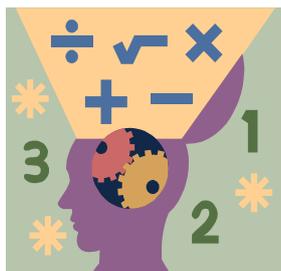


HOW TO ANALYSE AUDIT DATA



In this guide we look at how to analyse audit data using simple descriptive statistics to find out how well the standards have been met. This covers the principles of analysis rather than software techniques, e.g. use of Excel to perform analysis. On-line training in Excel and other Office software is available on the UBHT intranet at http://intranet/IMT/training/new_page_3.htm

Clinical Audit: “a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change”

A range of ‘How To’ guides have been produced by the UBHT Clinical Audit Central Office and are available on the UBHT Clinical Audit website, www.ubht.nhs.uk/clinicalaudit

Guides are cross-referenced using the insertion of the icon of other guides into the text to indicate where further information on the topic referred to can be obtained.



[What is Clinical Audit?](#)



[How to do Clinical Audit – a brief guide](#)



[How to choose and prioritise audit topics](#)



[How to involve patients in clinical audit](#)



[How to set audit objectives and standards](#)



[How to apply ethics to clinical audit](#)



[How to select an audit sample](#)



[How to collect audit data](#)



[How to analyse audit data](#)



[How to give an effective audit presentation](#)



[How to write an audit report](#)



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[How to get your audit published](#)

Further information about Clinical Audit can be obtained by contacting the UBHT Clinical Audit Central Office on tel. (0117) 928 3614 or e-mail Eleanor.Bird@ubht.swest.nhs.uk

You can also get advice and support on clinical audit from your divisional Clinical Audit Facilitator (contact details available from the Central Office or UBHT clinical audit website)

Clinical Audit Workshops can be booked through the Clinical Audit Central Office

Advice on **Clinical Effectiveness**, including how to write guidelines, is available from James Osborne, Clinical Effectiveness Co-ordinator, tel. (0117) 928 3827 or <http://intranet/ce-net/> (UBHT network) or www.ubht.nhs.uk/ce-net (limited external version)

HOW TO ANALYSE AUDIT DATA

Many people suppose that data analysis is a complex matter but it doesn't have to be. Similarly whilst the word "statistics" strikes fear into most hearts, the reality is that whilst there *are* occasions when complicated statistical tests are applied to audit results, most audits should only require the use of basic descriptive statistics, as covered in this guide.

Audit data comes in three different forms – numerical, 'tick-box' or freetext. Each requires different methods of analysis, but in each case the aim is to analyse how well the audit standards are being met.



See 'How to set audit objectives and standards' for an explanation of what audit standards are and for a preliminary discussion of how to analyse against them.

1. NUMERICAL DATA

Some of the data items you collect are likely to be numerical values (e.g. age, length of stay in hospital, blood glucose level and so forth). Lists of numbers like this can be summarised using measures of **central tendency** and **dispersion**:

- Measures of Central Tendency look at the middle/common values in a list of data items: the **mean, median and mode**
- Measures of Dispersion look at how spread the data is: the **range**

Measures of Central Tendency

The **MEAN** is the *average* value, calculated as:
$$\frac{\text{Sum of all the values}}{\text{Number of values}}$$

The table below shows data about length of stay (LOS) on three wards:

Length of Stay (days)	Number of patients discharged		
	Ward 1	Ward 2	Ward 3
1	4	4	1
2	8	7	3
3	12	17	3
4	18	10	4
5	20	7	10
6	18	4	15
7	12	2	4
8	8	2	2
9	3	5	0
10	0	9	0

