How to monitor progress to guaranteed waiting time targets

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Executive Summary

- There is a direct link between number on the waiting list and maximum waiting time
- Analysis of Trust waiting list data confirms the observation that the number on the waiting list at any point in time is controlled by random variation in all the factors influencing the waiting list.
- This implies that the link between activity and number on the waiting list is very weak.
- Trusts therefore need to change the method for monitoring waiting lists and the progress toward waiting time targets.
- A simple method using control charts will ensure that each Trust is able to take appropriate action to meet waiting time targets.

Introduction

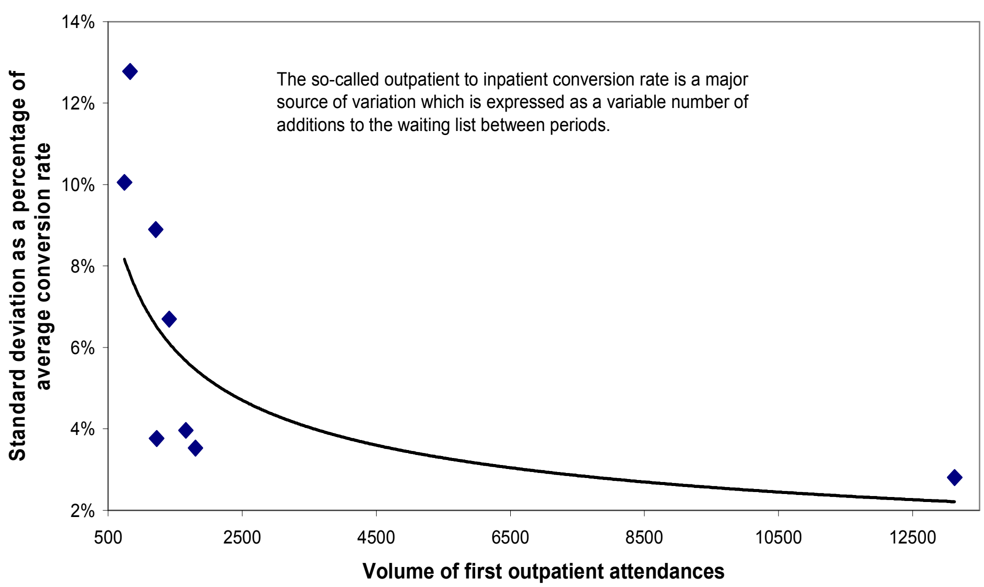
Most people will be aware that the number of patients on the waiting list varies from month to month. This variation can be described as 'the voice of the process' in that the size of the variation is a reflection of the many factors influencing the waiting list.

The pioneering work of Shewhart in the area of Statistical Process Control has given us a methodology to characterise the variation and then to set process control limits which will 'flag' when the waiting list is 'out of control'.

Where Does the Random Variation Come From?

The total number on the waiting list is the outcome of many processes all of which are subject to random forces.

Variation in the outpatient to inpatient conversion rate



- Additions to the waiting list

These arise mainly from outpatient appointments. Not only does the number of appointments seen in a month vary but so to does the conversion rate (additions to the waiting list per outpatient appointment which very much depends on the mix of urgent, routine and soon patients seen in each clinic) – see figure above.

Follow-up appointments can also lead to an addition to the waiting list. Cancelled clinics and DNA lead to further random variation in the number of monthly additions.

The lag between decision to admit (in outpatients) and actual addition to the waiting list is a further cause of random variation in the number of additions in any month.

An additional source of random addition is via suspended patients being added back onto the active waiting list.

