Review Paper

A Proposal for Improving Genetics Teaching for Medical Professionals in Saudi's Medical Education

Ahmed A. Al-Kuwaiti

ABSTRACT

Objective - To look into ways that the teaching of genetics to medical professionals can be improved within Saudi Arabia's medical education system.

Design - Review of literature on genetics, genetics teaching and problem-based learning in order to identify potential improvement areas within genetics teaching in Saudi Arabia.

Setting - Literature obtained from published materials in the form of reports, online journals, articles and websites.

Method - This proposal will look at the situation of medical education and the teaching of genetics in the Kingdom of Saudi Arabia before attempting to relate this to the experiences of other countries, in order to draw a plan of action.

Results - This article critically evaluated the genetics instruction in the medical curricula of Egypt, Iraq, Jordan, Tunisia and the United Arab Emirates. Further, it explored the genetic teaching in Saudi Arabia with respect to the current teaching practices. This literature study rationalized and proposed a Problem based learning approach for enhancing the genetics instruction in the Kingdom of Saudi Arabia.

Conclusion - While the problem-based approach is not currently being used to teach medical education in Saudi Arabia, this would be an appropriate method for genetics education.

Keywords
Genetics, education, teaching, Saudi Arabia, medical professionals.

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Correspondence:
Dr. Ahmed Al-Kuwaiti
Deanship of Quality & Academic Accreditation,
King Fahd Hospital of the University,
P.O. Box 40065,
Al-Khobar 31952,
Kingdom of Saudi Arabia

Tel.: +966 3 8966666, Ex. 3010
Fax +966 3 8587105
E-mail: akuwaiti@yahoo.com

Key Message

- There is a high prevalence of genetic diseases in Saudi Arabia.
- Rapid advances in medical genetics have been taking place, but medical education programmes around the world have been slow to fully incorporate developments in research into the medical curriculum.
- There is need to improve the teaching of genetics education in Saudi Medical schools.
- Problem-based learning, along with other teaching methods, would be appropriate in medical genetics training in the context of Saudi Arabia's medical education system.

INTRODUCTION

Haemoglobin disorders, inherited metabolic diseases, neurogenetic disorders and birth defects are common among Arab populations. For many countries, particularly the oil-rich states, the slow progress in developing and implementing preventive genetic programmes is due to legal and cultural issues, not financial ones.[1] A survey of the general population in the Eastern region of Saudi Arabia in 1988 showed the prevalence of disease, with 60% of the region's population suffering from hereditary blood disorders (mainly sickle cell disease, other haemoglobinopathies and glucose-6-phosphate dehydrogenase deficiency).

A study of various Arab countries had Saudi Arabia's consanguinity rates at 30%.[2] An earlier study, conducted on 3212 Saudi families to investigate the prevalence of consanguineous marriages, showed that the overall rate of consanguinity was 57.7% of the families screened[3]. The highest rate of consanguinity was 80.6% in Samtah, and the lowest rate was around 34% in Abha in the south-western province. These results placed Saudi Arabia among the countries of the world having the highest rate of consanguinity.[3] The rising incidence of genetic disorders resulting

from consanguineous marriages is likely to affect the quality of life of an increasing number of survivors and, in the absence of marriage counselling services, the problems are likely to multiply further. There is also a high proportion of births to older mothers in the Arab world, with up to 50% of children with Down's syndrome estimated to be born to mothers aged 40 or over.[2]

Strategies for the prevention of genetic disorders in the region should include the integration of community genetics into the primary healthcare system and medical education as well as into the existing specialised genetic service.[2] Medical education must be responsive to the changing needs of the community it seeks to serve, and it is therefore imperative that improvements be made to genetics teaching. Furthermore, the incorporation of current trends in genetics into medical education is equally essential, at a time when medical schools across the world are making efforts to improve the teaching of genetics in their medical curricula.

