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RESEARCH ARTICLE

Pharmacogenetics education in British medical schools

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Abstract Pharmacogenetic tests allow medications to be tailored to individual patients to improve efficacy and reduce drug toxicity. In 2005, the International Society of Pharmacogenomics (ISP) made recommendations for undergraduate medical teaching in pharmacogenetics. We aimed to establish the quantity and scope of this in British medical schools. An electronic survey was sent to all British medical schools. Nineteen out of 34 (56%) medical schools responded. Sixteen of the 19 (84%) respondents provided pharmacogenetics teaching, usually 1–2 h in total. Only four (21%) medical schools offered the four or more hours of teaching recommended by the ISP. However, 10 of 16 (63%) schools felt the amount of pharmacogenetic teaching offered was sufficient. The quantity of undergraduate teaching of pharmacogenetics is low. However, a majority of UK medical schools teach it, covering a broad scope of elements. It is encouraging that future clinicians are being provided with the knowledge to deliver pharmacogenetics into clinical practice.

Keywords Pharmacogenetics · Pharmacogenomics · Teaching · Education · Medical schools · Survey

Introduction

Pharmacogenetic tests allow medicines to be tailored to individual patients. There are a growing number of examples of pharmacogenetic tests used in clinical practice (Lesko 2007; Giacomini et al. 2007). They potentially allow identification of individuals in whom a particular treatment is likely to be effective or avoidance of this treatment in those who have an increased chance of a life-threatening adverse reaction to a particular medication.

Although pharmacogenetic tests are currently only useful to a minority of patients, it is likely that they will influence clinical practice to a greater extent in the future (Lesko 2007; Giacomini et al. 2007). For example, the USA Food

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and Drug Administration (FDA) now recommends, but does not mandate, testing for single nucleotide polymorphisms (SNPs) in the 2C9 isoform of cytochrome P450 (CYP2C9) and vitamin K epoxide reductase complex subunit 1 (VKORC1) prior to prescribing warfarin in order to detect patients at increased risk of haemorrhage (Gage and Lesko 2008). Testing for *VKORC1* and *CYP2C9* variants, used with other clinical information, is particularly valuable to determine the correct dose at the start of treatment (Flockhart et al. 2008). In the UK, adoption of pharmacogenetic testing has increased for a few indications within the last 5 years, with the routine testing of thiopurine methytransferase (TPMT) activity prior to thiopurine use and *HLA-B*5701* typing prior to abacavir use in patients with HIV now standard practice (Newman and Payne 2008).

A recent qualitative survey of patient preferences concluded that patients would prefer pharmacogenetic testing to be integrated into their management plan by the medical team looking after their specific condition (Fargher et al. 2007). This requires that healthcare professionals, in all disciplines where pharmacogenetic testing is or will be available, are familiar with the tests' interpretation and sufficiently confident to explain and incorporate the results into each patient's management. However, at present, most doctors do not feel that they have the responsibility, time or capacity to provide and interpret genetic tests (Fargher et al. 2007). Clearly, inadequate education both at undergraduate and postgraduate levels is a potential barrier to the widespread uptake of pharmacogenetic tests (Baars et al. 2005; Newman and Payne 2008). In 2005, the International Society of Pharmacogenomics (ISP), recognizing this unmet need, published a number of recommendations, including one for undergraduate medical teaching of pharmacogenetics (Gurwitz et al. 2005). They proposed that "basic MD pharmacogenomics education should ideally encompass at least 4 h, and ideally about 8 h of teaching". These figures were primarily based on the teaching experience of one of us (DG), who was the lead author on the ISP recommendations manuscript (Gurwitz et al. 2005) and who has been teaching pharmacogenetics to medical students at the Tel-Aviv University medical school since 2001 (Gurwitz et al. 2003). There it has been found that 4 h of teaching were the minimum required for good coverage of the most important clinical aspects of pharmacogenetics. The ISP has proposed that the teaching should encompass basic elements on genetic variation, including polymorphic alleles of key drug metabolising enzymes and drug transporters affecting drug response and the potential of pharmacogenetics to improve the quality and safety of prescribing practice. Clinical examples of pharmacogenetics in current usage should also be included.

Therefore, between September and November 2008, we carried out a survey of British Medical Schools aiming to assess the amount and type of pharmacogenetic teaching currently offered and to establish to what extent the ISP recommendations had been adopted.

Methods

Survey design

The questionnaire was designed using the free internet software 'Qualtrics' (http://qtrial.qualtrics.com).