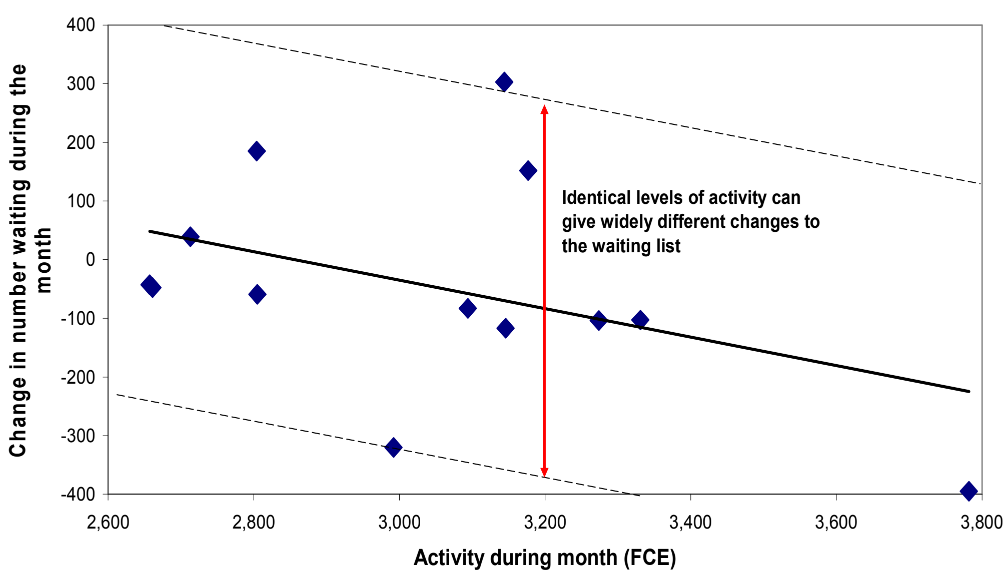
- Removals from the waiting list

The number of operations performed in any month varies with the casemix selected from the waiting list, the available working days, cancellations, etc. Other removals can come from patients who relocate elsewhere, die or who are suspended for medical or social reasons. All of these are subject to randomness.

Therefore it is not surprising that the dominant factor controlling the number on the waiting list is the overall randomness arising from many individual process steps each of which are subject to random variation.

In this context activity does matter but its individual contribution will tend to be overwhelmed by the contributions from the many other factors – see figure below.

Lack of strong relationship between activity and change in the number on the waiting list



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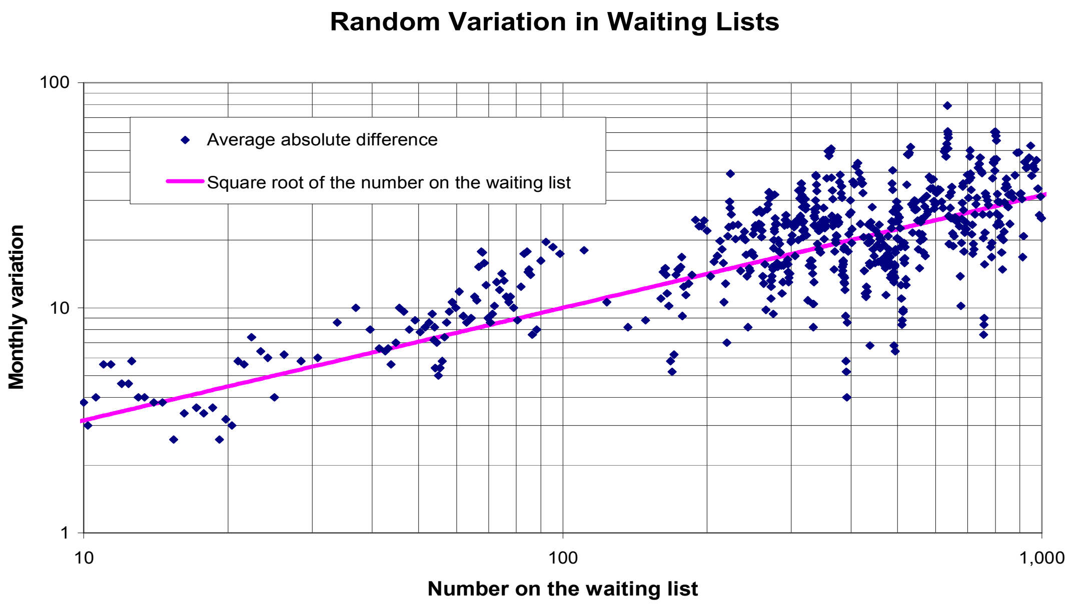
How do we understand the variation?

This is achieved by looking at the absolute difference in the total number waiting from one month to the next. For example, In January there are 250 on the waiting list while in February there are 210 – the absolute difference is 40. This calculation is performed for successive pairs of months over a number of years.

The average of the absolute differences is calculated and related to the size of the waiting list as in Figure One. In this figure the monthly waiting list numbers covering the period May-98 to May-02 were analysed across all specialties at Heatherwood & Wexham Park Hospitals. Identical results will be obtained from other waiting lists in other hospitals.

As can be see the results from all specialties and the total combined waiting list are similar and can be displayed on a single chart irrespective of waiting list size or type, e.g. overnight or daycase.

