

A Connected and Automated Medicines Supply Chain Supported by Clinical Decision Support

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Digitisation of elements of the medicines supply chain has greatly improved medication safety in the hospital setting – electronic medication management (eMM) systems have been shown to reduce the rate of potential adverse drug events (ADE) by 71% leading to estimated savings of A\$63-66 per admission (MedChart)^{1,2}.

This paper explores new possibilities for streamlining and automating dispensing workflows while also providing clinical decision support – specifically anti-microbial stewardship (AMS). As a clinical hospital pharmacist, you have a central role to play in the continued improvement of inpatient medication safety and efficacy. Further modernisation of medicines management provides new opportunities for you to offer expertise at critical points in the supply process.

A disconnected medication supply chain

When electronic medication management systems are disconnected from other elements of the medication supply chain, some dispensing and administration tasks become labour intensive and error prone. With an eMM system in place, staff are able to electronically prescribe or view a medication chart. They may not however be able to identify the medication source – ward imprest stock, pharmacy or patient's own supply? Knowing the source may be important for expedient prescribing and ensuring that the medication is administered without delay or error.

The following table outlines the impact of this uncertainty on the prescribing doctors, clinical pharmacists, dispensing pharmacists and ward nurses involved in medication supply to admitted patients.

Disconnected medication supply chain – impact by stakeholder

Stakeholder	Scenario	Impact
Prescribing doctor	Unless I am very familiar with the ward, I have no way of knowing what is in imprest. When I want my patient to receive a medication immediately, although I can see that it is stocked in the hospital, I don't know if it needs an urgent dispense, whether it is available in imprest, and if not, whether a suitable alternative exists.	<ul style="list-style-type: none"> • Extra time • Staff interruption • Patient may not receive urgent medication promptly
Clinical pharmacist	When I'm doing a pharmacy review, the medication chart shows me which medications have been ordered but not their source. To know if I need to request a dispense from pharmacy I first need to know if the drug is available on the ward. If I don't know the ward well, I'll need to ask a nurse or look it up in the pharmacy system.	<ul style="list-style-type: none"> • Extra time • Staff interruption • Potential drug administration delay
Dispensing pharmacist	As we don't have enough clinical pharmacists to do all medication chart reviews, registered nurses often perform this task. At times relieving or casual staff must do the reviews and often they don't know what imprest is held on the ward and may make dispense requests for medications that actually are available on the ward.	<ul style="list-style-type: none"> • Inefficient use of time – validating the source for each dispense request • Staff interruption • Potential drug administration delay
Ward nurse	If the medication chart can't be reviewed by a clinical pharmacist, it's up to me. I need to assign the source for each medication ordered and make dispense requests for any non- imprest medications. It has taken me a while to build up this knowledge. When I am sick or on leave, it is very difficult for an RN unfamiliar with my ward to cover for me.	<ul style="list-style-type: none"> • Time consuming and error prone process • Staff interruption • Potential drug administration delay

Inefficient and error prone tasks

The limited availability of clinical pharmacists along with high workloads, transient staff, and the use of agency nurses increases the risk of medication related errors. Furthermore, the process of documenting medication source is manual and knowledge dependent. Nurses are distracted from direct patient care and clinical pharmacists from higher value tasks.

While convenient and potentially expedient, the use of ward stock is associated with a high error rate. The Australian Commission on Safety and Quality in Health Care's (ACSQHC) Medication Safety in Australia report of 2013 cites administration error rates of 15% to 18% when (non-electronic) ward stock systems are in place, and 5% to 8% when individual patient supply systems are used³.

Frequent interruption

An important factor contributing to medication error is interruption. Interruptions at the time of administration are known to increase the risk of error – as much as 12% according to the ACSQHC report. Research indicates that nurses are interrupted 58% of the time while administering medications. Removing the need for ward staff to determine if a medicine is held in imprest is likely to reduce distractions and therefore mistakes.

An integrated medicines supply chain for improved patient safety and efficiency

By joining up the elements of the medication supply chain there is opportunity to not only improve patient safety but also efficiency. Instead of wondering if a drug will be available, doctors can prescribe with confidence knowing that only available options will be presented and that the drug will be promptly and automatically supplied either from imprest or from pharmacy stock. Nurses and pharmacists would no longer need to laboriously determine and record the source of each medication which means greater focus on core duties and higher value tasks.

The following table outlines the benefits of an integrated medicines supply chain augmented by clinical decision support.