The questionnaire included 16 questions in total (see in full at supplementary information); questions that were not relevant given the preceding answer were automatically skipped. Information regarding the amount and type of pharmacogenetics teaching offered and attitudes to pharmacogenetics was sought.

Survey distribution

The survey was sent by email to a nominated primary contact for each Medical School, which was identified by The Higher Education Academy Subject Centre for Medicine, Dentistry and Veterinary Medicine.

The primary contact was invited to identify the appropriate staff member with responsibility for pharmacogenetics teaching to respond to the survey. Attached to the initial contact email was a covering letter describing the purpose of the questionnaire and an article describing the ISP recommendations for pharmacogenetics[8] (8 should be available in Supplementary information). One reminder email was sent after 2 weeks.

A subset of eight non-responding medical schools was contacted to identify the reasons for not completing the survey.

Results

Nineteen of the 34 (56%) medical schools contacted completed the survey. The reason for non-response given by eight of the eight medical schools contacted was lack of time. Two reported that finding out the relevant information was time consuming. Where problem based learning (PBL) was a major component of the teaching, two responders commented that precisely what was studied by the students was difficult to determine.

Amount and type of pharmacogenetics teaching currently offered

Sixteen of the 19 (84%) respondents had pharmacogenetic teaching in the curriculum. Of the 14 respondents, who

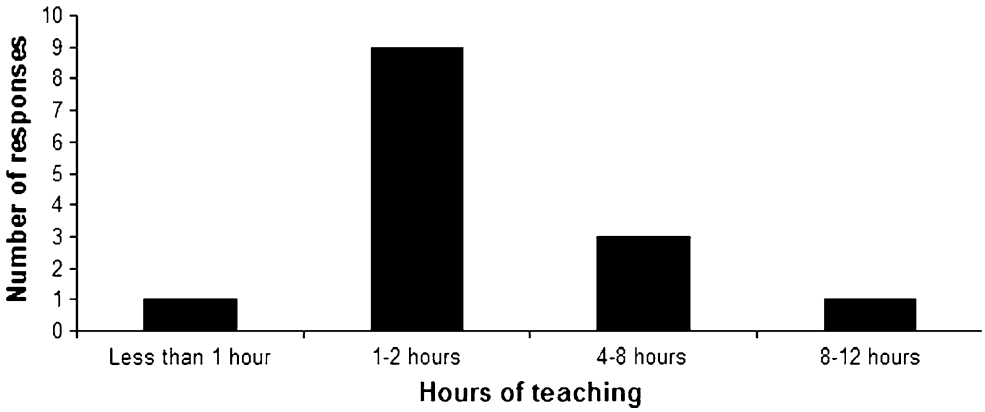

Fig. 1 Hours of pharmacogenetics teaching (number of respondents 14)

answered the question, nine provided 1–2 h during the medical degree, compared to one school which had <1 h, three with 4–8 h and one providing 8–12 h (Fig. 1). Eleven medical schools had questions on pharmacogenetics in the medical student examination. The elements of pharmacogenetics covered in the curricula are summarised in Fig. 2. One medical school that used predominantly PBL, commented that it was not possible to determine precisely what was learnt, as the students could choose their own topics based on the cues within the PBL case.

Pharmacogenetics teaching was provided as lectures by 14 respondents to this question, with some schools supplementing this with PBL ($n = 4$), case led studies ($n = 3$), seminars ($n = 3$) or computer based learning opportunities ($n = 2$) (Fig. 3). The pharmacogenetics teaching was provided in pharmacology modules (8 of 16), with other schools providing it in both genetics and pharmacology modules ($n = 2$) or as part of integrated learning or specialist modules. No school provided pharmacogenetic teaching exclusively within the genetics curriculum.

Six medical schools had student feedback on pharmacogenetics teaching; however, none of the respondents were aware of the opinions of the students concerning their pharmacogenetics education.

Ten of the 16 (63%) medical schools with pharmacogenetics teaching felt that they offered a sufficient amount, whereas six (37%) felt this area could be improved on with more in-depth teaching or improved integration into the rest of the course. Two medical schools commented that pharmacology teaching in general was a weak area and needed improvement:

"[Pharmacogenetics] content OK when compared to content of rest of pharmacology teaching in curriculum which is not great".

Of the three schools that did not offer pharmacogenetics teaching, one felt that this area was not relevant to the type of course they offered and two felt that there wasn't enough time to include this area in the curriculum without excluding something else.

