

# Dose banding of chemotherapy in the Edinburgh Cancer Centre

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**AIM** • To implement redesign of pharmacy services through introducing dose banding within the day case chemotherapy area.

**DESIGN** • Audit.

**OUTCOME MEASURES** • Time taken to dispense chemotherapy.

**SETTING** • Edinburgh Cancer Centre.

**RESULTS** • The number of items delivered late was half of that before the introduction of the service redesign.

Verbal feedback from pharmacy and nursing staff was positive.

**CONCLUSION** • Dose banding provides rapid access to chemotherapy for all patients in the south-east of Scotland oncology managed clinical network without compromising quality and safety. Dose banding using ready-to-use doses can potentially increase access to chemotherapy provision in the cancer units and equity of care between the cancer unit and centre is assured. This is essential for the implementation of “Cancer in Scotland”, the Scottish strategy for the care of patients with cancer.

Chemotherapy treatments in the Edinburgh Cancer Centre have increased by approximately 30 per cent over recent years due, in part, to greater numbers of day cases, made possible by the ability to manage side effects of chemotherapy more effectively. In addition, chemotherapy regimens and clinical trials are becoming more complex and a greater number of patients with advanced cancer and co-morbidity factors now receive treatment. Treatment with systemic anti-cancer treatments is likely to double in Scotland over the next 10 years<sup>1</sup> increasing the demands on already overstretched pharmaceutical services, and delays in commencing chemotherapy may adversely affect patient outcomes. Prescribing, dispensing and administering chemotherapy is a high risk area requiring intensive pharmaceutical input to minimise risk to the patient and to other health care professionals.

The Association of Scottish Trust Chief Pharmacists commissioned a working group to produce a capacity planning framework to address capacity issues. The results of applying this framework to the capacity of staffing and workload demonstrated a similar pattern across Scotland with departments working in excess of their capacity, increasing the likelihood of errors and increasing product dispensing (turnaround) time. Rapid access to modern, effective

treatment is essential for implementation of “Cancer in Scotland, action for change”, the Scottish strategy for the care of patients with cancer.<sup>2</sup> As the demands on pharmaceutical services for chemotherapy continue to increase, novel ways of improving efficiency through redesign are needed to address the predicted increasing number of patients attending for chemotherapy.

Chemotherapy dosing in cancer patients, with a few exceptions, has traditionally been calculated using body surface area derived from the Du Bois and Du Bois formula published in 1916.<sup>3</sup> Body surface area is used to calculate chemotherapy doses in phase I clinical trials and continues through drug development and into routine practice. It is widely recognised that this is not the most accurate method of calculating chemotherapy doses since the formula was derived for metabolic studies using a small number of subjects.<sup>3</sup> Dosing in this manner requires preparation of individual doses for patients, often resulting in delays to treatment, thereby decreasing satisfaction with cancer treatment services.

In contrast, dose banding is a system whereby doses of intravenous cytotoxics are

calculated on an individualised basis and are rounded up or down within an agreed band to predetermined standard doses. A range of ready-to-use chemotherapy syringes or infusions, manufactured in-house or purchased as “specials” from commercial sources, may be used to administer the prescribed dose.<sup>4</sup> Dose banding does not result in a significant variation compared with dosing using the conventional method because each banded dose is within a 5 per cent tolerance limit. This system has worked successfully in other cancer centres in the United Kingdom.<sup>5</sup> Dose banding offers many advantages to both patients and staff and allows pharmacy departments to manage increasing work-load without delaying patients’ treatment (Panel 1).

