

AUTOMATED DISPENSING

— an overview of the types of systems available

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Technology to automate aspects of the dispensing process is being installed at an increasing number of hospital pharmacies in the United Kingdom. This article, the first in a series, sets out the background to automation, giving details of the main pharmacy-based, original pack dispensing systems that are currently available

Automation is currently a hot topic for hospital pharmacy. However, hospital pharmacies started using automation as far back as the 1970s in the form of electronic tablet counters. They were invaluable for counting large quantities of solid oral dose units but had their limitations – for example, they could not be used to count transparent capsules or uncoated tablets. At about the same time, hospital tablet pre-packing units started using industrial type machines, including strip packaging, to meet the demand for pre-labelled packs of popular lines for accident and emergency departments.

In the early 1980s some hospitals were experimenting with unit dose dispensing using “Baker cells”, which were semi-automated hoppers that ejected loose tablets or capsules into a dispensing bottle. There were several challenges with these systems, including interfacing them with pharmacy computer systems which were then in their infancy. Limited success and decisions by hospitals not to pursue this type of dispensing quickly caused their demise.

Recent years have seen increased use of automation in pharmacy aseptic units. In particular, repeater pumps for filling of syringes and compounders for total parenteral nutrition solutions are now often found in larger aseptic units.¹

Over the past few decades, hospitals in the US and continental Europe have migrated towards unit dose dispensing and automation has become an integral part of this form of supply. In contrast, hospitals in the UK have opted for original pack dispensing, a system that requires a different type of machine.

The number of UK hospitals with automated dispensers is now well into double

figures and set to rise over the next few years.^{2,4} There are three distinct groups of automated dispensers available:

- Unit dose repacking systems for inpatient and outpatient dispensing, the latter being used by some specialist units (eg, psychiatry) to promote compliance
- Ward-based automated dispensers which can have a dual role of giving a high degree of security as well as aiming to reduce the risks of medication administration errors
- Pharmacy-based original pack dispensers, some of which are also used for ward stock box picking

The subject of this article is the pharmacy-based original pack dispensers (see Panel 1, p67, for some general information). These automate the storing of products and the picking stage of the dispensing process. The article considers the common aspects of the key systems available in the UK and looks at the products in turn, considering their similarities and differences. It only aims to give an overview – the manufacturers’ websites (see Panel 1) and literature should be consulted for more detailed information.

COMMON ASPECTS

In all of the systems, the stock database and mechanical movements are governed by software which normally sits on a separate, dedicated PC. The contents of the database can be viewed to determine the presence and quantity of items stocked. The pharmacy’s stock control system is usually connected to the automated dispenser’s software through an interface that triggers the pick during the dispensing process (eg, label production). Picking can also be requested independently of the interface in real time using the controlling PC. Interface-driven or independent picking can also be

scheduled for later retrieval (eg, for overnight ward box filling).

Once picked, packs are usually transferred to the requesting station by some sort of transport system. Depending on the layout of the pharmacy involved, a combination of mechanised conveyors and gravity feed chutes may be used. Conveyors may include “drop-off” arms, which direct travelling packs to a particular delivery chute. Software controlling the conveyors may reside on the same PC as the main system or be managed separately.

ROWA SPEEDCASE

The Speedcase’s design is of a picking head on a track situated between two sets of vertically arranged shelving. This shelving is usually of glass and the spacing between the shelves is determined by the size range of the stock to be held. Stock storage is random in that packs are placed anywhere on the most appropriately sized shelves. The picking head moves simultaneously in both vertical and horizontal planes and can turn to access stock in either shelving unit. The picking head also puts new stock on the shelves and always leaves a precise gap between packs.

Storage capacity and density are determined by the length and height of the shelving units and the mix of pack dimensions stored. Speedcases may be installed singly but many hospitals opt for tandem units. This doubles the picking speed and gives a degree of cover should one unit fail.

The Speedcase has permission from the Home Office to allow the storage of CDs. ROWA has also developed a refrigerated module. The refrigerated area is closed off by a mechanised door, opening only when a refrigerator-designated item is to be picked or put away. The Speedcase will, however, only take rectangular packs and has limits for pack size and weight. In the picking process, the picking head aligns itself with the item

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on the shelf and a small diameter tube extends to touch the end of the pack. A vacuum is created within the tube which holds the pack while the tube retracts, drawing the pack onto a carrier plate. Once the pack is on the plate, the head tracks to the end of the unit and ejects it to a chute or conveyor.