"There is a massive restraint on the period of teaching for each module and we have several areas of pharmacology we would wish to expand. Indeed, some we would consider more important than the current call."

However, one school currently without pharmacogenetics teaching thought it should be introduced, despite time constraints, because "it may potentially become a central criterion for rational prescribing."

Six (32%) responders felt that pharmacogenetics was likely to become more important in the future. However,

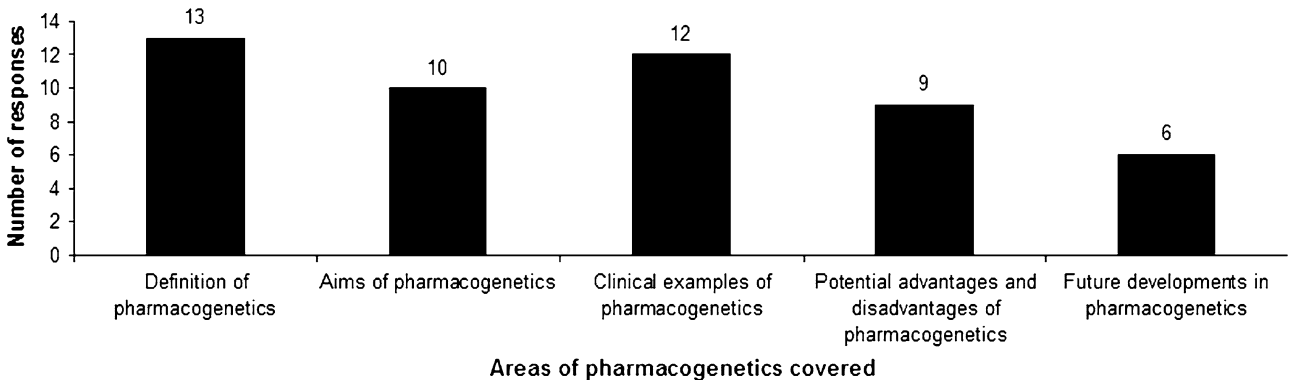

Fig. 2 Pharmacogenetics topics covered by the medical schools (number of respondents 16)

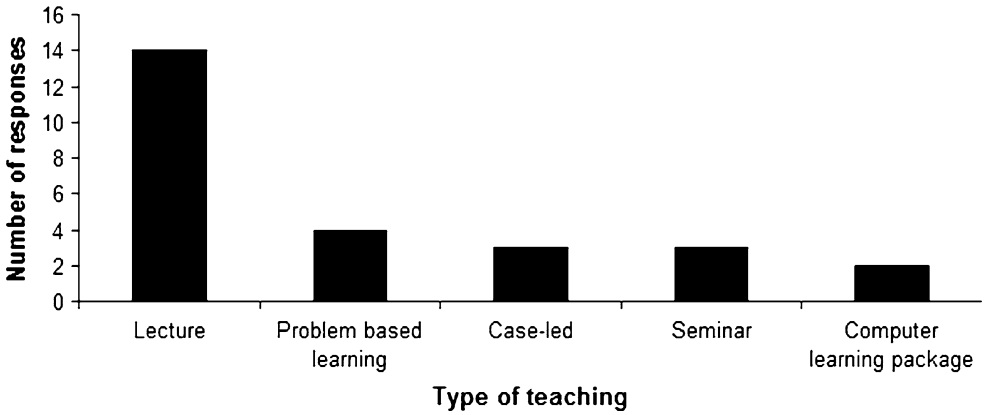

Fig. 3 Types of pharmacogenetics teaching (number of respondents 15)

