STATISTICAL EDUCATION FOR PHD STUDENTS IN UK MEDICAL SCHOOLS

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SUMMARY

Little is known about the provision of statistics teaching for PhD students in UK medical schools. A recent survey found that statistics courses were available to PhD students in 13 of 21 schools responding. The provision across these 13 schools was variable in terms of contact hours and content. At a meeting of 27 medical statistics teachers, consensus was reached that such teaching should be undertaken by a subject specialist, however there was no consensus as to the best mode of delivery. We describe the rationale for, content of, and student feedback from our newly developed course programme which emphasises aspects of both design and analysis of research projects.

Keywords: *Statistics education research; Teaching; Medicine; Postgraduates; Survey*

1. INTRODUCTION

The importance of statistical education for PhD students undertaking medical research is becoming increasingly recognised. Medical Research Council guidelines (MRC, 2002, Section 5.2 Skills training) state that

> The MRC expects each student to have access to training in generic research skills (eg. experimental design, data handling, statistics, intellectual property rights, exploitation), and access to transferable skills training, (eg. oral and written communication, IT skills and time management) during their MRC-funded training period, in addition to subject specific training.

Whilst some discussion has taken place regarding statistical teaching in undergraduate courses for both medical students (Lancaster, 2002), and dental students (Smeeton, 2002), there is little known about the provision of statistics training for PhD students in UK medical schools.

Researchers may also improve their understanding of statistical issues through consultation with a statistician. Statistical consultancy for researchers has been the subject of several papers (Svensson, 2001; Ospina & Ortiz, 2001; Shia, 2001; Jolliffe, 2001; Godino, Batanero, & Jaimez, 2001; Belli, 2001; Mji & Glencross, 2002; Bangdiwala et al., 2002). However there is no information available concerning the provision of such support for PhD students in UK medical schools.

In order to make informed decisions regarding the content and delivery of statistical teaching for PhD students in the Faculty of Medicine at Liverpool, we undertook a survey of UK medical schools. In this paper we report the results of the survey, together with a discussion held at the Burwalls annual meeting of 'Teachers of Medical Statistics', and present our plans and rationale for the teaching of statistics to our PhD students.

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2. METHODS

Medical statisticians working in each of the 26 UK medical schools were identified from either the Burwalls 'Blue Book' (http://www.mas.ncl.ac.uk/~ndw/bluebook.htm) or personal contact. A questionnaire was sent to either a single statistician or a group working within each medical school in February 2003. If they were unable to help, they were asked to forward the questionnaire to the Director of Postgraduate Studies.

The first author led a discussion workshop at the 2003 annual meeting of 'Teachers of Medical Statistics' at Burwalls in April. Prior to seeing the results of the survey, the audience was split into five groups with four to five people per group. Each group was asked to consider the following questions relating to the statistical teaching of PhD students in a Faculty of Medicine: Which students should be taught? When should they be taught? Who should teach them? What should they be taught? How should they be taught? Should attendance be compulsory? Should the course be assessed? The groups discussed these issues during a 20-minute period and were asked to report back during a feedback session.

3. RESULTS

3.1 SURVEY

Questionnaire replies were received from 21 (81%) of 26 UK medical schools. Of these, statistics teaching was provided specifically for PhD students in 13, under review in three, and not provided specifically for PhD students in five although they could apply to join Masters modules in two. Table 1 describes the content and delivery in those 13 schools where such teaching is provided.

The shortest courses lasting six hours covered data description, hypothesis testing and some elements of study design. This contrasted with the longest course of 50 hours which included these topics plus ANOVA, correlation and regression, multiple regression, logistic regression, survival analysis, and laboratory statistics. The content with respect to analysis was classified as introductory level when it included only topics from the following: data description, estimation, hypothesis testing, ANOVA, correlation, and simple linear regression. The classification was intermediate when topics covered included the above plus some or all of the following: multiple regression, logistic regression, survival analysis, multivariate analysis. The methods used for formal assessment in four institutions were examination (3), written assignment involving data analysis (3) and protocol development (1), and critical appraisal (1).

The question 'Is there any one-to-one statistical consultancy provided for PhD students?' was also asked. In three cases, the answer was not known. Of the remaining 18 schools, there was provision in 15. Of the 15 schools where consultancy was offered, free advice was available to all Faculty PhD students in 10, to those students able to access an advisory service funded by the National Health Service in three, and to students in departments employing a statistician in one. In one school, consultancy was available but had to be paid for.

Overall, there was some level of statistical teaching and consultancy in 9 schools, teaching alone in 3 and consultancy alone in 5. Of the remaining four schools responding, consultancy was provided but the teaching was under review in one. Whilst it was not known whether consultancy was provided in the other three, teaching was provided in one and was under review in two. Thus in 19/21, some level of statistical teaching and/or consultancy was provided.

