinicians reverted back to the old paper process with no clinical impact. For some, however, a temporary black cloud had emerged over MOE/MAR.

Despite the dissatisfaction among some of the clinical staff, the silver lining for the Project Team was that the pilot was only terminated due to system performance problems that were considered solvable. It must be remembered that the pilot was intended to uncover possible weaknesses; in this regard it was a success.

The organization maintained its resolve to continue with the implementation after the performance issues were addressed. "It wasn't just a case of the staff resisting change," according to one MOE/MAR Project Manager. "We looked closely at the concerns they were having with the system and found them to be valid. The pilot really opened our eyes about the extent to which the system needed to be tested prior to going into the live environment. In the production environment there were many

people entering, changing, holding and discontinuing orders. Realistic system load, from network traffic combined with variations and changes to real medication orders and administration routes and times, was a reality that the Project Team was not able to duplicate in the development environment."

Disappointingly, the technical performance issues took nearly a year to resolve before the Project Team could even begin to revamp its testing procedures prior to any further go-lives. Despite this setback, the Project Team worked closely with the system vendors, UHN's information technology experts and the key clinical teams to rebuild the system and to develop better ways to test the system under production-like conditions.

Getting Ready for the Full Implementation: Rebuilding Internal and External Confidence

In addition to working closely with the clinical staff in Internal Medicine to improve the system following the initial pilot, the Project Team put significant effort toward rebuilding the confidence of clinical staff with MOE/MAR to ensure they were committed to using the system again. For example, the key physicians within the group were identified and one-on-one meetings were conducted with them to increase their familiarity with the system and gain their support for its functionality and workflow.

Acutely aware of how the system's design had worked well in the development environment (albeit collapsing under the stress of a real production environment), the Project Team opted to conduct a short "proof of concept" test prior to the next full implementation. The system was set up once again on the Internal Medicine ward in the live production environment, but with usage restricted to members of the Project Team. Several weeks were spent extensively testing the system by using fake patients and fake medication orders, all within the context of Internal Medicine's real operational policies and workflow.

"We were very happy we chose to do it this way," recalled one Project Manager, "because we found a number of technical issues similar to those experienced during the first pilot that we were able to fix and re-test in a controlled environment." Once again it was back to the drawing board in terms of working with the system vendors (although this time around, for a far shorter period). Once the problems were resolved, the Project Team was confident that the system was ready for its first real MOE/MAR go-live.

Strong Teamwork Marks First Go-Live

In June 2004, the new system was brought up to full production mode for two GIM Units, plus the admitted patients in the Emergency department at TGH. This doubled the number of patients compared to the initial pilot. The Project Team chose to go live with this group first because it would provide the most stringent test of MOE/MAR. The Emergency and GIM

> *… key physicians within the group were identified and one-on-one meetings were conducted with them to increase their familiarity with the system and gain their support for its functionality and workflow.*

departments provided some of the most complex set of services in the hospital. These services cared for a broad spectrum of patients and illnesses with the most combinations of required medications than in any other clinical service. The GIM service uses a team-based approach to patient care, involving physicians, nurses and pharmacists working collaboratively within the units. The Project Team's decision was to pick the services with the most complex set of medication orders as the starting point for MOE/MAR with the expectation that subsequent clusters would be incrementally easier.

As the first cluster, both Project Team and clinical staff faced especially substantial skill and knowledge development challenges. As such, clinical staff in the Emergency and GIM departments had to contribute significant amounts of time to ensure that all potential workflow scenarios were anticipated and addressed prior to implementation.

This first MOE/MAR deployment in the Emergency department and GIM service at TGH was referred to as "Cluster #1." The Project Team was careful not to call it another "pilot" in order to avoid the (incorrect) message that this was another test. During this initial cluster, the Project Team and participating clinical staff gained much knowledge about how to improve subsequent clusters, particularly controlled production testing. It took approximately four months for Cluster #1 on the GIM and Emergency Units at the TGH site to be considered by clinicians to be "running smoothly." Although considered a success by hospital senior management, getting to Cluster #1 had taken significantly more time than anyone originally anticipated. The Project Team's morale was waning in anticipation of the massive amount of work ahead and the Senior Project Manager and other Project Managers knew that streamlining the implementation process in the future would be critical to maintaining the team's momentum.

Rolling Out MOE/MAR across the Organization

During the Cluster #1 implementation, the Project Team and senior clinical leadership of the hospital planned the sequence of implementations across the rest of the enterprise. The remaining clinical services were divided into nine additional clusters based on similarity in patient flow, staff workflow, complexity of medication orders and geographic proximity. As well, clinical leadership advised that MOE/MAR in surgical services should

Table 1. MOE/MAR Clusters

		Services	Go-Live Date
Cluster	1	General Internal Medicine, Gastrointestinal, Nephrology & Emergency Department (TGH)	July 2004
	2	Psychiatry & Emergency Psychiatric Assessment Unit	November 2004
	3	General Internal Medicine, Family Medicine, Cardiology & Emergency Department (TWH)	February 2005
	4	Orthopaedics, Rheumatology, General Surgery, Post Anesthetic Care Unit, Acute Pain Service	April 2005
	5	Neurology, Neuro-Surgery, Neuro Step-Down Unit, Interventional Radiology, Respiratory Therapy	June 2005
	6	Cardiovascular Surgery, Vascular Surgery, Cardiology, Cardiac Preadmission Clinics, Endocrinology Consults	November 2005
	7	Oncology Clinics: Head & Neck, Breast, BMT, Gynecology, Gastrointestinal, Sarcoma, Thoracic, Brain, Genitourinary, Hematology	November 2005
	8	General Surgery, Post Anesthetic Care Unit, Gynecology Oncology, Urology, ENT, Plastics, Head & Neck, Thoracic/Respiratory, Acute Pain Services	February 2006
	9	Consulting Services: Infectious Disease, Endocrine, Palliative Care, Chronic Pain Service, Dermatology, Hematology, Infection Control	March 2006
	10	**Transplant, Intensive Care Units, Oncology Inpatient Units, Ambulatory Care Areas**	**Phase Two**

go late in the sequence to allow more time to assess clinical workflow redesign requirements in these exceptionally complex service areas. Table 1 lists all 10 clusters with their actual MOE/MAR go-live dates.

The Psychiatry Units at both TGH and Toronto Western Hospital (TWH), which are a more defined and smaller group of patients and clinicians, were selected as Cluster #2. The rationale for putting Psychiatry second was to select a service that had a relatively high likelihood of success. The Project Team wanted to quickly gain credibility with the clinicians. As well, the Senior Project Manager felt the Project Team needed a boost in confidence. Cluster #2 proved to be a "quick win" compared to Cluster #1, and the Psychiatry clinicians and the Project Team were able to celebrate a second success in a comparatively short time frame. Another benefit of gaining momentum in this manner was that it created a "halo effect" around the project, which secured more support from decision-makers and stakeholders throughout the organization.

Cluster #3, which included Internal Medicine at TWH, also went relatively smoothly because the Project Team had developed experience and credibility through its efforts with Internal Medicine at TGH during Cluster #1.

With each additional cluster, the Project Team gained confidence and credibility; as well, the project as a whole gained momentum. Thus, on it went, cluster by cluster, over the course of approximately 20 months, during which the Project Team successfully implemented MOE/MAR in most inpatient areas across TWH and TGH and all ambulatory services at PMH using the same, but increasingly more streamlined and regimented deployment process for each cluster.

By the end of March 2006, MOE/MAR had been implemented and was fully operational in the first nine clusters (eight and nine were combined at the end). To date, however, UHN has yet to implement MOE/MAR within the Intensive Care Units, Transplant Unit or Chemotherapy Inpatient Units due to the highly complex medication and workflow needs not fully supported by the current technology. To our knowledge, few hospitals in North America have successfully implemented MOE/MAR within these environments for the same reasons experienced at UHN. The Project Team continues to explore required enhancements with our system vendors and assess clinical workflow redesign requirements to accommodate these areas.

Project Management Tactics to Support Clusters

Project management rigour was essential to ensure a well-planned and disciplined MOE/MAR implementation. UHN project managers and technical staff applied Project Management Institute (PMI – see www.pmi.org) principles and processes as well as Information Technology Information Library (ITIL) best practices for change management. To further support the MOE/MAR project, the Project Team also employed two major tactics that were key to keeping the project on an aggressive rollout schedule: (1) using a fluid project team organization structure combined with (2) a well-ordered and consistent cluster implementation cycle.

Project Team Organization Structure

During the rollout, the Project Team was organized into a number of smaller change management teams. These smaller sub-teams could work in parallel on as many as three clusters

Figure 2. MOE/MAR project structure and roles
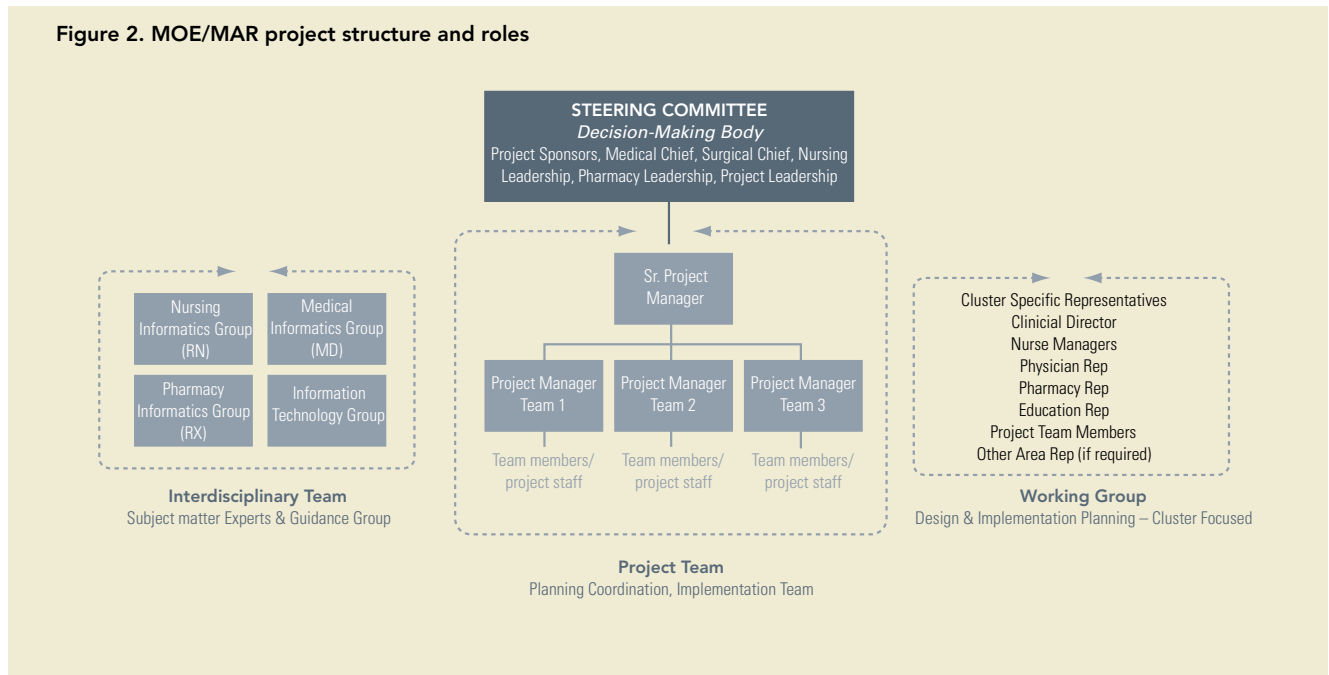
at a time even though they were each at a different stage of the implementation cycle. This approach enabled the Project Team to follow an aggressive rollout schedule and leverage expertise developed across clusters (see Figure 2).

The Project Team was able to rapidly hone its skills in training, support, relationship building, negotiation, issues management and change management by continuously problem-solving across multiple clusters. The Project Team also implemented a formal process to reflect on its successes and failures as it went along, allowing the learning curve to be greatly shortened for each subsequent cluster.

MOE/MAR Cluster Implementation Cycle

One of the most important tactics to keep the project momentum high was to utilize a consistent set of activities with each cluster. As the Project Team began to develop an understanding of the appropriate sequence of implementation steps, it began to codify its "methodology" to be rolled out in subsequent clusters. Figure 3 depicts this project methodology.

Each cluster's kick-off meeting was crucial in helping key clinical stakeholders understand why UHN was implementing the MOE/MAR project. In addition to highlighting the benefits of on-line medication order entry (to their patients, to UHN and ultimately to them) the meetings addressed expectations about what the system would and would not do. We also requested the commitment required from the clinical leadership to make the process successful.

Subsequently, weekly clinician engagement meetings were held with the clinical teams (Pharmacy, Nursing, Physicians) to undertake the crucial change management activities that would prepare each area for the MOE/MAR implementation. These activities included workflow analysis and redesign, medication order set development, downtime preparation, device analysis and status updates. The level of attendance and participation by stakeholders in these meetings made for a reliable barometer of how successful the implementation of MOE/MAR would be.

The environmental device assessment involved an analysis of each physical area to determine the number and types of point-of-care devices (e.g., electronic whiteboards, mobile medication carts, desktop computers, laptops) that would be required. Managing stakeholder expectations was crucial during this activity since many clinicians considered this an opportunity to "go shopping." This was the Project Team's opportunity to distinguish between clinician wants and requirements.

Next, a team of industrial engineers conducted pre-implementation time and motion studies to measure patient safety indicators in the paper-based medication environment. These metrics were later compared to post-implementation metrics representing the electronic environment in order to quantify and understand the impact MOE/MAR had on patient safety. The results of these studies are presented in "The Benefits of the MOE/MAR Implementation: A Quantitative Approach," (see p. 77 in this issue).

A team of Database Analysts then built service-specific screens with order sets within the HIS database. Both technical and clinical members of the Project Team tested these order sets extensively to ensure their accuracy and appropriateness.

Back order entry, which was conducted the weekend before

Figure 3. MOE/MAR project methodology
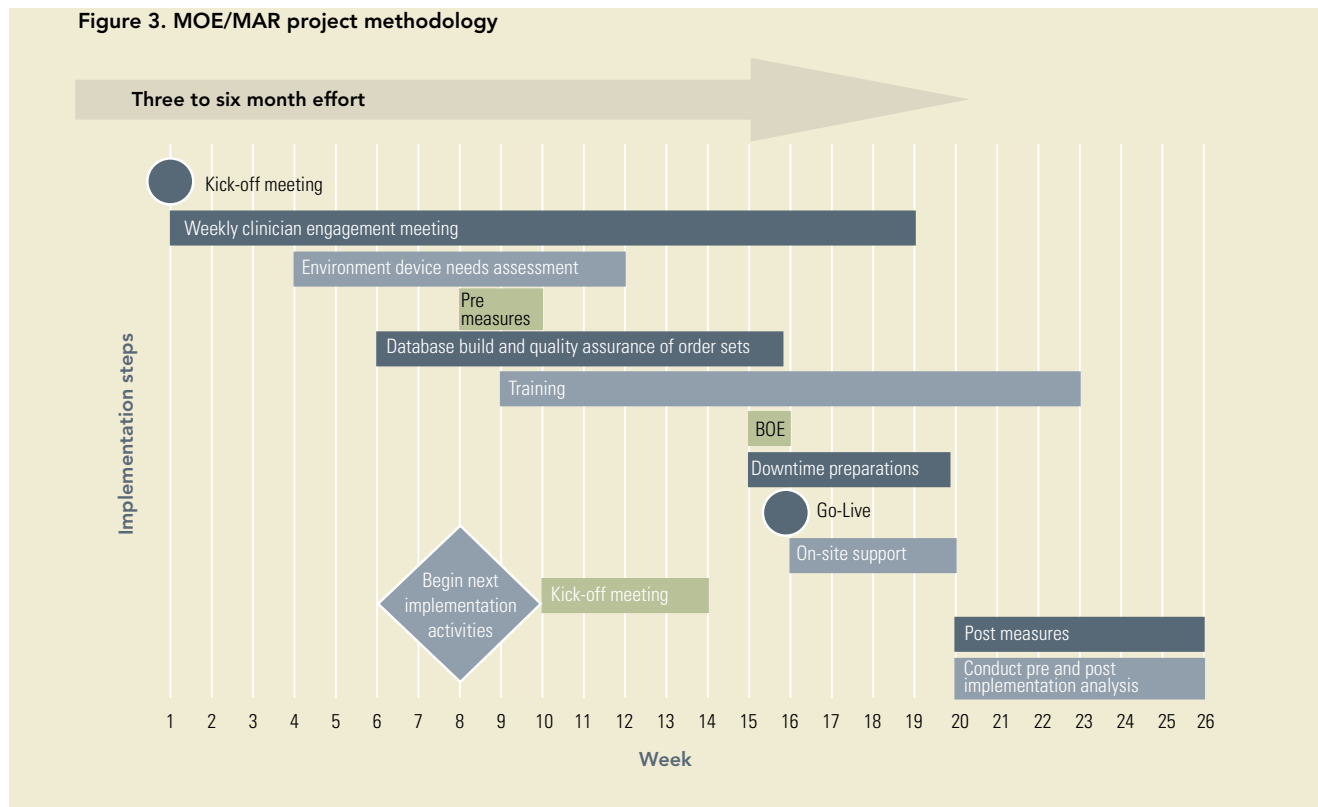
each go-live, was an extremely detailed and labour-intensive process requiring pharmacists to enter all paper-based medication orders for each admitted patient in a particular cluster. A second pharmacist and a nurse verified each order to ensure accuracy.

Downtime preparation included installing a designated downtime computer and printer in each area. We also conducted in-service training on each ward to ensure clinicians knew how to activate emergency downtime procedures in the event of a system outage. As well, the go-live included four weeks of on-site, 24/7 support following each MOE/MAR implementation, during which daily auditing activities were conducted to ensure the new system was being utilized efficiently and safely. Then, and to this day, we believe this was crucial to MOE/MAR's success.

The use of a consistent project management methodology helped the Project Team plan more effectively than if they had used a customized approach for each cluster. It also helped to manage expectations among the clinical teams about their roles when it came time for them to participate in MOE/MAR. Supported by parallel, sub-Project Teams, we could maintain multiple clusters working simultaneously, thus enabling the planned enterprise implementation at a rate of one cluster per four months on average.

Reflections on Implementations

Through its formal learning process, the MOE/MAR Project Team compiled volumes of lessons throughout the entire project. Again, since there were few models of successful MOE/MAR implementations to look to in other hospitals, most of these lessons came from trial and error. This section highlights the most important reflections gleaned from our UHN experience. We acknowledge that in many respects UHN is not a typical hospital. However, we believe that the following reflections can be generalized to any organization contemplating a major CPOE implementation, as they primarily relate to general change management principles.

Avoid Re-inventing the Wheel

Given the scope and complexity of UHN's MOE/MAR initiative, the Project Team sought external project planning and implementation guidance. We did extensive research and sought advice from other hospitals (especially those using the same HIS) that were undertaking similar CPOE initiatives. Most of these hospitals are in the United States.

"We spoke to a number of institutions via phone, and even conducted some site visits," reported a Manager of Information Management. "Although we were able to take a few pieces from here and there, we found that no one was able to provide a

single, complete project management or implementation model that was suitable for our use."

To further strengthen UHN's ability to manage such a complex project, it hired external consultants who had clinical informatics or project management expertise in other healthcare institutions. These consultants were able to suggest valuable ideas about project planning and support. The consultants also validated the Project and Technical teams' change management practices. An independent pharmacy consultant and a nursing consultant were hired to strengthen the clinical support capabilities of the two respective informatics groups. While the consultants were not involved throughout the entire project, they were extremely valuable at the beginning of the Project to fill in skill gaps on the evolving Project Team.

Workflow Redesign Is an Iterative Approach

For physicians and nurses, administering medications is at the very core of how they treat their patients. Implementing MOE/MAR not only impacted how they ordered, procured, administered and documented medications, but also impacted how they communicated with each other. Removing the physician order sheets and paper MARs removed the tools that had been used to convey information between clinicians; thus it was necessary for them to develop alternative means of communication. "Thinking that MOE/MAR is just a medication IT solution would be a serious mistake," reflected a Director of the Project Team. "It's a change management initiative focusing on medication, but it also has a broad impact on the way people in the hospital work."

Redesigning clinical workflow for the electronic environment first required a complete understanding of how clinicians worked in the paper environment. Clinicians were able to describe the way things worked in the paper environment, but it was more difficult to obtain agreement on how things should work in the new electronic world. Often, when processes were redesigned for the electronic environment, they would initially turn out to be impractical or inefficient.

The workflow redesign became an iterative process requiring many attempts to reach a desirable end state. The use of mock scenarios – walking through the major workflows and understanding when, where and what information was needed – helped identify holes in proposed processes and generated new and better solutions. Upon reflection, the Project Team could have conducted more (and better staged) mock scenarios. Had it done so, the resulting workflow would have better illustrated undesirable occurrences that often did not surface until go-live. When this happened, the Project Team had to correct them in a reactive mode. Indeed, one of the greatest challenges for the Project Team was identifying what they did not know.

Expect to Uncover Pre-existing Clinical Practice Issues

Several inconsistent clinical practice standards and policy issues surfaced during the project as a consequence of conducting in-depth workflow analysis and automating manual processes. Although many of these predated MOE/MAR, the project nevertheless often brought these issues "out into the light." For example, the majority of patients

Lessons Learned

1. **Avoid re-inventing the wheel** – Seek outside assistance if possible and learn from others' mistakes first to avoid wasting time and energy up front.
2. **Workflow redesign is an iterative approach** – An on-line medication management system must be designed around clinical users and their workflow. It is important to review, resolve and standardize, wherever possible, all relevant clinical workflow policies and practices before designing the system.
3. **Expect to uncover pre-existing clinical practice issues** – Clinical practice issues and inconsistencies will be exposed when assessing workflow for MOE/MAR. Although they may predate the project, they will need to be resolved to carry on with MOE/MAR implementation.
4. **Credible champions are key to managing change** – Select project "champions" who recognize the benefits of on-line medication order entry and medication administration; who have practical and comprehensive knowledge of the daily clinical processes within their services; who are respected by their peers as credible leaders; and who can challenge peers and others when needed.
5. **Different services have very different needs** – Understand the differences in culture between various hospital services (Medicine, Surgery, Anesthesia, etc.), and make sure the project timelines and workflow design are adjusted appropriately to accommodate those differences.
6. **Expect politically motivated interference** – Do not underestimate the time, effort and resources required in handling project and organizational politics. Project team members should have strong facilitation and negotiation skills to manage sensitive situations.
7. **Continuous communication sets the tone** – Do not "sugar-coat" messages; direct and open communication styles work best when giving tough messages. Also, be prepared to use a wide variety of communication vehicles to ensure that people at all levels receive the key messages.
8. **Proactively manage expectations** – MOE/MAR is a clinical transformation initiative, not just an IT project. The Project Team needs to be able to effectively negotiate with clinical leadership on "needs" versus "wants" in order to gain support for implementation.
9. **Take time to celebrate your successes** – Appreciate that a little recognition goes a long way to maintaining the enthusiasm and momentum needed.

prepped for surgery are given an order for an antibiotic to be administered "on call" to the operating room by the anesthetist. The antibiotic is typically sent along with the patient from the ward, physically attached to the patient's chart. During the MOE/MAR workflow analysis for these medications, it was discovered that often anesthetists typically disposed of the antibiotics that accompanied the patient from the ward and later administered an alternate antibiotic. In this case, the project had exposed a previously existing problem. Although this practice did not have a direct impact on how the MOE/MAR system would operate in the environment, pressure was put on the Project Team to address this issue prior to the implementation in the surgical areas. Realizing this practice issue did not require to be resolved to proceed but would still remain an issue in the post-implementation environment, the Project Team continued with the rollout and highlighted the ongoing issue to existing clinical committees for resolution. MOE/MAR also enabled pre-existing policies to be better enforced than in the previous paper world, where it was difficult to monitor non-compliance. For example, under federal policy, Advanced Practice Nurses (APNs) are prohibited from ordering controlled substances, including narcotics. However, in analyzing their workflow, it was discovered that APNs were previously not prevented from ordering controlled substances (such as Ativan and several types of narcotics). With MOE/MAR, however, the controlled substances policy is automatically enforced through role restriction in the HIS, making it impossible for unauthorized personnel to order restricted medications.

> **It was quickly discovered that the most effective champions were those who: recognized the benefits of on-line medication order entry and medication administration; had practical and comprehensive knowledge of the daily clinical processes within their services; were respected by their peers as credible leaders; and, most importantly, were comfortable in challenging peers and others when needed.**

UHN did not have a forum for these types of issues to be identified prior to MOE/MAR. As such, the Project Team often took on many of them directly, even though they were clinical practice issues rather than directly attributed to the MOE/MAR implementation. In response to MOE/MAR having highlighted a number of these types of clinical practice issues, UHN initi-

ated a new corporate "Clinical Best Practice and Information Technology" committee to be a regular forum where clinical leadership could debate and resolve issues in a timely fashion.

