



How Pharmacy Informatics and Technology are Evolving to Improve Patient Care



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Impact of Emerging Technologies

CPOE

Among the most essential components of a modern pharmacy operation is CPOE (computerized provider order entry). This system allows prescriptions to be instantaneously transmitted from clinician to pharmacist.

As part of the process, the related clinical decision support (CDS) system checks prescriptions to prevent allergies, drug interactions, dosage mistakes, and any other red flags in the patient's medical history. If a patient has a penicillin allergy, for example, the CDS will immediately alert any provider who tries to prescribe penicillin about the patient's allergy. Additionally, appropriate dosing can be determined based on patient demographics and evidence based care. Both pharmacists and clinicians can use it to verify that the right medication is chosen.

The electronic nature of the process prevents the errors and wasted time that can occur due to poor handwriting and inaccurate transcription. (Although some written orders still come in, many pharmacies are able to get the [CPOE rate for orders up to 90% or more](#).)

In terms of everyday operations, the electronic and mobile aspect of CPOE helps pharmacy staff to move outside of their centralized location. Order validation can be done from remote terminals, tablets, or laptops, allowing pharmacists to spend more time in other

areas of the hospital working directly with patients and clinicians. CPOE also speeds up the process of medication ordering, significantly reducing the time from when the physician orders the drug to when it can be validated by pharmacy to final administration by nursing. This not only improves patient care; it also enhances pharmacy workflows.

From a patient care perspective, CPOE introduces several checks into the process by which drugs are chosen and given to patients. The ordering interface reduces incidence of the wrong drug being prescribed for a particular patient. Evidence-based treatment protocols built into the system help physicians order medications that are shown to be the best treatment for a particular ailment. This information, from the best medication to patient demographics to dosing, is right there in front of clinicians. In cases where an EHR is fully integrated with CPOE, all of the patient's information is in there as well, including medical history, diet, medications, exams, lab orders, and lab results. This information serves as the basis for prescription order and the checks that go along with it. By incorporating this information, CPOE helps to increase patient care coordination.

Combined with other technology like automatic dispensing machines, IV robots, and barcode administration, this close-looped system tracks all parts of the medication process and decreases the chances of serious errors. The ultimate result of an effectively integrated CPOE system is a reduction in adverse drug events (ADEs) through a decrease in prescription errors. This moves patient care toward the ultimate goal of a universal system that helps to provide holistic treatment and brings pharmacy workflows into the 21st century.

Pharmacist validation of orders remains ripe for further evolution as CPOE and CDS advance in coming years. Because of the possibility of physician errors with CPOE, validation is still essential to the process. Initially, better systems to help pharmacists prioritize orders will lead to faster validation for the most at-risk patients, as well as greater efficiency in pharmacy workflows. These scoring systems would be based on patient condition, medical history, and several other factors, all determined by automated data analysis. This is the first new frontier in CPOE evolution.

The second is more of a revolution: increased automation and accuracy in CDS could lead to a day in which validation is no longer done by pharmacists but by the CDS itself. In general, CDS growth is an area of significant potential in CPOE, with patient data eventually

being used for predictive analysis about the best course of treatment. That day still remains far off but as integration between EHR and CPOE improves and automated tools become smarter, this could become a reality. In the process, it will significantly alter the day-to-day responsibilities of pharmacists.

Automated Dispensing Machines

Automatic dispensing machines make hospitals safer while freeing up time for both pharmacy and nursing staff to focus on patient care. Automated dispensing machines (ADM; also referred to as automated dispensing cabinets, ADC, or automated medication dispensing cabinet, AMDC) allow pharmacy-validated orders to be immediately available to nurses at dispensing machines throughout the hospital. These machines can work with a CPOE system to ensure the right drug is placed in the machine for the nurse to access and administer. Ultimately, this setup leads to faster filling and increased productivity. When integrated with CPOE and CDS, it helps with patient safety by preventing mistakes.

