STATISTICAL TRAINING FOR DOCTORS IN THE UK

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This paper reviews the current status of teaching both undergraduate and post-graduate doctors in the UK. An example is given of the way both areas are covered at the University of Sheffield UK. The use of topical subjects to interest students is described. The future of the teaching medical statistics, the way it may be delivered and its links with Evidence Based Medicine are discussed.

HISTORY OF TEACHING STATISTICS TO UNDERGRADUATE MEDICAL STUDENTS IN THE UK

The general acceptance of training in statistics as a component part of medical education has only been so in the UK since 1967. In that year the General Medical Council published *Recommendations as to Basic Medical Education*, which stated that the undergraduate medical curriculum should include instruction in statistics and biometric methods, probably because of the increasing us of statistics in medical research papers. Since then appointments of statisticians, mainly with mathematical backgrounds, to teaching posts in medical schools increased throughout the country in response to the perceived need. They were often nested within existing departments of Public Health Medicine, often as a single academic with no supporting staff. In 1979, a meeting was held at the University of Manchester to pool ideas, and provide support for these isolated academics (Wakeford, 1980).

This conference provided a foundation for an annual three-day meeting of "Teachers of Medical Statistics", which has now been running since 1980. It is held at the University of Bristol at a hall know as Burwalls (ironically once owned by the Wills tobacco family) and so the meeting is often known as the "Burwalls" meeting. The original remit of the meeting was to invite a single representative from each medical school in the UK (at the time there were about 30) to come and pool ideas about the unique problems of teaching of the MBChB undergraduate medical course. Other areas of teaching have also been considered such as the teaching of statistics to nurses, dentists and other para-medical specialties and to post graduate doctors. Factors that impinge on teaching such as consulting, the use of statistical packages and textbooks have also been discussed. The originators of the series felt that by restricting the participation from each individual medical school, a wide variety of opinions from different medical schools could be gleaned, but within an informal setting, in which junior and more senior colleagues could be free to express an opinion.

The proceedings of the 10th anniversary meeting of the series in 1989 were published and provide a useful snapshot of what was considered important then (Day, Hutton & Gardner, 1990). The 21st anniversary proceedings are also soon to appear.

Since 1979 the whole of medical education has undergone a major change. Emphasis is now on self-learning skills and the ability to communicate. There is much less emphasis on rote learning of facts. "Problem based learning" is becoming more fashionable. In 1993 the General Medical Council (GMC) published *Tomorrow's Doctors* (General Medical Council, 1993) which has provided a catalyst for changes in the medical curriculum. The main recommendations from the GMC report are that the course should be "system-based". This means that the basic sciences of a system, such as (say) the respiratory system, which includes the anatomy of the lung and the biochemistry of oxygen exchange, are integrated with the clinical aspects of lung disease, and the impact of lung disease in the community. However the only reference to statistics comes under the heading "Finding out: research and experiment" which include "an awareness of biological variation, an understanding of the scientific method, including the principles of experimental design". In the main recommendation there is a requirement to promote "the critical evaluation of evidence."

Parallel to these developments has been the rise of "evidence-based medicine" (EBM). At the core of EBM is critical review, and this is required not just at an undergraduate level, but as a

skill regarded as essential to future professional competence. Morris (2002) has argued that EBM is the best opportunity to teach medical statistics. However Armstrong and Walters (2002) have shown that teaching EBM to first or second year has not met with success in Sheffield. The reasons are common to those of teaching statistics, an appreciation of EBM requires a basic knowledge of medicine, and the students are too immature to appreciate it.

The 1989 Burwalls meeting, in prescient anticipation of *Tomorrow's Doctors*, suggested the following aims and objectives of teaching statistics to medical students

Aims

1. To produce doctors with increased skills in diagnosis, prognosis and treatment
2. To educate doctors to be competent to interpret data presented in the press, pharmaceutical literature and learned journals

Objectives

Students should be able to

1. Understand variability and how to assess it.
2. Appreciate the value of medical statistics and the limits of their knowledge, and hence when to request professional statistical advice
3. Understand methods of estimating and the meaning of confidence intervals
4. Understand methods of making comparisons and how the results are presented
5. Reason sensibly about problems involving numbers
6. Assess critically the sources and validity of data

Recent informal reviews tend to show that medical statistics teaching has also undergone changes following the publication of *Tomorrow's Doctors*.