Credible Champions Are Key to Managing Change

At the beginning, the Project Team struggled to find the right mix of people to serve as MOE/MAR "champions" or people that would informally lead other clinicians to adopt MOE/MAR. The Project Team initially turned to clinicians who were "techies" (i.e., those comfortable using new software systems). These individuals tended to be younger clinicians rather than seasoned veterans of their clinical service. Although highly enthusiastic, their junior status hampered their ability to challenge more senior clinicians, and thus diminished their success convincing others of the value of the MOE/MAR initiative.

To facilitate the MOE/MAR rollout, meetings were held with senior leadership within each cluster to identify Physician, Pharmacy and Nursing "champions" to assist the change management team in preparation for the go-live. Working closely with the Project Team on as much as a daily basis leading up to the go-live, UHN's champions supported the workflow analysis efforts and provided specific information needed by the Project Team for building the system, redesigning workflow and preparing to deliver training. The champions also helped with decision-making and with communicating and promoting the project to their colleagues. It was quickly discovered that the most effective champions were those who: recognized the benefits of on-line medication order entry and medication administration; had practical and comprehensive knowledge of the daily clinical processes within their services; were respected by their peers as credible leaders; and, most importantly, were comfortable in challenging peers and others when needed.

Since the time commitment of these champions was significant, the Project Team conducted introductory meetings with them as early as three to four months ahead of go-live – six months ahead in the case of a complex cluster. Most often, these champions – having been identified by the most senior clinical leadership in UHN – willingly engaged with the Project Team immediately. However, escalation to senior leadership was sometimes necessary to "encourage" less enthusiastic individuals to work more closely with the Project Team.

The Project Team never made any final decisions without first getting the cluster champions to sign off (literally) on project plans, workflows and screen designs. This process demonstrated the significance of the champions' role in MOE/MAR and to their units. From the initial introductory meetings through to go-live, meetings between MOE/MAR Project Team members and the cluster champions were held weekly, without fail, to plan for implementation. After go-live, these meetings continued on a daily basis through the end of each cluster's four-week support period.

Education, Training and Support

Due to the large number of staff and the complexity of MOE/MAR, it was determined that training would be best achieved in a classroom setting. The instructional design of the courses – delivered as a suite of on-line tutorials, later complemented by on-line documentation – was done with support from an Education Working Group established for the MOE/MAR project, consisting of representatives from Education, the Project Team, Computer User Support Program and Nursing Informatics. Physician input was also sought during the development of the physician courses.

"This group, which met regularly throughout the MOE/MAR project to review and provide input on education agendas, content and issues, proved to be invaluable to the ultimate success of our education and training efforts," notes the Manager of SIMS Education.

A seven-hour classroom course on MOE/MAR was initially recommended for nurses, while physicians would attend a two-hour course. However, for staffing and financial reasons – it would simply cost too much to take nurses out of service for a full day – the classroom training for nurses was reduced to four hours in length. After MOE/MAR was deployed in the first two clusters, it became apparent that the four-hour classroom courses were not adequate to cover all the training that nurses required, and nurses and nurse managers began asking for longer training sessions. A new five-step education process developed by the Education Working Group provided staff with the training they needed (see accompanying diagram).

CUSP Basic Functionality Training
• Review current functionality (e.g., chart review, patient care schedule)

Pre-Training Drop-In Sessions
• Fifteen minute in-services
• Various topics covered over four weeks (e.g., intro, workflow, MAR)

Classroom Training
• Four hours in length
• Curriculum revisions based on learnings-to-date/new functionality

Post-Training Drop-In Sesssion
• Practice sessions to review concepts taught in training

Four weeks of Go-Live Support
• Reinforce concepts learned in training
• Assist nurses with more complex concepts

1. Basic Functionality Testing
A number of nurses coming to MOE/MAR classroom training benefited from some basic computer and EMR training. Staff from UHN's Computer User Support Program (CUSP) worked with nurse managers in each unit to identify nurses needing assistance, and then delivered basic computer and EMR training through a series of informal, one-on-one sessions conducted in the units.

2. Pre-Training Sessions
A series of 15-minute drop-in MOE/MAR demonstration sessions on each Nursing Unit were included in the training process to relieve apprehension over the new system. This helped increase comfort and knowledge levels before staff went to the classroom, making them better prepared to receive the actual MOE/MAR system training.

3. Classroom Training
Early in the implementation, the project educators found that classroom time for nurses was being consumed by workflow and logistics questions

such as how MOE/MAR would work on their units, how the new point-of-care carts would be used, and so on. While all the questions were valid, they nevertheless took up too much classroom time; sometimes the questions had the result of derailing the classroom effort altogether. To address this problem, the Education Working Group members created a "day in the life" series of photos shot on a ward where nurses were already using MOE/MAR. Through this presentation, nurses got a good idea of what MOE/MAR would look like. Frequently Asked Question (FAQ) sheets were also created and distributed in the classes, providing information on the post-training sessions and the go-live support as well as contact numbers for the Project Team. With workflow-type questions and issues minimized, the four-hour classroom period could be used solely to train nurses how to actually use MOE/MAR. The accompanying chart summarizes the scale of the classroom effort.

After the initial design of the classroom training, the Education Working Group played a key ongoing role as a feedback and curriculum update mechanism. The group provided a forum for discussing class content priorities and helped to ensure that the curriculum was updated as system functionality changed over the course of the full MOE/MAR rollout.

Group	Length of Course	Average Class Size	Number of Classes	Number Trained
Physicians – MOE/MAR only	2 hours	3	423	1,281
Physicians – new to UHN + MOE/MAR	4 hours	5	129	587
Nurses	4 hours	5	434	2,226
Pharmacists	4 hours	5	31	138
Pharmacy technicians	.5 hours	9	2	18
Respiratory technicians	2 hours	4	17	66
Support staff	3/4/6 hours	5	19	101
Total			1,055	4,417

Notes:
• Physicians new to UHN attended a four-hour class (instead of the two-hour class) covering basic HIS functionality as well as MOE/MAR functionality.
• The Physician courses included Staff Physicians, Residents, Fellows, Medical Students and Advanced Practice Nurses.
• The Nurse groups were comprised of separate courses for Nurses, Nurse Managers, Registered Practical Nurses and Nursing Students.

4. Post-Training Sessions
To ensure maximum information retention, classroom training should ideally take place no more than three weeks prior to go-live. Due to the large number of nurses that had to be trained, however, and because they could only be taken off the wards a few at a time, the training for each cluster had to start as much as six or seven weeks ahead of the go-live, by which time much of what they learned could easily have been forgotten. To keep the classroom training information fresh in the nurses' minds leading up to the go-live, the Project Team conducted practice sessions on the units that focused on functional areas identified by the nurse managers as being key to that unit. By reinforcing the classroom learning, these post-classroom sessions proved to be most effective in ensuring a smooth go-live, but only when attendance was mandatory; otherwise, few nurses attended.

5. Post-Go-Live Support

The purpose of this phase of the education was to reinforce the training the nurses, physicians and pharmacists had received during the first four steps of the process and to help them resolve problems they were encountering while actually using MOE/MAR to manage their medication management activities.

Each go-live was followed by a four-week period during which the Project Team provided 24/7 on-site (i.e., right on the unit) support to give clinicians immediate face-to-face assistance as they got comfortable with the system and to help them solve technical or workflow problems as they arose. It was initially thought that four weeks of support might be too long, but it turned out to be necessary. Although the bulk of the questions came during the first couple of weeks, the extra time was needed to cover the unit staff's changing rotation.

During this phase of the education, the project team was expanded through the addition of other staff members from Nursing Informatics, Pharmacy and the Information Management departments to ensure a high level of clinical, technical and project management support capability. Support team members continually roamed within the unit, wearing red lab coats that read "SIMS Support" to make it easy for unit staff to pick them out on the busy floors.

After the Go-Live … Knowledgeable Support Was Key

The questions asked and issues raised were all logged and tracked by the Project Team. Daily meetings between the Project Team and the clinical leadership were conducted during this four-week period to review each day's activities, discuss policy concerns and go through the list of outstanding issues (see diagram below for overview of types of questions received during the four-week support cycle). Resolving issues as quickly as possible showed clinicians that the Project Team was serious about their concerns, thus helping to build stronger relationships and credibility with clinicians in the units. The key to the success of these meetings was that they included the right people with the right authority, so that final decisions could be made and the project could move forward.
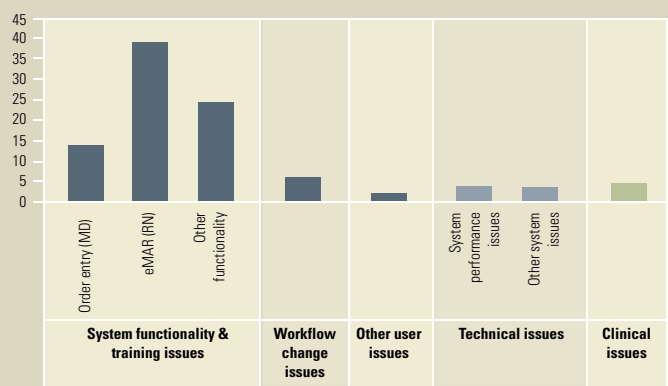
Over time, the Project Team was able to determine when it could taper the support staff on the units over the four-week support period while maintaining an optimal level of support for clinical staff. This was done in consultation with cluster champions, unit managers and other clinical staff on the unit, as each unit was considered unique in its needs for post go-live support.

Different Services Have Very Different Needs

Apart from the need to customize the MOE/MAR system to meet the unique functional and workflow requirements of each cluster, significant cultural and workflow differences were also encountered between various services such as Medicine, Surgery and Anesthesia and specialty services such as the Acute Pain Service. Different services had different needs, thereby presenting different challenges to the Project Team. The impact these differences had on our go-live schedule was initially underestimated.

General Internal Medicine

GIM at UHN is a very collaborative environment where nurses, physicians and pharmacists typically round together. In terms of working with the MOE/MAR Project Team, the physicians showed themselves to be problem-solvers willing to try things out and to compromise. In addition, the staff were willing to incorporate MOE/MAR into their teaching. This helped new residents rotating through the service learn how to use the new system.

Surgical Services

Surgeons and surgical residents are primarily focused on performing surgery. Since most of their time is spent in the operating room, surgeons are usually off the unit for the majority of the day; thus their ordering practices are distinctly different from those in Medicine. Surgeons typically order medications when they do rounds each morning, visiting each of their patients and adjusting their meds as required. After rounds, however, there are often very few surgeons left on the ward to help the nurses solve any problems that might arise with those orders.

Acute Pain Service

The Acute Pain Service deals with the pain needs of both medical and surgical patients throughout the hospital. As such, this group required that their orders be uniquely identifiable from all others. They also required their own queues for identifying and tracking their patients, who could be anywhere in the hospital. Due to the high-risk nature of the drugs that they order, their ordering practices are meticulous and extremely focused on patient safety. As a result, they had high expectations for sophisticated clinical decision support capabilities in the system, including drug-drug interaction checking and duplicate order alerts.

Anesthesia

Because anesthetists operate at such a fast pace and are always under great pressure to keep patients moving through the operating rooms, anesthetists have little time to enter post-op medication orders. With a shortage of staff and with surgery cases often scheduled back to back, anesthetists were highly concerned about the impact on delaying subsequent cases due to the time it might take to enter medication orders.

Expect Politically Motivated Interference

The MOE/MAR project was politicized from the start. Politics existed between middle management and hospital executives; between the three clinical disciplines (Physicians, Nursing and Pharmacy); between the various hospital services; between the individual units within a single cluster.

For all of its meticulous project plans and Gantt charts to estimate time to complete each of the standard activities in a given cluster, the Project Team significantly underestimated the amount of time required to address the politicking throughout the project. Many MOE/MAR Project Managers soon became expert facilitators, negotiating among various groups to bring various political issues to rest. These facilitators often got mired in the middle of issues that had little to do with the technical aspects of the project, but as rollout leaders they were expected to address these issues.

For example, Project Team members were often challenged with questions about the benefits of the initiative and why UHN was investing in such a large project. Because many staff perceived the project as likely to increase their workloads, they resisted the change. Project Team members were often criticized for being too pushy or for making decisions without having all the information. In spite of this resistance, however, the Project Team had to keep the project moving forward. For nearly half of the 20-month project, the Project Team was consumed with relationship development, political adversity and helping intended users appreciate how MOE/MAR could help them improve patient care and safety.

Continuous Communication Sets the Tone

At the beginning of the project, the Project Team tried to "sugar-

Figure 4. MOE/MAR report card

coat" the communications regarding the impact the new system would have on the staff. In retrospect, it was obvious that its failure to be fully open with senior management (in other words, shielding senior management from some of the implementation problems) was a mistake, as it risked confidence in the Project Team's ability to deliver. There was also considerable initial nervousness about sharing too much too soon, so initial communications were very targeted rather than broad-based. The Project Team's initial strategy was to wait until it was absolutely sure it was going to be successful before initiating communications.

After the lessons of Cluster #1, the Project Team started using a variety of mass-communication vehicles – e-mail, newsletters and UHN's intranet – to inform the clinical population about the benefits the system could deliver as well as the potential impact it could have on them as individuals. As part of their effort to build face-to-face relationships across the organization, Project Team members took advantage of every opportunity to present the MOE/MAR story to as many groups as possible. Key messages in later communications came to be more up front about the need for the substantial knowledge and skill development that would be needed to use MOE/MAR.

A number of project management and reporting tools were used on an ongoing basis to keep hospital staff informed of the project's progress. Biweekly Status Reports were sent out to a massive distribution list, providing an update on project milestones, issues and risks. A project Report Card used green, yellow and red indicators to score how each unit was progressing in terms of measures such as the percentage of physicians that were placing orders directly into the new system (see Figure 4). Interestingly, this report card led to an informal competition between the units based on their respective CPOE rates, which pressured less compliant units to improve.

Proactively Manage Expectations

A big challenge was to continuously manage the staff's expectations. Because UHN was an early adopter of this new technology, the Project Team expected that difficulties would emerge. Open and honest communications helped staff stay focused on the bigger picture goals, making it easier for them to accept that new changes to the system could take multiple years to implement.

Another constant challenge for the Project Team was staying focused on the project scope and distinguishing between legitimate user needs versus wants. Virtually every service within the hospital had a "wish list" of things they wanted that were beyond the scope of what the MOE/MAR project could afford or deliver (mainly in the areas of system functionality and device requests). Although most of these were revealed during the initial workflow assessments, additional requests surfaced during go-live and the subsequent support phase. Rather than taking these

wish lists at face value, the Project Team had to work closely with cluster champions to identify the true priorities.

Take Time to Celebrate Your Successes

MOE/MAR was a long and difficult project involving commitment and considerable effort from many people. As each cluster was successfully deployed, an executive site visit was conducted to bring senior hospital leadership from across the organization, including the CEO, to congratulate the unit and thank front-line staff for their hard work. A site-wide celebration was also held after the rollout of MOE/MAR was completed in each hospital, which was well attended by front-line clinical staff. While not initially budgeted, these celebrations were well worth the expense as they became important milestones to signal the hospital's appreciation for the staff's contribution. They also helped maintain the enthusiasm and momentum as deployment continued in other clusters.

Conclusion

In what most feel was the most challenging, yet most rewarding project they had ever been involved with, the Project Team spent a great deal of time and effort ensuring that the MOE/MAR deployment went as smoothly as possible. Throughout all phases of the MOE/MAR project, each cluster challenged the Project Team to develop new approaches and more efficient project management methods of engaging clinicians and leadership in the change process. Although UHN clinicians are now able to access the full functionality of MOE/MAR, the work continues. MOE/MAR is a significant step to realize UHN's goals of improved patient safety.

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Commentary

MOE/MAR Project Management: A (Well-Informed) Bird's Eye View

Denise Zarn

As an outsider looking in, I can confidently say that UHN has done a spectacular job implementing MOE/MAR. The University Health Network (UHN) has long viewed information management (IM) as important to its mission to provide exemplary patient care and innovative research and teaching. Consequently, for the past five years UHN has asked my company to conduct an annual review of the hospital's IM strategy and related implementations. So again this year, as leader of the Accenture review team, I was privileged to get a first-hand look at UHN's progress. Our review included in-depth interviews with executives and clinicians as well as staff focus groups drawn from across the organization that gave the MOE/MAR (order entry) project high praise. We also applied other measures, including a survey that was responded to by nearly 500 physicians, nursing and allied health professionals.

> ## I also know from my own involvement in UHN's first order entry project nearly 20 years ago that implementing MOE/MAR has been no quick-fix, overnight task.

I also know from my own involvement in UHN's first order entry project nearly 20 years ago that implementing MOE/MAR has been no quick-fix, overnight task. When the hospital first embarked on its electronic patient record journey, it was thought it would be accomplished in three years. However, no one imagined then how difficult this project would be in the long run. In response, the organization and the staff in charge of the electronic patient record project (of which MOE/MAR is a significant portion) have consistently shown an unusual amount of organizational tenacity, paired with substantial investment to support its IM implementations – 4% of operating budget annually, compared with 1–2% at most other Canadian hospitals.

What's behind UHN's IM success to date? Rigorous project management expertise and achieving actual senior clinician sponsorship are two success factors that my team has witnessed over the past five years.

SIMS (UHN's shared information management services group) is expert at project management – and not just by adhering closely to good project management principles. Eighty percent of SIMS' project managers are certified by the Project Management Institute (PMI) and the rest are in progress for their certification. SIMS has nurses, physicians and other clinicians on staff who provide clinical expertise and credibility to its implementations. All SIMS project staff must complete rigorous user requirements, clinician-approved test and training plans and evaluations of every project to ensure that projects deliver on plan. When SIMS project staff put a project plan together, the Project Management Office enforces it aggressively.

What's behind UHN's IM success to date? Rigorous project management expertise and achieving actual senior clinician sponsorship …

Because order entry has such significant clinical impact, SIMS very carefully and deliberately engaged senior clinicians alongside senior executive management to own the project. Although our review uncovered multiple occasions where obstinate clinicians could have derailed the entire MOE/MAR initiative, sponsors readily addressed issues head-on before they could undermine the project.

This year the release of our IM review coincided with final implementation of MOE/MAR's phase-one rollout. And how did people feel about it by then? It was very encouraging to find from our survey and focus groups that 73% of UHN clinicians understand the goals of UHN relating to information management and the electronic patient record, and that MOE/MAR was rated as the Number One information technology tool that has had the most positive impact on clinicians' work environment.

About the Author

Denise Zarn is a partner in the Health and Life Sciences Practice at Accenture, Inc. She has been involved in physician order-entry projects for over 20 years and has worked on advancing electronic patient records at the enterprise and regional levels both in Canada and the United States.

The Time Has (Finally) Come for the Digital Hospital

As anyone with the slightest connection to the healthcare sector knows, hospitals are unique environments. They are the cornerstones of our communities and they provide for the well-being of our citizens.

Physically, they are complicated places, with buildings, people and a vast amount of sophisticated equipment. Publicly, they are under constant scrutiny and pressure to become more patient-centred. Financially, they face a near-constant state of having to do more with less.

Understandably then, the technology requirements of hospitals are unlike those encountered in any other sector.

> " St. Olav's Hospital will probably be one of the world's most advanced for some time to come. Among other things, we are the first hospital in the world to operate all data, TV, radio and voice communication via IP.

For quite some time, the ideal hospital was envisioned to be unified, well-equipped technologically and multi-functional; however, for a variety of reasons – not the least of which is budgetary restraint – hospital IT environments have featured piecemeal implementations, which might satisfy financial management concerns, but do little to increase patient comfort and care or meet increasingly sophisticated departmental needs.

After many false starts, stretching back at least two decades, where the existing technologies – both hardware and software

– simply could not deliver on the promise of complete integration, greater efficiency, at less cost, the Digital Hospital is now finally a reality.

The Digital Hospital Arrives

Serving a regional population of some 650,000 people, the 1,000-bed St. Olav's Hospital – a health enterprise and university hospital located in the mid-Norway health region near Trondheim, Norway – has become one of the world's first hospitals to implement a Digital Hospital Infrastructure or DHI.

In some respects, it was a matter of technology advancing to the point where specific developments – in this case, the robust Internet Protocol or IP Network and the increased functionality of wireless devices – matured to the point where both widespread applicability and a reasonable cost have now become accessible.

The IP net-work at St. Olav's has con-verted its 11 buildings and grounds into one massive "hotspot" where-in a single central network can be wirelessly accessed by a variety of devices – transportation robots, laptops and telephones.

To ensure maximum usage and buy-in, every employee at St. Olav's has an IP phone and access to a PC. The telephone offers direct and efficient communication including patient signal, and, in the near future, staff may view patient information and day-to-day task lists as well as receive notifications.

And when it comes to collaboration, data created by vital hospital equipment and patient monitoring devices, machines like the ECG – which gather and monitor information but often

can only display it locally – a DHI enables this data to travel seamlessly from one instrument and be made available to user output devices.

For teaching purposes, the network is also enabling real-time learning. Through the DHI, students and aspiring surgeons alike are given remote access to operating theatres via broadcast access points situated in the complex's auditorium. These events are made available live or in a recorded format, and allow students to get a first-hand look at medical procedures in-action.

Acting on the Data

While comprehensive record keeping is paramount to the healthcare sector, patient records are, if you will, an "after the fact" application, an account of what has happened and only as current as the last entry. They cannot actually deliver a service in real-time to patients. Part of the appeal of the DHI is that an IP-based network can act in real-time to govern the dispatch and monitoring of healthcare professionals on an as-required basis.

For example, with the Nurse Call application, when someone triggers a bedside alarm button, a message is sent to a dedicated server that shows the location of the pressed button on one or more Nurse Station displays, while instantly sending a message to the Nurse Call Process, locating the nurse assigned and sending an alarm message to the nurse's mobile device. It's like having a medical professional constantly at a patient's bedside.

There's also an application for hospital orderlies that assigns duties such as moving a patient from one place to another or taking a drink to a patient. Taking into account proximity and workload, this application streamlines the delivery of routine tasks.

For the patient as well, the DHI can deliver impressive features through a Patient Monitor – everything from streaming video to high-speed Internet, to telephone access and food orders. The end result of such convenience and connection is that patients feel less isolated and more entertained or occupied during their stay.

"When it comes to technological infrastructure, St. Olav's

The Digital Hospital Infrastructure enables data to travel seamlessly from one instrument to another and be made available to user output devices, such as broadcast access points allowing medical students remote access to operating theatres.

Hospital will probably be one of the world's most advanced for some time to come. Among other things, we are the first hospital in the world to operate all data, TV, radio and voice communication via IP," notes Tore Indrerak, Head of ICT for Helsebygg Midt-Norge, the healthcare authority for the central Norwegian area.

Given this functionality, medical practitioners and support personnel are finding that the time wasted in locating staff not on duty is much reduced. For example, calls can be made to the "anesthetist on duty" without consulting duty rosters; as such, getting service to the end user – the patient – happens in a much more timely fashion.

Over the coming months and years, there will doubtless be many more discrete medical and administrative applications developed. With the open systems architecture of the DHI and the Internet, they will easily be integrated into the infrastructure.

The Team Delivering DHI

Hewlett-Packard has assembled and leads a consortium of companies – each expert in its respective field – to provide *all* the building blocks of an integrated Digital Hospital Infrastructure.

Based on its successful experience at St. Olav's, HP brought Cisco Systems on board to provide the communications backbone – Cisco's Medical Grade Network, designed specifically for healthcare environments, which demand high availability and rapid response times.

Cardiac Medical AS is a premier designer of medical devices and software. Its IMATIS Inte-gration Platform is an integration engine that compiles, collates and visually presents massive amounts of current information from networks, data sources and equipment anywhere in the hospital. Through rules, modelling and forecasting defined by an individual hospital's own policies and procedures, this information is highly usable and immediately actionable.

Security, Availability Issues

Security features (i.e., levels of access) are inherent in any IP system that meets the stringent legal and ethical needs for patient record confidentiality. Pre-set parameters to digital records are routinely simpler to enforce than monitoring physical exposure to paper-based files, so patients and administrators can be assured that only those who need to know have access to files.

Clearly, system availability within the 24/7 healthcare environment is crucial; system downtime is simply not an option. St. Olav's has duplicate or redundant fault tolerant systems at every point.

Core Benefits

In addition to significantly reducing "running" time, a key benefit of the DHI for healthcare professionals is a marked decrease in the laborious, often error-prone manual processes. Less paperwork means more patient care.