ADMs create a situation in which drugs are already present at the point of care and do not need to be continually transported from the pharmacy or less secure locations for patient administration. This makes medications more easily accessible to nurses, allowing them to spend more time with patients and less time acquiring the drugs. Through automation and multi-dose packaging, errors are decreased and there is greater accountability and tracking for each dose as well as the elimination of medical waste.

The lack of medication transportation and the presence of authentication controls and tracking in some ADMs also helps to stem drug diversion and increase overall security, while providing better inventory management and more accurate billing. The result is greater efficiency that increases patient care time while the precision of the automated system (especially when combined with barcodes) also increases patient safety.

The effects of ADM can be seen on how pharmacies function and help create a shift toward pharmacy staff involvement in patient care. It separates the drugs from the pharmacy itself. As ADM increases in adoption, the idea of a main in-patient pharmacy within the hospital may become obsolete. With the security and accuracy of ADM, drug storage and administration could be decentralized, changing the essence of in-patient pharmacy. As with CPOE and other technology innovations touched on below, the widespread adoption of ADM presages a future of pharmacy integrated into patient care with traditional pharmacy responsibilities done remotely.

Although errors are still possible with ADM, many of these can be prevented with a combination of training, effective clinical decision support to prevent errors in the initial prescription, and the use of barcode administration to prevent errors in administration.



Barcode Medication Administration

One of the most important developments in improving patient safety by focusing on the “five rights” is barcode medication administration. Barcoded med administration works by the inclusion of a unique barcode for each medication and each patient. A nurse scans the barcode on the patient wristband and on the drug to make sure they are both correct and match.

Through the redundant checks that it provides, medication errors can be significantly reduced. With full integration of other IT systems, this creates a closed-loop system in which everything from the drug order to the final administration is verified. There are checks and balances at each step to make sure the right patient receives the right medication at the right time at the right dose by the right route. Many organizations have seen an enormous difference in patient safety from this system. Along with the other tech innovations, this provides further automation of the medication workflow, improving overall patient care, efficiency, inventory tracking, and compliance.

Barcode administration can also help with pharmacy inventory and retrieval processes. It can be used in medical, surgical, and intensive care units, as well as in bedside medication administration. With barcode med administration, pharmacy staff can spend less time on

managing inventory. Combined with IV robotics, ADCs, and other devices for automated dispensing, it eliminates some of the verification process, freeing up time for patient-facing activities.

Barcode technology may eventually be replaced by RFID technology, which provides much of the same benefit but is faster to scan and may potentially work better with the increasingly automated processes likely in the future. Portable RFID idea readers are not yet widespread enough, however, to replace barcode technology in the near term.

RFID for Kits and Trays

RFID (radio frequency identification) is mainly used now in the checking of medication kits and trays. This technology allows the verification process to be increasingly automated. Traditionally, the process of checking kits was performed manually, which could be time-consuming with greater likelihood of errors. Technicians would have to check the entire tray and pharmacists would have to double-check them, taking many hours out of the day of each position.

Whereas kits and trays typically have to be manually checked for restocking and also for expired medication, RFID allows these to be quickly scanned, revealing items that need to be restocked or replaced. It can save several minutes for each kit and prevent the human error of missing expired medicine. The RFID system also can detect if extra items have been added to the kit. Additional benefits include better tracking of medication used during surgeries and as part of emergency services. With RFID, organizations can expect greater accuracy in kit refilling and improved overall inventory management.

The significant time savings can have an effect on patient care by freeing up pharmacy and nursing resources, while ensuring expired drugs are removed from kits. In most cases with this system, the pharmacist no longer has to check the kits/trays and this frees up their time for more value-added services like communicating directly with patients. RFID also makes the work of pharmacy technicians easier and potentially leads the way to future system in which all drugs are tracked via RFID for ease of scanning and use with automated systems.

Compounding Area Camera Surveillance

Incidents in the past several years involving contamination during compounding procedures have lead to an increased focus on compounded sterile products and the environments in which they are produced. For organizations that still use manual compounding, surveillance can lead to timesavings. Being able to remotely monitor the compounding area provides added security and helps free up pharmacists from constantly going in and out of the compounding room; instead, they can look at video of what a technician is mixing to validate that it's correct.