Connected medication supply chain – benefits by stakeholder

Stakeholder	Scenario	Impact
Prescribing doctor	When prescribing an antibiotic, especially a restricted antibiotic, the eMM system prompts me that Anti-Microbial Stewardship (AMS) guidance is available as I prepare the prescription. It allows me to seamlessly view the guidance issued from the AMS system without interrupting the prescribing workflow, and to complete the prescription appropriately. Alternatively, it informs me that the antibiotic I have chosen is inappropriate, based on local microbiology and antibiograms, and recommends best practice alternatives.	<ul style="list-style-type: none"> • Timely prompts • Clinically appropriate antibiotic orders • Supports antimicrobial resistance guidelines • Better patient outcomes • Reduced inappropriate use of high cost antimicrobials
Clinical pharmacist	When I'm doing a pharmacy review, I can clearly see the source of every medication on a patient's medication chart. For medications that don't exist in the ward Drug Cabinets, I can authorise an automatic dispense request to be forwarded to the pharmacy dispensing system and I can see the dispense status.	<ul style="list-style-type: none"> • Efficient pharmacy review • Automated dispense requests • Dispense status clearly visible on electronic medication chart
Dispensing pharmacist Pharmacy technician	Integration between our pharmacy system, the eMM system and the Drug Cabinets means that we now only see ward dispense requests when a medication is not stocked in the Drug Cabinets (ward imprest). To dispense a medication all I have to do is select it from the dispense queue – the pharmacy dispensing robot prepares and delivers the medication to my workstation ready for me to complete the final step in the workflow. Formulary medications are automatically updated to the Drug Cabinets, which means no more double entry.	<ul style="list-style-type: none"> • Appropriate and timely dispense requests • Robotic delivery of medications to dispensing workstation • Reduction of erroneous dispense requests • Increased throughput • Drug cabinets are automatically updated – no double entry
Ward nurse	When I commence a medication round, the medication profile for each patient is clearly visible on the Drug Cabinet display in the drug room. It also shows me locations for medications on patient charts. Selecting a Drug Cabinet medication opens the appropriate drawer or door to access that medication. The location for non-cabinet medications is clearly indicated. I am able to take the prepared medications to the patient bedside and record administration in the eMM system.	<ul style="list-style-type: none"> • Automatic patient profiling in Drug Cabinets by eMM system • Reduction in selection error when preparing medications • Record administration electronically

Integration models for a connected medication supply loop

Hospitals in Australia and New Zealand have begun to digitise and integrate elements of the medicines supply chain – this creates a basis for the streamlining of medicines management processes. Information about the patient's medication profile must be available electronically for use by elements in the supply chain. This information can come via integration to either the pharmacy or electronic medication management system. The diagram below presents a simplistic view of integration and messaging for a solution featuring: anti-microbial stewardship, automated ward or pharmacy dispensing along with eMM. To determine the detailed interactions for this model it is necessary to consider existing systems and their handling of medicines information.

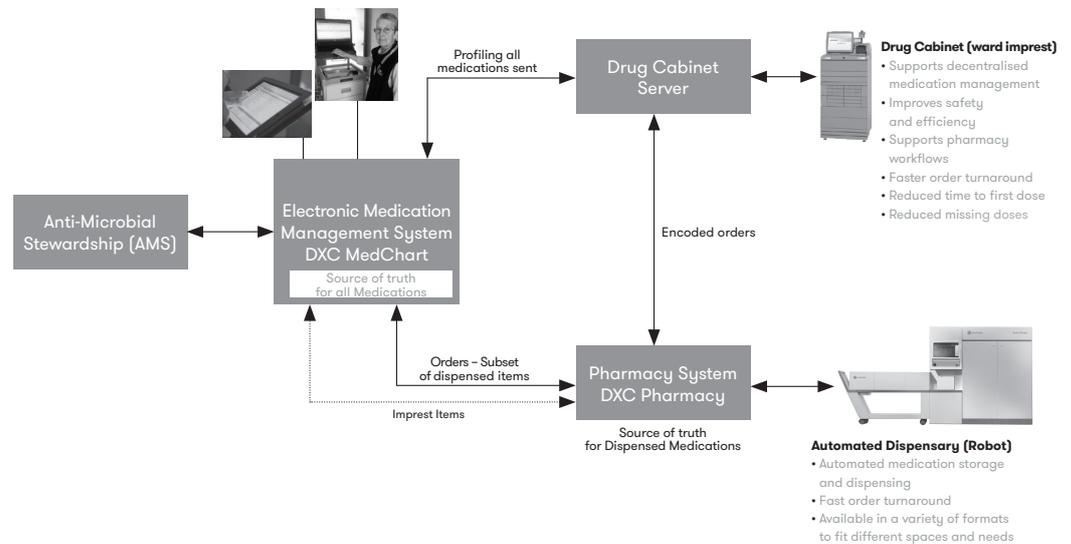


Figure 2. Simple view of an integrated medicines supply chain.