The DHI enables a reduced stress level by eliminating overhead paging and visible/noisy patient signals. With nurses receiving patient calls directly and patients all enjoying IP-based entertainment terminals in their single rooms, the entire environment is more comfortable and less anxious, which can help speed patient recovery and release, while reducing stress and strengthening trust and confidence in the outcomes of their stay.

For hospital administrators, there are a number of concerns that a true DHI addresses. Most important, productivity increases with all the financial and operational benefits such improvement entails. Precious human and dollar resources are put to better use because of improved access to information, less duplication of effort, faster response times and shorter patient stays. Moreover, increased control over physical assets results in better utilization rates and tracking.

Looking forward, a DHI is clearly a long-term solution because, simply, the Ethernet does not age. Being open standards and Internet-based, the DHI can reach back, to incorporate legacy systems and devices, thus protecting investments already made. At the same time, it can reach forward to accommodate future developments that may only be a notion today.

This inherent flexibility means that return on investment is rapid, and that new applications can be brought on-line as appropriate and with the full knowledge they can be integrated into the existing infrastructure without major retrofitting.

Operationally, hospitals with a DHI will experience cleaner workflows and processes by eliminating bottlenecks and achieving quicker responses with better information upon which to make more informed decisions. At the macro-level, administrators have a better overview of workloads and requirements so that they may allocate human resources more effectively.

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Understandably, over the years, hospitals have been frustrated and consequently suspicious of unfulfilled promises concerning the "next" great thing in healthcare delivery and administration. Equally reasonable is the continual demand for affordable, sustainable healthcare technologies to meet ever-tightening budget considerations.

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Thorough **Planning** and Full **Participation** by Pharmacists Is Key to MOE/MAR Success

Monique Pitre, Karen Ong, Jin-Hyeun Huh and Olavo Fernandes

Introduction

The successful implementation of the University Health Network's (UHN) Medication Order Entry/Medication Administration Record (MOE/MAR) project was dependent on the Pharmacy department working collaboratively with many other stakeholders in the organization. This paper highlights the Pharmacy department's contribution to MOE/MAR by assessing four main areas: (1) the Pharmacy department's role in developing the technical MOE/MAR solution; (2) Pharmacy department staffing challenges; (3) workflow changes and "workarounds"; and (4) clinical practice changes to support the implementation. While some of the patient safety benefits from MOE/MAR will be alluded to in this paper, more detailed analysis of MOE/MAR benefits are found in "The Benefits of the MOE/MAR Implementation: A Quantitative Approach" (see p. 77 in this issue).

The UHN Pharmacy department had been using a Pharmacy departmental application since 1996. Although not "perfect," UHN pharmacists were generally satisfied with the vendor and comfortable with the application's medication inventory and dispensing functionality prior to MOE/MAR. In this regard, the Pharmacy department was used to working with electronic tools to support departmental processes. With MOE/MAR, the Pharmacy department wanted to continue to use its own Pharmacy departmental application to process orders once received, while replacing the former paper ordering process with electronic orders. While there was concern among pharmacists at UHN about the inevitable changes that MOE/MAR would bring, it was well understood that this electronic capability was a key enabler to achieving many patient safety benefits.

To monitor the balance of operational workflow changes with patient safety benefits, the Pharmacy department would conduct a time and motion study to assess the pre- and post-time for pharmacists when processing an order to evaluate the project's impact on staff.

As expected, MOE/MAR brought substantial changes to the Pharmacy department's electronic tools and related workflow. These changes required many departmental accommodations in order to support and sustain the implementation.

Pharmacy's Role in MOE/MAR Development

Developing UHN's technical solution to support MOE/MAR proved to be a highly complex undertaking. Many stakeholder groups were involved in integrating the Pharmacy departmental application with the existing hospital information system (HIS) that was to be used by physicians, nurses and pharmacists for MOE/MAR. These included the Pharmacy department, the organization's information technology department (known as Shared Information Management Services (SIMS)), the Nursing Informatics Department and clinicians (e.g., physicians, nurses, pharmacists).

In developing the overall MOE/MAR strategy, the Pharmacy department's interests in keeping its own application were well understood by the senior leadership at UHN. The initial planning that led to UHN's decision to remain with the existing vendors and develop interfaces between the HIS and Pharmacy departmental application was led by SIMS, with input from the Pharmacy department, based on the costs, feasibility and ability to deliver the project in a timely fashion. Although this decision did ultimately receive the support of the Pharmacy department,

more direct participation in this decision-making process by Pharmacy could have reduced some of the inter-departmental conflict that was experienced. More importantly, had Pharmacy staff been involved earlier in the design process, the development phase would have been accelerated.

The Pharmacy department was involved in numerous technical development activities including database development, system-to-system interfacing, user screen design and design of system functionality. Each one of these activities proved more challenging and time consuming than either the Pharmacy department or SIMS originally thought when early project plans were devised. The total time from the date we initiated the system integration work to the date we piloted the MOE/MAR solution in production required three years. Further changes were required over the next 18 months before enterprise implementation could begin.

> **… there is a fundamental difference between physician order entry systems and Pharmacy departmental systems. Physicians do not order products; they order medications.**

The database development effort to support MOE/MAR was complex due to (1) the need to accommodate the UHN's medication formulary, (2) the variety of other medication products and (3) the many possible routes of administrations. The UHN formulary lists more than 3,000 products, each of which has specific dose information. Each product requires a separate set of technical development tasks based on the type of product, the route of administration, special administration requirement or hospital restriction policies. The original estimate for the entire database build for all of the organization's medications was only three to six months. After only minimal progress was achieved in the first three months, this quickly proved to be an unrealistic goal, given the complexity of UHN's environment and patients. Given this realization, it was determined that the build effort would have to be done incrementally – service by service – instead of trying to build everything at once. In large part, this incremental technical approach was a major factor in establishing the overall project management implementation approach (to be described in more detail later).

The database development effort was also complex due to the many different clinical requirements for how medication orders should be placed and administered. UHN clinicians wanted to see their "typical orders" for each generic medication on the formulary. These typical orders should list the most common doses ordered as well as the possible routes of administration and the schedules. Most typical orders were complete orders (i.e., dose, route and frequency); however, there was also the desire to have the option for a physician to change a dose or schedule. Clinical pharmacists provided significant input to the process to build orders, including data from Pharmacy departmental system reports that provided historical prescribing patterns. These were important inputs to enhance the build process that had been initially led by SIMS technical staff. Eventually, the Pharmacy department and SIMS began to identify building standards across multiple orders. Unfortunately, this happened only after a large number of them had to be rebuilt after realizing that they did not initially meet clinicians' requirements.

Notably, there is a fundamental difference between physician order entry systems and Pharmacy departmental systems. Physicians do not order products; they order medications. For example, a medication such as acetaminophen is available as approximately 10 different branded products (Tylenol®, Life Brand®, etc.). Pharmacy-based systems are product-driven while a physician-based system is based on dosages. Most Pharmacy departmental applications are linked to inventory management and are built around the product being dispensed. In order for the two systems to communicate, there had to be a way of translating the medication/dose/route into a product. In order to accomplish this task, interfaces were built around the assumption that the computerized physician order entry (CPOE) functionality in the HIS would pick the product and send the product code (mnemonic) to the Pharmacy departmental application. This meant that the product tables (catalogues) had to be identical in both systems.

Another function to be built into the technical MOE/MAR system was a feature to accommodate pharmacists' ability to override the system. For example, if a physician placed an order for metoprolol 75 mg twice a day, the dosage is the most important factor for that physician. But if the pharmacist did not have a 75 mg tablet of metoprolol, could the patient receive a 50 mg and a 25 mg (or 1½ of a 50 mg) tablet instead? Prior to MOE/MAR, the clinical pharmacists made such decisions as they entered orders into the Pharmacy departmental application. With MOE/MAR, the order indicates exactly what the physician ordered, which takes away some of the flexibility needed by pharmacists if they do not agree with a particular order. The interfaces between the HIS and the Pharmacy departmental application had to allow pharmacists to override the exact order for such substitutions when deemed clinically appropriate.

Pharmacy went through many iterations of testing the system – going through every order that was built – to see if it was clinically appropriate and if the interface was working correctly. Simple orders worked fine, but for complex orders (such as continuous infusions) a much more intricate build

and testing process was required. In our early plans, we underestimated how complex this interface mapping between the HIS and Pharmacy departmental application would be. Thus, perhaps the most important lesson learned during the MOE/MAR implementation process was the need for adequate time to complete advance work well before "go-live." Vendor staff, Pharmacy department staff, clinicians and SIMS had to work very closely together to ensure that all teams were working in a coordinated fashion. This did not always occur, resulting in rework and slowing progress at times.

Another technical challenge pertained to developing usable computer screens that would support MOE/MAR functionality. Different clinical services had very different needs from one another. Before MOE/MAR, paper order sets (bundled orders of typical medications for specific clinical service areas) were highly customized to the specific needs of each clinical service. When it came time for MOE/MAR screens to be built to support order entry functionality, the lack of a standardized approach to the original development of paper order sets made the electronic build process very complex. To lessen the impact on physicians and nurses, the technical team accommodated these differences into the order sets. This proved problematic in implementation, however. While less of a workflow issue for pharmacists, this lack of standardized screens made it more difficult for interns and residents to use the system later, since they rotated through multiple clinical service areas.

We also discovered numerous complexities while building the functionality into the user screens designed to support the MAR. This included the need to understand various interpretations in how nurses administer medications based on the orders. For this, an intimate understanding of the nurse's and pharmacist's roles was required. In any hospital, numerous professional judgments are involved in the administration of medications, and these judgments were difficult to capture in the MAR requirements during the design stage. After multiple iterations of building the electronic MAR functionality through a series of mock workflow scenarios, it became clear that the design of MOE/MAR required early Pharmacy involvement. Throughout the technical development phase of MOE/MAR, the Pharmacy department was concerned about Pharmacy workflow changes that would be triggered by the new functionality. As this likelihood became apparent, Pharmacy truly became engaged in and took a larger leadership role in the technical build process. However, engaging in the project had been very difficult especially in the first year. The Pharmacy department had pulled individuals from various clinical duties in order to backfill for those individuals involved in the technical build process. There was no planning in the initial project plan to add new Pharmacy resources to support this work. As such, it was a struggle initially to get pharmacists to participate in the building and data quality assessment work while also juggling clinical pharmacy responsibilities.

Pharmacy Department Staffing Challenges

There were numerous staffing challenges experienced by the Pharmacy department as a result of participating in the MOE/MAR project. Already experiencing staffing shortages, the Pharmacy department had the added pressure to allocate staff time toward technical development work as well as provide input in various leadership forums created to support MOE/MAR.

Given these demands, Pharmacy department management became increasingly concerned with protecting adequate levels of staffing to maintain clinical pharmacy operations. To ensure project success while maintaining clinical pharmacy operations, UHN created the position of Manager, Pharmacy Clinical Informatics. The individual recruited into this role had both a pharmacy and information technology background that made this individual well suited to take on project leadership to direct the Pharmacy department's contribution to MOE/MAR.

During the first year of the MOE/MAR project, the Pharmacy department supported five full-time equivalent pharmacy positions to contribute to the project by providing clinical expertise and input to the system design and development effort. However, these were not fully dedicated to the MOE/MAR project. As a result, these pharmacists were often challenged to manage their project work and their clinical work.

Senior leadership realized that the Pharmacy department's involvement was critical to the overall success of MOE/MAR and allocated additional resources to the project to increase the department's capacity. This resulted in the formation of a new Pharmacy Informatics team led by the Manager, Pharmacy Clinical Informatics. It included a full-time pharmacist, three part-time pharmacists and three application specialists. These new positions were fully dedicated to working on MOE/MAR, rather than being split between clinical and project duties. The pharmacists on the team were responsible for the data quality and clinical pharmacy assessment of the functionality built into the MOE/MAR system. The application specialists were also important in troubleshooting any issues with the interfaces between the HIS and Pharmacy departmental application.

In addition to supporting technical development work, the Pharmacy department leadership participated in the UHN MOE/MAR Project Steering Committee. This Steering Committee was instrumental in informing policy changes, recommending resource allocation changes, clinical practice changes required for implementation, and other key MOE/MAR development issues described in the previous sections. However, it was not a suitable forum to address more tactical issues regarding standardizing the design and build of the MOE/MAR technical solution. Within UHN, there was no other forum aside from working group meetings within the discrete hospital departments (e.g., Pharmacy, Nursing Informatics, SIMS) to discuss and debate issues that required both clinical and technical stakeholder input. This resulted in the tactical issues occasionally

being brought to the Project Steering Committee, only to be delegated to individual departments to resolve. Only after the enterprise rollout of MOE/MAR did the UHN finally create such a forum, called the "Clinical Best Practices and Technology Committee." This was born from the need for a forum involving both influential hospital leaders and front-line staff.

Clinical front-line pharmacists also faced a significant change as a consequence of MOE/MAR. Thus, it was important for Pharmacy leadership to meet with these pharmacists regularly not only to keep them up-to-date, but also to get their feedback and to show an understanding for what they were going through. Regular and frequent communication within the entire Pharmacy department was critical to keep staff informed of the project and its impact on day-to-day operations. This revealed that pharmacists wanted to understand the specifics of how their roles and duties might change in addition to understanding the strategic importance of the UHN's patient safety strategies. Pharmacy leadership made every attempt to be realistic with pharmacists. This included setting expectations that the initial go-live might not be the ideal end-state model. This helped to prepare the team to embrace challenges as opportunities to improve, rather than just as setbacks.

Staffing Challenges with the "Cluster" Approach

As previously mentioned, the complexity of the technical build process led to the realization that project implementation should be broken down into interim steps. Senior hospital leadership was concerned with the organization's ability to implement MOE/MAR using a "big bang" approach. As a result of months of discussions, the Pharmacy, SIMS and Nursing Informatics departments worked with UHN's senior leadership to identify the "clusters" for enterprise implementation. Clusters were groups of clinical services bundled for implementation due to similarity in patient populations, clinical workflow, medications ordered and geographic proximity. The intent was to identify these like clinical service areas and bring them "live" together to reduce the opportunity for creating "hybrid paper-electronic environments" where MOE/MAR Units would have to substantially interact with units that had not yet implemented MOE/MAR.

The first group to go live with MOE/MAR was the Inpatient Nursing Units in General Internal Medicine and the Emergency department. From the Pharmacy department's perspective, this resulted in a superb mix of orders that helped pharmacists understand the range of complexities in the medication ordering and administration processes. However, due to the many system enhancement requests with this initial cluster, the Pharmacy department and MOE/MAR technical groups were not able to implement any other clusters for another 18 months until system functionality and workflow issues were addressed.

Such a cluster approach allowed us to focus on the orders for specific services one at a time. It made for a logical and focused way of implementing the system, as it created the opportunity to incrementally bring medication orders on-line rather than having the pressure of anticipating all medication order types for the entire organization at once.

While the clusters provided an effective method for UHN to implement MOE/MAR across the enterprise, many pharmacists believed that the organization could have done a better job providing support after the cluster implementation was completed. Each cluster go-live was supported with four weeks of on-site, 24/7 support to the units. Many pharmacists would have preferred more continuity in communication with the project staff over a longer duration beyond the four-week cluster support time frame. However, due to project resource constraints, this was not possible.

> **Clinical front-line pharmacists also faced a significant change as a consequence of MOE/MAR. Thus, it was important for Pharmacy leadership to meet with these pharmacists regularly.**

As well, from the Pharmacy department's perspective, some of the cluster go-lives were scheduled too closely together over the duration of the entire MOE/MAR project. The Pharmacy Informatics team had difficulty supporting the aggressive cluster schedule. While these individuals were supporting one cluster, the same people were asked to work with the other project team members to prepare for the next cluster. To keep pace, the pharmacists had to communicate findings and decisions from previous clusters to benefit the planning and implementation of the next cluster. When this information was not easily accessible to all staff it further exacerbated the difficulty in working to tight timelines.

Workflow Changes and "Workarounds"

The transition from a paper to electronic order entry and medication administration required a continuous effort to review pharmacy workflow changes and their potential impact on Pharmacy policies. Many issues surfaced only during cluster implementations. This required the Pharmacy department, particularly the Manager, Pharmacy Clinical Informatics, to constantly assess operational changes that might need to be made to support the new electronic environment throughout the duration of the project. For example, under the new process physicians would need to schedule "now doses" if they wanted a medication to start right away. Physicians using MOE/MAR often overlooked this step in the early clusters. This resulted in

pharmacists needing to clarify orders with physicians for the start time and date. Medication order clarification requests by pharmacists were sometimes considered a nuisance by physicians. For now doses, the timeliness of orders and, more importantly, the administration of medications created urgency in this follow-up. Therefore, the scheduling step became a policy requirement that physicians had to meet for such orders to ensure patient safety.

Another significant workflow challenge pertained to those occasions when patients moved from a MOE/MAR Unit to a unit that had not yet implemented MOE/MAR. This occasionally increased the chance of medication order discrepancies from one unit to the next. Early clusters struggled with patient transfers between units, but planning for this challenge did improve with subsequent clusters. Key changes made in these later clusters included improved attention to cross-unit policies regarding patient transfers and increasing nursing staff training to prepare for medication orders and administration needs when transferring patients to another unit. To date, UHN has not yet implemented MOE/MAR in its Transplant Unit or the Intensive Care Units. As such, it is still necessary for pharmacists to closely monitor patient transfer medication orders to ensure that discrepancies do not arise when patients are transferred to/from these areas.

There were numerous instances where pharmacists had to perform extra steps to accommodate system limitations, or implement "workarounds." For example, if something could not be built to interface correctly from the HIS to the Pharmacy departmental application, pharmacists would have to accept the order in the format it came in. They would then manually create a separate order in the Pharmacy system with the proper format. This created a need for pharmacists to remember to apply certain workarounds to accommodate system limitations.

In a time and motion study conducted within the Pharmacy department, it was determined that there was no significant difference in comparing the overall time required to process an order in the MOE/MAR system (i.e., order verification) from the time required for a pharmacist to enter the order manually into the system. The time required to complete the clinical pharmacy evaluation of the order remains the same. Prior to MOE/MAR, pharmacists would utilize the paper orders for their clinical assessment and only enter an order into the system once they had determined its appropriateness. Now with the orders electronically interfacing into the Pharmacy departmental system, pharmacists find they are highly dependent on pharmacist-computer interaction for daily work activities. While disappointing that the order verification and clinical assessment processing time had not decreased with MOE/MAR, this study was important to ensure that the patient safety mandate had not had a significantly negative impact overall on the Pharmacy department's operations.

Lessons Learned

1. Involving front-line pharmacists early in the design process and throughout the project is critical to success.
2. Allow protected time for front-line pharmacists to take part in technical design and development rather than adding it onto their other clinical responsibilities.
3. A time-neutral impact on pharmacist work effort as it pertains to processing a medication order is achievable; however, workload time savings were not achieved at UHN given the need for additional time.
4. The patient safety mandate was advanced through the elimination of transcription errors, improved communication among clinicians, greater availability to patient clinical data to support decision-making and the use of real-time clinical alerting.
5. Consider the "cluster" approach to implementation, which is based on the examination of similarities in patient populations, medication orders, dispensing and administration workflows, and geographic proximity.
6. Continuous quality improvement and lessons learned from each cluster implementation should be documented, shared and adopted in future implementations.
7. Plan to mitigate the potential risks associated with medication order discrepancies in "hybrid environments" (e.g., MOE/MAR Units working with non-MOE/MAR Units within the hospital).
8. Anticipate and prepare for changes in pharmacist workflow/operational processes, including adapting to electronic means for communication and documentation to allow for smoother clinician transitions.
9. MOE/MAR can complement existing clinician expertise, judgment and interpersonal interactions, but cannot replace them.

The challenges indicated here were unexpected at the start of the MOE/MAR project. With experience, the Pharmacy department learned how to handle these issues through an iterative approach to identifying issues and real-time problem-solving. Arguably, the Pharmacy department leadership knew at MOE/MAR's outset that it would not be able to anticipate all workflow issues that might arise. However, the frequency of these types of issues, and their broad organizational impact, was substantially underestimated by all involved. Critical for us at UHN, and for others contemplating the introduction of MOE/MAR, is the need to ensure that processes and the technical functionality of the MOE/MAR system support clinical judgment, rather than clinical judgment being constrained by system functionality.

Clinical Practice Changes to Support the Implementation

A transition from paper-based to electronic orders represented a major, positive adjustment for pharmacists in their peer-to-peer communications and use of the HIS functionality. Pharmacists were highly familiar with the many espoused practical benefits of CPOE, including the reduction in medication errors associated with handwriting illegibility, nursing transcription and pharma-

cist computer entry from paper-based orders. UHN pharmacists believed that MOE/MAR was the right thing for the organization to implement, despite the anticipated challenges of changes to clinical practice to support new multidisciplinary prescribing, dispensing and administration practices.

For example, prior to MOE/MAR, pharmacists would frequently make follow-up notes on paper orders to consult with other pharmacists to seek their professional opinion. These notes on the paper orders or other "problem orders" would often be physically placed into a desk tray to be resolved at a later time. Pharmacists adapted to the paperless environment by developing an electronic note field similar to an electronic Post-it Note® for the order. Since this communication information was now recorded electronically into MOE/MAR, it was accessible to other pharmacists. In the paper world, a pharmacist's scribbled notes would often be discarded even though other pharmacists could have benefited from reviewing the information. This electronic communication field improved the efficiency of the communication process between pharmacists.

Another change to Pharmacy with the paper-to-electronic transition included access to more comprehensive patient information to support the medication clinical assessment process. With the paper-based prescribing system, pharmacists used to view lab and diagnostic orders on the same paper order sheet. For example, antibiotics may have been previously ordered on paper in conjunction with microbiological cultures and antibiotic levels. With MOE/MAR, pharmacists view medication orders on a different screen from the other clinical orders. This change required some pharmacist adaptation in workflow by requiring an extra step to review patient charts – that is, the lab order entry section – in order to obtain the information needed to determine medication appropriateness. In some cases, this review process in the patient chart has led to changes in the pharmacist's process to completing essential cognitive patient medication assessments. Although this has presented pharmacists with new steps in their workflow, pharmacists also believe that this increased access to information benefits patient care.

MOE/MAR has already begun to demonstrate improvements in appropriate prescribing by physicians with clinical decision alerts. This is especially important for high-risk and high-cost medications. In the paper-based prescribing system, a physician might write an order necessitating a "reactive," time-consuming communication from pharmacist to physician (e.g., regarding hospital guidelines/restrictions or to inquire about the appropriateness of an agent). In contrast, MOE/MAR efficiently prompts clinicians in the prescribing/dispensing process about related hospital medication guidelines and restrictions before a medication order is placed.

Likewise, MOE/MAR clinical-decision-support functionality indicates which medications are or are not on the formulary, and provides recommendations about substitutions or restrictions.

This has provided physicians with critical information at the point of order entry – efficiently and in real-time. Compiled in the MOE/MAR system's database, medication-ordering patterns can be analyzed through detailed reports that now support in-depth utilization management and evidence-based prescribing-pattern-improvement processes of the organization's Pharmacy and Therapeutics Committee.

It is important to emphasize that MOE/MAR is an electronic platform to support prescribing, dispensing and administration practices. As such, it does not replace regular face-to-face communication and interaction between pharmacists, nurses and physicians. Throughout the MOE/MAR implementation, Pharmacy department leadership reiterated to physicians and nurses that the system would not replace all interdisciplinary interactions, consultations or collaborative discussions about selecting the most optimal patient-specific medication alternatives. For pharmacists, it had to be emphasized that the system would never replace a holistic, therapeutic clinical assessment for actual and potential medication-related problems. The system was to be relied upon as a tool to support, but not replace, clinical practice.

Conclusion

In conclusion, MOE/MAR has positively benefited the Pharmacy department at UHN. Nevertheless, the Pharmacy department faced numerous technical, staffing, workflow and clinical practice challenges during the design and implementation of MOE/MAR. While the implementation of MOE/MAR within the Pharmacy department has yet to demonstrate significant efficiency benefits to its internal operations, UHN pharmacists have already begun to see improvements to patient care and safety. An indication of UHN's MOE/MAR acceptance is seen in UHN pharmacists who now remark that it would be nearly impossible to revert back to the previous paper-based system of prescribing and administering medications. The translation of paper to electronic processes has brought about clinical practice changes, new ways for clinicians to interact and communicate, and more proactive care with improved clinical decision support.