As the camera technology has evolved, it's now possible to capture video of the compounding area from multiple angles and ensure that health guidelines are being followed to prevent contamination and ensure quality control. Surveillance provides an increased level of accountability from pharmacy staff, potentially improving compliance further. Both of these things help to increase patient safety by reducing the incidence of mistakes and ensuring a lowered level of contamination through compliance with compounding guidelines. Overall patient care improves, once again thanks to pharmacists being freed up to spend more time directly involved with patient health management rather than other order verification tasks.

IV Robotics

IV robots are used in areas of IV compounding to prepare and fill IV bags and/or syringes, depending on the system. Once the pharmacist reviews the medication order, the IV robot receives and processes it. The robotic system validates stock items through gravimetric or volumetric measurement and barcode verification. Once verified, the stock items are sterilized and transferred to an IV bag or syringe based on order information from the pharmacy system, ideally CPOE. Compounded doses are verified and a barcode label is applied for further verification. The nurse picks it up and administers it.

To achieve the best results, a hospital must optimize the interface between the robot and the hospital's EHR. In the future, expect more functionality, capabilities, and customization. One of the questions with IV robotics that affects patient care is whether to use batch compounding or patient-specific dosing. A patient-specific approach, which represents the future of the technology, requires the IV robot to interface with a hospital information system that has patient-specific records and order management. Without this, only batch compounding for general use is an option.

IV robotics provides for a reduction in waste and the production of a retrievable electronic audit trail. They also help to remedy drug compounding bottlenecks. When used with hazardous substances, they reduce employee exposure.

IV robotics provides a high-level of accuracy with in-process barcode scanning and image recognition to verify ingredients. It also can automate the final product labeling, decreasing the chance of error. Combined with effective remote verification, it increases pharmacy efficiency and improves patient care by preventing mistakes. Its sterile environment also prevents contamination. IV robotics allow hospital pharmacies that are currently outsourcing CSP production to bring them back in house, in the goal of reducing costs, while strengthening quality control and oversight.

Impact of Changing Processes

RxNorm

RxNorm helps to enable greater interoperability between IT systems by giving standard names to clinical drugs and delivery devices. It is increasingly becoming the means of communicating medication data electronically. The nomenclature for each drug includes its active ingredients, strength, and form, resulting in a unique RxNorm name. The system was initiated by the National Library of Medicine (MLB) as part of its Unified Medical Language System (UMLS®). The full RxNorm data set is released at the beginning of each month, and this is complemented by weekly updates of newly approved drugs.

RxNorm helps avoid mistakes by assuring consistent naming across platforms. Pharmacy staff must become familiar with this convention in order to be successful. Once it's fully implemented, the consistency and interoperability should help to ensure increased coordination of patient care across all departments. RxNorm enables systems that use different naming conventions to share data with less effort, reducing the need for manual intervention and interpretation of this data.

The data normalization that results from implementation of RxNorm helps with compliance. It also eases medication reconciliation across facilities.

RxNorm helps with the goal of semantic interoperability. Semantic translations are necessary to sort, categorize, and label the drug data included in HL7 messages. This helps to prevent duplication of medication items while capturing correct doses. All of this helps with the goal of bringing together a complete medication history of a patient (both active and historic medications) to provide a full understanding of a patient across several institutions. For example, a retiree who moves to a new state could have all of her records transferred from her old physician and, with RxNorm, the drugs indicated in these records would match with drugs at the hospital in her new state.



Mobile Access to Orders

Systems that give pharmacy staff remote access to order management have the potential to change the location-specific nature of pharmacy. Typically, pharmacy staff operate out of a centralized location, reviewing orders on computer terminals based near where the prescriptions themselves were mixed and filled. With mobile access to orders, this model can be changed. Pharmacy staff has the ability to validate orders from other parts of the hospital, making it easier for them to be more directly involved in patient care, from the admission process to care during inpatient stay to discharge. Pharmacists can also switch quickly from working with a patient to validating orders.