Input to the Speedcase is a semi-automated process. The pack is first identified by its European Article Number (EAN) bar-code using a scanner, then placed in the measuring unit where the pack dimensions are measured and compared with those already stored in the database. Once the pack's identity and size are confirmed, it is taken into the machine by a holding conveyor where it waits until it is put away. The picking head takes the pack from the holding conveyor and transfers it to the allocated space on the shelving. The vacuum tube extends to push the pack a precise distance onto the shelf and the process is complete. The software always gives priority to picking, putting stock away at quieter moments. If the expiry date is registered in the database on pack entry, this enables the software date expiry check feature which can be run periodically to remove expired stock. With tandem machines it is usual to separate all stock for input into two identical sets to maximise pick speed and cover if one unit fails. ROWA have developed systems to fully automate the loading process.

— SWISSLOG PACK-PICKER

The Pack-Picker stores and picks stock in a different manner to the Speedcase. Each self-contained storage module is of fixed width with variable length and height and has two storage walls, one each side of its picking head. The modules are usually arranged in a line but can also be arranged in a curve or even a cube. A typical German community pharmacy will have a two or three module system whereas a large UK hospital may have five modules.

The storage walls are made up of plastic honeycomb sections of fixed external dimensions but with varying "cell" sizes within them to cater for different sized packs. A standard mix of cell sizes creates a module which can hold around 4,000 packs. To allow maximum use of space and flexibility, all modules in any one system are configured identically. The honeycomb sections are angled at 45 degrees to the vertical so that each cell is a diamond shape with its base forming a "V". Sitting in the base of the honeycomb is a "V"-shaped plastic shelf which holds the stock. Depending on size, up to five packs can be stored end-to-end on a shelf, with no spaces between them.

The picking process is able to select any of the packs on a shelf. The picking head is

comprised of two 21 inch (53cm) conveyors oriented to align with the shelves. Beneath the conveyor set is an opposed pair of small arms each with a hook on the end. The hook connects with a hole in the outer end of the shelf during the pick process. The arms travel horizontally along the picking head so they can pick from either storage wall. The picking head sits on a crane which travels horizontally and vertically to reach the storage cells.

During the picking process, the crane aligns the head with the selected honeycomb cell. The picking head arm extends to the left or right (as required), hooks the shelf and pulls it onto the conveyor set, when a small gate arm descends behind the rearmost pack. The shelf is then returned to its cell and because of the gate arm, the packs begin to slide off the shelf onto the conveyor set. The software knows the exact length of every pack, so if the pack to be picked is the first on the shelf, as soon as the shelf has travelled the length of the pack, the gate is raised, allowing the remaining packs to return with the shelf. During the shelf return the conveyor set simultaneously pulls the selected pack in the opposite direction, retaining it on the picking head. If the selected pack is the second, third etc, on the shelf, all packs up to and including that one are slid onto the conveyor set with the selected one at the end of the

Panel 1: General information about the key pharmacy-based original pack dispensing systems available in the UK

Key products

The key products, which have all come from Germany, where automation is well established, are:

- ROWA Speedcase, marketed in the UK by ARX Ltd (further details from www.arxinter.net)
- Swisslog Pack-Picker (further details from www.swisslog.com)
- Baxter Consis (further details from www.baxterhealthcare.co.uk)
- Westfalia Medimat (further details from www.westfalia-net.com)
- Westfalia Speedbox (further details as above)

Market penetration

- The ROWA Speedcase is the current market leader with 14 machines installed in UK hospitals (including at St Thomas' Hospital, London, installed in 2000).
- The Swisslog Pack-Picker is installed at two sites (Royal Liverpool Hospital and Charing Cross Hospital London, both installed in 2003)
- The Baxter Consis is installed at one site (New Cross Hospital, Wolverhampton, installed in 2003).
- The Westfalia Medimat and Speedbox have yet to penetrate the UK hospital market but a Westfalia machine has been installed in at least one community pharmacy

line. The picking head travels to the drop-off point and the pack is ejected by the conveyor set moving the pack forward until it drops off. Any packs remaining on the picking head are returned to the original shelf in the same order they came off.

Stock is put into the Pack-Picker via a semi-automated process which identifies each pack by its bar-code and measures the pack's dimensions. The software then uses the pack dimensions to determine the most appropriate module, honeycomb and cell in which to place the pack. Stock storage is random, although the software does equilibrate the stock of similar sized packs between modules and will similarly distribute packs of the same items between modules. The pack is taken from the input unit into the first storage module via a small transit conveyor. If the pack is destined for a different module, a combination of pick head and transit conveyors will carry it there. If a pick head is busy, the pack waits on a transit conveyor until it can be moved. Once the pack is on the pick head, it is taken to the required shelf and the conveyor set moves the pack onto the shelf. The hooked picking arm finishes the operation by pushing the pack the final few millimetres. New packs will always be on the front of the shelf with packs already present pushed back. The software takes account of all the new positions. If the expiry date is registered on pack entry, this enables the date expiry check feature which can be run to remove date expired stock.

