Nurse dispensing of pre-filled chemotherapy syringes on an oncology day unit

The second article in our special oncology section is an original research paper by Matthew Small, Yung Strawbridge and Rebecca Batley. These authors recognised the potential benefit of having trained nurses dispense pre-filled chemotherapy syringes in their oncology day unit, and they set out to assess the acceptability and feasibility of this.

Abstract

Objectives: To introduce the dispensing of pre-filled chemotherapy syringes by chemotherapy trained nurses and assess its acceptability by monitoring for errors.

Design: Following a risk assessment a protocol was drawn up and nurse training undertaken. Syringes were stored in fridges on the oncology day unit and segregated according to strength. Following receipt of a pharmacist-endorsed prescription the appropriate syringes were dispensed by one trained nurse and checked by a second trained nurse. Subsequently all assembled prescriptions were further checked by an oncology pharmacist or checking technician and errors monitored over a 130-day period.

Participants: Nursing and pharmacy staff on the oncology day unit at the Norfolk and Norwich University Hospital NHS Foundation Trust.

Main outcome measures: Number and type of process and dispensing errors observed.

Results: A total of 904 prescriptions containing 1736 chemotherapy doses made up of 2837 separate syringes were dispensed. A high number of process errors occurred but these were predominantly a result of nurses failing to record fridge temperatures on any given day (13.85%). Other frequent errors in this category included dispensing without the prescription having a pharmacy stamp (0.67%) and failure to record the checking nurse's signature (0.77%). Most importantly dispensing errors were kept to a low level (0.63%). These included dispensing expired syringes (0.29%), dispensing the wrong dose (0.12%) and dispensing the wrong agent (0.06%).

Conclusions: The results of this study show that providing pharmacy checks are maintained, nurse dispensing of pre-filled chemotherapy syringes represents a safe and efficient system. Both nursing staff and pharmacy staff benefit from its introduction as ultimately do patients by ensuring the timely provision of chemotherapy.

Introduction

The Weybourne Day Unit (WDU) at the Norfolk and Norwich University Hospital (NNUH) typically administers 1000 intravenous infusional or bolus chemotherapy doses each month. Within this setting we wanted to investigate the option of having chemotherapy trained nurses dispense from stock pre-filled syringes for a limited range of chemotherapy regimens. The intention was to both relieve pressure on pharmacy preparation services and simultaneously enable the nursing staff to start treatments without needing to wait for dispensing and delivery from the pharmacy.

Method

The project was developed in collaboration with pharmacy and the lead nurse on Weybourne day unit, and a full risk-assessment was completed on all aspects of the process before the project began. The risk-assessment concluded that the project carried no increased risk in comparison to current dispensing systems for pre-filled syringes.

Regularly prescribed chemotherapy regimens were identified for which pre-filled syringes could be made available to supply the required dose for each agent. To facilitate nurse selection of the pre-filled syringes, pharmacy developed dosage selection tables setting out the combinations of syringes that are needed to make up typical doses for most patients. These tables were placed on each of two fridges. Each fridge was set up with clearly labelled containers holding syringes of a single strength of each agent.

Typical chemotherapy regimens identified included CHOP (cyclophosphamide, doxorubicin, vincristine and prednisolone), FEC (Fluorouracil, epirubicin and cyclophosphamide), bolus fluorouracil AC (doxorubicin and cyclophosphamide) and single agent doxorubicin. Therefore cyclophosphamide, doxorubicin, vincristine, epirubicin and fluorouracil syringes were stocked in each fridge. Doxorubicin and epirubicin syringes were stored in separate fridges because of their similar appearance and strengths, as were fluorouracil and cyclophosphamide. Prescriptions in which one or more of the prescribed doses could not be filled by the syringes available were excluded from the process and sent to the pharmacy, in the usual way, for dispensing.

A protocol was drawn up for nurse assembly of pre-filled chemotherapy syringes and this was approved by the Trust Professional Protocols, Policies and Guidelines Committee (PPPG). A summary of the process outlined in the policy is

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shown in Figure 1. The flow diagrams in Figure 2 demonstrate the differences in the new procedure compared with our former pharmacy dispensing system.