A remotely accessible system that's also secure allows pharmacy order validation to be done from different hospital locations or even from home. (In a hospital, one potential challenge is ensuring consistent Internet access.) All of this will serve to provide more flexibility to

pharmacy staff, both in terms of where they work and how they interact with patients and clinicians. One case in which the benefit is clear is when a pharmacist is needed to consult directly with a clinician and patient about a medication-based problem. In the past, leaving the pharmacy (and thus being unable to process orders) would have been impossible. Mobile access allows pharmacists to deal with pressing patient care issues while maintaining their order validating workflow.

The use of mobile technology is an important component in getting pharmacists to the patient floors, so they can become more directly involved in patient care from medication guidance to individualized therapy. Health system pharmacists who use remote verification during rounds actually spend less time on this aspect of their work than do pharmacists who work mainly at a computer terminal in a pharmacy. Remote management significantly speeds up the time from order receipt to verification and allows easier prioritization, which is better for patient care. A tablet that combines CPOE with EHR also provides a more holistic view of patient care, which helps with patient health management.

Automated alerts

As part of clinical decision support, automated alerts can help assure that errors are avoided. Pharmacists and clinicians can be alerted to problematic interactions, incorrect doses, and allergies. More advanced use of alerts include the ability to detect potential risks from medications based on a patient's condition. For example, some hospitals have developed screening for delirium that can be built into the CDS that, based on a patient's history and age, can detect whether they are a greater risk of delirium and prevent medication orders that may make it worse.

One of the downsides, however, is that alerts can sometimes lead to a false sense of security and move clinicians and pharmacists away from more in-depth thinking about the efficacy of a certain medication. This can be avoided by a greater focus on patient care management that includes the pharmacist as part of the team, providing collaboration with clinicians and patients that increase the likelihood of noticing problems that automated alerts may not yet detect.

Another potential problem of alerts is that the presence of too many of them lead to "alert fatigue" in which system users may not bother to evaluate every alert when many are of low quality or simply irrelevant. This can result in the most important alerts being missed. Not having an effective alert system that is well timed in a workflow and relevant can also yield a flawed system.

Nevertheless, when alerts are used to their full potential, they help to speed up verification and prevent errors both by the clinician ordering a medication and the pharmacist validating it. This system frees up pharmacist's time and improves patient outcomes by preventing errors.

Looking toward the future, it's important that alerts come at the right point in the workflow. They should also be proactive by indicating solutions and advice related to the problem they identify.



Interoperability

The ability of disparate systems to interact is essential to the future of healthcare. The degree of effectiveness of this integration largely determines the overall effectiveness of everything from all areas of the healthcare IT system, from CPOE to EHR to CDS. Such interoperability provides the most significant challenge for CPOE.

In many cases, transferring patients to a new hospital necessitates sending a continuity care document, which in some cases is as simple as a PDF that must be manually re-entered into the new institution's system. Additionally, the use of different vendors can often be difficult to bridge. Possible solutions include better data communication between [disparate systems](#) (through intermediary software), greater standardization in data fields and nomenclature (such as RxNorm and HL7 standards), and the use of the same vendors across healthcare systems.

Health care organizations must meet these challenges by developing effective means of breaking down barriers that prevent the full coordination of care. When it comes to

pharmacy, ensuring that prescriptions can be transferred to other institutions is important, as is communication with internal facilities like oncology or emergency care. The benefit of increased interoperability is the unification of patient care across several systems from the resulting easy flow of data. Everyone from the patient to the clinician to the pharmacist can have access to all data that affects the patient's care.

As patient care management expands further into the digital world of wearable devices and, potentially, medical technology integrated into a patient's body, the ability of data to flow seamlessly through these new systems to hospital EHR, CPOE, and other systems, increases the likelihood of better patient outcomes. A continually updating diabetic sensor may be able to automatically transmit data to the clinician and pharmacy upon patient hospital admission, helping to choose appropriate care and medication in an emergency. Without sufficient interoperability between these systems, such a future cannot be realized.