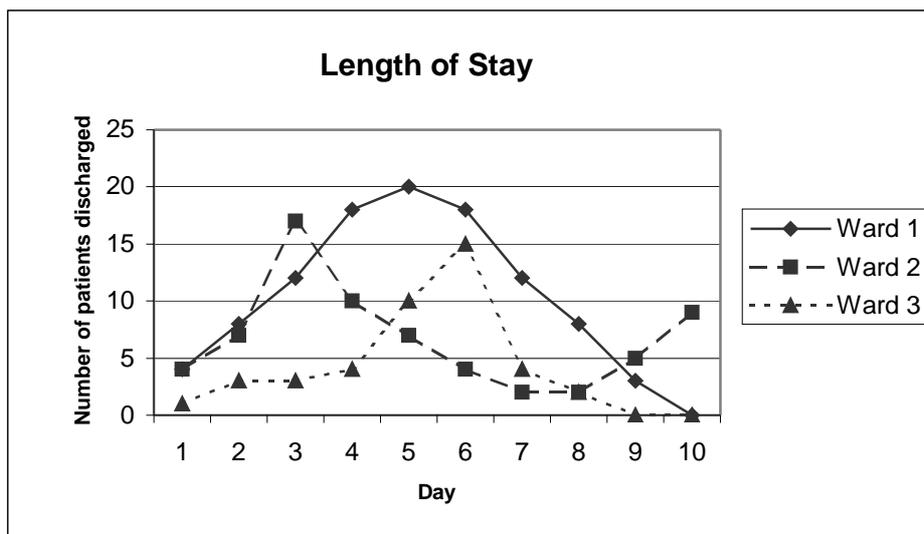
For Ward 1, the mean is:

$$\frac{(1 \times 4) + (2 \times 8) + (3 \times 12) + (4 \times 18) + (5 \times 20) + (6 \times 18) + (7 \times 12) + (8 \times 8) + (9 \times 3)}{4 + 8 + 12 + 18 + 20 + 18 + 12 + 8 + 3} = \frac{511}{103} = 4.96$$

or 5 days (rounded to nearest whole day)

If you use the same formula to calculate means for wards 2 and 3, you will find that for each ward, mean length of stay is 5 days. However, the mean is not always the best measure of central tendency. Look at the next page to see this information in a graphical form. If you just quoted the mean you would think the data for these wards were the same but the graphs tell you otherwise. The problem with the mean is what it doesn't tell us.

HOW TO ANALYSE AUDIT DATA



The data collected for Ward 1 is almost perfectly fairly symmetrical, the graph following the shape of a “bell curve”. Data that conforms to this shape is known as “parametric” data - in this instance the mean is an appropriate measure of central tendency.

The data for Wards 2 and 3 is non-parametric – their graphs do not form a symmetrical curve. Describing their notable features, Ward 2 has a significant proportion of patients with a LOS of 3 days together with a number of patients staying 9 or 10 days. Ward 3 has a peak LOS of 6 days. It can be seen that using the mean alone with non-parametric data is not very informative. The *median & mode* can help to convey the missing information.

The **MODE** is the most commonly occurring value. For Ward 2 this is 3 days and for Ward 3 it is 6 days – this should be obvious from both the raw data and the graph. There is no clear convention to follow if the highest occurrence is shared by more than one value - you could either state them all as modal values, or none. For example, if for Ward 3 there were 10 patients discharged on both day 5 and day 6 you could either say there were 2 modal values of 5 and 6, or that there was no mode.

The **MEDIAN** is the mid-point of all the values. For Ward 2, we have data on 67 patients. If we made a list of lengths of stay, placed in order from the lowest to the highest, the mid-point would be the 34th value (i.e. there are 33 values below and above this). The 34th value relates to a patient who was discharged after 5 days, so this is the median. For Ward 3, we have data on 42 patients, i.e. there is no single mid-point. In this case, take the average of the 21st and 22nd value (there are 20 values below and above these two values). The 21st value relates to a patient who was discharged after 5 days and the 22nd value relates to a patient who was discharged after 6 days, so the median is 5.5 days (5+6 divided by 2).