GENETICS AND GENETICS TRAINING

Although the relationship between the scientific field of basic genetics and the applied field of medical practice has been becoming gradually closer over the past three decades – owing in no small part to recent discoveries about the genetic aspects of a variety of human diseases – medical educators around the world have been slow to find innovative ways in which to incorporate findings regarding genetics into clinical and pre-clinical training programmes. Childs (1993) observed that "none of us has been satisfied with how genetics has been treated in the medical curriculum." Indeed, in the 1990s, the number of hours of genetics given at John Hopkins declined further rather than increased.[5]

Dr. Gro Harlem Brundtland, Director-General of WHO, has stated that genome research, if handled correctly, can change the world for healthcare and, what is more, has the potential to allow developing countries to leapfrog decades of medical development and to bring to their citizens modern and greatly improved methods in care in the very near future.[6] Guttamacher et al. also observe growing evidence that genomics will irrevocably change the practice of medicine, but consider that the precise details of the steps towards this change are still unclear. They emphasise the need to further define the knowledge, skills and attitudes that 'genomic medicine' will demand, and to develop and implement methods by which the healthcare workforce can learn them. There is danger of many individuals suffering unnecessary illness and premature mortality if the benefits of genetics are not moved into patient care as expeditiously as they were discovered in biomedical research.[7]

Future medicine and medical decision making is going to be heavily dependent on clear understanding of (i) Genetic risks (ii) Genetic variation in drug handling (ii) targeting prophylaxis against certain malignant and degenerative disorders on the basis of genetic risk evaluation (iv) Transplantation immunology (v) prenatal diagnosis technology (vi) molecular diagnostics as used for bacterial & viral diagnosis like estimation of viral load in HIV infection with its pitfalls and fallacies (vii) principles of gene therapy and complications which may potentially arise from such therapy (viii) National programmes to control heritable disorders like thalassaemias etc[31]. The role of genes in influencing the risk of disease, its course and response to therapy, now pervades virtually all branches of medicine[32]. Medical schools are responsible for imparting the next generation of physicians with adequate knowledge of medical genetics so that they can take full advantage of the coming advances in genomic-based diagnosis and treatment. With rapid advances in medical genetics and with fewer physicians specialising in the field, all physicians must be better prepared to extend the revolution in genetics knowledge to patient care.[8]

REPORTED STATUS OF GENETICS EDUCATION

Genetics education varies between countries and, as seen from the literature reviewed, variation occurs also between medical schools within a country.

The 1994 Regional Consultation on Community Genetics Services, organised by WHO/EMRO and held in Alexandria, Egypt, showed the amount of time given for genetics instruction in the medical education curricula of Egypt, Iraq, Jordan, Tunisia and the United Arab Emirates. A summary of the findings follows.

Firstly, in Egypt there were between 10-15 hours of genetics per year for the first two academic years, with emphasis on the basic aspects. There were then 4 further theoretical hours and four to eight practical hours of clinical genetics in the paediatrics course in the fifth year.[9] In Iraq, 8 out of 10 medical schools followed a unified system. First-year students had between 10-15 hours of theoretical teaching within biology, covering the basic principles of genetics and an introduction to disease prevention. In the third-year pathology course, there were 6 theoretical hours and between 3 and 6 practical hours of cytogenetics. There were

also some small-group discussions, as well as student presentations on important genetics-related topics. 3-5 further teaching hours were integrated into paediatrics and medicine in the fourth and fifth years. In Jordan, human genetics was taught as a part of biology in the first year, with strong reinforcement through an independently structured course in the third year. In the United Arab Emirates, genetics was integrated into the biological and medical science course in the third academic year. Finally, in Tunisia there were about 52 hours of theoretical and practical teaching on genetics.[9]

A comprehensive survey of genetics teaching leads in UK medical schools (those staff identified by school deans as taking responsibility for genetics in the curriculum) under the auspices of the Cambridge Public Health Genetics Unit found that the teaching of genetics is usually undertaken by basic scientists and clinical teachers, with social scientists or other healthcare professionals rarely involved.[10] Many institutions were found to provide undergraduate medical education with little formal central regulation, and an increasing emphasis on problem-based learning was found to leave those institutions with a special interest in genetics less scope for short, taught courses.[11]

The results of a report looking at the status of genetics education in U.S. and Canadian medical schools showed that approximately half of the 112 responding schools have medical genetics as a stand-alone course and half have it integrated into other courses. Most courses are taught in the first two years of medical school, using instructor-led lectures, case studies and group discussions as the predominant instruction formats. Other areas looked at in this survey included which topics were taught as a part of medical genetics, what amount of contact time was spent on each topic, and whether medical genetics was integrated into clinical teaching. Whilst at least half of the schools studied were integrating genetics into their teaching programmes, this was evidently not the case for the other half.[8]

A Recent study was conducted at the George Washington University to evaluate the medical students understanding of neurogenetics and its clinical applications to design a pilot curriculum into the clinical neurology clerkship. This study utilized both needs assessment and a written examination to evaluate the genetics knowledge of 81 third and fourth year students. The results of this study indicated that the students reported more competence with basic science learned during the preclinical years than clinical concepts and 70% of the students demonstrated a relatively low knowledge levels in clinical neurogenetics concepts in the examination. Moreover, at least half of the students reported minimal understanding or awareness of key genetics websites[30].