These tend to be

- Much more emphasis on critical appraisal.
- More emphasis on concepts and less on techniques
- Less emphasis on formal lectures
- More variety in teaching e.g. small groups, workshops etc.

THE SHEFFIELD UNDERGRADUATE CURRICULUM

The Sheffield course currently (2001/2002) consists of one introductory lecture to all the students, and five 2 hour workshops. The introductory lecture attempts to set the scene, and impress upon the students the importance of medical statistics, with some emphasis on the nature of variability. It contains examples of how the population approach has helped different areas of medicine. These include i) the Bristol Royal Infirmary Inquiry, ii) the Harold Shipman case and iii) the 3rd generation oral contraception scare. It is perhaps unfortunate that these examples show the medical profession in a negative light, and might cast the statistician as "police". However, the former two examples have a high profile in the UK and are topical, and the data are readily available. In the Bristol Royal Infirmary Inquiry, the students are asked whether a mortality rate of 60% is excessive for heart surgery on infants. They are then lead to consider comparative data from other sites. It is shown that we then need to consider the play of chance, to see if Bristol was merely "unlucky". Finally we show that it is most unlikely that chance, or a different case load are responsible for the excess death rates. The purpose of this example is to show that we need to consider chance variation, particularly when dealing with small numbers.

The Harold Shipman case develops the theme. Shipman was a general practitioner who was jailed in 2000 for the murder of 15 of his patients. The statistical point here is that he was not detected by routine statistics- although the number of deaths he certified was high, it was not thought excessive, considering the wide variation in death rates in the large number of practices in the country. He was caught because a relative of one of the victims became suspicious about a forged will and alerted the police. The data are available in a subsequent report (and are available via the Internet http://www.doh.gov.uk/hshipmanpractice/). However, when the data are examined closely, anomalies are immediately apparent. Table 1 gives the deaths by age and sex for Shipman's patients and those that would be expected if his rates were comparable to other GPs in the area.

Table 1
Age and Sex Distribution of Deaths from Shipman

Age	Women Observed	Expected	Men Observed	Expected
0-50	3	7.2	9	7
51-64	26	26.5	18	28.6
65-74	74	58	41	48
75-84	168	130	58	52
85+	96	145	28	18
	P<0.001		P=0.06	

The deviations are immediately apparent, particularly in women, but not all the deaths are excesses, which partly explains why suspicion was not raised about overall mortality. The most striking figure, however, is when the times of day of the deaths of Shipman's patients are compared to those of comparable GPs (Figure 1).

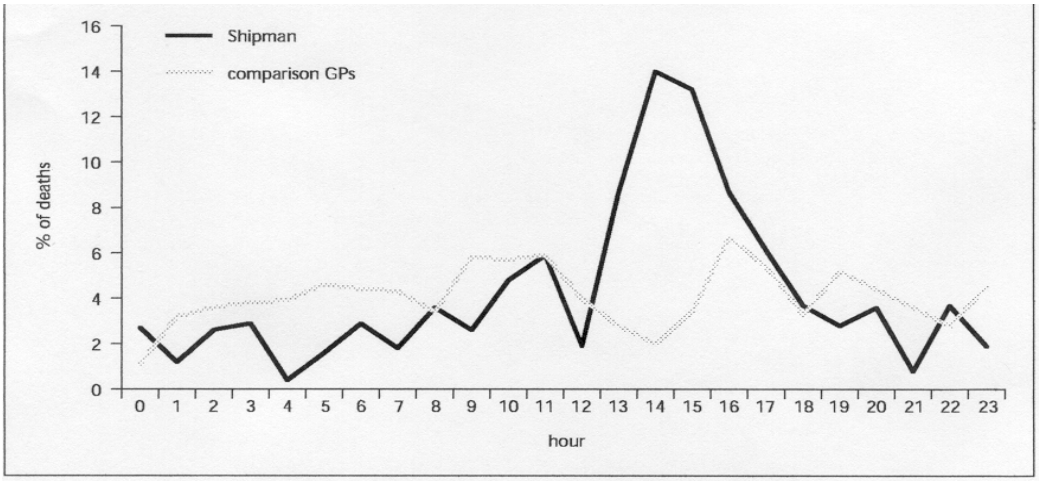

Figure 1. The Percentage of Deaths of Patients of Shipman and Comparison Practitioners in Each Hour of the Day.