Table 1. Survey results

Question: responses	Number of schools
Specialty of person responsible for teaching:	
Statistician	11
Statistician plus molecular biologist	1
Not known	1
Year of PhD in which teaching provided:	
First	7
Any	5
Not known	1
Mode of delivery:	
Lectures only	1
Computing sessions only (STATA)	1
Lectures plus tutorials	1
Lectures/computing or lectures/tutorials/computing	8
(MTB 2, SPSS 4, MTB/SPSS 1, STATSDIRECT 1)	
Not known	2
Total hours: 6,6,6,7,10,10.5,13,16,19,20,30,50, not known in one	
Brief content of teaching:	
Analysis (introduction)	4
Analysis (intermediate)	1
Analysis (intro) plus design	1
Analysis (inter) plus design	3
Design plus analysis (intro)	1
Design plus analysis (inter)	1
Not known	2
Formal assessment:	
Yes	4
No	7
Not known	2
Compulsory attendance:	
Yes	4
No	7
Not known	2
Funding provision:	
Yes	4
No	7
Not known	2

3.2 BURWALLS WORKSHOP

The audience of the Burwalls meeting were all university medical statistics teachers. In total 27 statisticians attended the meeting comprising a mix of approximately 40% senior academic (professor, reader, senior lecturer) and 60% academic staff (lecturer, research fellow, research associate). The

majority of statisticians were from Departments of Public Health, Centres for Medical Statistics or Mathematics and Statistics Departments at their various institutions.

The audience varied in terms of their experience of teaching medical statistics. However all groups were consistent in identifying the need to teach general statistical principles of design and analysis, and computing. Four groups felt that all PhD students should be taught whilst the fifth group thought that course attendance should be by negotiation. All agreed that the students ought to be taught early on in their first year. One group thought the students ought to learn when to involve a statistician and what to expect from a statistician.

All groups thought the teaching should be undertaken by a subject specialist, although two groups suggested the teaching could also be done by an experienced non-statistical researcher. No group identified a single best mode of delivery: suggestions included lectures, problem-based learning, Computer Aided Learning (CAL), workbooks, small group work, computing, and practicals.

Three of the five groups thought attendance ought to be compulsory, one at least for core subjects, another as part of a research training package. Four groups thought the teaching should be assessed, although proposed methods of assessment varied from self assessment to examination to a mini-project within the PhD area of the student.

Several further comments of interest were noted during the discussion. Firstly, teaching may create a demand for individual advice that cannot be met later. Secondly, joint PhD supervision by a statistician is a good idea. This was agreed in principle but several people commented about whether the workload would be realistic. Finally, the remark was made that it would be beneficial if supervisors also attended the courses.

3.3 PROPOSED TEACHING

At Liverpool University, teaching in statistics for PhD students within the Faculty of Medicine is being provided for the first time in the academic year 2003/2004 by the newly established Centre for Medical Statistics and Health Evaluation. The students are predominantly non-medical health scientists. Funding has been provided for a new statistics lectureship within the Centre with specific responsibility for this teaching. In practice, the teaching will be undertaken by the four statistics lecturers within the Centre. Table 2 describes the course programme in statistics.

Table 2. Details of the PhD course programme in statistics

Course title	Maximum number of students	Credits
PhD courses and attendance for November 2003:		
Statistical issues in the design and analysis of research projects	30	25
Design and analysis of randomised controlled trials	20	5
Design and analysis of diagnostic test and method comparison studies	20	5
Design and analysis of laboratory-based studies	20	5
Proposed new courses:		
Introduction to logistic regression	15	7
Introduction to longitudinal data analysis	15	7
Survival analysis	15	7

The teaching schedule consists of four courses, a week-long introductory course entitled '*Statistical issues in the design and analysis of research projects*', and three specialised one-day courses entitled '*Design and analysis of randomised controlled trials*', '*Design and analysis of diagnostic test and method comparison studies*', and '*Design and analysis of laboratory-based studies*', for which prior knowledge of the content of the introductory course is assumed. A higher number of places are allocated to the introductory course to ensure that we meet demand as this is viewed as the core course. Places on the specialist courses are more restrictive to allow more specific discussion and interaction with the students about their particular projects during the teaching sessions. In the proposed new courses where computing practicals are to be introduced then places are restricted again to allow for closer interaction and computer support.

PhD students are required to gain 90 credits in compulsory and optional university training courses, as suggested by their supervisors and heads of department. The statistics courses are classified as optional training. They run twice a year in November and April to allow for student registration at different times of the year, and priority is given to first-year students. In the academic year 2002/2003 approximately 150 first year PhD students were registered in the Faculty.