Summary procedure for nurse dispensed pre-filled chemotherapy syringes

1. Oncology pharmacist clinically checks the prescriptions for pre-filled syringes.
2. Prescription is stamped and signed to clearly indicate it has been clinically checked by the oncology pharmacist.
3. Clinically checked prescriptions are delivered to Day Unit on the working day before they are needed.
4. Each morning a trained nurse assembles syringes for each prescription according to combinations recommended for each agent.
5. The details of each syringe assembled are recorded on a log sheet kept for each patient (including details of the agent, dose, syringe size, batch number, expiry date).
6. The refrigerator temperatures are checked and recorded.
7. The assembling nurse signs a log sheet and a second nurse checks the assembly and signs the log sheet if correct.
8. Once all prescriptions are assembled the designated pharmacy checker is bleeped to complete a final check.
9. If everything is found to be correct administration proceeds according to normal procedures.

Figure 1. Summary of the procedure for nurse dispensing of pre-filled chemotherapy syringes

Pharmacy developed a training package to support the process, which was delivered to all registered nurses on Weybourne day unit. The training package comprised workshops with test prescriptions and log sheets for the nurses to complete. All workshop prescriptions were marked and feedback was given. Nurses that passed the training with all records correctly completed were deemed competent to participate in the process.

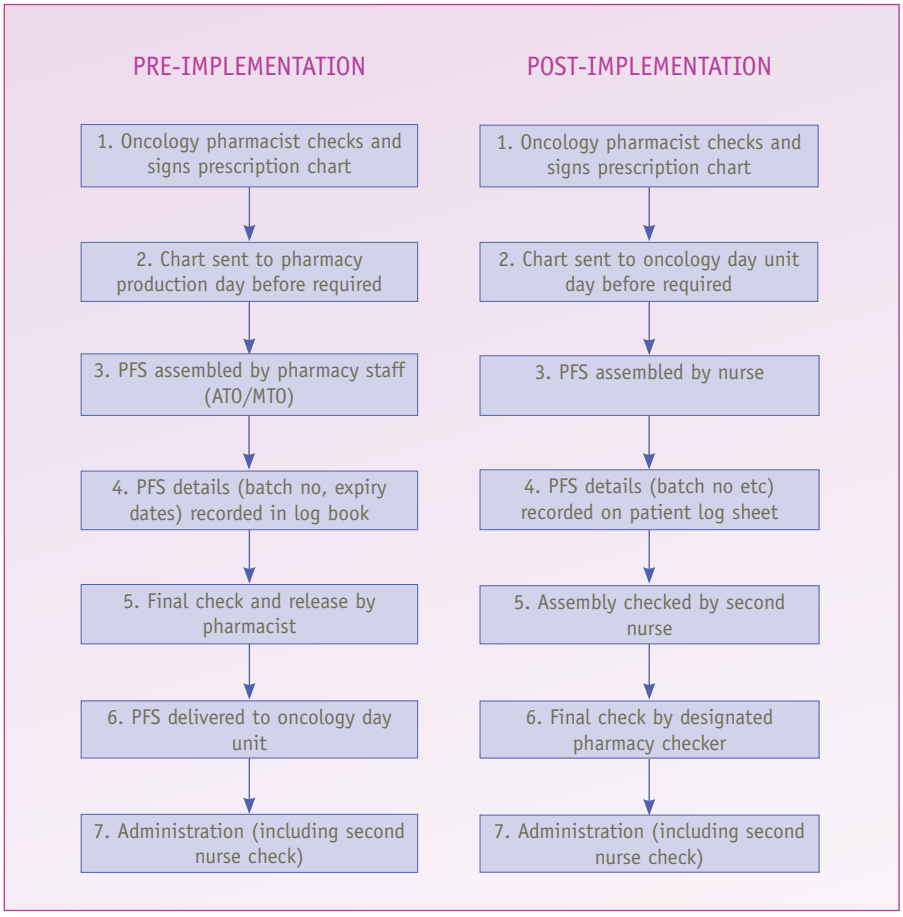

Figure 2. Flowchart comparing the dispensing process before and after implementation of nurse dispensing of pre-filled chemotherapy syringes. (PFS = pre-filled chemotherapy syringes)

An initial study period of six months was established. During this time all dispensing errors or breaches of protocol detected after nurse assembly and checking of the syringes were recorded by the pharmacy checker. All nursing staff were chemotherapy trained and pharmacy checks were completed by the oncology pharmacist or a pharmacy technician trained to final check dispensed prescriptions.