Table 1 Additional feedback on pharmacogenetics/pharmacogenomics teaching

Understanding of disease susceptibility and treatment response is changing rapidly given advances in biomedicine in general. Doctors need to be much more aware of these developments and their incipient impact on medical practice
Content OK when compared to content of rest of pharmacology teaching in curriculum, which is not great
This questionnaire does not really work for our integrated programme
I can only really speak for the clinical course, and I am sure there are aspects of pharmacogenetics that are covered in the preclinical years, in both genetics and pharmacology, although I do not have this detailed information. In the clinical years we concentrate on teaching pharmacogenetics in the context of therapeutics, so where there are examples that can readily demonstrate its uses
In terms of their needs for F1 prescribing, I think the current amount of teaching in pharmacogenetics/pharmacogenomics I give is probably sufficient. In 2007 I also set an integrative assignment on pharmacogenetics/pharmacogenomics for students doing a BMedSci in clinical pharmacology
Likely to gain in prominence
It is difficult to answer these questions in what is a student centred, self-directed PBL course. There are triggers within the PBL scenarios to some of the issues but the individual student will decide to what depth they need to explore so it is difficult to estimate 'teaching' of this subject in the traditional sense and we can only give estimates of learning. The nature of a PBL course should be such that students develop the skills of being able to find out what they need to know when they need to know it. They should also be searching in the most up to date evidence and thus should be meeting the areas you describe
We focus on the practical reality of PG and its impact on PD. Much of the impact that PG will make on prescribing remains aspirational rather than a reality with the exception of a few key drugs and ethnic groups. We introduce students to these issues. We do not examine students in a specific PG paper/questions but integrate such topics into more general clinically focussed assessments
I believe the report is correct to point out the importance of this. However, we already have modules and associated classes beginning at 08:00. To implement effective learning would require sacrifice elsewhere. I would be interested in information that could allow the students to attain at least the basics, but further expansion may be impossible

the barriers to teaching this subject are summarised by the following respondent's comment:

"The application of pharmacogenomics has progressed less rapidly than predicted. Given the overcrowding of the undergraduate medical curriculum, there are problems implicit in devoting 4–8 h to teaching knowledge which may not be core until a few years after students have graduated".

Table 1 provides a summary of the general feedback from medical schools about current pharmacogenetics teaching.

Discussion

The lack of adequate health care professional education and the lack of patient education are just two of the potential barriers to the adoption of pharmacogenetic testing (Baars et al. 2005; Newman and Payne 2008). This was also one of the key conclusions of a recent European Commission Joint Research Centre Report on pharmacogenetics and pharmacogenomics (Zika et al. 2006). To address the future professional need at an undergraduate level, one of the ISP education forum's recommendations was that a minimum of 4 h of undergraduate pharmacogenetic teaching should be provided to medical students (Gurwitz et al. 2005). Whether the recommendations have been implemented in the UK has not been investigated. From our survey, it is encouraging to discover that pharmacogenetics teaching is provided in over 80% of the medical schools that responded. It is possible that schools responding to the survey were more likely to offer teaching, but our follow up survey of non-responders does not support this potential concern. Also the number of UK medical schools providing pharmacogenetics teaching mirrors the 78% of pharmacy schools in the US providing teaching to pharmacists in a survey undertaken in 2004 (Latif 2005). It is sometimes difficult to fully establish all

of the opportunities available to students in a medical school as teaching occurs over a long time frame; in many settings (university, ward-based, computer), and with many individuals teaching in formal and *ad hoc* situations. Therefore, it is possible that this survey underestimates the amount and extent of pharmacogenetics teaching to UK medical students.

It is of interest that only four of the 14 responding schools (29%), offering pharmacogenetics teaching, met the ISP recommended quantity of four or more hours. However, the scope of teaching, with most schools including the major elements proposed by the ISP, suggests that the core areas of pharmacogenetics are being addressed. Furthermore, only six schools felt that increased teaching of pharmacogenetics was warranted. The major concern expressed, regarding increased teaching in pharmacogenetics, would be the deleterious effect that this might have on other areas of the curriculum and the competing interests of other subject elements to be included in the course. However, a number of resources are already available to assist in developing a pharmacogenetics course relevant to medical students (Brazeau and Brazeau 2006; The National Genetics Education and Development Centre).

What medical students think about pharmacogenetics and the education they receive on this topic is not clear. Most medical schools did not have student feedback on this topic and those that did, were not sure what their opinions were. This is particularly pertinent as an assessment of a pharmacogenetics course for pharmacists in the US found that many students thought pharmacogenetics was not relevant to the current practice of pharmacy and evaluated the course more favourably when specific examples of applications and future developments were highlighted (Latif 2005). Clearly, the high use of practical examples in medical student teaching should address this concern.

In summary, the number of pharmacogenetic tests in clinical use is likely to increase considerably over the next decade. At present most testing is provided by specialist clinicians in oncology, HIV medicine and by physicians using immunomodulators. Future pharmacogenetic tests are likely to be relevant to primary care physicians and potentially available at the point of care. It is vital that all doctors are aware of the potential and impact of this technology and that they have the knowledge base to implement it in the clinical care of their patients. UK medical schools are providing a core competency in pharmacogenetics, which must be encouraged and supported and allowed to develop to mirror its increased clinical application.

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