Another study, conducted in 2002, looked at genetics education in the Netherlands. The study showed little or no evidence of genetics education, with genetics education completely invisible in the case of non-genetics healthcare professionals. In addition, there was some doubt regarding whether or not the current education in genetics for medical students and non-genetics health professionals was sufficient to allow them to acquire adequate knowledge of genetics by the end of their training. An investigation of inappropriate referrals by medical doctors of children born with congenital anomalies justified the concern that education in genetics was insufficient.[12]

Furthermore, a survey on education in medical genetics for physicians in Germany through the undergraduate, postgraduate and continuous medical education stages showed ill representation of genetics at all levels. Written examinations at the end of the relevant section at the undergraduate level include very few genetics topics, whilst at the postgraduate level only four specialities require knowledge in genetics that may be subject to examination. At the continuous medical education level, medical genetics plays a very minor role.[13] Similar findings of gaps in genetics knowledge among both medical students and practising physicians were confirmed in Sweden and France under the auspices of the GenEd project.[7]

SAUDI ARABIA MEDICAL EDUCATION AND GENETICS TEACHING: A BACKROUND

Medical education in the Kingdom of Saudi Arabia was first taught in 1969, at the medical college of King Saud University (KSU), Riyadh.[14] King Faisal University (KFU) and King Abdul Aziz University (KAU) medical colleges were then established in 1975, followed by King Khaled University medical college in 1982 (Al-Khazim, 2006). Since 2002, a further nine colleges have been established in Saudi Arabia.[15]

The undergraduate medical curriculum is the first stage in the professional education and training of physicians in the Saudi Arabian education system. As stated by Schmidtke et al., "the colleges of medicine administer a six-year undergraduate medical curriculum with a one-year mandatory internship. In the first four years, instruction is based on a yearly time table. It is comprised of 48 weeks for pre-clinical students and 42 weeks for

clinical students, with whole-day teaching from 8.00am to 4.00pm."[16]

In Saudi Arabia, the undergraduate medical curriculum is comprised of four stages: the pre-medical, basic science phase, focusing on biochemistry; the pre-clinical phase, teaching pathology; and the clinical phase, teaching such courses as paediatrics. With reference to genetics, there is now a module called clinical genetics taught in the clinical year. From a study on genetic disorders in the Arab world, medical genetics education was seen to assume particular importance across the Arab world because of the high frequency of genetic disorders and the generally low genetic literacy. However, it was found that inadequate numbers of specialised personnel experienced in medical genetics were available, that genetics was not adequately emphasised within medical curricula, and that effective teaching methods and integration between medical genetics and other clinical specialities were lacking. A further problem found was that the distribution of clinical courses is not always based on the actual requirements of society. Some mandatory subjects are redundant for a general practitioner and would be better taught as an optional speciality.[16] The study therefore identified the importance of a well-informed and educated population in the prevention of genetic disorders, and in recognition of this, Saudi Arabia, the United Arab Emirates and Bahrain have introduced genetics information, particularly on haemoglobinopathies, to the public health worker, to primary healthcare centres and to the public through the media.[2]

Generally, Saudi Arabia's medical education relies heavily upon lectures and teacher-centred activities, with few open-discussion or problem-solving sessions. Furthermore, lack of facilities in the form of library and other information resources for both students and teaching staff also hinders the process of education. In recent years, there has been a huge increase in the amount of information needed to be understood and memorised by medical students and, consequently, the current trend in undergraduate medical education within developed countries involves teaching methods that reduce the number of facts to be memorised. These methods include community-oriented and problem-based learning, integrated medical education, and learner-centred educational activities.[17]

THE PROBLEM-BASED LEARNING APPROACH

Problem-Based Learning (PBL) offers a specific teaching technique by developing active and independent learners, creative and divergent thinkers and good communicators. It facilitates deeper learning through relating knowledge to the learning objectives, and has the potential of integrating different courses and phases of the curriculum.[18]