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Focus on Clinical Best Practices, Patient Safety and Operational Efficiency

Brenda Laurie-Shaw, Wendy Taylor and Carol Roach

Introduction

The following article explores the MOE/MAR-driven changes from the perspective of nurses. The examination of the collaboration and coordination of the Nursing Informatics (NI) Team with Nursing, the role of Nursing Informatics, the collaboration with the Project Team from Shared Information Management Services (SIMS), the Education Working Group and the Computer User Support Program (CUSP) are features of this journey into the electronic world during the implementation of MOE/MAR.

Background

The nursing staff at UHN represents the largest group of employees and clinicians at UHN. Prior to the implementation of Medication Order Entry/Medication Administration Record (MOE/MAR), nursing staff used the HIS for processing patient admission assessments, entering written orders for diets and reviewing laboratory and diagnostic test orders and results and patient chart content. Despite a large portion of the patients' results being available electronically, almost no electronic clinical documentation had been implemented, creating the need for all clinicians to work in a hybrid paper-electronic environment.

At UHN, it was decided that MOE/MAR would be implemented before electronic clinical documentation because of the significant impact it would have on patient safety. This approach had pros and cons. It was generally felt that on-line medication

order entry would have a positive impact on all other order entry. A downside of this approach, albeit only in the short term, was that MOE/MAR necessitated greater adoption of the HIS by nurses, becoming a mandatory medication management tool used by all nurses on a continuous basis. One can only speculate that had clinical documentation been implemented prior to MOE/MAR, nurses might have been more comfortable using computers by the time MOE/MAR was implemented. As a result, the need for significant change management to ensure 100% adoption by Nursing was critical for success.

Change Management

Moving from a paper-based medication management environment to completely on-line processes was a major change for nurses. The key to a successful transition for nurses was to have Nursing Informatics be an integral part of the Project Team to facilitate the following:

- understanding of nursing workflow
- education of nurses about the MOE/MAR vision and project management process
- preparation of nurses to successfully manage the change
- identification, documentation and resolution of challenges affecting workflow, workload and policies
- support for nurses' ongoing learning and problem-resolution processes for post-implementation issues

A key aspect of the project was to address the concerns of nurses about becoming less efficient; as experts in the field of medication management, nurses were concerned that the move from paper to electronic could result in efficiency and competency challenges, while they were becoming proficient with the technology. Important confidence-building tactics were part of the change management approach and included efforts to involve nurses in the design of the MOE/MAR, answer nurses' questions promptly and review the process for solving go-live problems at daily meetings.

Nursing Influence on Design

The consultative role of Nursing Informatics was the primary way in which the needs of nurses were incorporated into the design of MOE/MAR. Nursing Informatics comprised a diverse group of experienced nurses who combined their clinical knowledge with an understanding of the information requirements of nurses and the use of technology in the nursing environment. Nursing Informatics is a corporate Nursing department reporting through a Director to the Vice-President and Chief Nurse Executive. In addition to the Director of Nursing Informatics, the department also included four Project Managers, eight Clinical Support Analysts (described later in this article) and an Analyst. The role of Nursing Informatics is to identify nursing information and knowledge requirements to ensure they are accommodated by new technologies and, thus, effectively incorporated into nursing practice.

For the MOE/MAR project, Nursing Informatics acted as "translator," spearheading the gathering of nursing input and making nurses' requirements known to the SIMS Project Team. To maintain consistency across the enterprise, one Nursing Informatics Project Manager was dedicated full time to MOE/ MAR; a second full-time resource led each of the individual clusters.

As part of the MOE/MAR project, the specific roles of the Nursing Informatics resources included

- assessing and documenting nursing workflow
- collaborating with Pharmacy and SIMS to establish technical development standards for electronic orders, incorporating available best practice and safety guidelines information
- configuring the customizable parts of the system with the SIMS technical development team
- collaborating with SIMS on screen design
- interpreting and clarifying pre-printed orders to the SIMS technical development team
- testing new development
- conducting user trials for device selection
- recruiting and training clinical support personnel
- assisting with curriculum design for nursing training

- resolving nursing workflow and other process issues during implementation (e.g., the role of transient agency nurses in workflow)
- addressing clinical policy issues that arose as a consequence of MOE/MAR

Not only did Nursing Informatics' input lead to a better design, but having Nursing working with SIMS as "co-creators" was also considered a wise political decision by the Project Team and the hospital senior management.

During the ramp-up to the MOE/MAR pilot project, and then again as part of the go-live preparations for each hospital service implementation (referred to as "clusters"), Nursing Informatics worked with nurse managers, clinical educators and practising nurses to create the workflows for that service. Medical Informatics, Pharmacy Informatics and Nursing Informatics spent considerable time negotiating solutions required to resolve workflow challenges during the pilot and first cluster. This was done through an ongoing series of meetings on the ward to discuss system requirements and also by observing and documenting their daily medication-related activities. This information was then used to map the nurses' existing paper-based medication management workflow. Work redesign programs often highlighted new, changed or different workflow requirements to reduce potential patient safety risks. These mappings covered the typical drug management processes – notification, verification, preparation, administration and documentation.

Order Notification

Nursing needs uniquely shaped the design of the MOE/MAR environment at UHN. The advent of the "electronic whiteboard" order notification tool is illustrative of how this took place. Previously with the paper medical record, a chart flag system was used to inform nurses of new orders. Nurses required a similar notification system in the hybrid paper/electronic environment. Even with on-line medication management, Nursing Informatics felt that nurses would not be logged into the system often enough to use the Inbox functionality within the system. In order to reduce the risk of missed electronic orders, the electronic whiteboard notification tool was created to mimic the whiteboard typically found in a nursing station. An electronic whiteboard would help make the transition to MOE/MAR more familiar for nurses by making electronic orders visible without logging in. In this case, this notification tool was a dedicated computer monitor at each nursing station used to notify nurses of new orders requiring their attention (see Figure 1).

Although Nursing's adoption of the electronic whiteboard varies from hospital service to hospital service, it is widely felt to have improved the overall transition to dealing with electronic orders.

Figure 1. UHN testing inpatient unit whiteboard

Verification and Preparation

Nurses contributed to the design aspect of the project. For example, nurses determined that to support medication preparation, the MOE/MAR application should include a link to an on-line drug reference manual and recent relevant lab values. These links were easily incorporated and assisted with nurse adoption. Another design contribution by Nursing was to develop reports that improved data display within the electronic system. A "Med Prep Report" tool was created to replace the paper MAR in providing information for medication preparation. This report assembled information such as the medication order, last dose, last administration site (for injectables) and special instructions from the physician, pharmacist, another nurse and the patient. Nurses also wanted a display of the seven-day history of medication administration, which was also accommodated with the development of an electronic report. The physician group found this report valuable as well to support communications with nurses.

The workflow analysis showed that nurses needed to have easy access to the MOE/MAR system at all "points of activity" during the medication management process. As part of the MOE/MAR deployment, a computer was installed on an articulating arm beside each drug dispensing machine. This gave nurses access to up-to-date patient and MAR information.

Administration and Documentation

The shaping of the MOE/MAR workflow around nurses' needs continued to the medication administration and documentation stages, most visibly in the form of the nurses' mobile medication carts. One of the greatest challenges was finding an appropriate mobile solution that combined a computer with transporta-

tion, security and sufficient storage capacity for multiple patients' medications and other nursing tools taken to the bedside. Although none of the devices evaluated met all of Nursing's and SIMS's criteria for an "ideal" device (devices favoured by nurses were unaffordable in large numbers), a decision was eventually made to go with a mobile wireless computer on carts.

The mobile devices on carts did yield immediate patient safety improvements by eliminating transcription and by increasing nurses' ability to correctly read the orders. However, the patient identification process was disrupted in relation to safe medication practice with the use of the carts. Since the carts were too large to be taken into many patient rooms, they were often left in the hallways. The carts were also found to be slower than the speed at which an unencumbered nurse wishes to move. Because the carts (which could not always accommodate the medications and other supplies nurses needed at the bedside) were too large to move into a patient room, nurses sometimes eliminated the direct verification of the MAR with the patient. Not performing this last step of the "Five Rights" at the bedside hampered positive patient identification. Although the former paper-based MAR was also not always taken into a patient room prior to MOE/MAR to ensure positive patient identification, the carts made this step even more difficult. The design and utility of these carts remain a challenge that is still being addressed.

It should be noted that UHN chose not to use handheld computer solutions for MOE/MAR. Not only did these not meet the needs of storage and drug transporting, but the graphical user interfaces of existing products available did not meet usability requirements due to their small form-factor.

Adoption Readiness

Early on, Nursing Informatics observed that a change of the magnitude of MOE/MAR would require a gradual introduction of manageable information chunks to nurses. Developed in parallel with the design of the actual electronic system, a MOE/MAR training program for nurses was created. An Education Working Group consisting of representatives from Education, the Project Team, Nursing Informatics and CUSP designed and refined the curriculum with each cluster go-live. One particularly effective strategy was to target and incorporate clinically accurate workflow scenarios and examples into the classroom training. A five-step program evolved over several implementations when it was realized that a single, four-hour classroom session was insufficient to prepare such a large group for this major change. These steps included

- computer skills self-assessment and review by CUSP
- pre-class visit to unit to demo the MAR and answer questions about the upcoming change
- four-hour hands-on MOE/MAR functionality class
- post-class review (hands-on) prior to go-live
- post-go-live functionality review and self-assessment by CUSP

The first step of the program focused on improving basic computer skills through individual coaching by CUSP. In addition, the Nursing Units were visited during the day and the evening by Nursing Informatics and members of the Project Team, who provided previews of the new MAR and addressed nurses' questions. Nurses who had seen the MAR more than once outside the classroom were better prepared to deal with the "hands-on" portion of the learning in the classroom. Those who came in for a four-hour classroom session on their day off were far more comfortable with the learning than those who came after a 12-hour night-shift or during their regular workday. (This was paid time for the nursing staff provided for by their employment contract.)

During the final ramp-up to go-live for each cluster, Nursing Informatics and the Project Team again visited the Nursing Units to conduct small group "hands-on" refresher sessions to help nurses retain what they had learned in the classroom and to answer any outstanding questions. One of the useful tools was the self-assessment checklist already in use for other skill development programs. A competency assessment tool was created for MOE/MAR based on the required skills for independent functioning at the end of the four-week support period. The resulting checklist, administered by the computer support teachers about two months after the go-live, helped to ameliorate skill gaps. The checklist also identified areas where additional tutoring or coaching would be helpful.

The purpose of the tool was to ensure that nurses learned everything required of them in order to be effective when working with MOE/MAR, rather than serving as a performance review tool for Management. According to the Director of Nursing Informatics, "It also allowed us to focus our training efforts on specific needs rather than putting everyone back into the classroom again." In fact, teaching nurses the "mechanics" of using MOE/MAR was relatively easy compared to preparing them for the extent of the practice and workflow changes they would face.

Engagement

In the same way that knowledge levels around the use of computers varied widely across Nursing at the beginning of the MOE/MAR project, so did the comfort levels. There were nurses who were already making significant use of on-line applications and information as part of their everyday workflow and were quite comfortable doing so. Until MOE/MAR arrived, however, there were other nurses who had managed to avoid any significant use of computers through various workarounds.

> **… teaching nurses the "mechanics" of using MOE/MAR was relatively easy compared to preparing them for the extent of the practice and workflow changes they would face.**

Pilot

The choice to pilot MOE/MAR in General Internal Medicine (GIM) was particularly appropriate from a nursing perspective. Strong nursing leadership – found in GIM – was important to ensure successful engagement with nurses on that unit. The GIM nurses embraced the opportunity to be pioneers and to help shape the future MAR and medication workflow. User interfaces were tested on this group of nurses, and their workflow needs related to devices were studied in detail. The nurses' concerns challenged the Project Team and Nursing Informatics to find solutions to long-standing problems (e.g., verbal orders). Verbal order practices were one of the most challenging issues throughout whole implementation. Nursing Informatics and a physician champion worked out mutually accepted guidelines for the acceptability of verbal orders.

First Go-Live

Although they had been included in all the pre-pilot and go-live ramp-up meetings, nurses in the first few units to go-live felt as if they were operating in an entirely new world when it came to using MOE/MAR. Several nurses doubted that physicians would change the way they would do drug order entry, and some nurses were concerned that MOE/MAR would be stopped and all their efforts wasted, should physicians not support MOE/MAR. Consequently, the first go-live after the pilot was Medication Order Entry (MOE) – which ensured that physicians would adopt the system. In retrospect, we underestimated the impact of implementing MOE without MAR. In fact, nurses welcomed the MAR six months later.

During every implementation there were daily meetings with the clinical stakeholders – Nursing Informatics and the Project Team – to identify and resolve issues as they arose. The daily meeting typically reviewed and sought solutions to device, technical, interdisciplinary and training issues. This rapid resolution process contributed significantly to building the confidence of the nurses.

General Rollout

One of the tactics for planning the rollout was the thoughtful sequencing of clusters; they were organized by service in order of complexity (from least to most, in order to provide a rigorous test of MOE/MAR). As the rollout progressed, nurses in the early clusters became informal "ambassadors." Through discussions with their peers, they were able to help nurses in other units understand MOE/MAR better as well as gain honest insight into benefits and challenges of MOE/MAR. Although nurses were invited to visit already-live units, few availed themselves of this opportunity. More effective was the distribution and discussion (by nurses with nurses) of a series of photos depicting "a day in the life" of a MOE/MAR nurse.

Another positive dynamic that did occur among nurses adapting to MOE/MAR was the harmonizing effect MOE/MAR had on their units. An attitude along the lines of "we're all in this together, so let's work together to make it happen" emerged. On the other hand, MOE/MAR tended to reveal the best and worst of the clinical practices within the unit. This was valuable as it uncovered underlying clinical and process changes required at UHN.

Patterns of Adaptation

Over the course of the rollout, Nursing Informatics observed a consistent pattern in the reaction by nurses using MOE/MAR. There was intense scrambling during the week before go-live – Day 1 was chaotic and Day 2 was very tough. But noticeable improvement was made as early as the week's end. Indeed, the nurses were surprised at how quickly they saw the potential value in the system and how quickly they adopted it.

It also turned out that it was newer nurses – not the older ones as many had expected – who had the most trouble learning to use MOE/MAR. This was primarily due to the fact that they were struggling to learn nursing practices at the same time as learning how to use a new system.

> One of the tactics for planning the rollout was the thoughtful sequencing of clusters; they were organized by service in order of complexity.

The Clinical Support Analysts (CSA) provided 24/7 support to clinicians for four weeks following the go-live, and played a major role in helping nurses become comfortable using MOE/MAR. CSAs are nurses with informatics training skills. The big change and the big disruption that comes with implementing a capability such as MOE/MAR could easily shake any nurse's self-confidence and judgment; having the CSAs close at hand was very reassuring. With these knowledgeable peers readily available to them to address questions and concerns, nurses were more inclined to begin using the system. On average, nurses were fully up to speed using the system after only two weeks.

Shared Accountability

As expected with any initiative of this size and complexity, a wide variety of challenges were encountered throughout the MOE/MAR rollout. Clinical transformation was viewed as a collaborative effort with all the stakeholders who worked together in an iterative process and which resulted in better communication and acceptance of policy decisions.

For example, during the initial go-live periods, nurses were concerned about how they would be able to maintain a high level of patient care at the same time as they were trying to learn to use MOE/MAR. To help nurses with their workload during this period, the project did provide limited funds in the early clusters to allow for some additional nursing staff. Each nurse would be responsible for fewer patients, thus giving them more time to work on learning the new system. Due to insufficient project funding, however, it was not possible to provide this same support across all the clusters going live.

MOE/MAR also affected UHN policies related to nursing practice. Prior to MOE/MAR, UHN had a policy that medications were to be administered within 30 minutes before or after the scheduled time. It was never known whether this actually occurred. UHN moved to a generous two-hour window before and after the scheduled time on the electronic MAR; it was

recognized that the 30-minute administration time window was unachievable while nurses were learning. The two-hour policy still remains, as there have been no further administration issues with the change. However, UHN will continue to assess the opportunity to reduce this window.

Although the list of technical challenges had been considerably reduced from those identified during the pilot, there were still many design problems and workarounds that continued to frustrate nurses. Some common drugs still cannot be ordered on-line, due to the complexity of the protocols associated with them (e.g., insulin and heparin drips). Some orders must be handwritten; some documentation is still manual, thus perpetuating a hybrid paper-electronic environment (which nurses find frustrating and leads to extra work). Nursing Informatics and SIMS continue to work together with the hospital information system vendor to address these and other ongoing issues.

Lessons Learned

1. Personnel with first-hand nursing experience need to ensure that nurses' requirements are incorporated into system design and workflow specifications.
2. An effective and consistent support strategy is important. Ensure that support personnel appreciate clinical needs, are visible and accessible, and have both clinical and technical expertise.
3. Computer knowledge and comfort levels will vary widely. Bring the levels of computer skills as close to one level as possible before MOE/MAR training.
4. If possible, project planning and budgeting should include a provision for adding temporary additional nurses to any service during the go-live period to relieve workload concerns. This will give the permanent full-time nurses a chance to learn the new system.
5. Understand and assess necessary competencies in order to identify required training.
6. Ensure that the organization's helpdesk support model is adequate to support a newly operational MOE/MAR Unit; personnel who can distinguish between technical and clinical/practice challenges or problems are important.
7. Recognize that such significant change will make nurses feel like novices until they are able to re-establish the workflow and patterns that previously made them efficient.
8. Gaps and inconsistencies in the practice and workflow between hospital services will be revealed by the implementation of MOE/MAR. They should be resolved and standardized as much as possible.
9. Expect that there will be at least one workflow or practice surprise on go-live day. Be prepared to resolve it quickly.
10. Incident reporting may increase significantly when MOE/MAR is first implemented due to access to better information.

Sustaining Change

Although the go-live point for each cluster was clearly a major milestone for the MOE/MAR project, it was not the end. As they ramped up to full speed with MOE/MAR, nurses needed continuous support to reinforce their training and increase their confidence. For the first four weeks following the go-live, this support was provided by the CSAs and Project Team members stationed on the ward (available to nurses on a 24/7 basis). In the later clusters, red lab coats worn by the support team members made them even more visible to clinicians.

The CSAs were initially comprised of nurses recruited from throughout the hospital to join the support team on a temporary basis. Due to the general shortage of nurses, the borrowed staff had to return to their home units after each go-live support period, and a new group of seconded nurses were brought in to provide support. Initially, there were no nurses who were expert in the system, except in Nursing Informatics. This was problematic because there was a long learning period to master the system. The project would lose the benefit of the continuous knowledge-building from one cluster to the next.

As a result, Nursing Informatics and SIMS created a business case for a more permanent team of CSAs and went to the Occupational Health department to determine who might be available from the pool of nurses that were injured or otherwise unable to provide direct care. The CSA team also included some nurses who were interested in exploring Informatics as a career option.

By all measures, it appeared nurses were very positive about the CSA concept. They trusted the CSAs and were willing to approach them if they were having difficulty or if they wanted to discuss a practice issue without feeling threatened. The way that nurses engaged with the CSAs was different than the way they worked with the SIMS group – it was a nurse-to-nurse relationship and it appears that nurses felt more comfortable discussing the technical functionality in this context.

Deployments were made quickly to get the hospital up and running on MOE/MAR as soon as possible to minimize the hybrid environment. However, a backlog of "unfinished business" was left following the go-live. As a result, CSAs would circle back to answer the more advanced questions that arose; to investigate data that were puzzling to nurses; to assess whether there were any deviations from the prescribed workflow that could potentially affect data quality or safety; and to conduct audits that would verify that the system was being used safely. Audits performed by the CSAs after cluster implementations monitored several key aspects, including

- allergy documentation that used free text or outdated information
- duplicate orders in the system, which pose a risk for double-dosing the patient

- medication orders that were inappropriately written on paper and risked being missed
- doses of medication that were not documented or cancelled inappropriately

CSAs continue to conduct these audits.

In addition, UHN established a unique process with its helpdesk vendor to support MOE/MAR. Nurses originally found they could not get much help through the helpdesk because the vendor personnel did not have the required understanding of MOE/MAR's complexities. To improve the level of ongoing MOE/MAR support, SIMS worked with the helpdesk to establish a new "MOE/MAR option" on its helpdesk phone system that would automatically route the call to support staff specifically trained for that purpose.

Creating Safer Care Processes

The implementation of MOE/MAR revealed differences from cluster to cluster and from service to service in many clinical workflows. More importantly, it also revealed inconsistencies and gaps in procedures and policies. Although few, if any, of these problems were actually caused by MOE/MAR, a comprehensive project such as this had the effect of putting existing clinical practices under the microscope.

An example is seen in how UHN addressed incident reporting. Incident reporting was not comprehensively done at UHN prior to MOE/MAR because of the fear of blame. During the four-week go-live support period, Nursing Informatics and CSA staff spoke with nurses about the importance of reporting incidents, helped them write the reports and investigated the causes of the incidents to see if they had anything to do with MOE/MAR. Their goal was to get nurses to start seeing incident reporting as a learning mechanism rather than as punitive. With the growing focus on patient-centred care at UHN, the reporting of medication incidents has become an even more important business metric. The MOE/MAR project offered an opportunity to change perceptions around incident reporting – truly, a blame-free culture focused on patient safety.

A more significant challenge arose regarding UHN's Acute Pain Service (APS). In pre-MOE/MAR days, a nurse working in any unit could receive two drug orders for the same patient – one from a physician on the ward and the other from an APS physician, both of whom might believe their order had the highest priority. The nurse typically ended up having to sort this out, often requiring considerable discussion with the physicians. The absence of a pre-defined and consistent process in this area was brought to light when the Project Team attempted to analyze and map the APS workflow into MOE/MAR. It was also discovered that there were different practices at two of UHN's hospitals, and MOE/MAR had to be configured in a way that brought these two together into a single, consistent workflow. The Director of Nursing Informatics noted: "We were amazed at the lack of standardization of clinical practices across the organization and the challenges of bringing it all together."

Conclusion

Even though the technology behind MOE/MAR continues to evolve, MOE/MAR in its early days has proven profoundly valuable to nurses. Medication information is clearer, and thus there are fewer transcription errors. The previous need to copy order information from an expired paper MAR to a new paper MAR has been eliminated. Patient medication information is available more quickly (and in general, all the information is confined to one place). And nurses can easily obtain different views of this information.

Nevertheless, some inefficiency remains. Following new workflows or policies requires learning. Transforming electronic tasks from manual ones may require some nurses to spend more time than they did previously following up with physicians to clarify orders or other questions. In other cases, following good practices simply takes longer. Either way, MOE/MAR is rapidly becoming a part of the daily workflow for nurses.

While MOE/MAR has been nothing short of a clinical transformation for nursing at UHN, the transformation is far from over. Nursing Informatics continues to monitor the sustainability of what has been implemented by returning to units on a regular basis to assess nurses' progress and identify additional training needs. Nursing Informatics is also attempting to understand when nurses are taking shortcuts or workarounds, potentially indicating that some elements of the system require further modification.

But, in the final analysis, MOE/MAR has required that nurses interact with the electronic patient record on a continuous basis. As such, nurses are now well positioned for additional electronic patient record applications yet to come.

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Commentary

Nursing Perspective: Focus on Clinical Best Practices, Patient Safety and Operational Efficiency

Lynn M. Nagle

Organizational challenges and struggles with user adoption of computerized clinical applications are common and, as yet, not easily overcome. This case study demonstrates the complexity of the issues and processes that need to be addressed in the implementation of new technologies to support the management of clinical information. These complexities arise in the management of the people, the processes and the technology associated with the change.

More specifically, experiences such as this illustrate that the perceived value and ease-of-use of applications and devices by clinicians are critical to their successful adoption. Healthcare has a pervasive history of information technology solutions being acquired and implemented without considering or rethinking the workflow of users. Although becoming increasingly recognized as a key success factor, the concept of users being engaged and supported as needed – pre- and post-system implementation – remains largely inadequate. Additionally, designating individuals with the responsibility to support the clinical-technical translation (e.g., clinical informaticians) is a strategy that has had a meaningful and successful benefit to implementations in many organizations.

The art of redesigning workflow processes to accommodate new tools to manage clinical information is also yet to be mastered by most organizations. Incorporating new applications of technology without rethinking existing practices is likely to result in inefficient and potentially unsafe workarounds. It is also important to consider that new risks and inefficiencies may arise by introducing new technologies into the work environment. Nonetheless, users' mental models and unaffected work processes should also be considered in the overall redesign of specific work activities.

As discovered in the UHN experience, redesigning workflow processes is likely to uncover organizational inconsistencies in practice and the inadequacies in existing policies with respect to new processes. Organizations need to be willing to acknowledge and address the discovery of practices that violate accepted standards and policies. In addition, new strategies may need to be developed to replace lost functions and mitigate new risks (e.g., electronic whiteboard to alert staff to new orders).