Figure One: Relationship between variation in monthly waiting list numbers and the size of the waiting list.



The fact that the data falls in a straight line on a log-log plot confirms that the behaviour can approximately be described by Poisson randomness, i.e. the branch of statistics dealing with arrival events having only integer values.[1]

Hence the standard deviation (around the expected number) will equal the square root of the number on the waiting list (the straight line on the above chart)[2].

[1] Arrival events are things like GP referrals per month, emergency admissions per month, customers per hour in a supermarket, etc. In this instance the arrival event is the total number on the waiting list at the end of the month - the result of many processes which are mostly governed by Poisson randomness.
[2] Using the square root of the total number on the waiting list is itself an approximation to the average moving range since the best approximation is actually 1.1 to 1.2-times the square root of the total number.

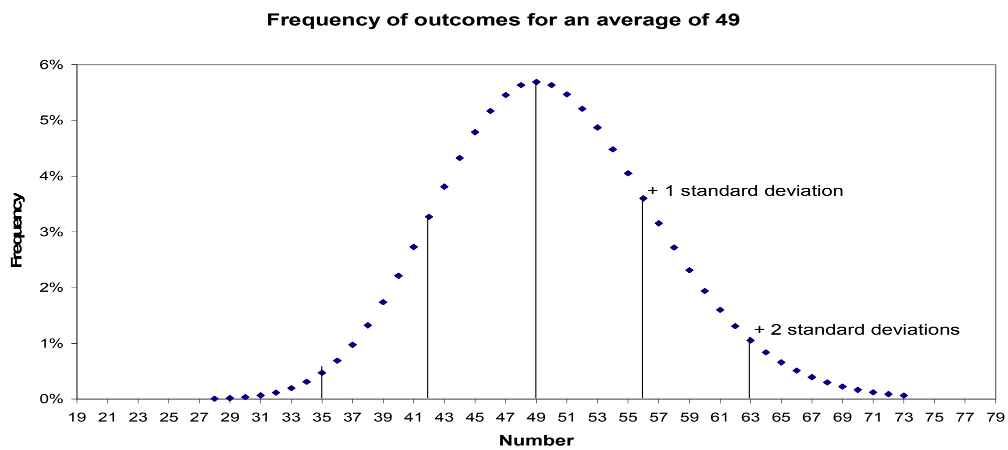
We can now use this chart to answer the question – when is a change in the waiting list significant? For example, at the end of March 2008 the General Surgery overnight waiting list had 680 patients in total but by the end of April this had dropped to 638. Was this change due to additional activity or simply due to random variation?

From the above chart we see that for an average of 660 we could expect the total number to vary by up to ± 75, i.e. up to three-times the average moving range (as approximated by the square root of the number on the waiting list). Hence the observed change of 42 was well within that expected from simple random variation and could not be attributed to extra activity.

Use in Managing the Waiting List

If the number on the waiting list is moving up and down due to random variation how can we be sure of delivering a waiting list target?

Figure Two: Frequency of outcomes around an average



Basically if you have a profile leading to an eventual target then any value within ± 2.66 x average moving range of the profile value is acceptable and no special management action needs to be taken[3].

However because the NHS targets are absolute targets then it is more prudent to take action if the month end number is greater than + 2 x average moving range away from the target. This prudent approach ensures small and manageable chunks of 'extra' work to keep the waiting list fully 'in control' to guarantee the ultimate target (see Figure Two for an example).

In this case the appropriate action to take is to do extra work (over and above that already planned, e.g. extra Saturday or private sector lists) in order to reduce the total number back to within + 2 x average moving range. In the longer term the appropriate action is to increase the productivity of existing resources or to add appropriate flexibility/capacity into the existing resources.