Unless you are well versed in statistics, we would advise that you use all three measures of central tendency, or show the information using a graph. In general, quote median rather than mean for non-parametric data (which your audit data is likely to be – you can check this by plotting it graphically).

Not all lists of numerical data should be analysed in this way. For example, if your standard is “Patient will be considered medically fit for surgery if temperature <38°C” and you collect a list of temperature data, it would not be meaningful to present the mean, median and mode temperature. What you are interested in here is the percentage of cases that met the standard (i.e. the percentage of surgical cases with temperature <38°C).

HOW TO ANALYSE AUDIT DATA

Measures of Dispersion

As well as stating the mean, median and mode, it is also good practice to provide some indication of how spread the data is. The **RANGE** states the lowest and highest values. In our example:

Ward 1 has a range of 1-9 days

Ward 2 has a range of 1-10 days

Ward 3 has a range of 1-8 days

A more subtle way of expression dispersion is to use **quartile** range. This involves listing your values from least to highest (as per calculating the median) and then dividing the values into four equal parts or sub-ranges. The range you are interested in lies between the second and third quarter (or 'quartile').

So, for example, some more LOS data:

Ward C: 1 2 3 5 | **5 6 6 7** | **7 7 7 9** | 9 11 20 38

In this case the range is 1-38 days, but the *quartile range* is 5-9 days

The quartile range is useful in taking out outlying data (data some distance away from the mean/median/mode), as in the case of Ward C above and Ward 2 in our first example. Ward 2 has the largest range but a comparable quartile range to Wards 1 and 3:

Ward 1 - range 1-9 days; quartile range 4-6 days

Ward 2 - range 1-10 days; quartile range 3-7 days

Ward 3 - range 1-8 days; quartile range 4-7 days

Analysing numerical data against standards

If your standard statement was "Patients will be discharged by the end of their 5th day following surgery", using length of stay data for ward 2, you find that 45 out of the 67 discharged patients had a length of stay of 5 days or less.

You would write this as **45/67 (67%) patients met the standard**

2. TICK-BOX DATA

It is likely that some of your data items will be answers to Yes/No questions, or tick-box options from lists of alternatives. In such cases, it is usual to add up the numbers of answers recorded for each option and express the total as a **raw number** and as a **percentage**.

For example, let's imagine that in an audit of 50 patients, the question, "Did the patient attend a pre-operative clinic?" produces 35 "Yes" answers and 15 "No's". A good way of expressing this data is:

"Did the patient attend a pre-operative clinic?"	<i>n</i> =50
Yes 32 (64%)	
No 18 (36%)	

Notice the "n=50" in the top right corner. The 'n' number tells you how many patients were in the audit sample/population, and is used to calculate percentages, i.e. $32/50 = 64\%$.

HOW TO ANALYSE AUDIT DATA

Be aware that yes/no options sometimes don't allow for "not applicable" answers - of which there are sometimes lots! In the case above, if certain patients did not need to attend a pre-op clinic, a number of entries would have been marked as "N/A" on the data collection form. In this instance you are faced with two alternative ways of expressing the resulting data:

Standard: Patients will attend a pre-operative clinic (target 100%)

"Did the patient attend a pre-operative clinic?" $n=50$
Yes 32 (64%)
No 13 (26%)
N/A 5 (10%)

OR... Patients will attend a pre-operative clinic where applicable (target 100%)

Yes 32 (71%) $n=45$
No 13 (29%)

You may have already thought of some reasons where this standard will be not applicable, and written into your standard as exception criteria:

Audit criteria: Patients will attend a pre-op clinic (target 100%)

Exception: Emergency patients

Yes 32
No 18 – but 5 of these patients were emergencies (met exception)

The traditional method of analysis in this case is that the number of cases meeting the exception are *added* to the number of cases meeting the audit criteria, i.e. **37/50 (74%) met standard**.

To work out which way to present your data, think about which way is most meaningful (or fair). Analyse against the standard as it has been written and make it clear how you have achieved your answer – quote figures and percentages, as in the examples above.