PBL has also been defined as the learning which results from the process of working towards the understanding or resolution of a problem. The basic PBL process involves the students first encountering a problem in a clinical context and then discussing the problem in small tutorial groups, assisted by a faculty tutor, in order to identify areas in which further study is needed. Students then pursue the knowledge required, and return to the group to apply this knowledge to the problem. The purpose of the problem is primarily to stimulate understanding of the basic science mechanisms involved, and secondarily to help students to arrive at the appropriate diagnosis[20]. The expected outcomes of PBL are many fold. Not only will the learner's knowledge base be expanded, his/her problem-solving skills will be taken to a higher level as well. PBL learners will be able to apply a variety of skills learnt to a wider context when solving real-world problems. These skills will have a long-term impact on a person's professional development, helping him/her survive in the complexity of the working world and of life in general[29].

The use of PBL for teaching genetics content to medical students was stimulated by the 1984 report, 'General Professional Education of the Physician', sponsored by the American Association of Medical Colleges (AAMC). In summary, it indicated that faculties should emphasise the acquisition of skills, values and attitudes by students at least to the same extent that they emphasise the acquisition of knowledge; this requires limiting the number of facts that students are required to memorise. Education should be flexible in order to accommodate changing demographics and modifications to the healthcare system, and students should be encouraged to learn independently through setting and working towards attainable educational goals; faculties should provide the opportunities to further the development of those skills. Education should require students to become problem solvers rather than passive recipients of data, and basic science and clinical education should be integrated with each other in order to enhance learning of the basic principles and to promote their application to clinical problems.[20] Other objectives identified include:

1. The acquisition of an extensive knowledge base that integrates multiple disciplines.

2. The development of effective and efficient clinical reasoning skills.
3. The development of effective skills in history taking, physical examination and patient education, as well as of communication and other interpersonal skills.
4. The development of an internal motivation (as opposed to the teacher-centred external motivations provided by tests and grades) to question, learn and understand.
5. An early immersion into the culture and values of medicine as a profession.
6. The development of the ability to work effectively in a team setting, solving problems, working collaboratively, assisting peers in their learning as well as learning from them, and both giving and receiving constructive feedback.[21]

The University of Texas Health Science Center at Santonio introduced a new course format with supplementary laboratory sessions based on a problem-oriented design to teach the problem-based medical genetics course in the fourth year. To fit the schedule of the fourth-year students, the new course was designed with 4 hours of lectures given to the entire class of 164 students, followed by 16 hours (4 sessions of 4 hours each) in which the students were divided into small groups of approximately 25 per session and then further divided into working groups of five or six for the problem-based learning experience. Application of the PBL format to the new course was perceived as completely relevant to the students' future medical practice, and the problem-oriented teaching of medical genetics was highly rated by the students. Many students, however, lacked a genetics background at the start of their clinical rotations, since many had not taken a genetics course as undergraduates. To teach the basic genetics concepts prior to their clinical rotations and to prepare the students for the medical genetics course in the fourth year, a computer tutorial was brought into the second year of medical school. The course helps the medical students to learn to recognise genetic diseases and to make appropriate referrals to genetic specialists.[22]

It has been strongly recommended that future changes in the curriculum reduce dependence on lectures. These changes could use PBL combined with other educational strategies, such as community-orientated medical education, outcome-based learning, integrated medical education, learner-centred educational activities and professional and clinical skills laboratories.[23, 24, 25] These strategies can also be enhanced if blended with medical humanities which, according to Wetzel, can help students to develop skills in observing, reflecting and understanding self and others.[26]

Community-based learning experiences include the training of students in primary healthcare units, centres and dispensaries, as well as work on community surveys and projects and family assignment projects in various kinds of communities, thus familiarising students with the individuality and importance of each community's social background.[27] These experiences would be useful to a medical student's genetics training in the Saudi Arabian context, where public health authorities are increasingly concerned by the high rate of births with genetic disorders. Therefore, it is imperative to scrutinize the available methods of prevention and management of genetic disorders. However, a minimum level of cultural awareness is a necessary prerequisite for the delivery of care that is culturally sensitive.[28] In looking at the improvement of genetics training, as with other subject areas, the curriculum must be tailored to Islamic values at the same time as it equips graduates to meet the professional challenges that lie ahead.[29]

PROPOSAL

It is therefore appropriate to structure a study examining the merits of enhancing genetics instruction in Saudi Arabia with the problem-based learning approach. A survey to assess the current status of medical genetics training at the various levels of medical education training would be an important starting point on the road to improving it.