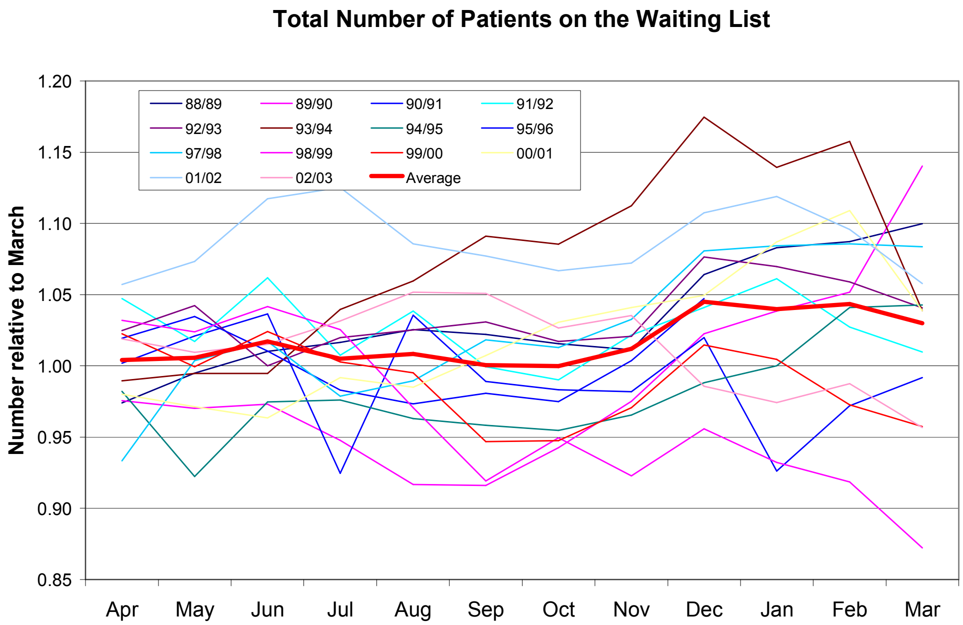
[3] The figure of 2.66 comes from the pioneering work of Shewhart in the construction of control charts. Under normal circumstances a figure of 2.66 should be applied, however, to avoid any possible chance of a waiting list 'getting out of control' a figure of 2 is applied.

How de we determine our profile?

Figure Three gives a review of 15 years of monthly waiting list data at a large acute hospital. The data shows that there is no apparent profile across the year other than a small step up in December, i.e. a flat profile is the best description of the true underlying trend.

Obviously, because of randomness, the profile across individual years is somewhat erratic – best described as what mathematicians would call a 'random walk'. The extent of the step up in December appeared to relate to the severity of the winter, i.e. surgical beds occupied by medical patients and to the fact that overall elective activity drops in December due to the Christmas break. The size of the 'average' step will be unique to each hospital and for the purpose of constructing an annual profile can be ignored because it only emerges as an 'average' from 15 years of data.

Figure Three: Monthly waiting list numbers over a fifteen year time scale.



The fact that the overall average is almost a straight line and that individual years are randomly distributed around this average merely confirms the conclusion of the analysis of monthly variation, namely, the waiting list is controlled by random factors. Therefore, in order to achieve the target of a six month maximum wait by December 2004 it is best to construct a straight line target sloping down from March 2002. The slope of this line is determined by the number of patients to be removed from the waiting list over this period.

Why is the link between activity and waiting list so weak?

Elective activity is only one of a larger number of forces acting on the waiting list. In this instance the other forces (including elective bed availability) combine to have a greater combined effect than any one force on its own.

When doing 'extra' activity we need to ask the question – 'extra' against which criterion? In many instances the so-called extra activity is 'extra' against the wrong benchmark. The only valid benchmark is therefore to use a control chart (see below) to determine when a truly significant change has occurred.

Is there a link between total number waiting and maximum waiting time?

The number on the waiting list and the maximum waiting time are linked via the waiting list shape. The waiting list shape is determined by the relative proportion of urgent, soon and routine patients and by the mismatch between demand and activity.

As the maximum waiting time approaches 6 months the differences in waiting list shape between different specialties will begin to become less important and a common waiting list shape can be assumed to apply to all specialties. This greatly simplifies the calculation of the reduction in the size of the waiting list in order to achieve a given target, i.e. 6 months maximum wait.

How do we calculate the reduction in the number waiting?

The reduction in the waiting list is calculated in the following way:

Number to be removed to achieve a 6 month maximum wait =

Total of all patients waiting longer than 6 months + (0.5 x total of patients waiting in the band 3 to 6 months)

The extra contribution from the patients in the 3 to 6 month band is required in order to deliver a 'stable' waiting list, i.e. it allows the waiting list to slope down to the maximum boundary rather than having large numbers of patients needing to be removed from the list the day before the maximum limit.