At the Edinburgh Cancer Centre all chemotherapy is prepared in a satellite pharmacy located within the chemotherapy day case area. The local pharmacy service specification states that chemotherapy will be delivered to the day case treatment areas within 15 minutes of the requested administration time. A baseline audit of the service specification in June 2001 showed that up to

## Panel 1: Advantages of dose banding

- Reduces waiting time for chemotherapy
- Reduces waste (deferred treatment, partially used single-use vials)
- Releases pharmacists’ time for clinical activities, such as prescription verification
- Products can be made in a licensed specials production unit
- Potential to extend expiry date (28–130 days) if made in a licensed unit
- Reduces occupational exposure/risk to staff
- Patients can be seen at short notice
- Rationalises chemotherapy dosing
- Fewer calculations therefore less scope for arithmetical and dose calculation errors
- Potential to roll out to cancer units — provision of near-patient care
- Facilitates administration of chemotherapy on any chosen day in cancer units
- Frees pharmacy capacity to allow preparation of more complex treatments
- Increases capacity to treat more patients daily if adequate nursing support

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20 per cent of all day case chemotherapy orders were delivered more than 15 minutes late. Process mapping, a component tool for service redesign, identified prescribing and preparation of chemotherapy as the system bottlenecks. The pharmacy capacity was often exceeded and dose banding of chemotherapy was identified as one solution to this.

The aim of the study was to determine the effect of dose banding on chemotherapy turnaround times in the day case chemotherapy area. The objectives were:

- To measure chemotherapy turnaround times before the introduction of dose banding
- To agree and implement a dose banding system with the directorate
- To reassess turnaround times and other parameters linked to efficiency after implementation of dose banding
- To seek multidisciplinary opinion as to the potential acceptability of dose banding as a means of improving efficiency

#### METHOD

We identified high workload regimens that used bolus cytotoxics that would be stable for up to four months in commercially prepared, ready-to-use syringes. These were regimens using cyclophosphamide, methotrexate and 5-fluorouracil, given predominantly to patients with breast and colorectal cancer. Such regimens represented approximately 50 per cent of the day case chemotherapy workload. Dose banding was approved by the chemotherapy services multidisciplinary team and introduced in October 2001. Doses of 5-fluorouracil, cyclophosphamide and methotrexate were rounded up or down to a predetermined band (Table 1), as described by Plumridge and Sewell.<sup>4</sup> A training package was developed and training sessions for medical, nursing and pharmacy staff were held before introduction of the dose banding system. The satellite pharmacy continued to prepare the chemotherapy doses while a tendering process identified a suitable special manufacturing partner against a service specification drawn up by pharmacy quality assurance. The contract was awarded based on set criteria and thereafter commercially prepared, ready to use doses were purchased as specials. A poster was designed for the day

TABLE 1: DOSE BANDING OF FREQUENTLY USED CYTOTOXIC DRUGS<sup>4</sup>

Drug	Dose	Syringe strengths (mg) purchased for use in the Edinburgh Cancer Centre
Fluorouracil	Dose <1g, round to 50mg	250, 300, 400, 500, 600, 1000
	Dose > 1g, round to 100mg	
Methotrexate	Round to nearest 5mg	75–100
Cyclophosphamide	Dose <1g, round to 50mg	300, 400, 500, 600, 1000
	Dose > 1g, round to 100mg	

TABLE 2: AUDIT SUMMARY, 2001 vs 2002

	June 2001 (pre-dose banding)	February 2002 (after dose banding)
Number of day case parenteral chemotherapy items prepared	1,299	1,175
Number of items >15 minutes late (% of total output)	110 (8.5%)	57 (4.8%)
Outpatient treatment days in month	21	20
Number of ready- to-use doses used	0	235

case ward detailing the chemotherapy doses to prescribe to support use of these dose units.

The effect of dose banding and ready to use chemotherapy doses was evaluated in February 2002, four months after the introduction of the service, by auditing turnaround times for all day case parenteral chemotherapy items, dose banded or not, over a four-week period. The number of parenteral cytotoxic items delivered 15 minutes after the agreed delivery time was recorded. The number of late items (>15 minutes) from this data collection period was compared with the number of late items in the baseline audit. Verbal opinions on both the usefulness of the syringes and the dose banding service were sought from pharmacy and nursing staff.