One can see immediately that there is an excess of deaths in the mid-afternoon, which is the time when Shipman visited patients in their own homes, between his routine surgeries. It suggests that 15 murders is a considerable underestimate. This example teaches the students that consideration of epidemiological data by age, sex and time is important. It also has considerably more general interest than epidemiological examples commonly used in this context, such as the link between smoking and lung cancer, since most students will have read about the case in the newspapers.

The third example relates to the studies in 1995 that suggested there was a relative risk of 2 for deep vein thrombosis (DVT) in women taking the 3rd generation oral contraceptives. However, this is in the context of an absolute risk of DVT of 30 per 100,000 cases per year. The consequence of the publicity surrounding the findings was that many women came off the pill, and got pregnant. The problem is the risk of DVT when pregnant is 80 per 100,000. The purpose of this example is to illustrate the use of both relative and absolute risk, and to emphasise the importance in being able to communicate concepts such as these to patients.

These examples are topical and to some extent culture specific, and dependent on students being aware of the background to them. They may not be of such interest in other cultures or as them memory of these events fades.

The five subsequent workshops are small group sessions (up to 32 students), three of which are based on videos produced by the University of Sheffield (Sheffield University Television *Why Use Statistics?*, 1996, Sheffield S10 2TN). These are i) Describing data ii) Sampling and Confidence intervals and iii) Bivariate data. Thus describing data covers simple

summary measures and graphing data, sampling and confidence intervals covers the idea of the standard error, and bivariate data covers regression and correlation. We supplement these with two other workshops on diagnosis and screening, and p-values. The videos are approximately 20 minutes each, spilt into four 5 minute sessions. At the end of each session the students have a practical exercise to do. For the other two workshops, workbooks and OHP transparencies are supplied. The advantage of using the videos is that students seem receptive to this form of instruction, there is less preparation required by the tutors, and one can ensure that the tutors are roughly all teaching the same thing. There is also a computer aided learning session using the package "Statistics for the terrified" (Radcliffe Medical Press Ltd, 18 Marcham Road, Abingdon, Oxon OX14), which is referred to as a useful aid for students who want further advice.

Thus one can see that the aims of the course are strictly limited, but in agreement with the aims and objectives enunciated at the Burwalls meetings. Our students should be able to understand the reasoning that leads to P-values and their limitations, but not be able to carry out chi-squared tests. In theory the course will be reinforced in later years with project work, where they will actually apply statistical methods to real problems and data but it is difficult to enforce this for the majority. No computing is taught at this stage.

The course is given to first year students. It has been suggested elsewhere that this may not be the optimal time to get the students (Fineberg, Colton, Dawson, & Imrey, 2001). I mentioned earlier in this paper, that the EBM course was discontinued for first year students in Sheffield because they tend to be young and immature, and poorly motivated to the disciplines of public health. Their backgrounds in quantitative methods tend to be very heterogeneous. They tend to have heavy workloads and the time allocated to statistics is meagre. Often what is taught is not reinforced in other areas of their education.

Small group work seems to be a good way of conveying statistical ideas. However it has a number of problems. One is it is difficult to maintain quality control and consistency with a wide variety of tutors. There is also the problem of having enough qualified tutors to cover small group work, with medical student intakes of 250 a year now, we need a minimum of 8 tutors, if tutors are not having to repeat the class several times or if there is only one slot in the timetable. Most medical schools in the UK cannot command that number of medical statisticians at one time, and help is regularly sought from epidemiologists and psychologists. Finally, and this is a common complaint for all small group work, there is also the administrative burden of sorting out classrooms and tutors.

THE FUTURE

I strongly believe that medical students should be exposed to the fundamental ideas of statistics. We are training students to be consumers, not producers of research and we must not loose sight of the main aim of all medical education: to produce better doctors, who deliver high quality health care. Different students have different learning needs and so we need to provide a variety of modalities. There is still a need, I believe, for the occasional full scale lecture for a number of reasons. i) the lecturer provides a role model for the students- someone who finds statistics alive and interesting ii) the lecture should motivate the students for other methods of learning iii) the lecture defines what is needed of the students. However, I think that much small-group work will be replaced by a virtual learning environment or a managed learning environment. The University of Edinburgh replaced a series of lectures by a workbook based on the text by Campbell and Machin (1997). (The workbook is available over the Internet on www.ed.ac.uk/phs/publications/qmm/introduction.htm) Students have lectures at the start and end f the course, but otherwise work through the workbook. They can sign up for optional tutorial classes if they have difficulties.

