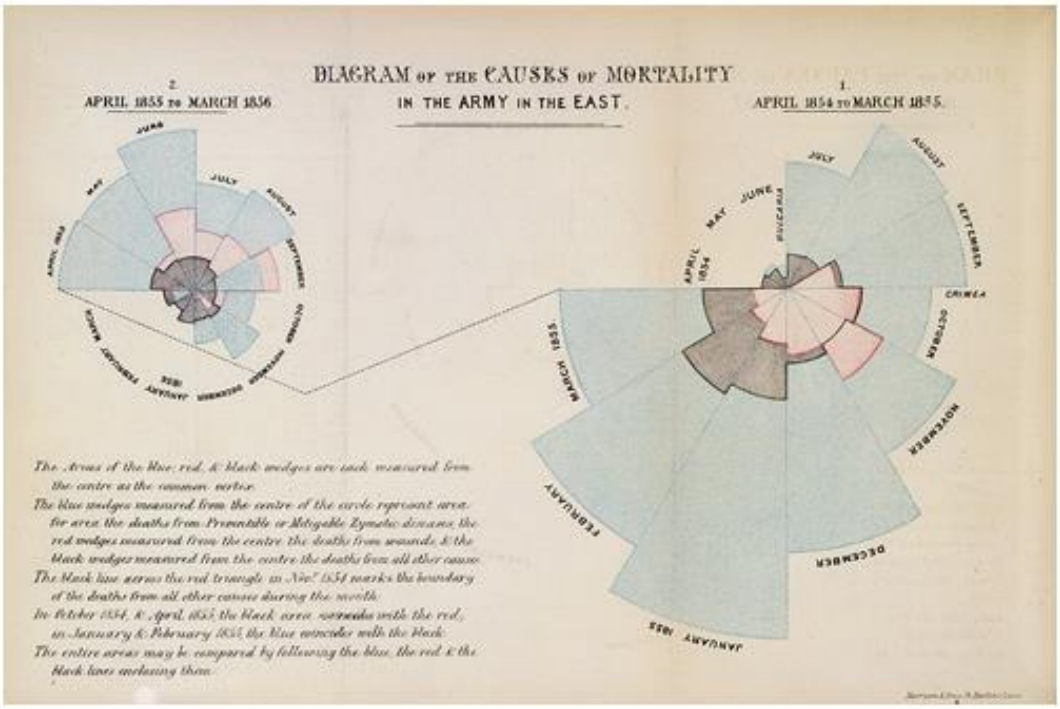
Pies are for eating, not for drawing

The first entry in the overlapping zone of the Venn diagram of wound care and statistical analysis may have been Florence Nightingale. Well known for her nursing work in the treatment of soldiers' wounds during the Crimean War, she is less well known for her statistical endeavours. Nightingale was a keen recorder of data, and kept meticulous records of mortality rates from various causes of the soldiers in her care. She produced these beautifully drawn "coxcombs" – which resemble in some ways the modern pie chart.



I think I would rather have a wound treated by Florence Nightingale than have her analyse my data. She made a number of fundamental errors in these charts; including the clear implication in both the text and the chart itself that mortality was proportional to the area of each sector; rather than the length of the radial lines, as it actually was. Categories in some sectors were invisible, being completely overlaid by others, and the choice of an angular representation to illustrate a linear trend was, to say the least, odd (February and March 1855 are followed by April 1854!).

But to be fair to Nightingale, as well as being a very good nurse, she was a pioneer in the field of data analysis, at a time when was it in its infancy. Nearly 200 years of statistical thought later, and I'm not sure that we have gone forward very much. The pie chart below records the number of wounds of various types recorded in a study by Leak et al.[1]

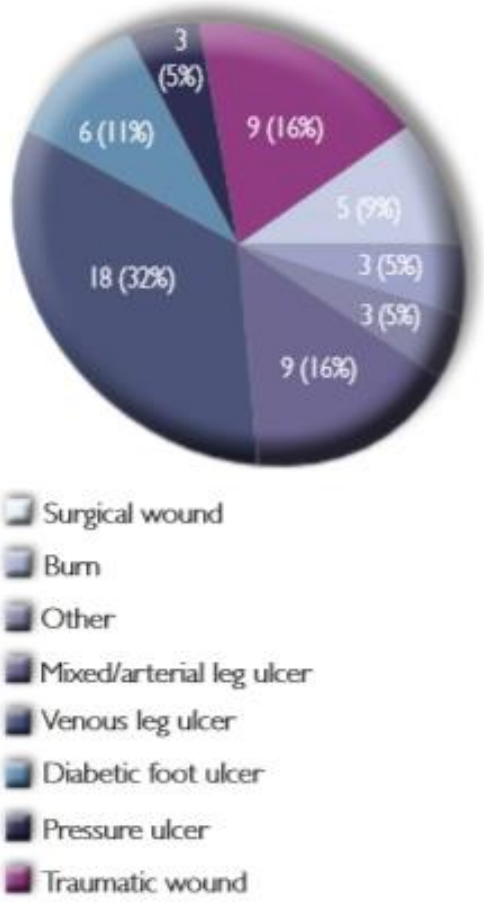


Figure 1. Wound type.

So we have a three-dimensional effect, a shadow effect, and a strange angular perspective effect – all of which add absolutely nothing to the chart, other than misguided artistry. I might also question the apparently random ordering of categories (not in increasing or decreasing size) and the similarity of shades of categories.