Furthermore, the long-term goal of CPOE as a universal system (that works across institutions and leads to the seamless and instantaneous transfer of secure patient data) depends on the development of systems that promote both internal and external interoperability. Without this, the full potential of CPOE – having data persist throughout all interactions and the elimination of redundant data capture – will not be realized.

Standardization

Standardization makes it easier for systems to communicate with each other and helps to reach the goal of interoperability. Standardization in pharmacy can be seen in RxNorm. Moving past individual elements like drug names, the goal of standardization is to allow data to flow between departments as well as applications built by different vendors. Each vendor may have a unique feature array or user interface, but the underlying data is consistent between platforms. The HIMSS Board has adopted goals for interoperability and the associated Health Information Exchange (HIE) is working toward ensuring that patient's care records can be more easily shared electronically.

For automated systems like clinical decision support to be successful, semantic interoperability must exist, ensuring that software is familiar with the various way of describing conditions, diseases, and ailments. Like with RxNorm, a standardized nomenclature could be developed. An alternative approach would be a smart database that is able to understand how a variety of names reference the same disease. Creating a health

information exchange software customized to fit a hospital's unique needs is one way in which this is done. Although merely getting systems to connect with each other allows faster transmissions of records, these records can only be used effectively if semantic standards are introduced. As systems move increasingly toward automation in the next 15 years, such standards will be essential.



Continuous Training

Training is an important underpinning of all of the technological and process advances in pharmacy. As the speed of change increases, ensuring that staff learns how to master the new devices, systems, and workflows is the only way to get the full value out of the technological advances.

Furthermore, as the mission of pharmacy shifts to a role focused more on health management, training will be an important in making sure this transition is successful. The best approach is to create a culture of continuous training in which all pharmacy staff look to improve their skills and working knowledge of new systems both before and after implementation. This will help to decrease the volatility that such changes could bring.

Training should focus on the mission of pharmacy to become more directly involved with patient care and how this is related to all of the systems in place. For example, a pharmacy

tech may spend time training on some of the pharmacist responsibilities (within licensing guidelines) that have been automated and moved to the pharmacy technicians' domain. This allows pharmacists to work more closely with clinicians.

Impact of New Role of Pharmacists

Increased Patient Care Responsibilities

With the evolution of technology and processes toward an increasing degree of automation and coordination, pharmacists are freed up to expand upon their traditional responsibility of medication verification and inventory management, to a focus on patient health management. Pharmacy staff can work directly with patients; interface with clinicians about care options; and assist nurses in medication remediation. The role of the pharmacist can further move toward drug therapy treatments and, in the further future, the development of drugs customized for individual patients.

Some of the key aspects of increased patient care responsibilities for pharmacy include collection of information, assessing a patient's health, creating a treatment plan, and evaluating the patient's continued status. Pharmacy must work with medication therapy management that involves all stages of patient care from intake to inpatient stay to discharge to the patient's home care. They should also be involved with focused medication management for high-risk patients. Pharmacists become part of the care team that ensures this happens. Pharmacists work with clinicians to develop individualized plans for patients based on evidence and cost effectiveness. Pharmacists will become part of an integrated care team on the patient floor, rounding with the clinical team, helping with admission and discharge. This process is about improving results and preventing readmissions.

Pharmacists can work closely with clinicians to examine a potential therapy in the context of the patient's health goals. This can range from identifying factors in the patient's genetics or family health history that may affect drug treatment or decisions about preventive care, such as immunizations.

In terms of data collection, pharmacy techs can be involved with capturing accurate information about the drugs that patients are taking. As part of the admissions process,

they can talk with the patient to create a more accurate medication remediation than a nurse would. In a study at Riverside Hospital System in Virginia, this practice was found to reduce errors by 30 percent as pharmacy techs were 95 percent accurate, while nurses were 65 percent accurate.

In all of these cases, the quality of care provided by pharmacy staff will be dependent on the acceptance of this focus on interacting directly with patients: getting out from behind the desk or pharmacy and out into the patient floors. As pharmacists are involved in more patient-facing roles, technicians will take care of more of the in-pharmacy work.