For example at March 2002:

Specialty	0-3 mth	3-6 mth	6-9 mth	9-12 mth	>12 mth	Total
A Specialty DC	600	400	300	200	10	1,510

Total number to be removed = (0.5 x 400) + 300 + 200 +10 = 710

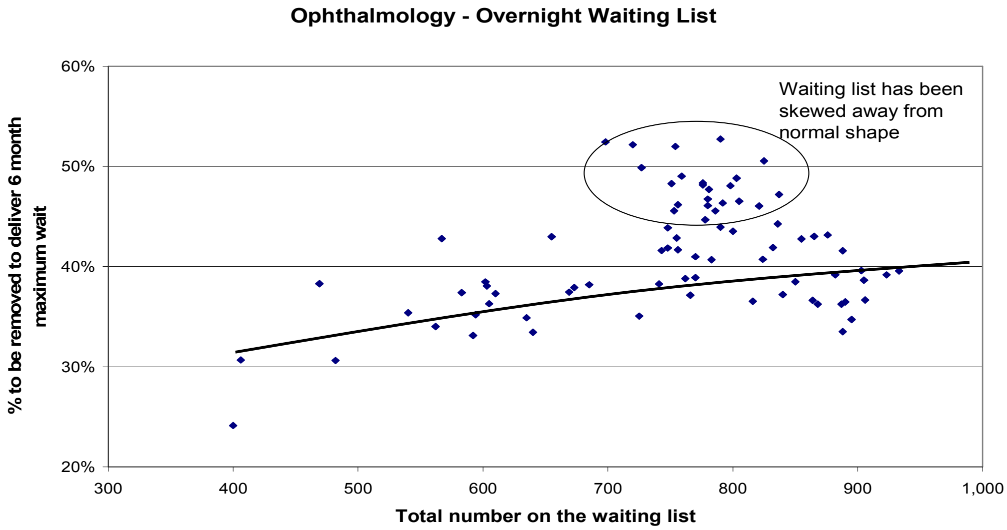
To be achieved over three years (in actual fact 2 years and 9 months) hence number removed per year = 710 ÷ 3 = 237

Or more correctly the number to be removed each month over 33 months to December 2004 is 710 ÷ 33 = 21.5 per month.

To calculate the number required to get from 6 to 3 months is a slightly different calculation since such a short waiting time implies that all waiting lists will look more like a 'shoulder' than an even slope down to the maximum wait. Hence in this case we would only need to take one-third of the number waiting 0-3 months and then add the number waiting 3-6 months.

Figure Four gives an example where this calculation has been applied on a monthly basis to 7 years data for an overnight Ophthalmology waiting list. As can be seen there is a normal waiting list shape where some 30% to 40% of the waiting list needs to be removed to achieve a six month maximum wait, however, on occasions this shape can be skewed such that up to 50% of the waiting list needs to be removed in order to guarantee the maximum wait.

Figure Four: Role of waiting list shape in determining number to be removed.



This skewing typically occurs at times when either demand has been much higher than capacity or capacity has been restricted due to unforeseen evens such as a theatre closure or long term sickness of a consultant. In order to deliver a maximum waiting time the waiting list shape is skewed. This cannot continue indefinitely and hence in the above example the data in the circle represents a 2 year period within the 7 year timeframe.

Are there any exceptions to this calculation?

Having performed this calculation many Trusts respond by saying that they simply do not have the capacity to do this many extra operations. The above calculation is designed to ensure that you deliver an absolute guaranteed maximum waiting time.

It could be argued that for specialties such as Ophthalmology and Orthopaedics where the proportion of routine operations is very high the calculated figure is too high. In such instances the figure of one-half the number in the band 3 to 6 months could be relaxed to say one-third or even one-quarter. However, such a relaxation considerably reduces the margin for error, i.e. the waiting list is now at higher risk of adverse events such as closure of a theatre or ward.

In addition for most waiting lists any such relaxation only results in a small reduction in the total reduction required from the waiting list.

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A final point to be made here is that after achieving 6 months the eventual target is a 3 month wait. This is an even more challenging target which implies that the more conservative calculation must be applied.

