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Medication management: medication safety from pharmacy to bedside

hospital pharmacy europe

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Expert pharmacists from around Europe discussed the role of technology in medication management from prescription to bedside administration at the Becton Dickinson satellite symposium held at the 21st EAHP Congress, Vienna, 17 March 2016

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The speakers covered the rationale for introducing new technologies, implementation and evaluation to improve medication safety.

How improving the quality of medication management helps reduce medication errors

Hospital pharmacists must have a strategic vision for the implementation of new technologies in the process of medication management, Professor Pascal Bonnabry, Chief Pharmacist at Geneva University Hospitals, told symposium delegates. Hospital pharmacists have a key role in implementing solutions to improve the safety, efficiency and traceability of drug use.

It is important to understand the mechanisms behind the errors that occur in getting medicines to the patient. An error reaching the patient involves two errors – one in the action, for example, selecting the wrong drug, and one in the control, for example, failing in the double-checking. Understanding this mechanism is very important because when implementing new technology, you have to look at both the action and the controls that are built into the system, to reduce the frequency of errors and increase the reliability of controls.

A simulation study of dispensing errors by nurses showed an error rate of 3% and the majority of errors found were drug selection mistakes. Given the number of drugs dispensed in hospitals every day, this is a lot of errors that can potentially harm patients.

Controls and double-checks work around 85% of the time but they are not a magic bullet, he said.

Human error

Many high-risk activities in hospitals are based on human reliability. Humans are not perfect, but in hospital, where patients' lives are at risk, it is a problem not to be perfect. The science of ergonomics can help pharmacists make their processes safer and the following are tips that can help overcome problems of human error in processes:

- Avoid reliance on memory
- Simplification
- Standardisation
- Use of constraints and forcing functions
- Use of protocols and checklists
- Information access
- Reduce handoffs
- Increase feedback.

Looking at these principles, he believes there is clearly a role for IT and automation.

Implementation strategy

The importance for hospitals to have a strategy that defines what it wants to do in terms of its medication management, and how it will implement new technologies into its processes in the future, was emphasised and this should be regardless of the current organisational process.

He showed the 'roadmap' developed at the Geneva Hospital (Figure 1), which

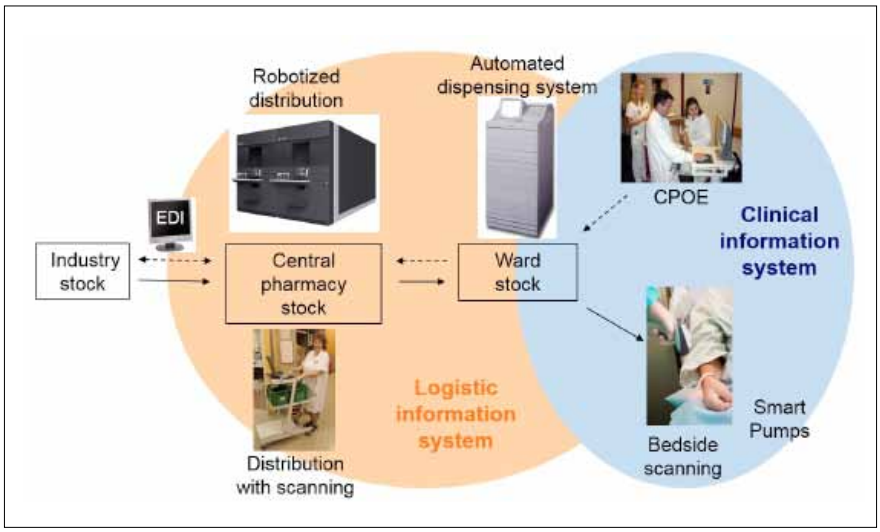

Figure 1: 'Roadmap' developed at Geneva Hospital

outlines the technological innovations it plans to introduce over time. Once you have a plan, you can set about implementing it against background constraints like budgets that don't allow you to have everything by tomorrow, he said.

The Geneva Hospital has robotised distribution with scanning, implemented full computerised physician order entry in the ward, and has started to implement dispensing cabinets. Smart pumps have been introduced in the neonatal intensive care unit and paediatric intensive care unit (PICU), and the hospital has introduced bedside scanning for cytotoxic drugs.