A Quicker Pace

Pharmacy staff will have to prepare for changes in their workflows. With the move toward a decentralized model based on care coordination and direct interaction with patients and clinicians, pharmacists will also have to adapt to a faster-paced environment. As mentioned in the previous section, pharmacists may have to switch rapidly between patient health management to validating prescription orders on a mobile device. The typical routine of double-checking the work of techs, monitoring inventory, and validating orders can sometimes be fast-paced but the movement necessitated by being involved with patients and clinicians makes constant movement a more significant part of the job.

Many of the benefits of technology and processes are related to how well they are implemented by staff members. Through continuous training, pharmacy staff should be able to adapt to these changes in the workflow, from increased shifting between tasks to working more and more with automated technology.



Openness to Innovation

These evolutions in the role of pharmacy necessitate acceptance of innovation in all areas. Pharmacists must be willing to embrace new practices and technologies to do their job. In many cases, key components of their job responsibilities will end up automated. As a result, work may shift to a caretaker and quality assurance role when it comes to the actual work with physical medication. Related to this, pharmacists must be open to innovation in how they work with technology to manage patient treatment. Part of this is interfacing with several systems simultaneously: reading lab results, reviewing surgeries, mapping patient's history, and sorting through alerts to determine the best course of action.

In some cases, pharmacists don't take advantage of the tools they have at their disposal. They may not use functions and features of software, resorting to workarounds instead of switching to new workflows. Such resistance to innovation can ultimately make a pharmacist's job more difficult in a changing environment. Software and devices are "tools" to empower pharmacists. With continuous training, pharmacy staff can become acclimated to the new systems to the point that they make effective use of all of its components.

Conversely, a key part of innovation that is often neglected is feedback from the users of the technology and processes. Pharmacy staff should continue to identify pain points while using systems. The process of improving patient care through system evolution requires feedback about how the systems work in real life. While many scientific studies exist to show the efficacy of certain systems and what improvements need to be, made the pharmacy

staff and clinicians at each health organization can provide valuable insight on how to make systems work better. Ultimately, the effectiveness of these systems depends on how humans use them. If pharmacy staff is unable or unwilling to use them effectively, they must be redesigned.

Conclusion

The use of pharmacy informatics and the development of new automated systems and devices are making the entire medication process safer, more efficient, and more compliant. It ensures the five rights that are key to avoiding adverse drug events. For pharmacy staff, these systems will create greater efficiency in nearly every process and the resulting time savings will cause a shift away from inventory control and medicine selection. A pharmacist's role will evolve into that of a clinical health care provider specializing in drug therapy interventions and treatment.

This verification and quality assurance role will be coupled with proactive patient management instead of assuring prescription orders are filled quickly. Although much of this can be done through a computer interface that combines patient health records, oncology, surgery records, and more, increasingly pharmacy's relationship to patient care is all about the value of face-to-face interaction, both with clinicians and then the patients themselves. This will improve medicine reconciliation at admission and help ensure patients understand their medication treatment at discharge.

Having pharmacists and technicians as part of the patient care team gives a medication-based perspective that can complement a clinician's perspective, leading to a more complete understanding of the patient's condition and a treatment regime. Much like surgeons should coordinate with non-surgeon physicians in advance of operations; physicians and pharmacy staff can coordinate before a drug regime is initiated. Pharmacists can help increase patients' compliance with medication regimes after they are discharged.

When it comes to moving toward this stage in the evolution of pharmacy, hospital administration needs to recognize the value of implementing the effective new technologies outlined in this eBook. It's simple: although the initial investment is high, new technology and processes can reduce errors, increase efficiency, and improve overall patient care in a way that also improves patient outcomes, the chief goal of recent shifts in the healthcare industry. Along with all of this

is significant long-term cost savings, and increased compliance that improves eligibility for state and federal discount programs. With technology in place, employee resources can be more effectively allocated. Pharmacists become part of the clinician healthcare team, medication therapy becomes integrated, and patient outcomes improve.

In need of pharmacy consultants to aid your organization with this evolution? Healthcare IS is here to help. [Contact us to request a consultation](#) or simply call 707-410-8829.

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