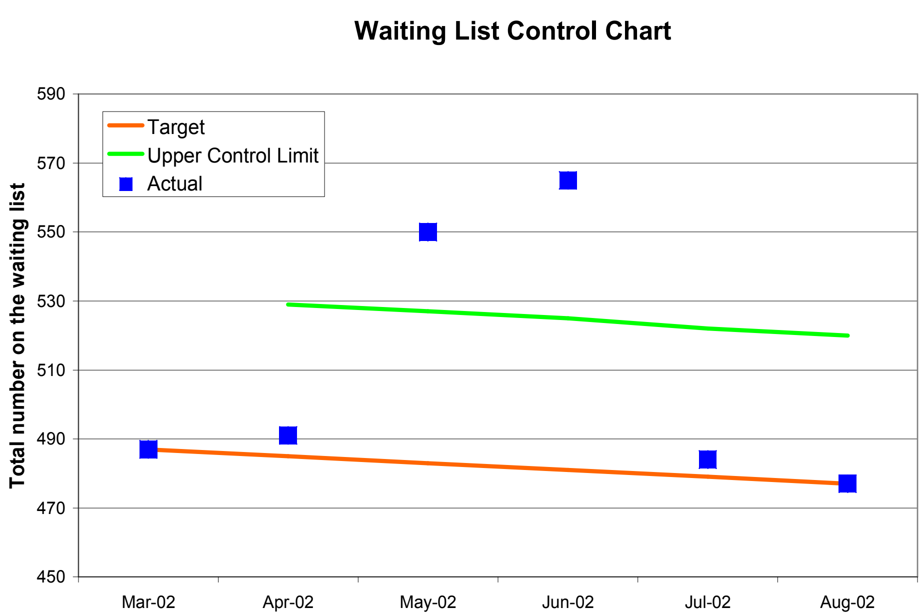
The fundamental issue of having sufficient capacity needs to be addressed at its root causes rather than trying to make the target 'look' more achievable by feeding in lower numbers and hence increasing the risk of eventual failure.

How to construct the control chart

Our waiting list profile now starts at the March-02 total (1,510 in the above example) and reduces by 21.5 per month (in above example) to its ultimate goal of 800 at December-04 (800 = 1,510 – 710).

Having determined the profile we can now construct a control chart with an upper limit of 2-times the square root of the expected number for each month. The figure of 2-times the standard deviation is chosen because the ultimate target represents the need to deliver an absolute guarantee.

Figure Five: Waiting list control chart with upper control limit



For example, at the end of June-02 our profile indicates we should have 480 on the waiting list. One standard deviation is $\sqrt{480} = 22$, hence, our upper control limit is 480 + 44 = 524 (see chart).

If we had 565 on the waiting list by the end of that month we would then know that we had to do 41 extra cases (565-524 = 41) over the following month in order to ensure we stayed on track for the eventual target.

If required, the profile can be recalculated when March-03 data becomes available, however, in practice the method is sufficiently robust and any recalculation will only give roughly similar numbers. Such recalculation would only be required if during

2002/03 there was insufficient capacity to deliver against the suggested profile – one could then question how is this capacity going to be made available in the diminishing time remaining to achieve the target?

Recalculation could also be justified if there is large over-achievement against targets during a year.

Hence in essence the control chart is a longer-term management tool which makes several assumptions:

1. Ongoing waiting list validation is keeping the waiting list 'clean'. If this assumption is violated the total number will rise above the upper control limit.

2. Long waiting patients are being removed (via the primary targeted list process) to ensure achievement of 12 months for Mar-03, 9 months for Mar-04 and 6 months for Dec-05. Hence in the short term you can 'fool' the control chart by reducing the total number on the waiting list by doing additional short- rather than long-waiting patients.

3. The waiting list of individual consultants are being well managed (see below).

How do we select the additional patients?

The control chart assumes that if the number on the waiting list is above the upper control limit then additional patients (additional to demand in that month) will be seen the month following to get back in-control.

As long as there are no imminent breaches of the current maximum waiting time then it is desirable that the extra patients be those with the greatest clinical priority.

What about individual consultant waiting lists?

It is usually the case that the waiting time problems arise from the individual waiting lists of one or two consultants in each specialty. In this case the correct approach is to calculate the control chart for these consultants as an aide to effective monitoring of their list. Issues around sharing of workload may need to be addressed to enable ultimate achievement of the waiting time target.

What does the control chart tell us?

In conclusion, the control chart gives a long term view to guarantee ultimate achievement of the target.

- It will also detect failure to validate a waiting list.

- It relies on proper waiting list management, i.e. long-waiting patients are not allowed to breach the maximum waiting time.

- It allows management to ignore random fluctuations in numbers and to only take action when there is a real requirement to do so.

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- It avoids the need to do additional activity if the underlying demand is lower than expected (usually due to random variation).

- When required it can be applied to the waiting list for individual consultants.

Help & Assistance

Contact the author for help and assistance with calculations relating to the 18 week guarantee.

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