Critical appraisal of the literature must form an integral part of any course but the course may be so integrated with, say, EBM, so that it is will not appear as a separate course. These have both opportunities and threats to the autonomy and standing of academic medical statisticians.
Clearly, to gain any respect from the students the course must have a compulsory assignment of exam.

POST GRADUATE EDUCATION IN THE UK

In the UK doctors are required to undergo Continuous Medical Education (CME) for which they earn "points" and they can do this by attending courses. They need to acquire a certain number of points each year. Courses have to be approved by the local CME tutor as being worth a certain number of points. Altman and Bland (1991) demonstrated ten years ago that doctors are poorly trained in Statistics and it is unlikely to have improved much.

In contrast to undergraduate courses, for postgraduate education are teaching doctors how to do research. I have been involved in a number of courses that have been given CME approval. These include: Research Methods, Research in Complementary Medicine, SPSS for Clinical Data Management, Clinical Trials and Sample size calculations for non-statisticians. Each of these contained a statistical component, as part of an overall package. We have also given courses on Practical Medical Statistics, Cluster Randomised Trials and Design and Analysis of Studies involving Quality of Life which did not qualify for CME approval, but which were attended by some doctors.

Training is also provided for by the National Health Service. It varies in different Regions, but for Sheffield it is provided for by an organisation called the Trent Institute for Health Services Research. This Institute runs a number of statistical courses for NHS employees, including doctors, nurses, health service managers, pharmacists and paramedics. The courses tend to be similar in content and scope to the undergraduate curriculum, not least because they are largely delivered by the same people! The advent of the *NHS University* may herald changes in this type of training. This is a new initiative by the UK Government to provide life-long learning to NHS employees, but its methods are unclear at present. The general messages are:

1. Doctors going on CME approved courses are only interested in statistics as a tool for helping their research. Although statisticians may think of themselves as the main source of information for research methods, it is perhaps surprising how little statistical methods feature in many research methods courses.
2. In the main, statistical analysis should be lead by issues, e.g. why are data from cluster randomised trials different? Little technical detail should be attempted in a course, but examples from the literature and further reading indicated.

The next cohort of doctors will have been trained in line with *Tomorrow's Doctors,* and one would hope that they would be imbued with a zeal for life-long learning. Thus one would expect a burgeoning of these courses as newly qualified doctors realise the limitations of their undergraduate training and seek to acquire new skills.

SUMMARY

This review has attempted to summarise the current position with regard teaching at an undergraduate and postgraduate teaching of medical statistics in the UK and in particular in Sheffield. There is still a vigorous debate about Who, Why, When and What? In the US there is still debate about whether it should be taught at all! (Fineburg et al, 2001) However there also appears to be a consensus over much of the curriculum. It would be of interest to contrast this with other countries, and to consider if different approaches to teaching statistics affect the eventual medical care of the patients.

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REFERENCES

Altman, D.G., & Bland, J.M. (1991). Improving doctors' understanding of statistics (with discussion). *Journal of Royal Statistical Society, A, 154*, 223-268.

Armstrong, G.K., & Walters, S.J. (2002). Discussion: Does EBM offer the best opportunity yet for teaching medical statistics? *Statistics in Medicine, 21*.

Campbell, M.J., & Machin, M. (1997). *Medical Statistics: a commonsense approach (3rd edn.)*. Chichester: Wiley.

Day, S.J., Hutton, J.L. & Gardner, M.J. (1990). Workshop on Teaching Statistics to Medical Undergraduates Bristol UK September 1989. *Statistics in Medicine 9,* 1011-1119.

Fineberg, N.S., Colton, T., Dawson, B.K., & Imrey, P.B. (2001). Debate: Required biostatistics courses should be dropped from medical school curricula. *Teaching of statistics in the health sciences.* ASA Newsletter Fall.

General Medical Council. (1993). *Tomorrow's Doctors: Recommendations on undergraduate medical education*. General Medical Council. www.gmc-uk.org/med_ed/meded_frameset.htm

Morris, R.W. (2002). Does EBM offer the best opportunity yet for teaching medical statistics? *Statistics in Medicine*, *21*.

Wakeford, R.E. (1980). Report: Association for the study of Medical Education- Statistics in Medicine. *Medical Education, 14*, 73-79.