ISSUES IN TRAINING PHYSICIANS IN THE USES OF STATISTICS: WHAT DO THEY THINK THEY NEED TO KNOW?

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Key to any educational development work is the question of what learners need to know. In terms of teaching statistics to non-statisticians this may be examined from the perspective of both educators and students. It is easy for statistical educators to feel they know what students need to know, but it is also clear that when teaching non-statisticians, these non-specialists, who will be expected to use statistics after graduation, will have a view on what they need to know. We surveyed both current medical students and practicing doctors about what they would like to know and how it should be delivered. This informed a new curriculum covering the topics found to be most important and lead to the development of a new mode of delivery, based around the problem-based learning model. The understanding produced provides valuable knowledge for both medical education and other disciplines where understanding statistics is essential.

INTRODUCTION

It has long been acknowledged that doctors need at least some basic statistical skills, particularly in a world where the importance of practicing medicine based on sound evidence is increasingly recognized (General Medical Council, 2003). These skills matter for interpreting research data critically and for understanding and explaining statistical information to patients–for example prevalence, risk and statistical confidence (General Medical Council, 2003). However, it is the case that whilst doctors increasingly need these skills it remains an unpopular part of the medical degree course (Windish, Huot, & Green, 2007). Often statistical teaching and learning is poorly integrated into medical training and little curriculum time is devoted to it (Campbell, 2002).

This paper details work undertaken to examine what should be taught as part of a basic medical statistics curriculum. It is part of an ongoing project to revise the statistics teaching that the medical students receive at our institution which will culminate in the development of problem-based learning (PBL) objects to facilitate improved statistical literacy. As its name suggests PBL is a method that facilitates learning through problem solving activities. It originated at MacMaster University in Canada in the late 1960s as a novel method for teaching medicine (Albanese, 2007). As an educational method it uses patient-based scenarios (problems) to facilitate the acquisition of basic and clinical knowledge. The original McMaster philosophy had at its core three key characteristics: self-directed learning; problem-based learning, based on a patient to stimulate learning; and small group tutorial learning with a tutor as facilitator as a stimulus for interaction, and these three key feature remain central to any PBL approach (Dolmans et al., 2005). Nowadays, whilst there are several acknowledged methods of delivering PBL teaching, what is common to all is the starting point of the patient problem. Whilst in PBL the specification of the problem is extremely important, in order for the PBL approach to work successfully, thought also needs to be given to what it is that the students need to know, as this will drive how the scenarios/ problems are set up, and how the students are to be guided through the problem solving process.

For medical students encountering statistics for the first time, with little prior knowledge, it is important that they encounter it in the context that they will be using it during their subsequent medical careers. Thus the PBL approach, placing learning in the context of a clinical problem has much to offer for the teaching of statistics. It is more closely aligned with actual medical practice than traditional courses and has long been considered to be an active method that promotes deeper learning and engagement with the subject material. Through the use of patient-based cases the relevance of statistics to medicine can be actively promoted. Viewed in context students can see how statistics is an everyday tool in medicine, particularly nowadays with the advent of evidence-based medicine. It is a more interactive student-focused method of teaching. In addition as more and more medical schools move towards a more problem-based curriculum, those parts of the

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course that do not keep pace with this, may find themselves becoming increasingly marginalized (Bland, 2004).

PROJECT RATIONALE

Central to any educational development work must be the question of what the learners need to know (Garfield, 1995). In our case we needed to develop a curriculum that would be relevant to the needs of the medical undergraduates during their studies and would also address their needs once they were practicing doctors. In terms of teaching statistics to non-statisticians this question of what the curriculum should contain may be examined from the perspective of both the educators and the students. It is easy for statisticians to feel they know what students need to know, but it is also clear that when teaching non-statisticians, these non-specialists, particularly once they become practitioners will have a view on what is necessary for them to work as professionals.

EDUCATIONAL SETTING

The current annual intake to the medical undergraduate degree programme in our institution is 260 students. It is a clinically-led programme and currently students received only 10 hours of instruction in medical statistics, delivered in their first year. Unless they elect to do a research year, they receive no further training in statistics during their undergraduate training. Thus the challenge is to give students enough instruction to ensure that they understand the basics well, without overloading them with unnecessary detail, within the limited time available. It is important that these 10 hours are not wasted and thus the teaching must be directed at ensuring that the knowledge the students take away is as relevant to their current and future needs as possible. Earlier work by the first author has redeveloped the delivery of statistics education to make it more relevant and learner focused with materials and examples that are relevant to medical education (Freeman et al., 2008). This work has now been built on and further developed with the introduction of an online learning resource to aid student engagement and learning. In addition to having the course handbook, it consists of four separate strands:

- the complete set of lecture notes and all videos and animations associated with each lecture,
- an illustrated glossary of all statistical terms used in the lectures, with content pitched at both the level of the lecture and at a deeper level for those students who wished to explore the concepts in more detail,
- an online test facility, built around four different medically orientated scenarios, with questions and detailed feedback, both for the correct answer and also for the incorrect answers, signposting students on where they have gone wrong and also on why the correct answer was the correct one,
- links to other web-based resources that might be of interest to students.

CURRICULUM DESIGN WORK

The project involved surveying both current students and practicing doctors in order to design a core curriculum that addressed their needs. We were keen to find out both what needs to be taught and how it should be taught. Whilst the ultimate goal was the development of the PBL objects, it is the initial work to decide upon the contents of a core curriculum that is the focus of the current paper.