An evaluation of robotised distribution in the Geneva Hospital showed the error rate when drugs were being picked manually was around 1%, but that after robotisation was introduced this fell to 0.5%. After working with the manufacturer to iron out problems, the error rate fell further to 0.13%

Demonstrating improvements in efficiency and showing a return on investment was an important part of the evaluation. With manual distribution, technicians at the Geneva Hospital were picking 300 items an hour, but this rate nearly trebled to 860 after robotisation was introduced. Effectively, one technician looking after the robot can do the job of three technicians picking packages by hand. It was pointed out that an increase in efficiency makes financial directors happy.

Dispensing errors were reduced by a factor of ten following the introduction of automatic dispensing cabinets, and selection errors completely disappeared because drugs were stored in secure drawers.

Professor Bonnabry summarised his key messages:

- Automation and robotisation are important strategies to optimise drug management
- Safety, efficiency and traceability can be improved through use of these technologies
- Implementation must be planned and conducted by a multidisciplinary team
- These projects are challenging and must be led by a competent team with the time to do the job
- A strategic vision is essential
- The selection of the right partner to automate is essential.

Achieving high levels of quality and safety in IV compounding

A gravimetric IV preparation system can improve accuracy and help avoid errors of overdosing or under-dosing that put patients at risk, Dr Robert Terkola told symposium delegates. Clinical Assistant Professor at the University of Florida, President of the Austrian Society of Oncology Pharmacy and CEO at Health-Concepts E.U., Dr Terkola discussed preliminary findings from a study he was conducting with other centres around Europe to look at how a gravimetric system could improve safety in the compounding of cytotoxic drugs.

The GPP (Good Preparation Practice) study is a retrospective review of data gathered since the introduction of a medication workflow solution system in 10 European centres. The study analysed the accuracy of the compounding of 1.2 million unique preparations using this software system, which supports IV compounding in the pharmacy. The system uses real-time gravimetric and barcode verification together with an on-screen guidance system to take the technician step-by-step through the compounding process.

As part of the comprehensive analysis of data provided by this workflow software solution, the study looked at error rates in the data overall, both by centre and by the > 200 individual operators. These 'errors' are not errors that reach the patient, but attempts at preparing the correct formulation that are picked up by the system and prompt the operator to adjust the compounding.

Data from centres showed that just under 10% of preparation attempts were incorrect, that is, outside of the tolerance ranges set by the centres, with figures ranging from 5–16%.

Individual drugs and accuracy

Data analysis showed that some drugs had a much higher error rate than others, with three drugs having preparation error rates over 50%. This information could be used to encourage the development of better formulations.

These preliminary findings showed that as the number of compounds prepared by a centre using an advanced gravimetric system increases so does the accuracy of the preparations. This supported the idea of encouraging technicians to stay in post rather than moving on, and he said this is sometimes advocated.

This gravimetric preparation system can improve accuracy and help avoid the errors of overdosing or under-dosing that put patients undergoing anticancer treatment at risk of toxicity or lack of effect. He explained how the use of a gravimetric system enables the identification and correction of potential errors.

The study also identified a range of drugs that are poorly formulated and make accurate dispensing difficult. It is to be hoped that new formulations of these drugs will be developed, allowing safer use, he concluded.

Infusion medication safety at the bedside: experience in paediatric care

Smart infusion pumps are effective in detecting and quantifying programming errors and preventing them reaching the patient, pharmacist Dr Silvia Manrique-Rodríguez told symposium delegates. The hospital where she works, the Hospital General Universitario Gregorio Marañón in Madrid, has spent the last six years implementing smart pump technology in its PICU and had analysed its effectiveness and economic benefits.

The pharmacy at the hospital manages eight million drug administrations a year and has always employed new technology to help in processes around the prescription and administration of drugs. As well as decreasing the likelihood of errors, the hospital believes new technologies free its pharmacists to spend more time providing patient care.

The hospital has 100% electronic prescriptions (EPS) in both inpatient and outpatient settings. Currently, 54 automatic dispensing systems are connected to the EPS, and there are four dispensing carousels in the central pharmacy and smart pumps in critical care units. In addition, electronic administration records (eMAR) and barcode administration for chemotherapy are being implemented.

The hospital is implementing the use of smart pumps on a step-by-step basis, starting with paediatric intensive care due to the high risks associated with the administration of IV drugs in this setting.

Smart infusion pumps incorporate safety software and a drug library that lists maximum and minimum rates of infusion. When the infusion rate of a drug is set outside of these pre-set

limits, an alarm is activated, which prompts the person responsible to check the rate they have selected is correct. These integrated features mean smart pumps can significantly improve the safety of IV infusions, as although they do not prevent programming errors, they prevent them reaching the patient, she said.