3. FREE-TEXT DATA



This is data such as patients' written comments in response to an open question. Generally this is harder to analyse and should be designed out of the data collection form where possible.

If you are left with free-text data, can you group comments into themes or categories? (i.e. as if you were creating tick-box options for the data collection form). You might also want to consider reproducing some comments verbatim in your report, if they are particularly pertinent.

DRAWING CONCLUSIONS

The end stage of analysis is concluding how well the standards were met and, if applicable, identifying reasons why the standard wasn't met in all cases. These reasons might be agreed to be acceptable, i.e. could be added to the exception criteria for the standard in future, or will suggest a focus for improvement measures. In theory, any case where the standard (criteria or exceptions) was not met in 100% of cases suggests a potential for improvement in care. In practice, where standard results were close to 100%, it might be agreed that any further improvement will be difficult to obtain and that other standards, with results further away from 100%, are the priority targets for action. This decision will depend on the topic area – in some 'life or death' type cases, it will be important to achieve 100%, in other areas a much lower result might still be considered acceptable.

HOW TO ANALYSE AUDIT DATA

STATISTICAL TESTS

Anything more advanced than the basic analysis detailed above is not usually required for Clinical Audit. However there are some statistical tests that may be useful, particularly where re-audit results are being compared to the previous audit results to see if there has been a significant improvement.

These tests are best calculated using professional software. An easy to use program called InStat is available in a demo version for Windows at <http://www.graphpad.com/demos/> or available from the Clinical Audit Central Office.

Comparing discrete ‘tick-box’ type data – Chi-Square Test etc

e.g. “Did the patient attend a pre-operative clinic?”

	<u>2002</u> (n=40)	<u>2003</u> (n=60)
Yes	25	50
No	15	10

The percentage of cases meeting the standard was 83% in 2003 and only 63% in 2002, however you need to know whether the results for 2003 are a *significant* improvement on those obtained in 2002.

The Chi-square test calculation gives a p value of 0.0184. As this p value is less than 0.05 (the cut-off level below which results are said to be significantly different) then we can say that there is a statistically significant improvement in the re-audit figures.

Chi-squared is well known however a more accurate calculation can be arrived at by using the Fisher’s Exact test (better when you have small numbers and non-parametric data but can only be used with a 2x2 data table, like the example above). The p-value for the example above with Fisher’s exact test is 0.0325.

These tests must be calculated using raw numbers NOT percentages. You should use a ‘2-tail’ p value rather than ‘1-tail’ – this allows for the fact that the re-audit results might be better or worse than the original audit results (the test is for a significant *difference* in the results which could be in either direction).

Comparing numerical data (means or medians) - Mann-Whitney etc

If your audit and re-audit produced lists of data, e.g. length of stay, waiting times, you will need different statistical tests to compare your results. Mann-Whitney compares the median values of lists of unpaired non-parametric data (i.e. measurements from the second audit not connected to the measurements in the first audit; data not normally distributed). You will need to enter the raw data then apply the test to compare the median values and produce a p value – if this is less than 0.05 then there is a significant difference between the two lists of data. Check the medians to find whether the re-audit showed an improvement or not, i.e. what direction this difference lies in.

If your audit & re-audit values are matched, e.g. figures for patient before and after an intervention or change in practice, the appropriate test would be Wilcoxon matched pairs (for non-parametric data). For example, a physiotherapy project used this test to see if a patient’s Sit-to-Stand outcome measure was significantly improved after a course of hydrotherapy. Patients’ score on the Sit-to-Stand exercise was measured before and after hydrotherapy. 13/16 patients had improved (higher) scores post-hydrotherapy. The median pre-hydro score was 13.5 moves per minute with a post-hydro median score of 18.5 moves per minute. The p-value from the Wilcoxon test was 0.0034 (2 tailed), denoting a highly significant difference (improvement) between the two medians.