

Robotics for cytotoxic drug compounding at Hammersmith Hospitals NHS Trust

In response to challenges created by expansion in cytotoxic compounding services, HHNT has installed a system aimed at automating and optimising throughput and efficiency

Ann Jacklin

MRPharmS

Chief Pharmacist

Department of
Pharmacy
Hammersmith
Hospitals NHS Trust
London
UK

E: AJacklin@
hhnt.nhs.uk

Healthcare organisations today face a large spectrum of challenges, including staff shortages, increased patient complexity and an ever-growing list of new and complex medications. Within this broader context, safe and efficient preparation of cytotoxic drugs and providing patients with optimal care are central concerns for the pharmacy department at Hammersmith Hospitals NHS Trust (HHNT).

The Hammersmith Hospitals prepare more than 27,000 reconstituted cytotoxic doses a year at a total value in excess of £3m. This service is highly valued by the Trust and has expanded greatly in recent years as chemotherapy activity has grown. Growth has inevitably led to some new challenges for our cytotoxics compounding service, which include:

- The current method of production is manually intense and may sometimes result in long lead times for doses. This is increasingly a problem as more patients are treated on both an outpatient and day-case basis.
- Both our aseptic units have had historical problems with operator repetitive strain injury, which requires us to limit work sessions, which in turn restricts capacity and limits the responsiveness of our services.

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From an economic perspective, an additional challenge to our aseptic units has been provided by the need to comply with the requirements of our Medicines and Healthcare Products Regulatory Agency (MHRA) licence. This has led to our having to cease the practice of "sharing" vials between patients, in order to guarantee final product separation by patient. This has led to considerable waste for the Hammersmith pharmacies, as we are required to discard partly used vials.

A new technology-driven approach to cytotoxic compounding

Until very recently, no automation solution was available to help us reduce manual steps in our patient-specific compounding processes. Cytocare is a novel, robotic-based technology that has recently been installed in our aseptic unit at Charing Cross Hospital to help us automate our processes and optimise throughput and efficiency.

The product is essentially an enclosed laminar-flow cabinet with a six-axis anthropomorphic robotic arm, which withdraws doses of cytotoxic drugs from single or multiple vials and transfers these doses to final containers

The Cytocare robotic dispensing unit was developed as a joint collaboration between the pharmacy department at Bolzano Hospital, Italy, and Health Robotics. It is marketed by Cardinal Health, an international leader in medicines-related healthcare automation products. The installation at our Charing Cross Hospital pharmacy is the first worldwide Cytocare installation, following the prototyping phase in Bolzano.

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The scheduling software and loading carousel are designed to keep the unit operating throughout



the working day, continuously preparing doses in advance. There is a "fast track" for doses required immediately, which cuts into the routine workflow on an as-required basis and produces each new dose in an average of three minutes.

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Moreover, the software for the Cytocare unit enables dose production to be scheduled for groups of patients receiving the same drug, so that partly used vials are retained in the unit for re-use between doses. We plan to demonstrate that the Cytocare unit delivers a high level of reproducible accuracy in its compounding, and are optimistic that we will be able to demonstrate to the MHRA that the sharing of vials does not represent a risk to our patients.

Expected benefits

Cytocare will sit alongside our existing isolator technology and will supplement current systems, which will be retained for both flexibility and backup. Consideration will be given to procurement of further

systems, should the first system deliver benefits in excess of current expectations.

We are planning to use the Cytocare unit in the first instance only for those drugs where a direct financial benefit can be obtained by reduction of waste.

Even in this initial phase of use the transfer of this substantial workload to the Cytocare unit will enable existing staff to provide a more responsive service and will enable us to repatriate work both from a commercial supplier and our own wards. The potential benefits of Cytocare we anticipate include:

- Reduced waste from partly used vials.
- Reduced risk of repetitive strain injury.
- Improved turnaround time.
- Reduced staff requirements.

Our aim is therefore to find out whether these benefits are borne out in practice, while maintaining current high standards of sterility and accuracy.

Evaluation strategy

In recent years the HHNT pharmacy department has established an international reputation for the development and academic evaluation of novel medicines-related technologies, in partnership with suppliers. This makes us ideally placed to evaluate the Cytocare system. As an early implementer of Cytocare we expect to work in close partnership with the supplier on the development of the system, and to be able to benefit directly from improvements. Our first

Table 1. Assessment of outcomes

Objective	How it will be measured	Expected results
Error reduction	Comparison of error levels between manual and automated system, automated dose calculations, greater consistency in the preparation of doses, efficiency of redundancy and buffers to prevent errors	Significant decrease in prescription, transmission, transcription, preparation errors versus the manual system
Reduced reliance on pharmacists and nursing staff trained in oncology	Number of preparations automatically handled by the system; ease of system use, efficiency of redundancy and buffers to prevent errors	Increased production capacity Decreased human labour Decreased learning curve for professionals
Increased safety for pharmacy staff (eg, minimisation of exposure risk, needlestick injuries, cumulative strain disorders)	Number of preparations automatically handled by the system; reduction of operator contact with cytostatics	Decreased human labour Enhanced results from exposure tests
Increased product protection from potential contamination sources by means of closed-system technology	Comparison of contamination levels with the manual and automated system	Decreased contamination versus manual system
Increased system efficiency	Reduction of wasted products, increased batching possibilities, reduction of waiting time for patients, electronic management and monitoring of the entire cytotoxic preparation cycle	Increased satisfaction level from professionals (measured through specific questionnaires)
Increased patient satisfaction	Reduction of errors, reduction of waiting time, increased safety, perceived increased efficiency	Increased satisfaction level from patients (measured through specific questionnaires)
Reduced cost	Reduction of waste, automation of activities previously performed by pharmacy staff	Decreased cost per patient

goal is to measure the impact of the Cytocare robot on the safety and efficiency of cytotoxic reconstitution in an NHS hospital, as well as on processes and staff satisfaction.

Table 1 identifies the outcome measurements we will assess, and considers how these can be measured. It is intended that, where applicable, these are evaluated both before and after introducing Cytocare.

Next steps

Before we can put the Cytocare system into

operational use we will need to complete the environmental, microbiological, particulate and air-handling validations of the Cytocare system to ensure that it meets all current European standards.

We will then perform a number of operational validation protocols to ensure safe and accurate compounding. We hope to work in collaboration with other early implementers of the Cytocare system in Europe to strengthen our findings. We plan to share our evaluation findings with all users via publications. ■