#### RESULTS

The results are summarised in Table 2 and Figure 1. Although there is a slight decrease in the number of parenteral items dispensed in February 2002 compared with June 2001, the turnaround time was halved. The num-

ber of ready to use doses dispensed was 20 per cent of the total number of aseptically prepared cytotoxic items. The principal reason for the decrease in parenteral chemotherapy was the growing use of oral cytotoxics such as fludarabine and capecitabine replacing infusional fludarabine and 5-fluorouracil.

The number of late items fell from 110 to 57 after the introduction of dose banding. The high peak on the data series of late items after dose banding corresponds to one day when four of five isolators were out of commission for several hours because of technical problems. This required parenteral cytotoxics to be prepared in another pharmacy within the trust.

#### DISCUSSION

Improvements to patient care were achieved by dose banding chemotherapy and using commercially prepared, ready-to-use chemotherapy doses. The turnaround time for parenteral chemotherapy was reduced as pharmacy capacity was increased. Delays in chemotherapy administration resulting

#### LISTENING FRIENDS SCHEME

The Listening Friends Scheme exists to offer free confidential help to pharmacists suffering from stress.

The scheme has been set up by the Royal Pharmaceutical Society but operates independently so that help can be sought in complete confidence.

The service allows any pharmacist under stress to talk to a fellow pharmacist who has insight into the particular pressures that apply in pharmacy. The service is not, however, restricted to work-related problems, but offers help with all causes of

stress, such as family problems, illness and bereavement.

The service is run by a team of volunteer pharmacists, all of whom are mature and experienced in their field of practice. All have been trained in listening skills and many have counselling training and experience. They are also able to direct pharmacists under stress to sources of specialist help where needed.

Contact with the Listening Friends is made initially by telephoning the scheme's automatic answering service on 020 7572

2442. Callers will be given brief details of the service and asked to leave their name, the area in which they live, a contact telephone number and a convenient time to call. A Listening Friend will then call back to discuss the details of the pharmacist's problem in complete confidence. Further contacts are usually by telephone.

Information about the scheme and how it operates is available in the form of a leaflet. This can be obtained by contacting the helpline number. Funding for the scheme is provided by the Society's Benevolent Fund.