But most of all, I ask myself: what useful information is the pie chart telling me? The frequencies and proportions of each wound group are given on the graph, but to work out which goes with which, I have to match the colour of a sector to a colour in the legend; sector by sector. And like most people, I have difficulty in comparing sizes of wedge-shaped areas or angles, so I can't easily get a grip on the relative frequencies of each type of wound, which was what the chart was presumably intended to facilitate.

So, if pie charts are a waste of ink, are bar charts any better? They may be. Or they may not be, as in this example by DiDomenico et al[2]. The caption underneath the figure explains what the chart purports to show, and if the authors had added to the caption the values of 20% (wound healing proportion in the SOC group) and 68% (wound healing proportion in the dHACA group), there would have been absolutely no need for the chart at all, which is basically telling me nothing more than that 68% is quite a lot bigger than 20%. I think I probably knew that already.

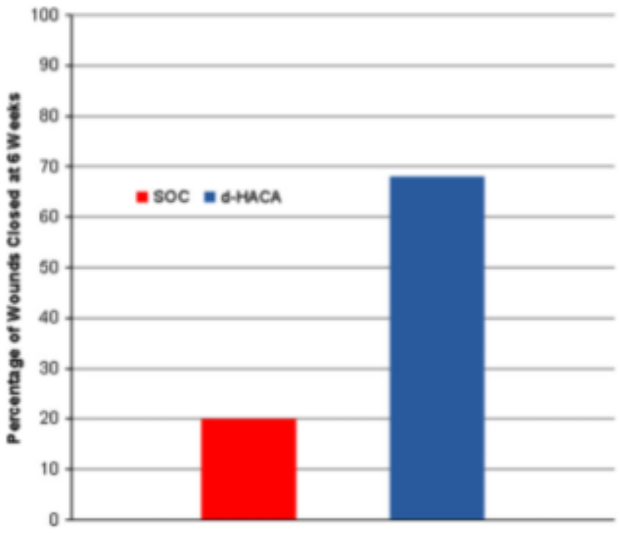


FIGURE 3 Bar graph showing complete wound healing at 6 weeks for the dehydrated human amnion and chorion allograft (dHACA) and standard of care (SOC) groups ($P = 1.9 \times 10^{-5}$)

Given that the exact figures from which bar charts and other types of graphs are derived can generally be presented in tabulated form, what exactly is the purpose of a graph? Graphs should make information more understandable; allow the reader to compare data and discern patterns and trends that would not be obvious in tables of values. But the main problem with the DiDomenico chart is that the information it is conveying – a comparison of 2 percentages – basically did not require a graph at all.

My own rule of thumb is that a bar chart is not worth drawing unless you have at least 4 categories to compare. If you have two variables to compare concurrently, a clustered bar chart can be particularly effective. This chart by Wild et al.[3] represents a sufficient number of categories (here the timepoints at which measurements were made); and the clustering of bars allows us to compare 2 brands at each time point. Unfortunately, Wild et al. somewhat spoil the effect by the ubiquitous (and pointless) 3-dimensional effect, the lack of a clear legend on the y-axis and heavy-handed use of colour and shading (I won't comment on the reporting of statistical significance!)

Notes:
The % reduction of yellow tissue comparing the SG and the CG was significantly better for the SG at day 7 (t=0.020)* and at day 14 (t=0.45)**.

Figure 2: Wound bed evolution, reduction of yellow (fluid necrosis and fibrin) tissue comparing SG and CG.

The trend lines also look decidedly odd. They look to me like they are constructed around points located somewhere at the tops of each bars – which leads to the question: what is the purpose of the rest of the bar? Bar charts are generally used to represent categorical data, where you can imagine each bar to comprise a series of invisible thin horizontal slices, with each slice representing one instance of the wound, or patient, or whatever the experimental unit might be. But when bar charts are used to represent numeric data, as here, the rest of the bar below the top is essentially meaningless. These bars should, and could, have been replaced with dots located at the top of each bar.

I am sure that in the days before graphs like these could be produced in seconds with a few clicks of a mouse, no-one would need to be reminded to not clutter their reports and articles with “chart junk” like the examples above. Restraint is definitely needed when considering whether to add a graph to a report, or whether to add features such as 3-D effects and shadows. The misuse and over-production we see nowadays is a shame because graphs, when used properly, can greatly enhance the readability of an article, and for some types of analyses are virtually indispensable. A scattergram presented as part of a correlational analysis gives confidence that any claimed correlation is not a result of a non-linear relationship or influential outlier, as well as adding insight into the nature of a relationship that figures or text just cannot convey. Similarly, a forest plot presented as part of a meta-analysis is a highly efficient way of conveying the direction, magnitude, relative weight and consistency of component studies, as well as the direction and magnitude of the overall estimate; a meta-analysis is just not complete without one. Box plots, histograms, survival curves and many other types of charts can also be highly effective presentational methods. We are all capable of resisting options such as pie charts, pyramid graphs, cone graphs and 3-D bar and column charts that a certain Microsoft spreadsheet program I could mention pushes prominently in our direction.

1. Leak K, Jones A, Brown S (2010). Non-comparative in-market evaluation of ALLEVYN Gentle Wounds UK 6(1): p 41-54

2. DiDomenico AL, Orgill DP, Galiano RD, Serena TE, Carter MJ, Kaufman JP, Young NJ, Jacobs AM, ZelenCM (2018). Use of an aseptically processed, dehydrated human amnion and chorion membrane improves likelihood and rate of healing in chronic diabetic foot ulcers: A prospective, randomised, multi-centre clinical trial in 80 patients. Int Wound J. 15: 950–957.

3. Wild T, Eberlein T, Andriessen A. (2010) Wound cleansing efficacy of two cellulose-based dressings. Wounds UK 6(3): p14-21.