Detected errors were classified as either process errors or dispensing errors. Process errors were defined as breaches of the procedures set out in the protocol but that did not directly result in a dispensing error. Dispensing errors were those that would have resulted in the patient receiving

Table 1. Chemotherapies prescribed

Chemotherapy regimen*	No. prescriptions
FEC	307
Bolus 5-Fluorouracil	297
Single agent doxorubicin	91
CHOP	76
CVP	50
Single agent epirubicin	37
AC (doxorubicin and cyclophosphamide)	19
PCV (oral procarbazine and lomustine and IV vincristine)	16
UKALL Maintenance	9
FEM	2

incorrect or inappropriate treatment had they remained undetected.

Results

Sample Data

Over 130 days, a total of 904 prescriptions for pre-filled syringes for 200 individual patients were dispensed and checked. A breakdown of each of the chemotherapy regimens prescribed is given in Table 1. For these prescriptions, 2837 separate syringes were dispensed either singularly or in combination to make up a total of 1736 chemotherapy doses. The number of syringes of each chemotherapy agent dispensed is shown in Table 2.

Process errors

Process errors that were observed over the study period are summarised in Table 3. The most common error was failure by nursing staff to record the refrigerator temperature each day. On one occasion early in the study, a nurse that was highly experienced but hadn't undertaken the required training performed the syringe check. A number of prescriptions were dispensed that had been signed as checked but not endorsed by the pharmacist as required. Similarly, the nurse who had checked that each prescription was correct failed to sign the patient log sheet on several occasions.

Part of the procedure required syringes that were not ultimately administered to the patient (e.g. because of a deferral in treatment) to be returned to their correct location in the fridge by one nurse with a second nurse checking and both nurses recording this on the log sheet. On one occasion this was done correctly but not recorded and on another the syringes were left out overnight.

Table 2. Chemotherapy syringes dispensed

Chemotherapy agent	No. syringes
5-Fluorouracil	921
Epirubicin	776
Cyclophosphamide	676
Doxorubicn	318
Vincristine	146

In one instance, dispensing details were recorded on the wrong patient's log sheet — this patient had the same name and was receiving the same treatment as another patient for whom this was intended. On two further occasions the combination of syringes dispensed matched the correct dose, but were different to the combination recommended.

Dispensing errors

The total dispensing error rate for the study was 0.63% of all doses dispensed (see Table 4). The most common type of error encountered in this category was the dispensing of syringes that were past their expiry date. To reduce this risk short expiry stickers were produced and placed on the short dated stock by the pharmacy technician. On two occasions one of the agents from a regimen consisting of combination chemotherapy was missing and there was a single instance of a dose being put into the wrong patient's tray.

Dispensing errors that can be considered as potentially hazardous to a patient if the chemotherapy had been administered were those where the wrong dose or wrong agent had been dispensed. The first wrong dose error occurred when a 1000mg cyclophosphamide syringe was dispensed for a prescription requiring a 900mg dose. The other instance arose when two 550mg fluorouracil syringes were dispensed to make up a prescribed dose of 1000mg instead of two 500mg syringes. Furthermore, the latter error was missed by the pharmacy check and only detected during the routine pre-administration nursing checks.

Table 3. Process errors recorded

Process errors	Number/Total*	Percent
No fridge temp. check	18/130	13.85%
Untrained nurse check	1/130	0.77%
No green stamp	6/904	0.67%
No second nurse signature	7/904	0.77%
Returns not logged	1/904	0.11%
Left out overnight	1/904	0.11%
Wrong patient sheet	1/904	0.11%
Combination not as table	2/1736	0.12%

**Number of events where a process error was recorded and the total number of recorded events*

Providing robust procedures are followed, nurse dispensing of pre-filled chemotherapy syringes represents a safe and efficient system. Dispensing error rates are low and continuation of pharmacy checks before administration helps ensure patient safety.

The most significant error detected during the course of the study was the single instance of a wrong agent being dispensed — two epirubicin 40mg syringes were dispensed instead of the prescribed doxorubicin 80mg. This occurred in the first week of the study and a contributing factor was an error in the initial stocking of the fridges where some epirubicin syringes were stored in a container labelled for doxorubicin.

