A Guide to Statistics used in Clinical Audit

Why do we need to use statistics?

Everyone is afraid of statistics and yet they can be very useful in providing robust evidence where any change is involved. Within clinical audit we are constantly measuring change as we move around the audit cycle and see improvements in patient care and outcome (hopefully!). Statistics provide us with robust tools for measuring this change or measuring current practice against agreed standards. They will tell us whether any change that is evident is due to errors in the sample we are looking at or that the change we have effected has actually had an impact i.e. it is statistically significant.

When are statistics needed?

Statistics can be applied to changes in numbers of procedures and numbers of complications as much as they can to patients responses at given times during a given treatment. For example, we can use them to measure whether there has been a significant increase/ decrease in the number of complications arising from a certain type of procedure.

The key word here is SIGNIFICANT. What we are doing when we carry out any statistical analysis is seeing whether our sample (those patients/interventions we are looking at) behaves in the same way the whole population would. For example, we need to know whether the patients responding to asthma treatment in county *x* are responding like typical asthma patients across the whole country.

Basic Descriptive Statistics

These include averages (mean, medium and mode), variation (standard deviation) and representation (confidence intervals). Definitions are listed below:

Mean – an average taken as the sum of the values divided by the number of values

Median – the middle number of a set of values

Mode – the most frequently occurring value

Standard deviation – a measure of how widely spread the values are around the mean

Confidence Interval – gives a set of parameters showing how well a sample is representative of the population

Whenever we use a sample (which is most of the time as it is almost impossible to look at everything) it is important that if we are quoting an average figure, especially a mean, then we **must** also quote the standard deviation and the confidence interval. This is because we can not be certain that our sample is a fair representation of the population as a whole.

An example is given below:

Suppose county *x* need to know 'What was the delay from arrival at scene to performing defibrillation?'. If we then looked at 10 patient report forms we might find the following times:

5 mins, 3 mins, 7 mins, 8 mins, 9 mins, 6 mins, 4 mins, 5 mins, 4 mins, 6 mins

Our sample size is 10.

The mean is calculated at 5.7 mins or 5 minutes 42 seconds.

The standard deviation is calculated at 1 minute 53 seconds.

If we decide we want to be 95% sure that this is a fair reflection of defibrillation delays across the country the 95% Confidence Level can then be calculated at 1 minute 10 seconds.

Therefore the 95% Confidence Interval is 4 minutes 32 seconds to 6 minutes 52 seconds inclusive (i.e. the mean +/- the confidence level). We can they say that in county *x* if we choose any group of patients at random we can be 95% confident that the average delay to defibrillation will be within this interval.

If you have any queries about basic statistics give the ASA Clinical Effectiveness Project a call. Also over the coming issues I shall explain how these values are calculated using Microsoft Excel and share a basic software package developed to undertake statistics within clinical audit.

A Guide to Statistics used in Clinical Audit - Part 2

In Part 2 of this guide we begin to look at statistical techniques used to compare data sets again explaining when they should be used how to interpret the results. This article will not go into how the statistics are calculated, but it will allow you to determine the validity of results published in journals where these comparative statistical tests are frequently used.

The Chi-squared Test is a statistical technique used for testing the independence of two samples. In other words if a change in practice has occurred and you have two sets of results, a sample from before the change and a sample from after the change, you can test to see if there is a significant difference between the two samples. Similarly, it may be that you are comparing two time periods.

This is a very useful technique for analysing clinical audit and questionnaire data. It can be applied to both numeric and non-numeric data. You can also group your data into meaningful categories for analysis. In essence the Chi-squared test compares the observed sample data to an expected distribution of results to see if there is any significant difference.

We can demonstrate this in a simple example. Let us suppose that a clinical audit has been conducted looking at the care received by asthma patients. The results show that crews are not recording the Peak Flow Meter Readings (PFR's) as often as they should for patients being nebulised. As a consequence the Training School start an educational process to remind crews of the necessity to record PFR's as a guide to the patients condition and for use in A&E to aid decisions about further treatment. A second clinical audit is then conducted which reveals an increase in the recording of PFR's.

What we need to know is whether the change is significant enough and can be attributed to a successful education campaign by the Training School or whether it is down to chance. The Chi-squared test will allow us to determine this.

A statistically significant result means that the change between the two sets of results is due to a factor other than chance i.e. a result of an intervening variable e.g. the circulation of educational material on recording of PFR's. A non-significant result is interpreted as a change which could be down to chance even if an improvement is noted i.e. the educational process was not as successful as anticipated.

In part 3 of this series on basic statistical techniques used in clinical audit we shall look at the Student t-test and how it is used to compare changes in the average values between samples.

A Guide to Statistics used in Clinical Audit - Part 3

We continue this theme with the Student t-test. This article will not go into how the statistics are calculated, but it will allow you to determine the validity of results published in journals where these comparative statistical tests are frequently used.

The **Student t-test** is a comparative statistic used to test whether two samples are likely to have come from the same underlying populations that have the same mean (average). It is therefore useful for comparing the means between different samples e.g. samples from different time periods or differing patient sub-groups etc.

An example would be where a study on the effectiveness of Nalbuphine Hydrochloride measured the average (mean) dose of drug given to different patient groups. The measures would show the mean dose of drug required to obtain a moderate relief from pain for samples of both trauma and medical patients. The mean doses given could then be compared using the Student t-test to determine whether trauma patients require a larger/ similar/ smaller average dose of Nalbuphine to obtain moderate pain relief than that required by medical patients. If statistically significant differences were found it would suggest trauma and medical patients require different considerations when it comes to pain relief. This may in turn with enough robust evidence lead to the development of drug protocols targeted at specific patient groups. The advantage of this would be the individual patient concerned would be receiving the most clinically effective dose of pain relief.

Let us suppose that the study showed that trauma patients require on average a larger dose of pain relief than medical patients. The Student t-test would then be used to determine whether this difference in means is statistically significant. If there is no significant difference it is interpreted that the samples of trauma and medical patients come from the same underlying population and must therefore be treated in the same manner. If there is a significant difference it can be interpreted that the samples of trauma and medical patients come from different underlying populations, and consideration could be given to treating the patient groups in differing manners. A protocol for pain relief amongst trauma patients would suggest using larger doses of Nalbuphine to control pain whilst a separate protocol for medical pain relief would suggest using smaller doses to the levels suggested by the evidence in the survey.