The Pack-Picker can accommodate cylindrical packs as well as rectangular boxes, but as yet, the value of this feature has not been significantly realised in the UK. Cylindrical packs must be uniform along the entire length of the pack, with no protrusions or significant gaps. Common hospital packs such as the Calcichew range and snap top tubs with tear off seals cannot go in.

■ BAXTER CONSIS

The mechanics of the Consis are much simpler than those of the Speedcase, Medimat and Pack-Picker but the Consis appears to offer a higher storage density. There are two versions of the Consis, one with a single-item picking head and one with a multi-item picking head. Consis modules can be set up with a combination of these variants, which gives the benefit of simultaneous picking by both units. High usage lines usually reside in the multiple picking head machine.

The Consis stores packs in a gravity-fed channel system. Shelves are of fixed width and angled downward to the front of the unit. The channels run the length of the shelf, holding the packs end to end with no spaces between them. The width of the channels can be manually altered within a set range and the channel mix is configured to make maximum use of the space on each shelf. For fast mov-

ing lines, packs may be stored in several channels. The lower end of each channel finishes with a small vertical lip that prevents the packs sliding out. Picking is achieved by a small "finger" on the picking head that flips up through a gap in the vertical lip, lifting the pack up and forward over the lip and onto the picking head tray. The pack is then delivered to the requesting points by either gravity-fed or mechanised conveyors. The multiple pick head operates in a similar way, but ejects several packs in one action.

Filling the Consis is a manual process, as detailed in Panel 2. The Consis can achieve a pack density around 3,300 packs/m², approximately twice that of the random storage systems mentioned above. It sits on a small footprint (ie, floor area) of less than 2m² which can enable the system to be located close to the rest of the dispensing process. This can help minimise the use of conveyors and help increase the speed of the whole dispensing process. Because of its simple storage mechanism, non-rectangular packs can be stored with relative ease.

The Consis is accompanied by additional software that can be used at the dispensing final check stage to confirm that the Consis picked items are the same as those specified by the prescription and requested to be picked. The software can also be used to check manually picked items, bringing benefits to the whole dispensing process.

■ WESTFALIA SYSTEMS

The Medimat The Medimat operates in a similar way to the ROWA Speedcase (see above), using the same type of storage shelving and a similar, but augmented, picking mechanism. The picking heads use a similar carrier plate and vacuum arrangement to the Speedcase, but the Medimat supplements this with a "gripper" arm on each side of the carrier plate. These are operated when packages exceed specified dimension and weight limits for the vacuum mechanism alone.

The semi-automatic loading of the Medimat is similar to that in other systems, with a bar-code scan followed by automated random storage in the module. The Medimat also has a fully automated loading option which, although attaining only half the semi-automatic loading rate, allows the operator to carry out other tasks while the machine loads itself. Packs are manually placed on a shelving unit ("storage door") in random order. When the loading unit is closed, the Medimat automatically transfers each pack in turn to the integrated scanning unit, then stores the packs in a similar way to that described for the Speedcase.

Westfalia describes the Medimat as being suitable for the dispensing of "medium to low turnover" items and offers the "Speedbox" (described below) as a suitable alternative for high turnover items. Westfalia offers a solution which integrates Medimat and

Panel 2: Filling the Baxter Consis system

Filling is assisted by a laser guidance system. Access to the storage channels at the rear of the machine is prevented by mechanised shutters. When the bar-code of a pack stored in the machine is scanned at the console, the shutter for the shelf containing those packs opens and the correct channel is indicated by a laser. The system is told how many packs are being loaded then the packs are fed manually into the channel until all packs have been added or the channel is full. This process is repeated for all packs to be stored. The filling rate can therefore be rapid and can be carried out while the Consis is picking.

Speedbox modules into one unit to cater for a comprehensive range of products. In an integrated system, the Medimat acts as the input route to both its own and the Speedbox storage areas. Both machines operate independently for picking, driven by the interface with the pharmacy computer system. Westfalia has developed software to allow part-packs to be stored in the Medimat.