Discussion

The preparation and dispensing of chemotherapy has traditionally taken place in the hospital pharmacy department. This has been determined by factors such as individual patient dosing needs, the requirement for facilities to provide aseptic preparation and operator protection as well as the safety aspect of preparing medicines away from clinical areas. However, introduction and adoption of the concept of chemotherapy dose banding[1] by many UK hospitals along with the availability of pre-filled chemotherapy syringes with extended expiry dates from specials manufacturers has enabled the preparation stage of the process to become obsolete for a number of chemotherapy regimens.

Table 4. Dispensing errors recorded

Dispensing errors	Number/Total*	Percent
Expired syringes	5/1736	0.29%
Missing syringes	2/1736	0.12%
Syringe in wrong tray	1/1736	0.06%
Wrong dose	2/1736	0.12%
Wrong agent	1/1736	0.06%

**Number of events where a dispensing error was recorded and the total number of doses dispensed*

This study set out to examine whether nursing staff could safely dispense the prescribed doses of a number of chemotherapy regimens from a limited range of pre-filled syringes. As in normal practice, each prescription was checked on the Day Unit by a chemotherapy trained pharmacist before dispensing. In addition to monitoring procedural and dispensing errors, pre-administration checks by a pharmacist or checking technician acted as a further safeguard. Introduction of a minimum 15 minute interval between dispensing and administration of doses was also put in place in case the same nursing staff were involved in each task. This was felt to be a reasonable and practical time interval to enable the mind to be cleared before routine pre-administration checks.

Breaches of protocol, or process errors, were relatively high throughout the study. These were predominantly caused by nursing staff forgetting to check and record fridge temperatures. As pharmaceutical refrigerators with temperature monitors that sound an alarm when they are out of range are used, this particular aspect of the procedure is probably not necessary aside from promoting good practice. Other process errors occurred infrequently and were easy to rectify. Nevertheless, ensuring adherence to the protocol has become a key element of the pharmacy checking step.

The total dispensing errors recorded were 0.63%. This compares favourably to published dispensing error rates for hospital pharmacies of 1.6–12.4%.[2–5] However, it is difficult to make direct comparisons because this system has only a limited range of items to select from that don't require further labelling. Weighing these results against error rates for chemotherapy manufactured and dispensed in the pharmacy and the detailed procedures this involves is also not directly relevant.

Nevertheless, the requirement to dispense combinations of syringes to make up many of the doses adds an additional level of complexity. We estimate that making improvements in stock rotation, ordering levels and changing suppliers of some of the syringes to provide more favourable shelf-lives should effectively halve this error rate by eliminating errors caused by dispensing expired syringes.

A major initial concern of this procedure was whether replacing the normal pharmacy procedures for dispensing pre-filled chemotherapy syringes with a nurse-led system would be robust enough in terms of preventing errors. However, we have simply substituted the initial dispensing step performed by a single member of the pharmacy staff with one nurse dispensing and recording what has been selected and another checking this has been done correctly. A further check by a trained pharmacist or technician still takes place in either system.

Although we have no comparative error rates for pre-filled chemotherapy syringes dispensed from the pharmacy we are aware of instances when incorrect doses have been provided and were only detected during routine nurse pre-administration checks. Importantly, similar serious errors with the potential for hazardous consequences to the patient, such as wrong dose or agent, were particularly low during our study period (0.18% in total).

Significantly, the WDU nursing staff fully support the continuation of this process despite it involving an increase in their workload at the beginning of each day. The main reason given is that they have a degree of control over the supply of some chemotherapy without relying on timely preparation and delivery from the pharmacy department. Further benefit is realised by a reduction in pharmacy workload, freeing staff to concentrate on the preparation of chemotherapy that requires reconstitution and thereby improving efficiency. It was also observed that close monitoring of the supply and re-ordering of prefilled syringes enabled the level of wastage of expired stock to be significantly reduced.

Most importantly, steps taken to help ensure the timely provision of chemotherapy help to promote an efficient service from which patients ultimately benefit.

Conclusion

Providing robust procedures are followed, nurse dispensing of pre-filled chemotherapy syringes represents a safe and efficient system. Dispensing error rates are low and continuation of pharmacy checks before administration helps ensure patient safety. Furthermore, nursing and pharmacy staff — and crucially, patients — can all benefit from its implementation. ✣

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Declarations of interest

The authors declare they have no competing interests.

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