Following focus groups to determine what questions to ask, an internet-based survey was conducted of medical undergraduates at Sheffield to find out their opinions of the current teaching, including its content and mode of delivery. In addition the students were asked whether there were any gaps in the current curriculum and their thoughts on whether the teaching could be delivered using a PBL approach. The practicing doctors were a convenience sample consisting of registrars (equivalent to American ‘resident’ grade) taught statistics by the presenting author as part of a three-day introduction to research methods. Whilst not representative of all practicing doctors as they are relatively recent graduates, and, as all registrars in our area undertake this training course, they do represent a broad mixture of different specialties. At the start of teaching the residents were asked to fill in a short questionnaire about their experiences of learning medical statistics as an undergraduate. As well as these questions about their previous experiences they were also asked

about what they felt should have been taught and the usefulness of medical statistics to their subsequent careers.

Ethics approval for both surveys was sought and but as they regarded as teaching evaluation inline with standard departmental teaching policy full ethics approval was not deemed necessary. The questionnaires were all anonymous and completion was not compulsory. As completion was anonymous, no attempt was made to link individual responses to grades.

SURVEY OF MEDICAL STUDENTS

A total of 111 students responded to the online survey of medical students. Given that there are approximately 1,000 students in all years this represented a response rate of about 10%. Two thirds of respondents were female and there was a good spread across all phases of the course. Over half of the students had pre-degree level mathematics, prior to the teaching. In addition to basic demographics and their knowledge of statistics students were also asked the following five questions:

- What do you want from a medical statistics curriculum?
- What is in the current curriculum that should be removed?
- What isn't in currently that should be?
- Is the current format (lectures followed by small group tutorials) appropriate?
- How should medical statistics be taught?

In terms of what students wanted to learn from a medical statistics curriculum the students were clear that they would like to be able to read journal articles and interpret the results of published studies. Quotes such as the ones below were typical of many respondents:

> *An understanding of the relevance of statistics to clinical practice, i.e., what results and risks mean in terms of how effective an intervention might be. The ability to look at papers critically and evaluate them*
> *Interpret study information in a way they can understand and then relate to patients*

Whilst there were few suggestions about what could be left out of the current curriculum, the question about what could be added elicited more responses with many students suggesting that the use of statistical software and more on specific statistical methods for data analysis would be helpful. In addition there was a recognition that more curriculum time devoted to statistics would be useful.

SURVEY OF RESIDENTS

Thus far a total of 58 questionnaires have been received from residents representing a response rate of about 60%. They all graduated between 1992 and 2004. Over two thirds agreed that statistics was relevant to their career and also that they would like to have a greater understanding of medical statistics. Over 80% felt that they professional life would be improved if they had better statistical knowledge. The three key areas in which they would like to have improved knowledge were:

- critically appraising and understanding journal articles,
- undertaking research,
- explaining risks to patients.

In terms of the undergraduate curriculum the majority of residents felt that the course should teach concepts rather than statistical techniques. Many felt that their undergraduate teaching had not been helpful and that they had not seen the relevance of it at the time. Thus the main theme for improvement was that teaching such be relevant to future practice and should reflect clinical practice. Thus an approach that used problem solving could be a useful way to proceed.

CONCLUSIONS

Thus far, the project has surveyed both medical students and residents about what issues should be addressed by the medical statistics teaching. From all the curriculum design work that was undertaken, the main issues that a core curriculum should address were:

- critically appraising and understanding journal articles
- undertaking research
- giving explanations to patients

Thus any potential scenarios need to be set in these contexts. In general, with one or two exceptions, both the doctors and students felt that a course based on teaching core concepts rather than particular techniques was most appropriate. They felt that an understanding of confidence intervals and p-values was important as was risk. The main theme for improving the teaching was ensuring that the teaching was relevant to future practice with lots of relevant examples.

Using the result of the curriculum design work, we are now seeking to develop PBL objects that address the issues raised by both the students and registrars. So far we have developed objects for displaying data, discussing risk, and diagnosis and screening tests. In terms of further work, having developed problems for risk, data display and diagnosis and screening, we now need to finish developing cases for sampling and hypothesis testing. These need to be tested for ease of use and to check that the learning objectives can be achieved.

Finally we need to assess the overall usability of the PBL approach and its effectiveness as a method for teaching statistics. However, this latter goal is problematic. Whilst both students and practicing doctors can see the benefits in conducting randomized controlled trials to test the efficacy of the treatments that they administer to their patients, all expressed concern about taking part in a randomized controlled trial of an educational innovation to assess its merits (or otherwise). In order to get round this, one approach could be to ensure that were a particular method found to be less effective, the students who were taught using this method should not be disadvantaged during their assessments, either through weighting their results to reflect the overall results of the better method, and offering these students further, extended tuition using the more effective method. An alternative to this approach could be to offer additional statistics tuition to later years. At our institution medical statistics is only taught in the first year. We could in theory offer additional voluntary tuition to students in later years as part of a randomized controlled trial of the two methods. This would be in addition to any other teaching they receive and would not form part of their summative assessment, although it would have to be assessed in order to compare the two methods. It is these two options that are currently being investigated. The understanding produced thus far has provided valuable knowledge for both medical education and other disciplines where learning statistics is an essential component and it is hoped that the further work that we are undertaking will extend this to the benefit of future students and statistical educators across a range of disciplines.

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