A multidisciplinary team including doctors, nurses, pharmacists, technicians and IT specialists were involved at every stage of the implementation process, from the development of the drug library in the early stages through to analysing data reports from the smart pump systems.

Error detection

Analysis of data from the smart pump systems showed that 10% of infusions programmed with the pump were started without using the drug library. This means that there was a 90% compliance with the safety software because 90% of all the infusions programmed with the pump were started through the drug library. And this percentage of compliance has remained constant over these years.

Over the five years since the system was implemented, 283 programming errors have been intercepted, with 58% of intercepted errors involving high-risk drugs. Example errors intercepted included an infusion of thiopental initially programmed for 18mg/kg/h and corrected to 8mg/kg/h, the upper limit for that drug; and an initial programming for insulin 75-times higher than the maximum limit. Further examples are shown in Table 1.

Having demonstrated the beneficial effect on safety in the hospital, the cost-effectiveness of implementing smart pump technology was assessed. A group of doctors and pharmacists examined the severity and likelihood of an adverse event from the first 92 prevented errors identified. 50% were classified as serious and 50% as having a high probability of causing an adverse event. Using a Spanish Ministry of Health guideline on the estimated cost of an adverse event being €6186, it was calculated that the hospital saved €160,092 in the first 18 months of implementation.

For every Euro spent on the technology, there was a return of two Euros. There were limitations to the estimates but the analysis provided a good idea of the scale of potential savings to the hospital, she said.

Table 1: Some of the infusion programming errors prevented by the smart pumps and the upper limits for those drugs in the drug library

Drug	Upper limit	Initial program	Final program
Alteplase	0.66mg/kg/h	1.6mg/kg/h	0.6mg/kg/h
Thiopental	8mg/kg/h	18mg/kg/h	8mg/kg/h
Amiodarone	Loading dose 5mg/kg (15 min)	50mg/kg	Infusion cancelled
Vecuronium	0.2mg/kg/h	0.6mg/kg/h	0.2mg/kg/h
KCL	1 mEq/kg/h (<20kg)	2.3 mEq/kg/h	0.3 mEq/kg/h
Insulin	0.2 U/kg/h	15 U/kg/h	0.2 U/kg/h
Levosimendan	0.2mcg/kg/min	0.9mcg/kg/min	0.1mcg/kg/min

The effectiveness of the smart pump system is dependent on user compliance with the safety software, which requires ongoing training and communication with staff. It is also necessary to keep the drug library updated and to ensure that all the pumps have the most recent version. Over the last year the hospital had been piloting a communication platform that significantly improved this process, allowing the pumps' drug libraries to be updated in real time and to be located in the ward. This platform also enabled continuous collections of data from the pumps, allowing the team to have regular analysis of the data and thus improving their infusion practice and clinical workflow.

Integration is essential

It is important to be aware that when standalone smart pumps are used it is only the dose administered that can be guaranteed. It could still be the wrong patient, the wrong drug, the wrong route and at the wrong time. She suggested the solution is technology integration, having all the tools – electronic prescriptions, automatic dispensing, barcode scanning and smart pumps – working together.

The future will be to have prescriptions validated by pharmacies, with a nurse with a barcode reader checking the identity of the patient, the type of medication and the dose, route and time. She predicted once everything is checked, the infusion would start automatically from the pump rather than having to be programmed manually.

In summary, smart pumps had been effective in detecting, quantifying and preventing programming errors reaching the patient in the hospital. "The data obtained from the smart pumps has allowed us to make improvements in our clinical settings and reinforced good clinical practice," she concluded.

Conclusions

Summing up, the presenters highlighted the most significant challenges around implementing new technologies in the hospital.

Commitment to the project is really important, Dr Manrique-Rodríguez told delegates. You have to be really convinced about the potential benefits of what you are doing and be able to transmit that enthusiasm to your colleagues.

Secondly, good team working is essential because you can't implement a significant new system on your own.

For Dr Terkola, it is getting the interfaces with other professions right to ensure smooth transitions of activity and responsibility between them. Integration of the systems, and the staff working with them is also key, he said.

Selecting the right technology company is important because you will be with that company for a long time, Professor Bonnabry said.

And process organisation is key. When implementing new technologies you have to redesign the whole system. You have to take the opportunity to introduce new ideas and improvements. Work with people who know how to re-engineer processes, he said.

Before closing the debate, he told delegates not to re-invent the wheel and advised that they talk to colleagues and visit hospitals that had implemented new technologies. "We have to improve the safety and efficiency of medicines delivery and new technology is the way forward," concluded Professor Bonnabry. ●