Improving medicines safety requires a pragmatic and incremental approach

Medical therapy is an essential part of modern healthcare; it is however associated with a high error rate and on occasion, serious harm. With many medication errors considered preventable, reducing avoidable medication related harm is an imperative.

Determining how best to use limited funds is a considerable challenge for healthcare provider organisations. Unlike most other kinds of clinical systems, there is compelling evidence for the cost-effectiveness of electronic medication management. In a study published in 2015, researchers from the Centre for Health Systems and Safety Research (NSW, Australia) concluded that the studied eMM system (DXC Technology MedChart), was more cost effective and less expensive than paper-based prescribing. For the cardiology ward studied, the researchers estimated annual savings of \$97,740 – \$102,000 resulting from avoided ADEs and their associated costs. The estimated savings calculation included MedChart operating and licence costs¹.

Based on our experience with some of the earliest and most successful eMM implementations in Australia, New Zealand and the United Kingdom, we suggest an incremental approach to both eMM implementations and also to improving other aspects of the medicines supply chain. While a big bang approach may appear expedient, in our experience it often comes at the expense of stakeholder engagement, learning and adoption.

- Incremental approach to eMM implementation: Start with one or two wards leaving time for staff to adjust to the new way of working, then review and adjust until all involved are satisfied and ready to act as mentors to the next wards. It's important to go at a pace that allows champions to circulate and support new users
- Incremental approach to achieving an integrated medicines supply chain: The eMM system, as the source of truth for all medications is a vital link in the chain. Start here and then build along the chain to gradually eliminate or improve inefficient or error prone tasks.

A foundation for continued improvement

Integrated and automated medicines management, storage and dispensing are foundational capabilities for modern, safe and efficient inpatient care. Augmenting these foundations with decision support, brings new opportunities to further improve care quality and consistency.

End-to-end Medication Safety from DXC

DXC is committed to closing the inpatient medication management loop. We provide end-to-end medication solutions that reduce effort, error and complexity. Customised solutions can include medication management, automated dispensing, anti-microbial stewardship and integration to enable the sharing of medicines information along the supply chain and for automated generation of accurate medication summaries at discharge.

Medication Management

- DXC MedChart

Pharmacy

- DXC iPharmacy, DXC ePharmacy

Anti-microbial Stewardship

- Treat AMS

Currently supported pharmacy dispensing robots

- Includes Rowa™, CareFusion/BD*

Currently supported drug cabinets

- Includes Pyxis™, CareFusion/BD*

Discharge medication reconciliation

- MedChart web services expose a comprehensive discharge reconciliation report for consumption by third party discharge summary systems.

* **Note:** DXC is an exclusive CareFusion/BD reseller.

For more information on DXC's end-to-end medication management solutions, please visit www.dxc.technology/emm

References

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Figure 1, Image 1 (tablet): Cabrini Health.

Figure 1, Image 2 (nurse at workstation): Little Company of Mary Healthcare, Calvary.

Authors

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Having practiced medicine for many years, both in hospitals and as a GP, Dennis found himself increasingly drawn to the technology side of safety and quality improvement. He eventually took on clinical director roles within the health IT industry and was a co-creator of the MedChart electronic medication management solution. He played an instrumental role in implementation of some of the earliest and most successful medication management projects in Australia, New Zealand and in the United Kingdom. Consequently, Dennis is a respected clinical change agent with deep knowledge of clinical decision support, drug data information and quality and safety improvement.



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With more than 20 years' experience in healthcare Delia's expertise includes patient safety, quality measurement, medication safety and service redesign. More recently Delia has been exploring, within the Australian context, how a population health approach can address the challenge of unsustainable demand and the role of technology to enable the new care models. She enjoys working with clients to co-create solutions that improve the patient experience and healthcare outcomes.



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