The design of applications and technologies to support clinical information management has markedly improved in recent years. However, the verdict is outstanding with respect to the most appropriate device to support the management of clinical information in healthcare settings by nurses and others. Trial and error and the responsiveness and affordability of devices seem to be prevailing criteria in organizations' choices of appropriate solutions. One might speculate that the ideal devices to support clinical computing have yet to be designed. In the meantime, it is unlikely that a single device will be identified to fit with the work patterns in all clinical settings. At best, efforts should be made to assure the device of choice works for the user and can be reasonably integrated with workflow processes without creating more work.

> … designating individuals with the responsibility to support the clinical-technical translation (e.g., clinical informaticians) is a strategy that has had a meaningful and successful benefit …

There is no question that the transition between manual and computerized information management poses many challenges in the delivery of safe clinical care. Similar to the dilemma of determining the most appropriate computing device, the most efficacious order of implementing specific applications remains open to debate. For those in the midst of implementing clinical information systems, early wins can be derived with solutions that are easy to use and bring value-adds to clinicians. This work necessitates thoughtful consideration of the scope and phasing of any implementation. Consider how much risk and disruption your organization is prepared to address in conjunction with the deployment of new technologies. These are disruptive technologies and success is largely dependent upon the diligence, attention and collaborative, collective energy of information technology and clinical experts. Support for users needs to be visible, sustained and grounded in the real world of the clinician community. The need to be accountable for quality, safe care in the face of learning new technologies is a concern for clinicians – a supportive, resource-supplemented infrastructure is essential to continue successful implementation of these new technologies. To chronicle and share experiences such as this is critical to our mutual learning about what works and secures success.

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Active Physician **Participation**
Key to Smooth MOE/MAR Rollout

Peter G. Rossos, Howard Abrams, Robert Wu and Peter Bray

Introduction

For UHN, it was clear from the beginning that the MOE/MAR implementation would only be successful if there were widespread acceptance of medication order entry by front-line clinical staff. Otherwise, this bold initiative would end in abject failure. Fundamental to the project's success was acceptance of MOE/MAR by UHN's physicians. Many physicians questioned whether MOE/MAR would impede their ability to care for their patients. At this stage, there was still uncertainty whether CPOE (Computerized Physician Order Entry) "did more good than harm." By constantly revising the system and by recruiting some key individuals that would act as MOE/MAR "champions" and advisors, resistance to the project decreased. The following article examines the implementation of MOE/MAR from the physicians' perspective.

Physician Support

To ensure physician adoption, UHN presented MOE/MAR as a patient safety initiative from the beginning. The prior failure of the CPOE initiative by physicians at Cedars-Sinai Medical Center in Los Angeles is well documented and created a cloud of doubt for future CPOE efforts elsewhere. Physician concerns related to patient safety and workflow resulted in a lack of cooperation that scuttled that institution's CPOE project (Wachter 2006). The project was withdrawn when many physicians threatened to leave en masse. The failure at Cedars-Sinai provided a useful lesson as UHN MOE/MAR supporters developed their implementation plans.

In addition, the UHN had a history of successful Hospital Information System (HIS) and CPOE implementation. An HIS was first introduced in 1986 at the Toronto Western Hospital and subsequently adopted enterprise wide. Over the ensuing years additional modules were added and specialized systems were integrated into the HIS. The hospital physicians became familiar with performing an increasing number of their clinical care tasks on-line including laboratory and diagnostic imaging order entry and review. Given this reality, it was reasonable for the Project Team initiating UHN's MOE/MAR to propose that MOE is the next step in CPOE and would meet with acceptance by physicians.

However, from the physicians' point of view, the MOE/MAR initiative came with two major challenges that required the attention of the project team before MOE/MAR would eventually emerge as a success.

Challenge One

Although physicians were generally pleased with the existing hospital system, they were concerned about the added time required to place electronic medication orders. In most cases, it is quicker to write an order on paper, "flag" it in the chart and then simply walk away as opposed to sitting in front of a computer terminal to log in, find the right patient e-chart, enter an order, review the order and then submit it. Physicians are generally under significant time pressure and the prospect of committing extra time to a system that has them function as glorified "data-entry clerks" was not appealing. Furthermore,

a device strategy was required to support the portability of medication ordering during ward rounds and patient conferences away from the nursing station.

Challenge Two

Ordering medications on-line is very different from ordering laboratory or imaging tests. How doctors do this directly reflects the different ways they practise. There are often several different ways to order drugs, and the "best way" for a particular patient frequently elicits debate among physicians. When it comes to medications, the stakes are much higher than with labs, medical imaging and diets, where there is likely little or no harm done if a duplicate test is ordered or if a mistake is made. With drugs, an error such as prescribing the wrong drug – or the wrong dosage – can be dangerous or even fatal. Thus, a physician is more committed to his or her – often idiosyncratic, albeit comfortable – way of doing things. Faced with these challenges, it was fortuitous that the MOE/MAR project was launched at a time in which patient safety was getting increased attention both within UHN and in the broader medical community.

Pilot Test Lessons Helped Shape Rollout Methodology

As described in detail in "Implementing MOE/MAR: Balancing Project Management with Change Management" (see p. 27 in this issue), a pilot test of the medication order entry system would be conducted within a single hospital service due to the complexity of the project and the potential impact that on-line medication management would have on traditional clinical workflow. The General Internal Medicine (GIM) ward was selected as the test site since electronic order entry was already well supported by the physicians on this unit. In addition, the diversity in the types of medications ordered on the unit, along with drug monitoring and multiple stop/change orders, provided an excellent testing environment.

The Project Team discovered that it was not the complexity of the clinical care area that determined the difficulty of converting a group to MOE/MAR; instead, it was the practice patterns of the physicians and their availability to interact with nurses and pharmacists at the point of care in solving problems with workflow and system usability. Although medication order entry on surgical units is often less complex, implementation may be more challenging due to the fact that surgeons are generally in the operating rooms during the day, and typically available on the wards for only very short periods such as early morning rounds; they are usually not immediately available to work with nurses or pharmacists to resolve drug order problems. Verbal and telephone orders are more common on these services, increasing the workflow impact of direct CPOE. For these reasons, most surgeons did not initially want to commit to performing "clerical tasks" at the expense of an operating procedure. With

these considerations the Project Team decided not to include surgical units in the pilot.

After much preparation with the clinical and Project teams, an initial pilot was launched in February 2003. It was stopped after a few weeks due to technical and workflow limitations. The major technical problem was related to an unanticipated load on the system resulting in response times that made the application unusable. From a physician workflow perspective, the interface was cumbersome and not intuitive. Furthermore, the SARS crisis in Toronto complicated the clinical environment. Although the initial pilot failed to lead directly to implementation, it provided many valuable lessons for the Project Team regarding the needs of physicians and how to engage them for subsequent re-introduction of MOE.

Physician Engagement Key to MOE/MAR Success

The initial pilot revealed that direct physician input into the interface was required to meet the needs of the physicians and reduce training requirements. With the help of the physicians, test scenarios and scripts were created to validate the order entry functionality for common clinical practices. A process of clinical engagement consisting of a review of medication order entry requirements, creation of common orders and customized order sets was implemented. A number of clinical safety, best practice and workflow issues were systematically addressed. In many cases CPOE ultimately offered both workflow advantages to the clinician and the ability to remotely order medications away from the hospital ward. A sign-off process by physicians regarding system design was required prior to implementation.

Creating templates of the common post-operative medications (known as "order sets") also played a key role in defining system usability. Prior to MOE/MAR, many surgical specialties had pre-printed order sets or "care maps" that were used following certain operative procedures or diagnoses. Identifying and implementing these order sets electronically was an important part of configuring MOE/MAR prior to go-live. Having these orders readily available to surgeons on-line as pre-built "typical orders" minimized the workflow change associated with the MOE/MAR transition and made the order entry process faster. This meant common medications could be easily ordered from a familiar list with appropriate mouse clicks.

One source of frustration that contributed to physicians' resistance to the pilot implementation was the excessive number of alerts generated by the clinical decision support functionality initially implemented within the system. Subsequent analysis showed that few of the drug-allergy and drug-drug interaction alerts actually provided any useful information (from the physician perspective). Most were just seen as nuisances, slowing physicians down at a time when they were trying to learn the system.

As a result, the alert mechanism was initially adjusted so

that only critical drug-drug interactions would trigger an alert. Over time, as the physicians continued to get more familiar with MOE/MAR, additional alerts were added to further improve patient safety.

Changing the Way Physicians Work

In the beginning, neither the Project Team nor Medical Informatics group realized how complex and difficult the MOE/MAR project would be and how significant a change it would have on the way physicians do their work. This realization, borne out of the GIM pilot test, led the Project Team to implement three important physician-specific improvements to the methodology that would be used to manage the balance of the project and the successful rollout of MOE/MAR across the organization.

1. Getting Physician Sign-off

Based on experience gained from the pilot test, the Project Team embarked on a program of one-on-one meetings with key physicians from each hospital service during the planning and system development period leading up to the deployment of MOE/MAR in each successive cluster. A first meeting was used to talk about the system and gather any special requirements the physician might have for that particular service. From a usability point of view, for example, the system was designed to minimize the number of mouse clicks and keystrokes required by physicians to perform a function. It was also designed to present as much pre-packaged information or filled-in fields as possible so that physicians would not have to enter any free-form text, a process that is both time-consuming and often error-prone. In a return meeting conducted once the system was designed, a Project Team member would walk the physician through exactly how the legacy paper-based workflow would be mapped into the new electronic MOE/MAR environment. The team member would then get the doctor to "sign off" on this makeshift tutorial, indicating that he/she fully understood the process and agreed with the way in which the system was being implemented. This extra step of getting physician sign-off made it far easier for physicians to accept and support MOE/MAR.

This approach not only ensured that the customization of MOE/MAR for each cluster reflected the needs and work styles of physicians on those wards, but also helped build stronger relationships between physicians and the Project Team and secured greater participation by physicians. Through the building of stronger relationships, physicians were able to see SIMS team members more as "IT experts" with whom they could share information and ideas around business and healthcare issues and clinical workflow, rather than "those people from IT who are always trying to change the system without telling us." The last element, physician participation, became an important indicator of the ultimate success of MOE/MAR from the physi-

cian perspective. As such, the greater the physician participation and buy-in, the more smoothly deployment proceeded.

2. Talking to Many Physicians

As an adjunct to the value and need to get physician sign-off to the system design before it was implemented, the pilot test experience also helped the Project Team to realize that no one physician in a particular service can possibly think of all the circumstances governing how the system should be configured for that service. Nor can that one physician represent the views of all the doctors within that service.

The Project Team learned that they needed to involve virtually all physicians in order to test, and often revise, their assumptions about how physicians operate. One of the lessons from the MOE/MAR implementation was that physicians performing the same task on the same ward often do it differently, or in the case of MOE/MAR, might want specific information displayed differently.

On a number of occasions when the Project Team found there to be differing views amongst physicians (e.g., on how some aspect of the MOE/MAR workflow should work, or what a particular drug order set should look like) the physicians were sequestered in a room to develop an agreeable compromise that the Project Team could then implement in the system. These situations produced an unforeseen benefit of allowing hospital practices to be standardized along the lines of industry best practices. However, this only worked effectively when the appropriate physicians participated in the design stage of MOE/MAR.

The Project Team also learned the importance of recognizing when an issue was a "clinical issue," and by implication, should be left to clinicians to resolve. The team did not attempt to become "content" or subject matter experts, but rather facilitators bringing physicians together to make the decisions about what *they* wanted the system to do *for them and their patients*. Additionally, the Project Team needed to play the role of mediator, to ensure that the various wishes of clinicians were compatible with each other. The Project Team also had to ensure that the wishes of clinicians would not exceed the technical and financial constraints of MOE/MAR.

3. Engaging with Physician Champions

Physician "champions" were chosen by senior management from among the physicians in each cluster to work as part of the Project Team during the ramp-up to the MOE/MAR go-live in each cluster. The champions supported the workflow analysis efforts and provided specific information needed by the team for building the system. The champions were also critical when it came to workflow and training issues. As well, they helped with decision-making and "selling" the project to their colleagues.

In the case of the surgical services, a particular medication might be ordered in different ways with respect to dosage,

frequency or route between different surgical specialties. Variations such as these are almost impossible for surgeons of different specialties to anticipate, let alone the SIMS Project Managers or cluster leads.

As a result, physician champions representing each surgical specialty were selected to represent their specialty and gather input from the rest of their division. Regular meetings of these

champions helped ensure that MOE/MAR design choices made to satisfy one specialty would not be to the detriment of others. Although the restricted availability of these busy surgeons made it challenging to convene meetings, communication tools such as e-mail made it possible to disseminate information and solicit feedback in a timely fashion. This also ensured that physicians knew that their feedback had an impact on MOE/MAR system design and implementation.

The pilot test and early cluster rollouts reinforced the importance of the role of champions, clearly demonstrating that champions needed to be committed, enthusiastic people experienced with front-line work. This proved to be a difficult task, but the team quickly discovered that without a savvy champion, it often did not get all the information required in order to properly develop the system. Even when champions were recruited, there were still issues that required prompt atten-

tion. Physician champions were chosen based on their problem-solving skills, commitment and availability. The authority and respect these physicians embodied was crucial in getting their peers to buy into proposed solutions. Reluctant colleagues were advised that on-line order entry was a compulsory part of the hospital's clinical practice, not an option. In rare circumstances, they were prepared to escalate the situation to either the Chief of Medicine or Surgery.

During the period leading up to the go-live on each cluster, physician champions had final approval on all decisions being made and were asked to sign off on all project plans, workflows and screen designs, giving them a significant stake in what was taking place on their units.

> **This extra step of getting physician sign-off made it far easier for physicians to accept and support MOE/MAR.**

MOE/MAR Rollout: The Learning Experience Continues

Although there was significantly more physician involvement in the project following the pilot test, and more tailoring of the system by individual services, the project methodology continued to evolve as MOE/MAR was rolled out from cluster to cluster. In some cases it was apparent that unique solutions were required. For example, the vascular surgery service required a system to closely manage anticoagulants. The vascular surgeons found their task was difficult to complete with MOE/MAR. Delegating the drug management task to a pharmacist who was subsequently added to the unit solved the problem. A literature review suggested this as an industry best-practice approach. This example illustrated that system redesign should follow best practices when available, even if it is costlier to do so.

Two other innovations were required for surgical patients. In the operating rooms, wall-mounted PCs were installed to increase workstation availability and to meet space constraints in areas where the addition of a desktop PC was not always possible. In addition, the Patient Transfer Report was developed to accompany patients who change locations within the hospital. It provides details on patient movements, current and pending medications. This was required to accommodate surgical patients who change locations within the hospital. Without this report, the patient could be in a location where medications may not appear on the local MAR.

Consultation Orders Present Impenetrable Barrier

One of the most challenging and contentious issues that had to be addressed – one still not fully resolved – was how to

build a MOE/MAR workflow to accommodate the hospital's practice around Consult Orders. It is presented here in detail as a noteworthy "case study" about trying to map paper-based clinical processes into an on-line environment.

In the pre-MOE/MAR paper world, a Primary Team Physician would ask a consulting service for a consultation on a patient. After the Consult Team saw the patient, a consultation note would be drafted (which may or may not have included a suggested medication order). The consultation note would be added to the patient's chart and the plastic order notification flag would be pulled out as usual, indicating a pending order. Nurses would not execute this order, however, until it was subsequently reviewed and co-signed (sometimes) by the Primary Team.

The benefit of this process was that the Primary Team was able to review the order before it was administered and agree that it made sense given the patient's circumstances. If there were multiple consultations, for example, the Primary Team Physician could resolve any conflicts in suggested orders and decide the best therapy. The downside of this approach was that nurses had to chase after the Primary Team Physicians to review and co-sign the consult orders. If matters needed to be done urgently to manage the patient, sometimes there was simply not enough time to find the physician. In this case, the practice was altered so that nurses would review the order themselves, and if it was from physicians they knew and trusted – and if the order made sense to them – they would go ahead and execute these orders on their own.

Regular meetings of these champions helped ensure that MOE/MAR design choices made to satisfy one specialty would not be to the detriment of others.

Due to limitations in the product software, it was not possible to emulate the consult order process in MOE/MAR. There was no easy way to enter "suggestion" type orders and then have a Primary Team Physician electronically co-sign them to turn them into "real" orders. Since the software was not designed to function in such a manner – and no solution was forthcoming from the product vendor – the hospital had to decide how best to manage the consult order process in the new on-line world.

As a temporary solution, a hybrid approach was chosen: Primary physicians would enter their own orders directly on-line, but the Consult Team would write consult orders on paper. Once co-signed, the consult orders would need to be entered on-line; it was initially agreed that pharmacists would do this

during Pharmacy hours, and the On Call team would do the order entry outside Pharmacy hours. The downsides of this hybrid process were that the paper orders were continually being missed; nurses still had to chase physicians to co-sign the orders; and at night, the covering On Call team members sometimes felt they did not know enough about the patient to co-sign and enter these orders. As more and more wards came on-line with MOE/MAR, pharmacists started complaining that because they could not manage the growing volume of consult orders that needed to be entered, they could no longer play this role. Another solution was needed.

After the situation was reviewed with multiple services, the Medical Advisory Committee and everybody else that needed to see it, it was decided that if the orders were "urgent or emergent" (i.e., needed to be done right away to help the patient), the Consult Team would enter the order directly into MOE/MAR at the time of the consultation and then contact the Primary Team via pager to let it know what had been done. If the situation was not urgent/emergent, the Consult Team would page the Primary Team to discuss what they wanted to do, and if there was no disagreement, the Consult Team would then enter the order on-line. If Consult Team members were unable to reach the Primary Team, they would go back to writing the suggested order on paper. This is what was *supposed* to happen. But what actually happened is that because of the difficulty and time it was taking the Consult Team to reach the Primary Team to discuss a suggested order, team members typically just skipped that step and wrote the order on paper just as they had done before. This resulted in very few consulting physicians entering orders on-line. Once again, a familiar problem emerged: Who would enter all the orders on-line? And there was the risk that the paper order might be missed altogether by the nurses, especially if the order sheet in the patient's chart filled up and the nurse flipped to a new page, leaving the unfinished consult order on the previous page.

Indeed, far from being an adequate solution, such a hybrid approach increased the risk of errors and omissions – and failed to fully leverage all the benefits of on-line order entry. It was also confusing to physicians and to nurses to have some services entering orders on-line while others were writing them on paper. The resulting process was not conducive to improved patient care and continues to be examined by the Project Team to this day. The lesson learned here: If an on-line order entry system cannot support a particular process or workflow item, then it is critical that everyone who has anything to do with that process be consulted, so that they can combine forces to resolve the problem together. Getting participation and support from all parties is key.

Managing Physician Expectations

Physicians developed their own expectations in terms of what

a hospital information system should be able to do based on what they see in the media, read in industry journals and hear from colleagues. The Project Team had to address these expectations and communicate whether they could be met and in what period of time.

User expectations were met with the help of the Medical Informatics Team and front-line physician champions through the following:

- Communicating openly and honestly to physicians about what the system will and will not do. Physicians did not want to feel "tricked."
- Advising that change is initially difficult, and that ultimately the system may not do everything they want it to.
- Telling them the system is not perfect, but that it will be a lot better than what they had before.
- Setting realistic expectations.
- Being prepared for physician complaints about unfulfilled expectations.

Ultimately, the Project Team successfully worked with Medical Informatics physicians to increase the level of peer-to-peer communications among physicians in the form of positive support for the system that grew in magnitude over the course of the rollout.

Tangible Benefits Keep Doctors Motivated

For other hospitals considering a MOE/MAR implementation, we believe hospitals need to be prepared for physician resistance, which may take the form of enduring opposition (e.g., Cedars-Sinai) or initial hesitancy and suspicion.

For the physicians, additional benefits included

- *clinical decision support:* Although not fully operational with the MOE/MAR system at time of writing, this capability prevents physicians from making a drug prescription error. It helps them make the right decision at the right time for the right patient.
- *saved time for physicians overall:* All the information needed to manage a patient is visible in a single place – namely, on the MOE/MAR screen – rather than the physician having to retrieve different bits of patient information from different documents in different places (paper patient chart, paper MAR, kardex files, etc.).
- *anywhere access:* Physicians can now manage patients from anywhere there is a computer terminal in the hospital or remotely from offsite (e.g., home) instead of having to go to the ward to write the orders. SIMS is making available remote access on all services to ensure access to staff and resident physicians on a 24/7 basis.

Lessons Learned

1. Ordering medications differs from ordering laboratory or imaging tests. There is no universal way in which physicians order medications for their patients.
2. The practice patterns of physicians and their availability to interact with nurses and pharmacists to solve problems – not the complexity of the patients – determines the difficulty of implementing MOE/MAR.
3. A new system may perform extremely well in a development environment, but be prepared for unpredictable things to happen when going live. For this reason, it is crucial to test systems in a production environment.
4. Involve physicians as well as nurses and pharmacists in the early stages of requirements definition, system design and usability testing.
5. Do not underestimate the degree to which MOE/MAR will require physicians to change the way they currently work.
6. Obtain physician participation and buy-in by engaging them in proposed project plans, workflows, screen designs and having them sign-off to their agreement. The greater the physician participation and buy-in, the more smoothly the deployment will go.
7. Engage as many physicians as possible. No one physician can represent the views of all others.
8. Early efforts devoted to rendering the ordering process faster or more efficient will result in greater satisfaction by physicians, with improved cooperation and buy-in as the implementation proceeds.
9. Physician champions must have credibility and be respected by their peers as advocates for both clinician and patient interests. Better results will be achieved in those areas with strong physician champions.
10. Implement a common workflow across services wherever possible, but expect physicians to need customization in certain circumstances.
11. Executive-level support is critical to reassure physicians that there is commitment at the highest levels to make this work. Executive-level discipline should only be used as a last resort to deal with resistance. The need to resort to executive authority may mean that there is a fundamental design or process problem that needs to be fixed.
12. Expect physicians to be reluctant to adopt MOE initially since using the system will slow them down. As such, they will need to be shown some personal benefits that transcend patient safety.
13. Be proactive about managing user expectations. Communicate clearly to physicians about what MOE/MAR can and cannot do.
14. Peer-to-peer communications among physicians will play a big role in setting realistic expectations.
15. Monitor the system closely for safety and efficiency of care.

- *staff supervision:* Remote access also makes it easier for staff and senior residents to supervise junior colleagues by monitoring their activity. It is generally acknowledged that things get missed when staff are busy, but it is easier to catch potential slip-ups when tasks are done and recorded electronically. For example, a physician can remotely review lab or radiology results as a basis for querying house staff on their activity/progress.
- *reduced workload:* Once patient information has been entered into the system, it should never have to be re-entered. For example, allergy information in a patient's EMR is instantly available to the pharmacy and hospital information systems for automated drug-allergy checking. Or, when creating a discharge summary, all the test results, diagnoses, etc., are in the system already and thus should be available for automatic download into the summary instead of requiring a clinician to re-enter all this data manually.

Notably, for some physicians, motivation also comes from being able to work on the leading edge in a relatively new area such as on-line medication management. This can be an important source of pride and satisfaction, and even part of their professional identity.

Future Holds Even Greater Promise

All stakeholders (with the exception of patients) experienced considerable growing pains when it came to the implementation of MOE/MAR. However, now that MOE/MAR is a daily fact of life at UHN, original concern and hesitance have gradually turned to widespread acceptance with the goal of substantially reducing medication errors and adverse events.

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Commentary
Implementation Is an Iterative Process

Ben Davoren

"Clinical Informatics is not a spectator sport," noted Dr. Randy Miller, Professor of Biomedical Informatics at Vanderbilt University, many years ago. The essence of that quote is borne out in the description of the Computerized Physician Order Entry (CPOE) project at Toronto's University Health Network in this journal. It is also borne out in the experience of developing and deploying North America's most widely utilized electronic medical record, the Veterans Health Administration's (VHA) Computerized Patient Record System (CPRS). The most critical elements of CPRS's success have not been technical advances; rather, the involvement of field-based participants – physicians, nurses, pharmacists and other medical centre support staff – has been the key. In fact, the origins of CPRS were not even supported by the national VHA structure of the late 1970s when the computerization effort started. As recounted in the book *Computerizing Large Integrated Health Networks* by Dr. Robert Kolodner (current VHA Chief Health Informatics Officer), an "underground railroad" of clinical users in VA promulgated the development of a clinical information system along with critical programming staff. This user-driven system evolved into CPRS over a period of nearly 20 years.

