Capacity planning for chemotherapy

Karen Shield describes how she set about producing a capacity planning formula for use in chemotherapy preparation units within the Northern Cancer Network

The 1995 report "A policy framework for commissioning cancer services"[1] provided a basis for establishing national standards for cancer care. Following this, the National Health Service plan[2] and then the NHS cancer plan[3] set out in detail a major programme of change in delivery of cancer services.

The implementation of increased screening and reduced waiting times together with National Institute for Clinical Excellence recommendations on cancer drugs has resulted in more patients having treatment for cancer than ever before.

An increase in cancer chemotherapy has been seen over the past few years. This increasing workload, often with few extra staff, can lead to stress and errors within chemotherapy reconstitution units.

In order to manage the increase in chemotherapy, it is now recognised that it is important to have internal guidelines on the maximum numbers of items that can safely be prepared, ie, capacity planning. This involves analysis and decisions to balance capacity in a unit with demand from customers. Capacity planning is used to examine volume and complexity of workload, time available and the staff and facilities required. Capacity planning, although a requirement for audit in both licensed and unlicensed units, has, to date, not been undertaken in many departments. Where capacity plans have been written, varying methods have been used to assess information, resulting in significant variation in the plans.

Work has been done in the past on ways of counting chemotherapy. Trudeau[4] in 1980 described an internal measurement system for chemotherapy based on time needed for completion of product. The total monthly time was divided by departmental man hours to yield a monthly productivity ratio. No account was taken of staff grades. The model was not used for capacity planning. Matanin[5] in 1984 determined an average preparation time for a cytotoxic item, with a slightly higher time for new items. No account was taken of the complexity of the manipulations, with the difference in time being due to clinical checking.

More recently, in February 2003, a capacity planning model was produced by Low *et al*[6] on behalf of the Association of Scottish Trust Chief Pharmacists. This model did not differentiate between different grades of staff or complexity of preparation of chemotherapy. To date there has been no published work linking the variable time requirement for different types of chemotherapy with grades of pharmacy staff carrying out the preparation.

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The Northern Cancer Network Pharmacy Group comprises production and oncology pharmacists from nine hospitals throughout the Northern region. It decided to produce a network-wide capacity plan. This plan, with an agreed uniform formula for calculating available capacity, could then be used for staff bids across the region. None of these sites had a specials licence for chemotherapy so was unable to batch-produce.

Traditionally there have been three main ways to assess workload: by counting the number of items prepared, by paying attention to the complexity of preparation, and by linking workload to the total preparation time. We decided that our plan should use the total preparation time to improve accuracy.

Preliminary survey

A three part questionnaire was sent to all nine hospital pharmacies in the Northern Cancer Network. This article deals with parts 1 and 3.

Part 1 gave a list of commonly used chemotherapy protocols, standardised across the network, and asked production pharmacists to estimate the time needed to prepare each regimen (actual manipulation of the drug in the isolator). They were also asked to state how many items (ie, patient ready, labelled syringes or bags) were included in each regimen.

Once the completed surveys were received it became clear that the time taken by each site to prepare each drug differed by only one to two minutes. These times were averaged. All sites agreed on the number of items in each regimen.

Responses to the questionnaire suggested a vincristine syringe to be the quickest item to prepare at five minutes, so this was deemed to be the lowest period. This period was called "one adjusted item". All other averaged preparation times were divided by five minutes to give the number of "adjusted items" for all drugs and regimens.

There was a rationale behind our use of adjusted items. All hospitals in the network had previously reported a change in the nature of chemotherapy with many complicated regimens and time-consuming items being prepared. Traditional counting methods, however, failed to show increases in workload because one product was counted as one item irrespective of labour intensity. Using adjusted items as a means of counting chemotherapy gives a more accurate reflection of workload, as the actual time spent preparing the item is used (see Panel).

Developing the formula

Part 3 of the survey asked for the time taken for each preparation step in chemotherapy production (not including manipulation) and the grade of staff involved in each step. The averaged results are shown in Table 1. These results were split into time taken per item and time taken per session (eg, half day). The average time for each step and the grade of staff undertaking that step is shown.

The time per item results in Table 1 were used to produce a formula for the preparation (without actual manipulation) of the cytotoxic item. These results are based on individual patient dispensed items and are not intended to be used for batch production of cytotoxics.

The formula can be derived as follows:

$$6P+6T+5T+5T+5P+11A+5P+3P+5T = 19P+21T+11A$$

where P=pharmacist minutes, T=technician minutes and A=assistant minutes

The time per session results in Table 2 were added together to give a sessional time of 52 minutes per session per isolator. This

Table 1: Time taken for chemotherapy preparation steps

Step (per step)	Average time taken (min)	Staff grade
1. Clinical check	6	P
2. Prepare labels	6	T
3. Prepare batch sheets	5	T
4. Set up ingredients	5	T
5. First check	5	P
6. Transfer decontamination	11	A
7. First check/release	5	P
8. Packaging	3	P
9. Delivery	5	T

P=pharmacist, T=technician, A=assistant

Table 2: Time taken per session

Step (per session)	Average time taken (min)	Staff grade
1. Initial isolator clean	22	T
2. Final isolator clean	15	T
3. Hatch clean and plates	15	T

T=technician

Advantage of using adjusted items over actual items

Part 1 of the survey revealed that a 5-fluorouracil infusor took 20 minutes to prepare, four times longer than the five minutes it took to prepare a vincristine syringe. The time taken to prepare the vincristine syringe was the lowest in the survey and was termed "one adjusted item", so one 5FU infusor represents four adjusted items.