The Speedbox The Speedbox is similar in storage and pick design to the Baxter Consis (see above). Packs are stored in channels on angled shelving and flipped over the end of the channel by the picking head. The Speedbox has a fixed footprint but is available in a range of heights. It is marketed alone, when loading is manual with an optional accuracy guidance system. It can also be integrated with a Medimat (see above), to give an effective solution to dispensing packs with varying usage rates. Here, the Speedbox is loaded automatically by the Medimat, with the fast movers being held in the Speedbox, with the other packs in the Medimat.

■ SUMMARY

Within the past three years the position of automated dispensers in UK hospital pharmacy has changed dramatically. Whereas such systems were perhaps previously regarded as expensive toys, they are now becoming a "must-have" item. An increasing number of hospital trusts are pursuing business cases and preparing to go out to tender.⁵ The past 18 months has seen the number of products available more than double and pharmacy automation is now a competitive market. This situation presents potential customers with a range of choices and means that manufacturers should develop their products to meet our ever increasing expectations.

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REFERENCES

1. Audit Commission. A spoonful of sugar: medicines management in NHS hospitals. London: The Commission; 2001.
2. Department of Health. Pharmacy in the Future — implementing the NHS plan. London: The Department; 2000.
3. Department of Health. Expert Group on Learning from Adverse Events in the NHS. An organisation with a memory. London: The Department; 2000.
4. McFadzean E, Isles C, Moffatt J, Norrie J, Stewart D. Is there a role for a prescribing pharmacist in preventing prescribing errors in a medical admission unit? *Pharmaceutical Journal* 2003;270:896–9.
5. Brady D, Dean B. An evaluation of the contribution of the medical admissions pharmacist at a London teaching hospital. *International Journal of Pharmaceutical Practice* (in press).
6. Collins DJ, Nickless GD, Green CF. Medication histories — does anyone know what a patient should be taking? *Proceedings of the UKCPA Progress in Practice symposium*; 2003 Nov 21–23; Blackpool. University of Leeds, 2003.
7. McRobbie D, Bednall R, West T. Assessing the impact of re-engineering of pharmacy services to general medical wards. *Pharmaceutical Journal* 2003;270:342–4.

8. Pickrell L, Duggan C, Dhillon S. From hospital admission to discharge: an exploratory study to evaluate seamless care. *Pharmaceutical Journal* 2001;267:650–3.
9. Hospital Pharmacists Group. One-stop dispensing, use of patients' own drugs and self administration schemes. *Hospital Pharmacist* 2002;9:81–6.
10. Farrar KT, Stoddart MJ, Slee AL. Clinical pharmacy and reactive prescription review — time for a change? *Pharmaceutical Journal* 1998;260:759–61.
11. Power A, McGlynn S, McKean C, Lindsay A, Beard K, Kimble V, Lindsay H. Assessing a clinical pharmacy service to a new medical admissions unit. *Pharmacy World and Science* 2000;22(Suppl):B26.
12. Logan-Rena MA, Radley AS. Identifying evidence based risk factors on an admissions unit to assist with targeting patients. *Proceedings of the UKCPA Progress in Practice symposium*; 2002 Nov 22–24; Blackpool. University of Leeds, 2002.
13. Bednall R, McRobbie D, Russell SJ, West T. A prospective evaluation of pharmacy contributions to post-take ward rounds. *Pharmaceutical Journal* 2003;271:22–3.
14. Hopkins S. The need for a pharmaceutical service to the medical admissions ward. University of Portsmouth; MSc thesis. 1999.
15. Price RN, Rogers A. Intervention monitoring on admission wards. *Hospital Pharmacist* 2000;7:81–4.

16. Foster P. Pharmacy services to a medical admissions wards. *Pharmaceutical Journal* 1995;254:656–7.
17. Department of Health. A vision for Pharmacy in the new NHS. London: The Department; 2003.
18. Slee A, Farrar K. What are normal working hours for a hospital pharmacy? *Pharmaceutical Journal* 1998;260:923–5.
19. Slee A. Should pharmacy departments provide an extended hours service? *Hospital Pharmacist* 2000;7:34.

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REFERENCES

1. Shah J. Automated dispensing of parenteral nutrition formulations. *Hospital Pharmacist* 2003;10:63–5.
2. Slee A, Farrar K, Hughes D. Implementing an automated dispensing system. *Pharmaceutical Journal* 2002;268:437–8.
3. Royal launch for Royal Free robots. *Pharmaceutical Journal* 2003;270:359.
4. Automated dispensing is a major step forward says First Minister of Wales. *Hospital Pharmacist* 2003;10:422.
5. Automated dispensing to be installed in hospital pharmacies within Wales. *Hospital Pharmacist* 2003;10:37.