Why is it so critical that front-line clinicians become intimately involved in the implementation of a computerized patient record system? The answers are manifold, but they can be divided into a few key areas. First, "implementation" of a provider order entry system is not an event. There are no ribbons to cut at a CPOE ceremony because implementation is never "done." Rather, it is an iterative process. The workflow of one group of healthcare providers will be different from another, and each will fit differently into the pathways that the software has created. The software will then have to be readjusted. As the providers adapt to the software, their own workflow will change, and new modifications to the software will again be necessary.

In VHA, CPRS is currently in Version 26, after its original testing and distribution in 1997. It is a nationally programmed application, with one new substantial version every four to six months, each of which needs to be tested, validated and then deployed across more than 160 medical centres and 600 outpatient clinics, with new training and support resources involved at each step. Having clinical champions heavily involved is crucial to the success of this process.

Second, computers are ruthless enforcers of rules – that's their real power in impacting clinical care – but they don't care what the rules are. In healthcare, practice patterns have evolved to such a point that no one person actually knows what all the rules are, at least not enough to guide programmers. They just know what they do. Front-line clinicians need to meet, discuss, bribe, cajole and then come to a consensus on what the rules are. Our experience has been that rules frequently have to be created in situations where we didn't know we needed any. Not only is clinical informatics not a spectator sport, it is a contact sport!

Third, healthcare really is different from other industries. Complex decision-making, non-linear workflow, shared responsibilities, extreme time-sensitivity of information flow and recognition of previously unrecognized patterns define medical care in the 21st century. Programmers and other technical staff have much to learn from clinicians. By and large, programmers enjoy it and can deliver better products and systems when clinicians can work with them to demonstrate what it is they really need to accomplish to take good care of other human beings.

About the Author

Ben Davoren, MD, PhD, is Director of Clinical Informatics at the San Francisco VA and has served as an advisor to the VA's national CPRS development for the past seven years. He is also Associate Professor of Medicine in Hematology/Oncology at University of California - San Francisco.

Commentary
Project Must Be Physician Led

Bill Fera

Many of the lessons learned and advice regarding the implementation of CPOE at UHN are eerily similar to the experience at UPMC (University of Pittsburgh Medical Center) St. Margaret Memorial Hospital. St. Margaret successfully launched a CPOE project in September 2004, achieving 100% compliance with physician order entry within one month. The only place where paper orders exist is where computer order entry is cumbersome or not well supported by the software, such as dialysis and chemotherapeutic regimens.

Similar to UHN, we believe our key to success was having the project be physician led. In no way was CPOE ever promoted as an information technology project. It was always a physician-led quality initiative. One of the key strategies in this regard was the appointment of a chief medical informatics officer. The CMIO was responsible for assembling a Physician Advisory Committee as well as recruiting and assigning tasks to other physician leaders.

A second key component in the physician engagement strategy was that all training was physician led. One physician was assigned to oversee training. This physician helped to develop all training materials and recruit and teach other "super user" physicians to lead all training. In every training session, there was a super user present to answer questions and help frame things in a context that physicians would understand.

This diversified physician leadership worked hand in hand with administration as well as with the CMO and all other physician leadership to promote CPOE as a physician-led quality initiative and was the main key to success at St. Margaret Hospital.

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Strong IT Effort Underpins MOE/MAR Success

Penny Hackenbrook-Rogers, Trevor Godfrey, David Eagan, Monique Pitre and Anna Barbosa

Introduction

The implementation of a Medication Order Entry/Medication Administrative Record (MOE/MAR) system inevitably involves substantial technological and change-process challenges. No system can meet the needs of all potential user groups, nor can any hospital's information technology (IT) budget for a MOE/ MAR-type initiative be unlimited. This paper describes the process by which the University Health Network's (UHN) IT department, called Shared Information Management Services (SIMS), in implementing this new system attempted to take advantage of recent technological advances, satisfy users and do so within budget constraints. The challenges of doing so in this large, academic hospital organization are identified, drawing on both our successful and less successful design and implementation efforts.

Prior to the deployment of MOE/MAR, the hospital information system (HIS) was being used by clinicians and non-clinicians throughout UHN as part of their daily workflow to help with a wide variety of care processes, including

- Patient registration and admission
- Order entry for laboratory investigation, diagnostic imaging, diet and other ancillary services
- Results review for diagnostic tests (including lab and diagnostic imaging)

- Managing the storage and retrieval of medical images (PACS)
- Documenting admission assessments, allergy assessments and other patient information
- Review of clinical encounter documentation including admission and discharge summaries, surgical procedures, ambulatory visits and numerous other encounter notes
- Information processing and storage for many departments/ labs

The other major component of the UHN IT infrastructure essential to the new MOE/MAR environment was the Pharmacy Information System (Rx System). That system is used by pharmacists to manage UHN's medication inventory. Prior to MOE/MAR, pharmacists entered medication orders into the Rx System in response to paper-based orders received from physicians.

Approach and Model

Considerable additional customization had to be added to UHN's HIS and Rx System environment to support the on-line order entry and administration management for medications. These additional capabilities required SIMS to

- develop procedures to allow existing paper-based workflows to be mapped into an on-line environment

- build a custom database of medication procedures based on UHN's formulary of standard medications
- develop multiple HL7 -based interfaces between the HIS and Rx System (Health Level Seven 2006)
- develop user interface ordering screens customized for each hospital service
- integrate a third-party medication interaction checking product
- implement an on-line equivalent for the Medication Administration Record (MAR)
- develop reports required by clinicians to manage the medication order/administration process
- implement a point-of-care device strategy involving personal computers (PCs), laptops and mobile carts

Choosing the Right Systems Model

One of the most significant decisions UHN had to make was choosing the best approach for the underlying systems architecture. Three possible options were considered:

1. Use the existing HIS (but add medication inventory management capability).
2. Use the existing Rx System (but add on-line medication order entry capability).
3. Integrate the HIS and Rx System.

SIMS chose the multi-system approach (see Figure 1), since no one system alone could address all the business and clinical requirements.

However, the two systems had different architectures, which created many interfacing challenges for SIMS, including negoti-

ating with both vendors to determine which system would be modified to accommodate workflow requirements.

System Interfaces

The effort required to integrate the HIS and Rx System centred largely on developing new interfaces between the two systems. It was equally important to assess the potential impact that implementing MOE/MAR might have on any existing interfaces. A rigorous change management process was also implemented to support the ongoing need for interface changes.

Application Development and Maintenance

UHN undertook a pilot launch of MOE/MAR in February 2003. The main objective of this pilot project was to identify any functionality gaps between the users and the application to support medication order entry and medication administration.

Beyond the pilot, UHN took a phased approach to implementing MOE/MAR to the remaining Nursing Units. This was necessary given the size, complexity and geographic dispersion of UHN's clinical programs. There were eight groups of Nursing Units or clusters to implement across the campuses, encompassing seven clinical programs with more than 20 service groupings. With each new cluster, new workflow requirements were identified to meet the specific needs of each of the clinical services. Building on the technical requirements of previous clusters, SIMS project and technical teams incrementally incorporated new application customization into the MOE/MAR environment. This required a high degree of adaptability and flexibility with our system-build process to accommodate changes.

For small to mid-size institutions contemplating MOE/MAR initiatives, we encourage them to consider whether they could, instead, accommodate a "big bang" approach rather than the slower, incremental approach taken at UHN. These organizations might assess their ability to conduct the analysis across *a representative selection of* the units first so they can build a complete and robust end-state system from the start.

User-Interface Customization

A substantial part of the IT effort involved mapping approximately 2,000 medications from UHN's formulary into the HIS medication database and building 10,000 predefined "typical orders" based on various dosage, route and frequency combinations for each of those medications. From these typical

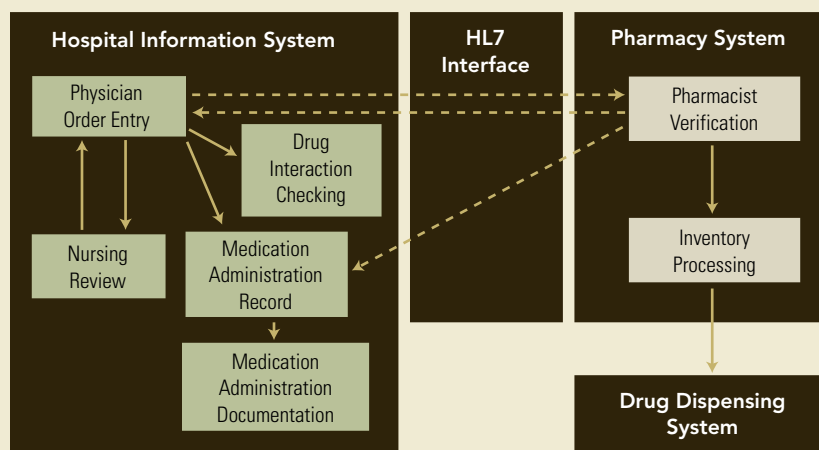

Figure 1. Multi-system approach

Table 1. System interfaces

Bi-directional orders interface	The outbound order interface carries new, changed and discontinued orders from the HIS to the Rx System. Pharmacists review these orders, and any medication product changes made on the Rx System are sent back to the HIS over the inbound order interface. The interface keeps both systems synchronized with respect to the orders and medication products.
Master file update	The Rx System controls which medication products are available to be ordered. A real-time, one-way interface between the Rx System and the HIS is used for loading and changing medication product information in the HIS database.

In some instances, UHN decided to standardize across the entire organization, such as adopting the use of generic names rather than trade names for all medication products in the UHN formulary. In other cases, medication orders were standardized just within a service, such as General Internal Medicine or General Surgery, so that the Pick List for all physicians within that service would be the same.

Quality Assurance

Each of the nearly 2,000 medications and 10,000 typical orders had to be tested to ensure that they were clinically correct. Due to the complexity and sheer volume of the typical orders, it took nearly nine months to build and test the entire formulary. This testing was done by pharmacists.

Nurses were also integrally involved in the quality assurance process. The nurses reviewed the order sets and nursing functions within the system to determine how the order was displayed, whether the order information was presented in a logical manner and if the information appearing on the MAR, Medication Summary, 7-Day Medication History and other reports was accurate. A special testing lab equipped with groups of computers physically clustered together was assembled where pharmacists and nurses could work side by side with SIMS staff for quality assurance testing processes.

Typically, physicians were active contributors to the creation and review of the custom order sets for their own particular services. The SIMS project and technical teams learned that having all the clinical groups involved in the Quality Assurance process was the best way to ensure that the procedures, typical orders and workflow around them met the professional standards of the three groups, were consistent with UHN policies and were clinically correct and appropriate.

The continuous cycle of creating, refining and testing standards for typical orders and order sets during the project had to be built into the overall project plan and schedule. Because of the phased approach it was often necessary to go back to incorporate change requests from earlier implementations.

orders, a custom "order set," or collection of the most commonly used orders, was created for each hospital service, totalling more than 130. These order sets were presented to physicians, giving them simple and easy-to-use "point & click" order entry capability. This not only saved physicians time and reduced the chance for error, it also helped UHN enforce standards and promote best practices through the use of approved medication orders appropriate to a particular service.

The challenges associated with creating custom order sets revealed the unique complexities of standardizing medication orders in a large, complex academic setting (e.g., new processes and medications are frequently introduced throughout UHN).

Clinical Decision Support

UHN undertook the MOE/MAR project to take advantage of the clinical decision support capabilities that electronic medication management and the electronic patient record offered for reducing patient risk due to medication error.

The MOE/MAR solution was designed to automatically check for medication-medication and medication-allergy incompatibilities as well as for duplicate medication orders

Figure 2. Standard "common medication" on-line order screen

Figure 3. Standardized on-line order set screen (clinical program-specific)

incomplete. For instance, several of the product files were in fact based on U.S. information (e.g., pharmaceutical naming) and incompatible with Canadian norms. The HIS vendor continues to work with the third-party decision support vendor to remedy this situation.

Device/Delivery Model

A key benefit of the MOE/MAR project was to move the "point of access" to information closer to the "point of care," specifically by providing clinicians computerized access to information at patients' bedsides. It was intended that this could improve patient safety by facilitating the real-time verification of patient information before medications were administered, and supporting nurses' ability to document the administration of those medications immediately thereafter.

Achieving this required SIMS to develop and execute a hardware device strategy encompassing the following challenges:

- How many and what type of computers would be needed by clinicians?
- Where should the equipment be located to optimally deliver information quickly and easily?
- How could the effects of potential system downtimes be mitigated?
- What mobility requirements needed to be addressed to ensure access to information at the right place and time?

Wireless Device Strategy Supports Mobility Requirements

Resolution of the mobility question was especially critical to UHN implementing an effective MOE/MAR solution. Previously, stationary PCs were located in all Nursing Units to support the range of HIS capabilities being used by the clinicians. However, physicians, nurses and pharmacists were recognized as highly mobile staff. MOE/MAR was the first project within UHN's overall Electronic Patient Record initiative that highlighted the hospital's need to add a mobility/wireless capability so that clinicians could interact with the computer close to the patients.

A dedicated technical sub-team was assigned to focus on implementing a wireless device strategy. They conducted a series of trials to assess the requirements of UHN's wireless infrastructure, including the number and locations of access points needed and the most appropriate physical devices to be deployed. In addition to providing adequate coverage for initial MOE/MAR implementations, this sub-team also determined that the wireless

and orders that are inconsistent with lab results. For anyone ordering medications (i.e., physicians, nurse practitioners), the operational concept behind the MOE/MAR clinical decision support was to alert them to any potential problems at point of order entry. This was accomplished using third-party medication interaction checking software completely integrated within the HIS application as well as within the Rx System.

At the project outset, when the medication checking alerts were being configured, it was decided that the decision support function should function in an "overly safe" manner. It was soon discovered, however, that this third-party product was overly cautious – according to physicians who believed that far too many alerts were issued. Consequently, the order-alerting mechanism was "dialled back" so that only the most critical alerts would be triggered. Physicians needed time to get used to the overall system first. Pharmacists were also provided with clinical alerts at the time of order verification on the Rx System. However, the alert level on this system was left high, as there is established tolerance by pharmacists for the alert interruption.

Additional alerts were eventually reintroduced into the system, and more specific requirements were provided to the vendor in order to make the alerting procedure "smarter." Since the original implementation of the third-party software, UHN has also begun to implement its own medication interaction checking outside of the third-party database using available HIS functionality.

One of the final decision support lessons learned by UHN was a "translation" issue unique to Canadian hospitals. UHN implemented a system provided by a U.S. vendor. Despite the vendor's assurances that the product had been modified for the Canadian market, these modifications were later found to be

infrastructure would have to be scalable (in order to support a growing number of devices as the EPR initiative continued to unfold). It also needed to be "multi-generational" so it could be easily upgraded over time without having to be replaced.

A key aspect of the wireless device strategy centred on exploring the range of mobile carts that could be used by clinicians to get information and medications to the bedside. A manufacturer provided several prototype carts with fixed wireless laptops for trial to support the functions being performed by the users. These included nursing carts with drawers for medications, and physician rounding carts. The trials showed that, although relatively inexpensive, the initial carts were too big and cumbersome to be moved easily in and out of patient rooms.

While no single cart was considered "ideal," the carts that the device team ultimately deployed worked well. Specifically, UHN chose to use thin-client devices as the mobile PCs in order to reduce cart size and weight and to optimize power consumption so that the rechargeable batteries supplying power to the carts would last for an entire shift. The decision to use thin clients, which depend on a server-based computing model for access to applications, fit well into UHN's existing IT infrastructure strategy, where Citrix had already been deployed to optimize application delivery through "virtualization." This would also simplify ongoing application and PC management. SIMS continues to assess new and improved cart designs, considering new requirements that continue to emerge, such as barcode scanning functionality.

Device Strategy Addresses Downtime Scenario

SIMS implemented a simple and effective solution to the eventuality of MOE/MAR downtime. Every 30 minutes, outstanding medication orders for all patients on a given ward would be downloaded to a PC (with natively attached printer) installed on the unit specifically for this purpose. The PC and printer were to be plugged into the hospital's emergency power system, which has generator backup to protect against possible power outage. If there is a system outage nurses can sign onto the downtime PC and print the Downtime Report containing the MAR information they need.

Reports

Many different reports were developed by SIMS for the new MOE/MAR environment. Several reports are launched as HTML pages within the HIS while others are available as printed reports. Some examples of MOE/MAR reports are shown in Table 3.

Figure 4. Mobile Point-of-Care (POC) device

Table 2. Example of deployment in a GIM Unit

General Internal Medicine Unit		
32 beds, 6 RNs per shift		
Device Type	**Quantity Pre-MOE/MAR**	**Quantity Post-MOE/MAR**
Nursing station desktops	10	10
Laptop	1	1
Reports printer	1	1
Blood label printer	1	1
Mobile cart	0	6
Med room device	0	2
Rounding cart	0	1
Isolation room	0	5
Whiteboard	1	1
Downtime PC	0	1
Total devices on unit	**14**	**29**

Source: Shared Information Management Services

The Medications Preparation Report in fact filled a pre-existing gap in the HIS functionality. Prior to MOE/MAR, there was no function to indicate to nurses exactly which medications needed to be obtained from the medication dispensing machines located in each ward. This ensures that nurses prepare the right medications for the right patient.

The 7-Day Medication History Report arose from the need for nurses to see what medications their patients had recently been given. The new electronic MAR only displays medication orders that still need to be given but not those previously administered. The 7-Day Medication History Report provides this "historical" information, saving clinicians from having to perform individual chart reviews to obtain previous medication administration data.

The Inpatient Whiteboard shows a list of all the patients on the ward, with corresponding indicators denoting activities that need to be undertaken for each (e.g., lab tests, radiology tests, medication administration). The Inpatient Whiteboard Report gives nurses a quick, visual indication of patient-specific tasks that need to be completed without requiring them to log onto the system.

Table 4. Technical challenges and considerations matrix

Technical Challenges	Technical Consideration Factors
System architecture	• Enterprise vs. interfaced systems approach
System interfaces	• Impact to existing interfaces (i.e., ADT) • Mapping between interfaced systems (i.e., routes, frequencies, products)
Application development & maintenance	• Trial with a production pilot • Customize for usability; standardize for best practice • Get clinical engagement in quality assurance
Clinical decision support	• Set the alert levels to avoid alert fatigue
Device delivery model	• Computers/devices – number, type, location, mobility requirements • System downtime planning for business continuity
Reports	• Address functionality gaps with customized report views • Audit reports to measure system use compliance

Table 3. Examples of MOE/MAR reports

On-line HTML Reports	Hardcopy Reports
Medications Preparation Report	Active Medications Transfer Report
7-Day Medication History Report	Missed Dosage Report
Inpatient Whiteboard Report	Untimely Documentation Report

The Active Medications Transfer Report provides hardcopy MAR information to nurses in non-MOE/MAR areas when a patient is transferred from a MOE/MAR Unit to a non-MOE/MAR Unit (to date, MOE/MAR is under development in Intensive Care Units and Transplant Units). Other reports, such as the Missed Dosage Report and the Untimely Documentation Report, were developed to provide Nursing management with information they needed to manage their staff's medication administration activities.

In the early days of the project, considerable time and effort was spent in unnecessary, overly iterative development of these reports. This resulted in early versions of reports that were serving too many purposes or were unusable because they were too large to run in a timely manner. The report development process did improve with careful clarification, up front, on report scope, purpose and recipients.

Figure 5. UHN inpatient order whiteboard

Lessons Learned

1. Where possible, choose a single-system approach to on-line medication management; avoid the need for complex interfaces and systems integration.
2. If a multi-system model is adopted, recognize the impact that operational processes may have on the interfaces between those systems.
3. Do not underestimate the time, effort and resources required to properly manage third-party product vendors.
4. System interfaces can be designed to support workflow that may be missing from the individual systems themselves.
5. Small to mid-sized hospitals should consider analyzing all representative and key workflows up front so that a complete end-state system can be built from the start.
6. Encourage clinical stakeholders to agree to basic system design and build standards, including medication management and clinical workflow policies, before designing the system.
7. Test systems in a real production environment before going live to ensure they will stand up to user traffic load and handle all normal and anomalous workflow situations.
8. Solicit input, review and approval from all three clinical disciplines when building custom medication orders sets; expect standards for medication orders and medication procedures to evolve over the course of the project.
9. Ensure that system design and clinical workflow can easily be changed to accommodate changes to the medication formulary – new medications being added, old medications being retired, etc.
10. When implementing clinical decision support alerts, start with only the most important ones and then add more over time as clinician comfort level increases.
11. Recognize that U.S. designed systems, despite vendor assurances, may need additional modifications to work effectively in a Canadian setting.
12. A wireless, mobile device strategy that gets the point of information access as close as possible to the Point of Care is key to a successful MOE/MAR implementation.
13. All spending decisions for mobile carts must also involve considerations of future technological advances.
14. Ensure clinicians still have access to critical medication management information in the event of a system downtime scenario.

Conclusion

From a technical perspective, implementing MOE/MAR at UHN tested our mettle. Many unique technical and vendor management issues were uncovered related to integrating two disparate systems. Understanding and building to the clinical requirements of diverse, multidisciplinary groups became an exercise in negotiations to translate medication management standards and operational practices into a functional and user-friendly on-line system. Ensuring that appropriate wireless devices and supporting infrastructure could support complex workflows required its own strategy in parallel with MOE/MAR. Finally, new reports needed to be developed to support a smooth transition to electronic MOE/MAR functionality from the previous paper-based environment.

In spite of these obstacles, MOE/MAR is now "live" in more than 25 Inpatient Units across the UHN hospital campuses, including the Emergency departments, pre-admission clinics and same-day service areas. As a result, UHN now has a robust and scalable technical architecture upon which to build more intelligent clinical alerts, and to continue with additional initiatives to completely replace paper-based patient charts with Electronic Patient Records (EPR).

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Commentary

Lessons Are Worth Heeding for Any Facility

Denni McColm

U HN is to be applauded for its successful initiative with MOE/MAR. Its efforts have saved lives, and will continue to prevent adverse drug events.

From our experiences with a comparable but much smaller implementation of computerized physician order entry and the electronic MAR, we perceive many similarities. The lessons learned are worth heeding for any facility planning a similar implementation.

Citizens Memorial Healthcare (CMH) is a rural healthcare network located in Southwest Missouri. The network includes a 74-bed rural hospital, five long-term care facilities, 16 physi-

cian clinics and a home care agency. All patient care services are connected into one electronic medical record (EMR). Network physicians enter their own orders for procedures and medications, eliminating paper medical records. The initiative, known as Project Infocare, serves 1,600 users.

The following lessons learned at UHN ring true for us as well.

If possible choose a single-system approach to on-line medication management; avoid the need for complex interfaces and systems integration. Fortunately, we were creating all new systems when we implemented computerized physician order entry and the electronic MAR at CMH. Because we chose an integrated strategy, we did not face the daunting task of interfacing systems as complex as those required by nurses, physicians and pharmacists to order, dispense and administer medications.

Small to mid-sized hospitals should consider analyzing all representative and key workflows up front so that a complete end-state system can be built from the start. We also experienced a need to "rebuild" the pharmacy and provider order entry tables so that the system was win-win for both the pharmacists (who tend to see medications as inventory items) and physicians (who tend to see medications in doses). Our system provides the capability to bridge the two viewpoints, but forethought, planning and communication are required to make it a reality.

Solicit input, review and approval from all three clinical disciplines when building custom medication orders sets; expect standards for medication orders and medication procedures to evolve over the course of the project. Like UHN, we built our own ordering conventions for medications. Building these "order strings," as we identified them, from the historical medication orders throughout our network proved useful. Vendors now have pre-set ordering conventions for purchase that will simplify this process for facilities in the future.

When implementing clinical decision support alerts, start with only the most important ones and then add more over time as clinician comfort level increases. We also implemented clinical alerts originally in an "overly safe" mode. We quickly realized that we were inducing "alert fatigue," as it is now called in the industry. Like UHN, we backed off the severe alerting status. In the future, I see clinical alerting becoming more sophisticated. For one thing, we will become better at identifying specific allergies. Currently, if our nurses enter an allergy to a combination drug that includes acetaminophen, the physician is flagged to the acetaminophen allergy – even though the allergy may have been to the other medication in the combination drug. Training in allergy specificity will help with this problem. Third-party vendors will also improve over time in their ability to alert appropriately.

Our congratulations to UHN on their successful implementation of a complex system across so many care units!

About the Author
Denni McColm is the CIO of Citizens Memorial Healthcare in Bolivar, Missouri – the first-ever non-academic and rural hospital to win the coveted Davies Organizational Award.

"No sense of humour."
[Comment from a respondent to a reader survey conducted in May 2006.]