PLAN OF ACTION

Each country has a characteristic pattern of common genetic disorders, and many issues associated with the practice of medical genetics differ between countries in their particularities, so that the curriculum cannot simply be adopted from elsewhere but requires serious consideration and planning in each country. There are, however, certain aspects which are relevant to any country's medical education curriculum. In addition to this, diseases form a spectrum from 'simple' Mendelian diseases with high penetration to 'complex' multifunctional diseases in which genetic factors have a relatively small role. However, genomics knowledge and approaches will soon be important to practitioners dealing with any diseases, regardless of where on this spectrum they reside.[7]

From a review of various reports and journal articles recently published, some important aspects in targeting the improvement of teaching medical

genetics in Saudi Arabian medical schools have been identified:

- In the basic curriculum covering basic and clinical genetics, a survey conducted in UK identified a list of essential core knowledge and skills for medical genetics in undergraduate education to find out which were being covered and assessed within courses, which were covered but not assessed, which varied between courses and which were neither covered nor planned to be covered in the future[10]. Adoption of that core knowledge and skills and customize it to incorporate in the medical schools would improve genetic teaching in the Kingdom of Saudi Arabia.
- Special study modules are useful in giving students the choice to pursue something of their interest; demand for such modules should be investigated in the light of what is already offered.
- In order to determine the structure of future genetics courses, it is necessary to look at current courses in order to find out whether genetics is covered as a separate subject or integrated with other subjects, and whether it is taught across departments or in only some departments. In 21 medical schools in the UK, the predominant types of curriculum used to teach genetics included problem-based, system-based and/or topic-based curricula.
- The amount of contact time already spent on each of the medical genetics topics in the curriculum would also be a guide as to how much more training is needed on each topic.
- Socio-cultural aspects of genetics teaching with reference to Saudi Arabian communities are also an important factor. In addition to financial reasons, legal and cultural issues may inhibit the progress in developing and implementing genetic programmes. Emphasis should be laid on training in relation to courses and topics dealing with the prevalent genetic diseases in the local population.
- The kind of learning resources currently used and their availability should be evaluated, establishing whether resources are developed by individual teachers themselves, accessed from the internet, developed in-house, based on CD-ROM material or other electronic resources, etc., and whether they are shared between members of staff. The budget for such resources must be considered.
- Another important aspect is, of course, teaching methods. In surveying genetics teaching leads in medical schools in the UK, the basic and clinical science teaching methods were found to include lectures, small-group teaching, self-directed learning of personal or group project work, problem-based learning assignments, clinic attendance, discussion classes, labs, demonstrations of practical work and also computer-based learning.
- It is necessary to find out the distribution of staff involved in teaching genetics, i.e. whether they are basic scientists, clinical teachers, specialist genetics teachers, social scientists or other healthcare professionals.
- Regarding assessment, it is important to decide whether genetics should be assessed as part of other topics or as a subject in its own right, and whether or not it is to be marked by genetics specialists.[10]
- Other important aspects are barriers to genetics teaching, the support that would be helpful in developing genetics teaching, and the place of genetics in continuing education programmes as well as in the prior knowledge of students entering medical college. Communicating genetic information and facilitating informed decision-making by patients is an essential skill, as is the skill of managing family dynamics, since genetics, unlike other areas of medicine, often involves families and not only individuals.[7]

RECOMMENDATIONS

El-Hazmi and Tekian, in their discussion of problems affecting student performance, note external examiners' constant assertion that training in problem-solving, conceptual thinking and self-directed learning is not emphasised sufficiently. Following final examination assessment, external examiners proposed that small-group teaching, with an almost mandatory amount of student participation, should be encouraged and developed. El-Hazmi and Tekian state that there is need to find out how far, if at all, this has been achieved over the years and to fully make problem-based learning and other educational strategies a reality.[14] To improve the teaching of genetics across the curriculum, a broad review into the current status of genetics teaching in Saudi Arabian medical schools would be necessary in order to identify specific areas that require improvement and also to identify ways in which these improvements can be made jointly or by individual schools.

CONCLUSION

Teaching genetics using the problem-based approach combined with other methods helps students learn to recognise genetic diseases and to

provide basic counselling in order to facilitate informed decision-making by patients and their families. Given the prevalence of genetic disorders within the Saudi Arabian population, it is crucial that medical professionals be equipped with the necessary training in genetics, using effective teaching methods that prepare them to play their medical role within their community.

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