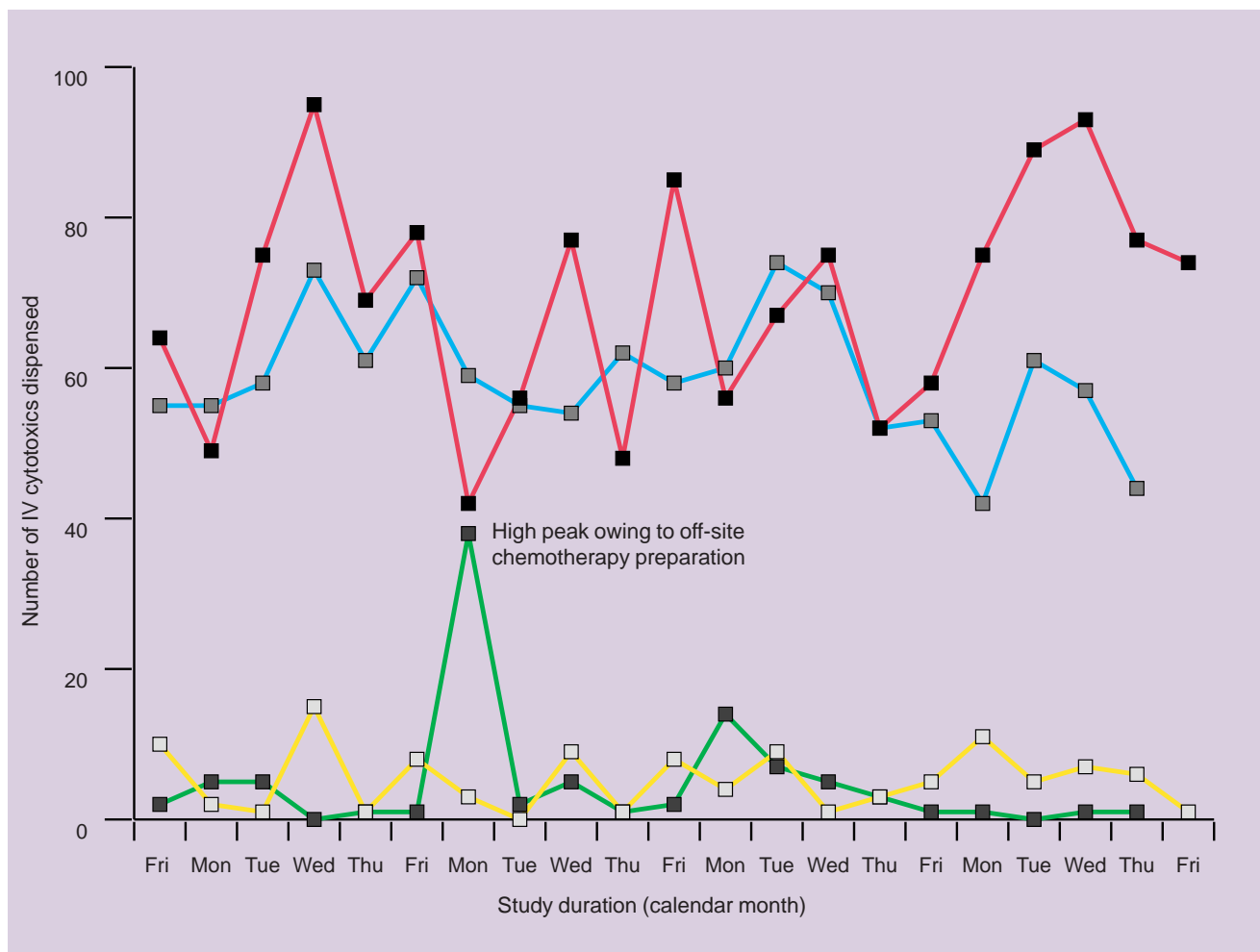


Figure 1: Daily intravenous chemotherapy items dispensed before and after dose banding

- Number of IV cytotoxics dispensed before dose banding
- Number of IV cytotoxics dispensed after dose banding
- Number of late items before dose banding
- Number of late items after dose banding

from low blood counts or toxicities were easily managed since the ready-to-use doses were returned to the fridge and reused on the new treatment day. This facilitated increased flexibility in the pharmacy service, which was easily able to accommodate a new directorate policy of delaying chemotherapy due to a low white cell count for only three days, rather than the traditional seven days in some breast cancer patients. In addition, wastage of dispensed items was reduced because the longer expiry time permitted for products prepared in a licensed aseptic facility gives freedom to reuse items cancelled at short notice.

Prescribing and dispensing chemotherapy in this way ensures equity of care

at the cancer centre and cancer unit and gives patients an element of choice in planning treatment days. There is increased access to care for patients attending the south-east of Scotland cancer units and positive feedback from pharmacy and nursing staff. Expanding the range of cytotoxics purchased as ready-to-use doses will continue to help address pharmacy under-capacity, will minimise delays in starting chemotherapy and assist with preventing the need for a waiting list for chemotherapy that would be detrimental to patient outcomes. This supports the Clinical Standards Board for Scotland breast cancer standards, which state that a minimum of 80 per cent of patients should com-

mence chemotherapy within four weeks of their final surgery.<sup>6</sup>

## CONCLUSION

This service redesign will be implemented throughout the south-east of Scotland oncology managed clinical network by the pharmacy team. This will facilitate treatment nearer to patients' homes meeting the needs of both the service provider and patients. Dose banding also facilitates treatment planning to allow for preparation of complex regimens and clinical trials. It will assist cancer care pharmacy teams to fulfil the requirements of "Cancer in Scotland" without compromising quality and safety.

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