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University Health Network Achieves Over 85% CPOE with Misys CPR, Improves Accuracy and Saves Time

The implementation of a computerized physician order entry (CPOE) and medication administration system may seem at first glance to be primarily an information technology (IT) challenge. Yet those institutions that have implemented these applications have discovered that success is often more dependent upon behavioural changes in the medical staff. The fact is, putting the world's most advanced technology at a physician's fingertips does not provide any guarantee that he or she will not simply bypass the system by scribbling out a prescription.

University Health Network (UHN) addressed this challenge head-on during its implementation of Misys CPR for CPOE and medical administration functionality. The UHN Project Management Team worked collaboratively with physicians and other members of the network's medical and administrative staff to ensure their inputs were considered in customizing the system and that key influencers understood the advantages of CPOE and supported the implementation effort.

The result is that, with the implementation process recently concluded, over 85% of the prescriptions ordered at UHN in the areas that have been implemented – essentially all of the inpatient areas – are already being processed through Misys CPR. "The success of our implementation has made it possible

University Health Network includes

- Toronto General Hospital: 353-bed acute care facility
- Princess Margaret Hospital: 115-bed acute care facility
- Toronto Western Hospital: 239-bed acute care facility
- 1,300+ physicians
- 11,000+ employees
- Almost 900,000 ambulatory visits
- More than 11 million diagnostic and therapeutic procedures

to put a large number of safety features into place that were impossible with the manual approach," said Matt Anderson, Chief Information Officer for UHN. "In addition, we have seen dramatic improvements in efficiency, such as a 28% reduction in the elapsed time from prescription order to administration."

"In the plastic surgery department, we customized the interface so that all of our common medications can be ordered with only a few clicks," added Dr. Peter Bray. "CPOE improves ordering accuracy since we don't have to worry about an inadvertent error or someone misreading or mishearing what we said."

Expanding Misys CPR Use

UHN began using the predecessor of Misys CPR in the late-1980s for a number of administrative applications such as registering and admitting patients. UHN's use of the software has increased greatly over the last several years, as it has successfully implemented CPOE for diagnostic testing and patient dietary management.

Leveraging the momentum generated by these wins, UHN then embarked on CPOE implementation – its most ambitious and potentially most rewarding effort ever. "This was probably the most important IT project in our history because it directly affects the safety and quality of care provided to our patients,"

said Stephanie Saull-McCaig, Director, Acute Information Management, Shared Information Management Services (SIMS). "The majority of adverse events or errors in any hospital are focused on the administration of drugs. We looked closely at the Misys CPR solution and determined that it did an excellent job of integrating order entry and the administration of medicines while making it possible to fully utilize the information contained within the system."

Winning Staff Co-operation

The biggest challenge in this project, as with other CPOE implementation efforts, was in obtaining the cooperation of the medical staff so that the system would actually be used. "We recognized from the very beginning this was much more than a simple IT implementation – it was an all-encompassing change management initiative," Anderson, the CIO, said. "Physicians are naturally quite attached to methods that they've been using for years, often since they began practising. Convincing them to devote the time and energy required to adopt new methods was not an easy process. It required a lot of time and effort to understand each department's requirements and provide the customization needed to ensure these requirements were not only met but exceeded."

The multi-faceted project team put together at UHN – consisting of representatives from Information Technology, Nursing, Pharmacy and Physicians – made a special effort to gain the participation of staff members who are leaders and influencers, regardless of their official role. And rather than taking a "big bang" approach, the team focused on one department at a time. After spending time with each group to understand how their specific order process worked, the project team customized the workflow to meet the department's needs while at the same time helping them understand the capabilities of Misys CPR and providing user training.

> " The main reason why Misys CPR has been so well accepted by the medical staff at UHN is that it is very simple to use.

> " While I have heard of many hospitals that have CPOE levels below 50%, ours was above 85% the first time we measured it. As a result, we've improved quality and efficiency.

Custom Version for Each Department, Each Patient

The decision was made early on in the implementation process to standardize as much of the customization as possible across the entire hospital while recognizing that each department's varying needs required individual approaches.

For example, the Internal Medicine Department uses a team-based approach in which physicians, nurses and pharmacists in a unit all work together, meaning any one of them might be called upon to meet the needs of a particular patient.

Each surgeon, on the other hand, has a one-on-one relationship with his or her patients. The surgeons typically come in each morning to check on their patients and write orders, and then they are off to the operating room for the rest of the day. The Behavioural Medicine Unit, conversely, provides a more relaxed environment because of the absence of medical emergencies and the fact that many patients are treated in group sessions. The medications tend to be less complex in this area, and many patients receive them directly from a nurse who watches to be sure they are swallowed.

The EHR Project Team began by defining the workflow for each department and setting up screens to move the order through each step in the process. For example, the anesthetists operate in groups, each of whom, in turn, follows many different patients. The process of customizing the application for this department included defining the groups and providing each member of the group's staff with access to information on and the ability to write orders for each assigned patient.

The team-based approach of the Internal Medicine Department made it necessary to develop a unique alert system. In the past, when a physician wrote an order, he or she would lift up a mechanical flag next to the patient's chart to let the nursing staff know that there was a new order. Now, when a physician

writes an order, a similar flag pops up on a chart that appears on the screen of all the nurses in the unit. The screen has the patients' names down the left side of the page and the different departments that might require action across the top, including medication, lab, diets, radiology, etc.

On the other hand, in each department's version of the Misys CPR system, individual patients have their own inbox that can be used to view lab results, radiology results and new medication orders. And each group has established shortcuts to create the most common orders, including drug name, frequency, dosage and route.

Quick Adoption Speeds Payback

"This process achieved the intended result of producing a CPOE system that meets the needs of each department and is easy to use," Saull-McCaig said. "While I have heard of many hospitals that have CPOE levels below 50%, ours was above 85% the first time we measured it. As a result, we've improved quality and efficiency."

The most important benefit – patient safety – is also the most difficult to quantify. "The Misys CPR implementation has made available a wide range of clinical support tools that did not exist in the past," Dr. Bray said. "As soon as the physician enters the order, but before it is accepted, Misys CPR searches its clinical database for drug-drug or drug-allergy interactions. The software generates an alert if any problem is identified. And thanks to the system's flexibility, we are continually adding alerts that detect a myriad of major and minor errors. For example, the system now alerts a doctor whenever he or she enters an order for anyone that is no longer an inpatient."

Safeguards in the software ensure that all of these orders are complete and leave no room for misinterpretation or data entry errors. For example, in a recent month, the system gener-

ated over 5,000 clinical decision alerts. Each department has created its own standardized orders that cover the vast majority of its orders, which further reduces the potential for error. The exactness of electronic ordering has eliminated the potential for mistakes that were previously possible due to miscommunication, such as when doctors would stick their head out of their office and call down the hall to a nurse to place an order. CPOE also helps prevent the possibility that doctors could forget they have prescribed a certain drug and then repeat the prescription.

Once the order is entered, the speed at which information can be transmitted electronically makes for a substantial reduction in the time required for the order to be reviewed by the pharmacy and then administered. For example, the time from order entry to review by pharmacy has been reduced by 26%. Doctors have also been able to save substantial time by cutting out visits to the three hospitals within UHN that took place only to put orders on paper charts. Now they can log in from their office and enter orders for all their patients electronically.

"The implementation of CPOE with Misys CPR set off an intensive change management process that has touched every department and level within our organization," Saull-McCaig concluded. "The results have clearly justified this effort. It's difficult to quantify the improvement in patient safety, because our previous methods were not capable of tracking errors, but it's clear that we have made major strides in this area. We have also seen significant time savings among the medical, pharmacological and administrative staffs."

Benefits Achieved through the Implementation of CPOE

- Over 85% of physician orders are now processed through Misys CPR.
- The elapsed time from prescription order to administration has been reduced by 28%.
- The time from order entry to review by pharmacy has been reduced by 26%.
- In a recent month, the CPOE system generated over 5,000 clinical decision alerts.

" The Misys CPR implementation has made available a wide range of clinical support tools exist in the past.

The Benefits of the MOE/MAR Implementation: A **Quantitative** Approach

Nick Zamora, Michael Carter, Stephanie Saull-McCaig and Joe Nguyen

Introduction

Once the decision was made to implement an electronic medication order entry and medication administration record (MOE/MAR) system at the University Health Network (UHN), a significant question soon emerged: How would UHN be able to determine if the project had indeed accomplished its stated objectives of improving patient safety and the medication ordering and processing cycle?

With this in mind, UHN enlisted the assistance of researchers who would conduct a quantitative study to measure the impact and benefits of the new system. While seemingly straightforward, this evaluation was made more challenging by the diverse expectations of MOE/MAR.

This article reports on the results of UHN's multi-year study looking at the impact of MOE/MAR. In our overview, we examine such elements as the methodology used as well as the challenges and constraints faced by the team. We also examine the following: the types of lessons learned during MOE/MAR's implementation; the effectiveness of teamwork; and the impact of external resources upon the project.

Why Study the Benefits?

The old saw, *you can't manage what you can't measure*, was the orienting principle behind the MOE/MAR evaluation from conception to implementation. The study's objective was to measure the impact of implementing MOE/MAR on patient safety, clinical workflow and the quality of patient care. We developed a number of specific performance indicators from which we expected definite results. We soon discovered there were very few studies, either at the UHN or anywhere else, that indicated consistent results regarding the impact of MOE/MAR. Some studies, in fact, indicated mixed or conflicting results. Up to this point, UHN had only conducted rudimentary benefits measurement evaluations on its IT projects as part of its overall project management function. Our experience suggested that this was common in the healthcare sector and provided us with yet another reason to move forward with our more comprehensive evaluation.

The need for a benefits/measurement study of MOE/MAR was made clear by UHN leadership. If the healthcare organization was committing significant time as well as human and financial resources toward implementing this major change initiative, it was essential to gather data and provide evidence-based research to justify to UHN decision-makers (and other healthcare organizations contemplating similar projects) that such investments were indeed worth the effort. Without such information it would not be possible to demonstrate MOE/MAR's effectiveness.

A comprehensive, multi-year study would provide ongoing information to the implementation team, users and administration that the project was proceeding according to plan. Study data would also be used to measure the implementation progress and any adjustments needed along the way to improve the process – allowing for the cycle of ongoing quality improvement at UHN.

Background and Overview

UHN's Shared Information Management Systems (SIMS) department had engaged an external healthcare consulting group to advise and support the overall MOE/MAR project. The lead consultant from the firm strongly advocated the need for a UHN leader-supported benefits/measurement study and engaged a faculty researcher at a local university to join him on the MOE/MAR study.

The researcher assembled a group of his undergraduate summer students and former graduates in industrial engineering to join the project team. From the outset, the students were integrated into the overall team structure rather than assigned tasks and sent off to work (and subsequently submitting reports of their findings). This was a successful strategy, as the students gained practical experience in their field and the organization (UHN) established a working relationship with the university that could be continued on future projects.

In addition, the team also convened a benefits realization steering committee that comprised the key stakeholders on the project to determine objectives and research questions.

The "Benefits" of Our Benefits Study

It was recognized that empirical evidence generated through the study could help validate (or challenge) the commitment to MOE/MAR. And, should MOE/MAR prove successful, it would positively affect attitudes and perceptions, supporting future implementations. Lastly, conducting the study reinforced a "culture of accountability" at the hospital so that the impact and benefits of future projects could be properly analyzed in a systematic and quantifiable way. By this time, SIMS staff had already incorporated a rigorous benefits/measurement framework into several other projects.

One of the key reasons we successfully secured support for the study was the promise of the ability to quickly show results. For example, as data were collected during the time spent on a unit with a particular group that had implemented MOE/MAR, we shared these data weekly (sometimes more often) with the groups so that each group could see what improvements there were on their specific units. Often, these included reductions in transcription errors in medication orders or change in time spent on recording medication orders into the MAR. Stakeholders were able to readily see changes that were both tangible and positive.

Methodology and Approach

A steering committee with diverse representation was established to oversee the study. To be consistent with the project management methodology in terms of the overall process, a project charter and detailed work-plan was devised and subsequently implemented. In this manner, the benefits measurement process could be separately tracked by the SIMS' Project Management Office to ensure it met timelines and project expectations relative to the MOE/MAR implementation.

Our approach to assessing the benefits of MOE/MAR proceeded in four stages:

1. **Select Key Metrics and Indicators**
   - Identify the right indicators to address the stated objectives of your MOE/MAR project. For example, is it patient safety or process improvements that the organization would most like to achieve?
   - Select indicators that are quantifiable, easy to collect and yield the most significant results. Recognize that clinical chart audits are very resource-intensive and require experienced clinician resources.
2. **Identify Data Sources**
   - For the UHN study, we developed our metrics around three different types of available data sources: Chart Audits, Time-Motion Study and Electronic Reporting (Data Warehouse).
3. **Collect/Tabulate Data**
   - Develop charts and tables that are accurate and easily interpreted so that immediate actions can be developed.
4. **Communicate Results**
   - Develop a communication mechanism to share results and feedback with stakeholders and users on a regular basis.

After documenting the medication ordering process (see Figure 1), we developed indicators that we felt would best demonstrate the impact of the MOE/MAR technology. The list of key indicators measured in the study is consolidated in Table 1. During this phase we were always mindful to choose indicators that would be meaningful and applicable for clinical and hospital executive decision-making.

Results and Findings

The data for this study were collected over a two-year period (May 2004 to May 2006) for all eight clinical service clusters that were implemented at UHN. These include both medical and surgical patient care areas, which exhibit different detailed medication ordering cycle workflows (see Table 2).

Technology Adoption

From the CPOE rate of 89%, we can conclude that the adoption of the technology is high; many institutions do not see this level over 50%. However, based on our surveys after a two-month implementation process, the clinicians (MD, RN, Rx) still had mixed feelings about the system, as they were still moving down the learning curve.

Quality of Care and Patient Safety

The ability to use clinical-decision support was a significant benefit of MOE/MAR that could not have been realized with a

Figure 1. Medication order processing cycle and indicators

(MD = Physicians; APN = Advance Practice Nurse; RX = Pharmacists; RN = Nurse)
(Please refer to Table 1 for detailed indicator definitions and explanations.)
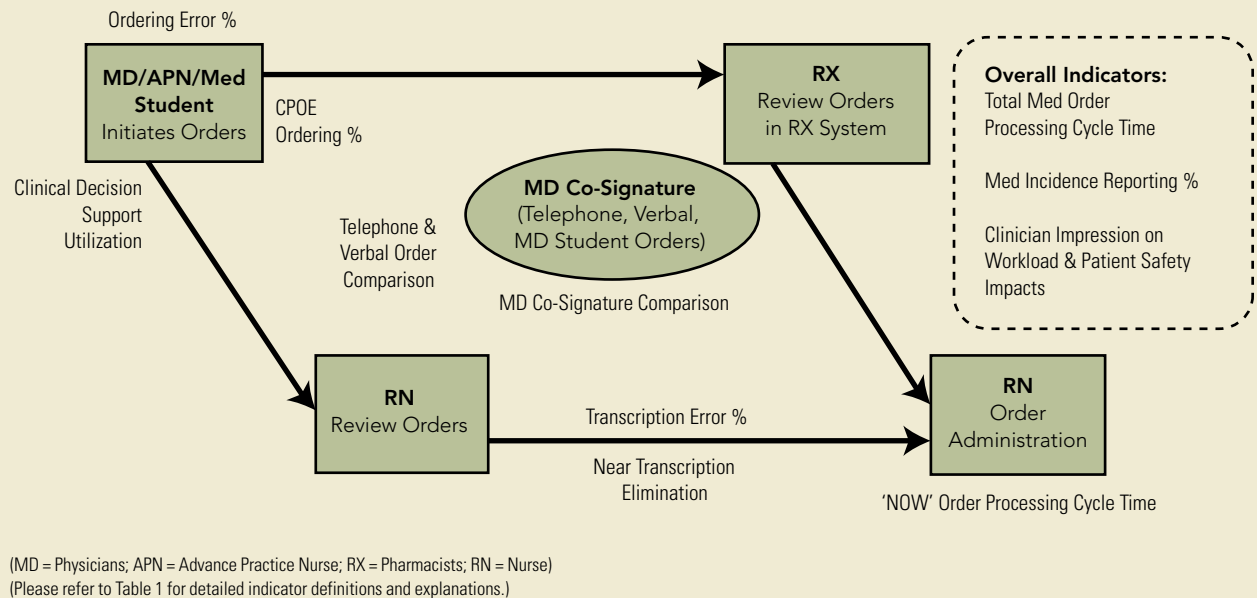
paper-based system. With an average of 4,000 interaction alerts "fired" per month, these numbers show that UHN is heading in the right direction vis-à-vis utilizing technology to further bolster patient safety. However, the mere fact that more alerts are being fired in itself is not necessarily a good thing. Over time the alerts could be considered a nuisance and eventually be ignored by a physician. This could not only reduce the usefulness of a potentially effective decision-support tool but could also lead to an increase in patient safety risks for patients. To ensure that this does not happen, SIMS and its clinical advisors continuously evaluate the alerts programmed into the system to ensure they are accurate and useful, as well as monitor the acknowledgment rate of the alert recipients.

The near complete reduction of transcription errors in both the chart audit study and the reported medication incidences has allowed us to establish the value of the MOE/MAR system and speak directly to patient safety. In addition, non-measured benefits (because there were no base-rate data) were realized from the system, namely, 100% complete and legible orders.

Clinical Workflow

The overall medication ordering process and turnaround time of the "Now" dose markedly decreased with the implementation of the MOE/MAR system. This creates an improved patient care environment due to fewer medication delays.

UHN has historically attempted to decrease the number of verbal and telephone orders. In this regard MOE/MAR has been able to facilitate a 75% decrease in these types of orders, thereby allowing the physicians and nurse practitioners to directly enter their own orders. This has noticeably reduced miscommunication while increasing accountability.

Finally, customized order sets – tailored to each practice area – and offsite accessibility have been valuable to address the challenges posed by residents and clinical fellows who rotate throughout an academic teaching hospital.

Policy Adherence

Throughout the project, we have seen a shift in accountability. The introduction of the electronic ordering and documentation of medication has created a shift in medication reporting practice. We have a seen a 150% increase in overall reported medication incidents. This is a positive step towards UHN's stated goal of "transparent" patient care practice, and is also good for the overall organization.

We have also seen an almost 97% co-signature rate for verbal and telephone orders. Thus, UHN has almost achieved its goal of 100% co-signed orders.

Process Improvements

Since the results of the study were shared and communicated on an ongoing basis after every cluster implementation, we were able to utilize the data to identify areas of improvement and our approach for the subsequent rollouts. This allowed us to provide an ongoing cycle of improvements, using a methodology similar to the PDSA cycle (Plan/Do/See/Act) created by the Institute for Healthcare Improvement.

Table 1. Key indicators and metrics

Metric/Indicator	Definition	Methodology/Data Source	Indication (Impacts Post-implementation)
Ordering & transcription error %	• *Ordering errors include incorrect dosage, orders against medication allergy, duplicate orders, missing key order elements (e.g., dose, route), incorrect abbreviations* • *Transcription errors include incorrect medication transcription, missed transcription and incorrect date transcribed* • *Percentage of ordering and transcription errors detected over total number of orders sampled*	Chart audit (sampling)	Potential ordering & transcription errors eliminated

Major vs. minor medication ordering & transcription error	• *Same as above indicator, categorized by major vs. minor categories*
	• *Major errors:*
	  • *Allergy to med*
	  • *Incorrect dosage*
	  • *Duplicate medication orders*
	  • *Missing key components (e.g., dose, route)*
	  • *Missed transcription*
	  • *Incorrect transcription*
	• *Minor errors:*
	  • *Incorrect abbreviations*
	  • *Incorrect date transcribed*
		Chart audit (sampling)	Potential ordering & transcription errors eliminated

Medication incident reporting frequency	• *Comparison of all reported medication incidents collected pre- and post- implementation (six-month period pre-, and three-month period post-implementation)*	Medication incident reporting	Potential medication errors eliminated; accountability and reporting culture shift in an electronic environment
Transcription error reported	• *Comparison of transcription error percentage through reported medication incidents pre- and post-implementation*	Medication incident reporting	Potential medication errors eliminated post-MOE/MAR; accountability and reporting culture shift in an electronic environment
Clinician impression on patient safety	• *Patient safety impression rating through user surveys post-implementation*	Survey response	Overall qualitative feedback
Total medication order processing cycle time	• *Time from physician order creation/entry to pharmacy or nursing order verification (whichever occurs last)*	Time-motion study (pre), data warehouse (post)	Timeliness of medication processing
"Now" order processing cycle time	• *Time from physician creation/entry to patient administration of "Now" dose*	Time-motion study (pre), data warehouse (post)	Timeliness of "Now" orders
Telephone & verbal order comparison	• *Percentage of telephone & verbal orders detected over total number of medications ordered*	Chart audit (pre), data warehouse (post)	Promotion of direct physician/ acute nurse practitioner orders
MD co-signature rate comparison	• *Percentage of signed "co-signature required" orders detected over total number of medications ordered*	Chart audit (pre), data warehouse (post)	Promotion of co-signature and adherence to policy
Clinician impression of MOE/ MAR regarding workload	• *Workload impression rating through user surveys post-implementation*	Survey response	Qualitative feedback
Clinical decision support utilization	• *Number of medication clinical decision support alerts "fired" over MOE/MAR system post-implementation* • *Alerts include duplicate orders, allergy interaction, limited drug-drug interaction*	Data warehouse (post)	Promotion of medication safety – utilization of clinical decision support tools
CPOE percentage	• *Percentage of medication orders entered by physician or acute nurse practitioner (as per medical directives) counted over total number of medications ordered*	Data warehouse (Post)	Promotion of direct physician/ acute nurse practitioner orders

+ - All samples and figures measured per medication order (not order sets).

Table 2. Key results & findings – measured indicators and metrics for the MOE/MAR Project

Area of Impact	Metric/Indicator	Pre	Post	Result
Patient safety	Major ordering & transcription error %*	10.2%	6%	42% Decrease in major ordering & transcription errors detected*
	Minor ordering & transcription error % *	25.6%	0%	Elimination of all minor ordering errors*
	Medication incident reporting frequency	1.9 reported incidences per unit/month	4.8 reported incidences per unit/month	152% Increase in reported medication incidences
	Transcription error reported	0.7 reported incidences per unit/month	0.1 reported incidences per unit/month	80% Decrease in reported transcription errors **
Medication order processing improvement	Total medication order processing cycle time	180 minutes	121 minutes	Average decrease of 59 minutes or 33%
	"Now" dose turnaround time	106 minutes	81 minutes	Average decrease of 25 minutes or 23%
	Telephone & verbal order comparison	11.2%	2.8%	75% Decrease in verbal & telephone orders
	MD co-signature rate comparison	42.6%	96.8%	126% Increase in MD co-signature – near complete co-signed orders
Other benefits	Clinical decision support utilization	N/A	3,865 alerts/month	Increased potential medication ordering errors detected at order entry per month
	CPOE percentage	N/A	89%	High compliance for direct prescriber order entry

* Sampled orders for two months pre- and post-implementation on one General Medicine Unit – all samples and figures measured per medication order (not order sets).

** Complex medication orders remain on paper and are transcribed manually.

• All samples and figures measured per medication order (not order sets).

• Please refer to Table 1 for definition and data sources.

There were three areas where we could use the results for improvement. The first area was the current product/application, as we had identified improvement opportunities in the customization of the application to better suit the clinician needs. We were also able to identify clinical work improvements by taking advantage of the electronic capabilities not available on paper. As well, we were able to use the data to improve on our project implementation processes by making mid-course corrections, our status report card (as mentioned in the Project Management section) and allowing us to identify unreported issues by the users and resolving them in a timely manner.

Challenges

The initial challenge for us was securing executive commitment to conduct a benefits/measurement study. While there was general interest, there were also many questions from organization leaders about what it would cost, how much time it would take to complete and how many people would need to be involved. In addition, there was some scepticism about how quickly results would be available. To put all these issues in context, we returned to our initial question: How will we know whether the decision to invest time, people and money in MOE/MAR was worth it? We, UHN's senior leadership, and MOE/MAR leaders all recognized that the best way to answer these questions was to proceed with the study, using available financial resources and developing a detailed and time-bound project plan.

During steering committee meetings, another issue arose. The committee was made up of researchers, clinicians, administrators, academics and project managers. This mix of people and perspectives naturally led to a diversity of opinions on the

Lessons Learned

1. Measuring patient safety
The benefits study was not intended to measure adverse drug events or to replicate the study by Baker et al. (2004). The results of the study do not demonstrate direct evidence that the system has saved lives but does however establish enough benefits to indicate a reduction in patient safety risks for medication therapy at UHN.

