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.

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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.

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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.

About the Authors

Monique Pitre, BSc (Pharm), is Manager, Pharmacy Clinical Informatics, and the Infectious Disease Pharmacist, University Health Network. **Contact: monique.pitre@uhn.on.ca.**

Karen Ong is Drug Utilization & MOE/MAR Coordinator with the Department of Pharmacy, University Health Network.

Jin-Hyeun Huh, BSc (Pharm), ACPR, is the Pharmacy Clinical Site Leader at Toronto Western Hospital, University Health Network.

Olavo Fernandes, BSc (Pharm), ACPR, PharmD, is a Pharmacy Clinical Site Leader at Toronto General Hospital, University Health Network, and an Assistant Professor at the Faculty of Pharmacy, University of Toronto.