The courses emphasise aspects of both design and analysis. The introductory course consists of six teaching sessions, three of which focus on basic statistical methods: variability and types of data; populations, sampling and confidence intervals; hypothesis testing (parametric and non-parametric), and two of which give an overview of simple linear regression, correlation and analysis of variance; and multiple regression. One additional session is devoted to an overview of study designs commonly used in health research together with design concepts such as sample size and bias. The practical work, which is designed as self-learning material, involves an SPSS analysis in which a basic two-group comparison is performed to construct a baseline characteristic table for an observational study. The students must identify appropriate summary measures, construct confidence intervals and perform relevant hypothesis tests. Lectures for this course are given on Monday, Wednesday and Friday mornings and afternoons, with self-learning on Tuesday and Thursday. The teaching sessions are organised as two-hour lectures, sometimes including a video, with an extra half hour 'question-time' where the students can discuss the practical work or their own work in the context of what they have just learned.

The one-day courses focus on specific subject areas. They take the same teaching format as morning sessions with self-learning using the STEPS programmes (STEPS TLTP consortium 1992-95) in the afternoon. There are no formal assessments for any of the courses. Additional resources, including recommended text books and CAL resources, are listed on the centre website and university intranet. Within the next five years it is envisaged that course materials will be made available on the university intranet using the new university VITAL (Virtual Interactive Teaching at Liverpool) learning management system and Blackboard virtual learning environment software (Blackboard Inc. 1998), to facilitate administration and to enable overseas students to have on-line access to the course, in line with university policy. The VITAL system is a very flexible system allowing not only storage of materials and resources but also messaging, on-line assessment, and evaluation.

At the end of each course students are requested to complete a course evaluation form asking how useful they found the course. Student feedback from the first delivery of the courses is shown in Table 3 and indicated that the courses were well received. Constructive comments on how to improve the courses are also requested on the evaluation forms. Comments made by more than one student included the following. For the 'Statistical issues in the design and analysis of research projects' course, six students requested more time to be spent on correlation and regression and multiple regression, and two would have liked less mathematical formulae, which were in fact kept to a minimum. On the 'Design and analysis of RCTs' course two students requested that more time be spent on sample size. All the students attending the 'Design and analysis of diagnostic test studies' found the course very useful and those on the 'Design and analysis of laboratory-based studies course' requested examples in SPSS.

Table 3. Student feedback on usefulness of course

	How useful did you find the course?				
PhD Statistics Course	Not at all	Not much	Adequate	Fairly useful	Very useful
Statistical issues in the design and analysis of research projects:					
Session 1: Variability & types of data		2	2	5	8
Session 2: Confidence intervals			3	7	7
Session 3: Hypothesis Testing		1	2	7	7
Session 4: Overview of study design		1	3	7	7
Session 5: Correlation & regression	1		4	7	6
Session 6: Multiple regression	1	3	2	7	5
SPSS self-learning practical			1	11	6
Design and analysis of Randomised Controlled Trials			1	2	3
Design and analysis of diagnostic test studies					5
Design and analysis of laboratory-based studies				4	6

4. DISCUSSION

The majority of UK medical schools responding to the survey provide some level of statistical teaching to PhD students, usually by a statistician. However the total contact hours was highly variable, from six to 50. Rather surprisingly, design issues were covered in only half of the courses. The five medical schools not responding to the survey all offer a PhD programme. The results presented here may reflect the best scenario in the sense that non-respondents may be schools where statistical teaching and/or consultancy is less likely to be provided.

A further unexpected result was the high rate of consultancy provision, since this is usually perceived to be more resource-intensive than teaching and there is generally thought to be a shortage of medical statisticians to undertake this. It is unclear whether the decision to provide either courses or consultancy has been made on the basis of evidence of effectiveness or on the basis of resources available.

Our own teaching plan has been devised as a minimum but crucial package for PhD students. Due to limited resources we decided to provide teaching rather than consultancy, but to allow discussion and question time at the end of each session. Further courses that are being proposed are listed in Table 2. They are being introduced as a result of student feedback requesting more specific training in multiple regression techniques, and will include 'hands-on' computing sessions. In addition, we promote joint supervision of PhD students by a statistical supervisor where appropriate, in keeping with recommendations made in the MRC guidelines for studentship funding (MRC, 2003, Section 3.1 Quality assurance – standards of student supervision), which state that:

> In some scientific areas e.g. Health Services Research, there may be grounds for joint supervision of individual students by, for example, both "basic" (e.g. psychologist, statistician) and "clinical" scientists (e.g. Professor of Nursing), to ensure that training spans both the methodology and its application in the field.

Our paper has been concerned with statistical education for PhD students in UK medical schools. Whilst we are aware of some courses in other countries (Harraway & Sharples, 2001), we have not undertaken a systematic search for non-UK reports. In particular, we are not aware of any recent survey of medical schools in other countries. Such a comparison would be interesting but would require further research.

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