2. Utilizing results to influence process improvements and stakeholder buy-in
As an example, by timely measuring the effect of technology on the entire medication management process, the project team was able to quantify the collateral impacts of a partial system implementation strategy and quickly change course to implement both ordering and administering functionality together. Consistent communication findings also helped clinicians and hospital administrators understand long-term benefits despite initial challenges moving down the MOE/MAR learning curve.

3. Unexpected and non-quantitative benefits realized
Customized order-sets for each practice area promoted standardized and complete medication orders, which provided a better teaching environment for rotating clinical staff. MOE/MAR introduced a new level of accountability, resulting in increased medication incidence reporting and a major decrease in verbal and telephone orders – facilitating best-practice and policy adherence. MOE/MAR also increases clinician EPR interaction time, which encourages higher utilization of other pre-existing electronic charting modules.

4. Managing expectations of results
MOE/MAR will not reduce the amount of clinician time spent on medication ordering and processing; however, it will streamline and expedite the overall medication management process. Utilize both the positive and negative results – the positive to demonstrate system effectiveness – the negative to create changes that will improve the system. MOE/MAR will never be "perfect" – it will consistently require changes and enhancement with technological improvements and changing medication practices.

5. Simplified and streamlined methodology
Focus on the "useful" and meaningful indicators and metrics. Keep to a simple methodology to minimize human resources required and for ease of study repetition. Maximize electronic reporting capabilities and refrain from manual chart audit methodologies; this is clinical-resource intensive.

6. Be aware of data collection issues before you begin
Ask the following questions: Is your system designed to extract the data you need? And do you have the personnel who know how to access this data? Finally, how do you plan to manage such a process?

7. Manage the expectations of the project steering committee
Choose a diverse group of people to steer the project but plan for management of the differing expectations and agendas. Once overall objectives and research questions have been sorted out, create an operational group of four or five individuals, to manage the progress of the study and report back to the steering committee.

8. Secure executive commitment and sponsorship
Before the project begins, clearly explain the value of a benefits/measurement study and have it incorporated into project planning. Be firm and persistent in order to win over sceptics.

9. Look for regional partners to cooperate on a study
Finding other organizations in your area will help defray costs and maximize resources.

10. Work with external experts
Contact your local or regional university to seek out faculty leaders and students with research, systems analysis and experience with process and project management.

purpose of the study, the attainability of the data and the value of the results that could be achieved. Managing these differing agendas was a significant challenge. Once a scope and focus for the study was determined, it was important to create a smaller operational group, made up of key members with commitment to the same vision. This group was responsible for monitoring the project and ensuring it stayed on track. In addition they would report back to the study steering committee to review quarterly and bi-annual findings.

We initially concentrated more of our efforts on the physician order entry impacts, as we had originally separated our project rollout to the MOE component only to help manage the implementation workload. However, our study had quickly identified serious process issues that come with an electronic MOE and a manual paper MAR system. This identification led the project team to revise their rollout schedule after the initial cluster implementation decision to include both MOE and MAR functionalities simultaneously. As a result, this corrected the hybrid process issues and helped realize the benefits of using both modules together.

Another major challenge was extracting data from UHN and SIMS' electronic reporting systems from which we could make decisions about the indicators we would use as measures. Generating data took months. And when we did produce data, we questioned the usefulness and quality. The electronic reporting system simply was not designed for this purpose. Most hospital information systems do not support process improvement activities; rather they focus on clinical and finance reporting. Many of the reporting and data sources for this study had to be customized and required periods of time to be ready. One challenging example was the medication timing report, which included order, verification and administration time. This may also be an issue for other organizations interested in conducting a similar study.

Finally, it is also essential to recruit people with a solid knowledge of process as well as analytical and problem-solving skills (not merely data collection or data entry skills). We were fortunate that our team had these core competencies. A study like this requires individuals who know how to interpret data. In short, professionals with research experience – as well as systems analysis skills – are essential to the project's well-being.

After the Study – Should We Continue?
What began as a research study has now evolved into a framework for how people do their work on a daily basis. While the MOE/MAR implementation has been completed, UHN continues to internally study the

results, submitting reports to senior administration and clinical leaders throughout the hospital network.

The plan over the next year is to continue to incorporate the key lessons from this project into a continuous cycle of planning for other information technology-based projects at UHN.

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Commentary

The Benefits and Impacts of the MOE/MAR Implementation: A Quantitative Approach

Denis Protti

This paper describes how UHN was able to determine if the MOE/MAR project accomplished its stated objectives of improving patient safety and the medication ordering and processing cycle. Though the authors qualify that the benefits study was not intended to measure adverse drug events or to replicate the 2004 study by Baker et al., the findings do add new evidence that MOE/MAR does indeed reduce ordering and transcription errors and reduce medication incidences.

These UHN findings are particularly significant, since other recent evidence suggests that, despite the growing use of error reporting tools, the healthcare industry is inexperienced in receiving, understanding and analyzing these reports. A recent Johns Hopkins study (Miller et al. 2006) found that, despite clear imperfections in the data captured, medication error reporting tools are effective as a means of collecting reliable information on errors rapidly and in real time. Their data suggest that administration errors are at least as common as prescribing errors in children.

Miller et al. (2006) found that, of the 1,010 medication errors reviewed, 30% were prescribing errors, 24% were dispensing errors, 41% were administration errors and only 6% involved medication administration records (MAR). About one-third of the medication error reports needed to have the subtype of error reclassified; 59% of these involved the reporter choosing the non-descript "other" category on the reporting tool (such as "prescribing other"), which was able to be reclassified by expert review. The overall distribution of error type categories did not change significantly with expert review, although only MAR errors were underreported by the reporters. The most common medications were anti-infectives (17%), pain/sedative agents (15%), nutritional agents (11%), gastrointestinal agents (8%) and cardiovascular agents (7%).

Whenever the subject of errors comes up, one is reminded of Morgan's 2004 paper, "In Pursuit of a Safe Canadian Healthcare System." In it, he asked: Are Canadian patients safer today? Has the national rate of medical errors decreased? Are fewer hospitalized patients in Canada dying from medical errors? Are Canadians less likely to experience an adverse drug event in the outpatient setting? Is our growing home care delivery safe? Are diagnostic investigations being performed in a timely and effective manner? Are the right patients being treated with the right medications in the right dosages for the right duration? Are patients achieving the expected and desired outcomes?

The recent Johns Hopkins paper suggests that further research is needed, not only in the area of computerized physician order entry (CPOE) for children, but also on ways to make the dispensing and administration of medications safer. Undoubtedly, the same applies to the UHN and other adult hospitals introducing medication order entry and medical administration record systems. However, thanks to the efforts underway at UHN and other leading facilities, can we say that some of Morgan's questions are being answered?

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Transforming Healthcare Organizations
Looking Back to See the **Future**

Robert Bell, Brian Golden and Lydia Lee

T he preceding papers in this issue of *Healthcare Quarterly* provide a "how-to" guide to mounting a complex, across-the-organization change, and also reveal the unique perspectives of the different professional groups involved in the change. In addition, the paper "Executive Perspective: The Business Case for Patient Safety" (see p. 20 in this issue) reveals how the University Health Network's (UHN) Executive Team came to the decision to pursue the specific Medication Order Entry/Medication Administration Record (MOE/MAR) initiative. Each paper in this issue of *HQ* ended with "Lessons Learned" unique to each UHN leader's perspective. In contrast, this paper looks back on the five-year initiative, from all perspectives, in order to provide a final set of observations for organizations considering the implementation of a MOE/MAR-type project. More generally, this paper speaks to healthcare leaders who are contemplating significant changes in their organizations.

Lessons Learned for the Future

As of Fall 2006, UHN's MOE/MAR Steering Committee determined that the organization was ready to implement MOE/MAR at the two remaining clusters (Transplant and Medical-Surgical ICU). At the same time, there are plans to implement MOE/MAR at several of UHN's strategic partners in the Toronto area. Both decisions reflect the Steering Committee's view that its implementation methodology has now been fine-tuned.

With a strong sense that MOE/MAR and its implementation have been a resounding success, and now having had the opportunity to reflect as we produced the series of papers for this issue of *HQ*, we take this opportunity to offer 10 additional insights that have either not yet been discussed or are worthy of emphasis here.

1. **Flexible, systematic change strategies are essential:** Heading into a change as profound as MOE/MAR, UHN leaders found it helpful to have a clear sense of how the change process should unfold. While not the only way to think about the change process, the four-stage framework presented in the paper "Transforming Healthcare Organizations" (see p. 10 in this issue) provides a systematic way of ordering the various change activities while not hamstringing change leaders when faced with unexpected events. Although this framework was not explicitly discussed as UHN initiated the MOE/MAR project, the four stages

– (1) determining the desired end state, (2) assessing readiness for change, (3) broadening support and organizational redesign, (4) reinforcing and sustaining change – nicely map on to the MOE/MAR experience.

2. **Wholesale transformation requires support from the Board of Directors:** Five years later, it is difficult to say whether the idea for MOE/MAR came from the Board or was brought to the Board by innovative leaders at UHN. What is clear is that the time was right for MOE/MAR: UHN's Board Chair had frequently expressed frustration with the archaic information systems in the hospital industry. In addition, the Board was aware of the increasing attention to medical errors resulting from system (not individual) failure. With the stage set, the Board was prepared to make patient safety, and MOE/MAR as a means to achieve it, a fundamental goal – worthy of substantial financial resources – for the next half-decade.

> For MOE/MAR to have been successful, it was critical that all people involved in MOE/MAR – not only the Steering Committee and clinical leaders, but the Project Team charged with implementing MOE/MAR on time and on budget – be brought together to provide a clear picture of the elephant called MOE/MAR.

3. **Expect to provide special resources to bring together clinical champions from affected disciplines:** In many ways, the experience of assembling the papers for this issue reminded us of the Indian tale of the Six Blind Men and the Elephant. In this well-known tale, each of the blind men had heard about and then touched different parts of the elephant, and naturally had come to very different understandings of what an elephant must be like.

Without being (intentionally) unkind, the professionals involved in the implementation of MOE/MAR, as well as those contributing to this issue, are like these six blind men. For MOE/MAR to have been successful, it was critical that all people involved in MOE/MAR – not only the Steering Committee and clinical leaders, but the Project Team charged with implementing MOE/MAR on time and on budget – be brought together to provide a clear picture of the elephant called MOE/MAR. The Steering Committee recognized that for the Project Management Team to get genuine support from clinical leaders (e.g., Informatics Specialists in Nursing, Medicine and Pharmacy), additional resources had to be provided. No one had sufficient excess capacity to devote to MOE/MAR, so capacity had to be created. For example, UHN bought the time of internal clinical informatics experts. No one believes these experts were "bought" in the sense of doing something against their better judgment; rather, the purchasing of their time freed them up to work on an initiative they already supported.

4. **Demonstrate credible commitments:** This lesson is related to lessons one and two in this paper, and related to a key concept in competitive strategy. Strategists have long been concerned with how to signal to their competitors that they are so serious about entering a market that their potential competitors need not even consider opposing them. For example, in its early days, Wal-Mart would build stores too large for their markets and take unusually long-term leases. The message to potential competitors was clear: "We have committed such significant resources that we cannot consider turning back." That is, Wal-Mart had made a "credible commitment" to an initiative.

At UHN, the Board's support, the Steering Committee's financing of dedicated resources and the very public announcements throughout UHN made it virtually impossible for potential opponents or sceptics of MOE/MAR within the organization to believe that it might fade away. UHN's very credible commitment to MOE/MAR suggested that this system would unequivocally change the way medications were ordered and administered at UHN. The only outstanding question was, "Who would sign on earlier rather than later?"

5. **MOE/MAR is scalable and can be leveraged:** Given the size and resource base of UHN, leaders at other healthcare organizations might wonder about the extent to which the experiences documented in this issue are relevant to them. We are quite optimistic. While certainly there are some basic fixed costs to MOE/MAR, UHN started relatively small and only rolled it out to additional clinical service areas (or "clusters") as each successive cluster was deemed a success. Now that MOE/MAR is firmly entrenched, and given UHN's experiences in MOE/MAR design and implementation, there are plans to implement MOE/MAR at several of UHN's smaller, non-acute care partner organizations. The ability to spread the fixed costs of development and maintenance of systems, such as MOE/MAR, provides tremendous opportunities to smaller organizations. And, at a time when geography-based cooperation among providers is increasingly required, this technology is available at the right time and provides a tangible way to demonstrate partnering. The future may also hold opportunities to spread MOE/MAR technology ever further into the community, for example, by connecting healthcare organizations and commercial pharmacies, further reducing opportunities for medication errors.

6. **Implement incrementally:** One of the most debated questions in the early days of MOE/MAR was whether to implement MOE/MAR incrementally or with a "big bang." Some at UHN argued for building MOE/MAR and implementing it in all clusters at once. Others argued for incremental implementation. While sensible arguments emerged on both sides of the issue (see "Transforming Healthcare Organizations" on p. 10 of this issue), UHN decided to roll out MOE/MAR incrementally. Today, leaders at UHN are even more convinced of the wisdom of that decision. Specifically, in the early days of this project, we could not have imagined all the technical and social complexity that would come to characterize MOE/MAR.

While it would be an overstatement to suggest that UHN leaders were walking with their eyes closed – in which case it would have been very wise to take small steps – in fact, there was little in the healthcare management literature at the time to guide UHN's MOE/MAR implementation. Thus, UHN made the explicit decision to proceed through a cycle of *plan, implement, review and learn* (to be repeated). While UHN leaders hope others will benefit from these experiences, both positive and negative, we would still maintain that complex change needs to be rolled out incrementally. This not only allows for technical problems to be worked out before infecting an entire organization, but it also builds the organization's confidence and appetite for change.

> **… there was little in the healthcare management literature at the time to guide UHN's MOE/MAR implementation. Thus, UHN made the explicit decision to proceed through a cycle of** *plan, implement, review and learn* **(to be repeated)…**

7. **Develop and support business continuity capabilities:** Although MOE/MAR was intended to reduce risks to patients, it is now clear that substantial system changes, such as MOE/MAR, could, in theory, temporarily increase risks. One need only imagine a world not too far in the future (we hope) when physicians, nurses and pharmacists in training have never worked in a non-MOE/MAR environment. The risk in such a scenario exists when a technical system failure requires clinicians to turn to alternative, paper-based medication ordering. Any organization that relies on technology to the extent that UHN does must ensure that backup processes exist and that clinicians turn quickly and naturally to them when required. And, as UHN learned

during its less-than-fully-successful pilot, procedures must be put in place – and resourced (e.g., with additional staff) – to enter paper orders when computer-based systems come back on-line. In general, project managers and system designers must be astute scenario planners, asking a series of creative "what if" questions (e.g., "How will paper orders get entered into the system?") in order to protect the organization from an overdependence on technical systems.

8. **No computer-based system fully replicates human judgment or is foolproof:** One of the challenges for designers of computer-based decision support is that the knowledge upon which it is based has to be codifiable. That is, it must be possible to transmit this knowledge to others through manuals, specifications, regulations, rules and procedures. In the case of MOE/MAR, clinician knowledge had to be codifiable in order for system designers to build that knowledge into the system (e.g., which medications are needed for order sets.) Tacit knowledge, in contrast, is semi-conscious or subconscious and is held in people's heads (Leonard and Sensiper 1998). To the extent that not all clinical judgment and knowledge can be built into MOE/MAR (e.g., a range of narcotic dosages is often provided in post-operative orders to allow nurses discretion in determining appropriate levels of analgesia), or at least not from the start, clinicians must remain vigilant about decision-making. A culture of questioning the system when it does not "feel right" must be developed and supported.

Related to the previous point, it must always be recognized that no computer-based system is foolproof, entirely mechanical, nor can it be fully divorced from (bad) human judgment and human error. Again, it is critical that MOE/MAR training ensure against mindlessness – the human tendency to operate on "autopilot" (Langer 1989). Even the best systems provide non-sensible recommendations – which should be challenged by clinicians – but some physical clinician-patient interactions may still provide opportunities for medical error. Thus, while MOE/MAR promises to reduce risks to patients, it can only best do so when it is part of a complete system of proper technology design and clinician/user *mindfulness*.

9. **Project Management should be a broad-based corporate capability:** The Project Management function at UHN, prior to MOE/MAR, was viewed too narrowly. As the papers in this issue of *HQ* make clear, strong project management capabilities were critically important for bringing disparate divisions and clinical areas together, and for MOE/MAR coming in on-time and on-budget. The enormity of this feat should not be discounted given that MOE/MAR represented uncharted terrain for UHN. An unanticipated benefit of UHN's experience is the recognition of how critical, and broadly applicable, project management capabilities are to

healthcare organizations. As a consequence of this realization, project management is now seen as a valuable corporate resource that all UHN leaders are encouraged to rely on when leading change initiatives.

10. **Changed systems change culture:** As the lead paper in this issue of *HQ* suggests (see "Transforming Healthcare Organizations" on p. 10 of this issue), an organization's culture develops slowly, and can be influenced by changes to core systems. This was unquestionably the case at UHN. Specifically, the initial commitment and investment in MOE/MAR signalled to all staff that UHN was serious about patient-centred care and patient safety. Like virtually all hospital leaders, UHN's leaders have mouthed those words – and indeed, had taken various steps to live by them. Today, however, with the ubiquity of MOE/MAR, clinicians now work with a system that supports a patient safety agenda. This fits hand-in-glove with the long-standing values and objectives of healthcare professionals, but is now substantially enabled by MOE/MAR.

Conclusion

The primary objective of this issue of *HQ* was to fill a gap in healthcare management writing that UHN's leaders identified as they contemplated the introduction of MOE/MAR at UHN. Specifically, while there was much written about the promise of Computerized Physician Order Entry (CPOE) to reduce adverse drug events – a generic name for UHN's MOE/MAR – there was a dearth of published advice about how to make the business case for CPOE and how to best implement it (for an exception, see Leonard 2004). What was available was so high-level, or provided such generic aphorisms about managing change (e.g., "get physician buy-in"), that it was of little practical use. Further limiting the utility of published work was that it typically recounted change from a single perspective (e.g., the Information Technology group of a hospital). To address this limitation of prior work, we explicitly acknowledged that different professional and administrative groups would have different perspectives on the design and implementation of CPOE. We urge change leaders to view healthcare organizations as prisms; where you stand influences what you see, and thus, the information upon which your support for, or opposition to, change is based.

Finally, this series of papers serves a very (but not exclusively) selfish objective at UHN, namely, the opportunity to learn and the opportunity to learn about learning. Harvard psychologists Argyris and Schön (1978), commenting on organizational errors, refer to these opportunities as "single-loop" and "double-loop" learning, respectively.

When the error detected and corrected permits the organization to carry on its present policies or achieve its present objectives, then that error-and-correction process is *single-loop* learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information (the temperature of the room) and take corrective action. *Double-loop* learning occurs when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies and objectives. (pp. 2–3)

For years, parts of UHN operated as most organizations do, engaged in single-loop learning, correcting the varied organizational errors that occur in all organizations. However, MOE/MAR represents the clearest manifestation of double-loop learning that we can think of – the modification of norms, policies and objectives – such that UHN is better able to ensure patient safety and further develop its capabilities to that end. We hope the experiences and analyses conveyed in this issue of *HQ* assist healthcare leaders in doing the same for their organizations.

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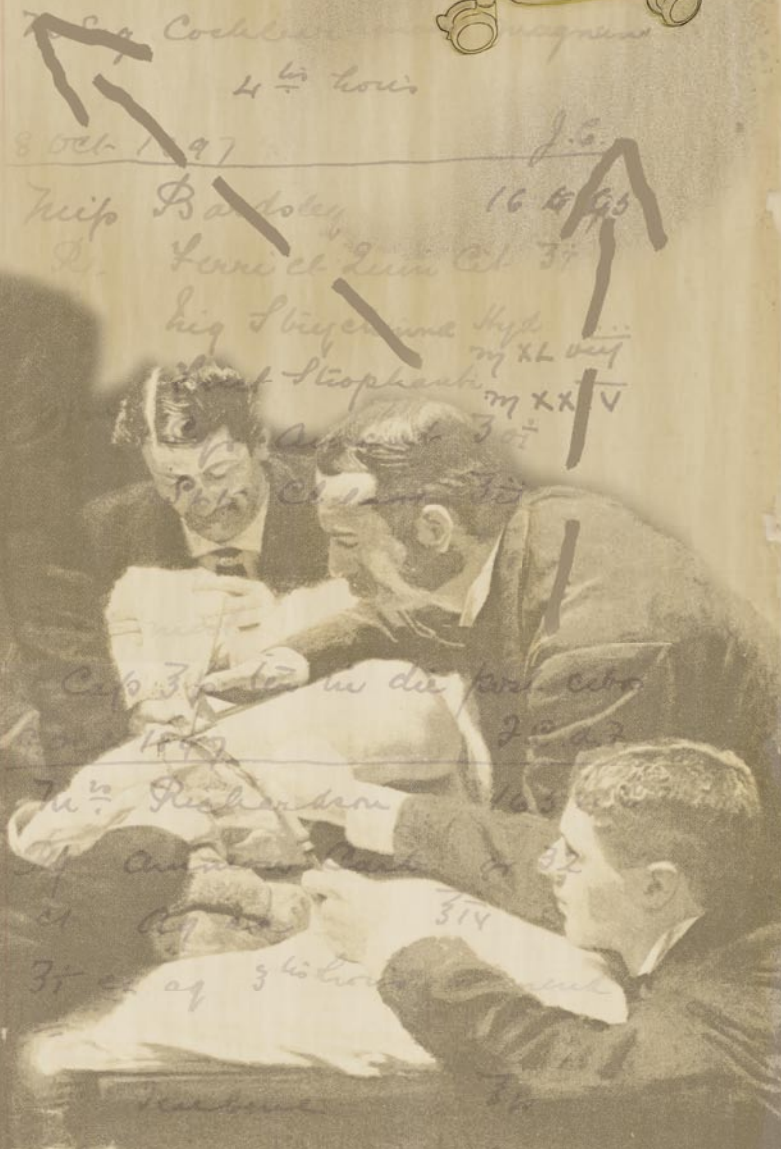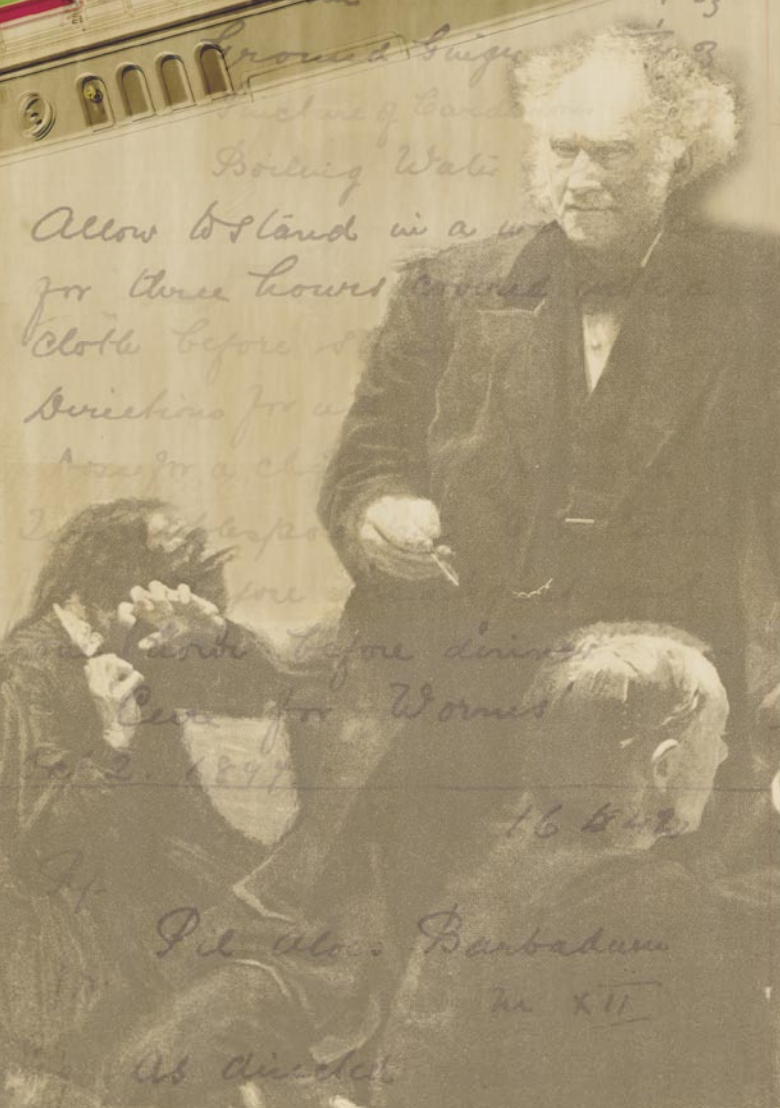
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