Our survey revealed that, in May 1997, 525 items were prepared; however, when this figure was adjusted as above, the total was 825. In May 2002, there were 732 items; however, when adjusted, the figure rose to 1,861. The percentage increase in workload since May 1997 is therefore 39 per cent for actual items and 126 per cent for adjusted items.

The adjusted figure more accurately reflects the increase in workload over the five-year period, because it takes account of the actual time spent in preparation, rather than simply the number of items prepared.

time per session is constant irrespective of the number of items prepared.

The time taken to prepare an item for manipulation can therefore be calculated as 19 pharmacist minutes plus 21 technician minutes plus 11 assistant minutes plus 52 technician minutes per session per isolator and can be shown as:

19P+21T+11A (time per item)
+52T (time per session)

The time taken to manipulate an item depends on the drug, as revealed by part 1 of our questionnaire. As described previously each five-minute time block was taken to be one adjusted item. By multiplying the number of adjusted items of a specific drug by 5T (five technician minutes) the time to manipulate that drug can be calculated.

The time taken to prepare chemotherapy per month (min) can then be calculated by using the formula:

Monthly items x (19P+21T+11A)
+Number of sessions per month x 52T
+Adjusted items per month x 5T

The time available for an average pharmacist, technician and assistant can then be calculated.

Pharmacist 39h per week minus two 20min breaks per day = 8,560min/month
Technician 37.5h per week minus two 20min breaks per day = 8,200min/month
Assistant 37.5h per week minus two 20min breaks per day = 8,200min/month

For an example, Sunderland Royal Hospital is used, giving the following result:

Total monthly items = 591
Total monthly adjusted items = 1,543

Table 3: Number of staff required in each unit according to capacity planning formula compared with actual staff present

	Staff (whole time equivalents)					
	Pharmacists		Technicians		Assistants	
Hospital site	Required	Actual	Required	Actual	Required	Actual
1	1.3	1	2.6	3	0.8	1
2	0.9	1	1.7	2	0.5	0
3	0.5	0.5	1	1	0.3	0.5
4	0.4	0.4	0.8	0.3	0.2	0.8
5	0.4	0.4	0.8	1	0.2	0.3
6	0.4	0.2	0.7	1	0.2	0.2
7	0.1	0.1	0.2	0.2	0.1	0.1
8	3.4	2	7.1	5	2	2
9	0.1	0.1	0.5	0.5	0.1	0

The negative pressure isolator is cleaned daily and the gloves changed each day so one day is equivalent to one session. Therefore there are 20 sessions per month.

Using the previous formula:

Monthly items = 591 x (19P+21T+11A)
Sessions = 20 x 52T
Adjusted items = 1,543 x 5T

So, time = 11,229P+12,411T+6,501A
+1,040T
+7,715T
=11,229P+21,166T+6,501A

To convert to whole time equivalent (WTE) the minutes per month worked by each staff grade is used.

Pharmacist 11,229/8,650 = 1.3WTE

Technician 21,166/8,200 = 2.6WTE

Assistant 6,501/8,200 = 0.8WTE

The formula gives the number of staff constantly needed in the unit and does not take into account holidays or sickness, assuming that these are taken outside the production unit. To convert to individual staff members in a self-sufficient unit, an uplift of 20 per cent can be applied to cover holidays and sickness.

It is accepted that staff often have other commitments such as technician top-up, clinical duties and ward rounds for pharmacists etc. In units where staff have these commitments the formula can be varied by reducing the total minutes per month worked by a staff group or member before performing the calculation. Time taken for audit, training, etc, can also be included by again reducing the monthly time available.

The number and grades of staff required in each of the nine hospitals were calculated and compared with the actual staff complement. This is shown in Table 3. It can be seen that there was a good correlation between predicted and actual staff numbers. There were however a few exceptions. One site had a shortfall of 0.5 WTE technician and an excess of 0.6 WTE assistant against predicted levels. This particular site used assistants to prepare chemotherapy. In units such as this one the original formula can be adapted so that the 5T for adjusted items can be changed to 5A before calculating. Other parts of the formula can also be changed to suit the skill mix of the particular unit. Another site had less pharmacist and technician time than expected. This site had experienced a huge increase in workload and had requested extra staff.

The formula can be used to plan for expected increases in workload. For example an overall increase in workload can be accommodated by applying a percentage increase to the monthly items and adjusted items before calculation. The extra technician time required due to an expected increase of 20 5FU infusors can be calculated by multiplying the 21T in the formula by 20 (monthly items) and the 5T by 80 (20 x 4 adjusted items) before calculating the amount of extra time needed.

The future

Since our formula has shown excellent correlation with our current staff complement (see Table 3), we will use it to monitor increasing workload and staffing requirements across the network and to develop bids for extra staff.

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