The medical laboratory scientist in the clinical chemistry service laboratory

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Summary

The recent opening of an official register for medical laboratory scientists in South Africa has prompted an examination of the professional role, training and qualification of one particular group of scientists, namely clinical chemists working in hospital pathology departments. Lack of recognition of the potential contribution of these non-medical graduates towards improved health care, together with the lack of facilities for their professional advancement, has hitherto inhibited the growth and development of clinical chemistry in this country. An urgent need is the local establishment of a specialist postgraduate qualification open to the non-medical clinical chemist.

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The year 1981 saw the half-centenary of the publication of Peters and Van Slyke's now classic textbook *Quantitative Clinical Chemistry*,[1] the outcome of an early and highly successful collaboration between a biochemically orientated physician and a non-medical biochemist. It is generally regarded to have been prominent in the development of the modern era of scientific medicine in this important field.[2] The same year saw the establishment by the South African Medical and Dental Council of a procedure for the registration of 'medical laboratory scientists',[3] as well as the finalization of proposals by the Education Committee of the International Federation of Clinical Chemistry (IFCC) for a 2-year postgraduate training programme for non-medical graduate clinical chemists.[4]

This seems to be an appropriate time to examine the role which this professional group should undertake within the existing discipline of chemical pathology, the training programmes required to prepare them to fulfil this role and the formal qualifications denoting competence to do so. Furthermore, it is necessary to consider the interrelationship of clinical chemists with the already well-established professional groups, chemical pathologists and non-graduate technologists.

Development and present scope

Clinical chemistry has been defined as:[5] 'The study of the chemical aspects of human life in health and illness and the application of chemical laboratory methods to diagnosis, control of treatment and prevention of disease'. In its wording this definition recognizes a basic division of the subject into two overlapping and mutually supporting components: (*i*) fundamental research into the chemical mechanisms of disease and laboratory methods for their elucidation; and (*ii*) a 'service' function, concerned with the investigation of individual patients by means of tests and analyses made available in hospital pathology departments.

The service component of clinical chemistry, while dependent on the research component for indicating which tests may be useful and for providing many of the methods for carrying them out, is in terms of the number of persons involved and operating costs by far the larger of the two. Mitchell[6] has estimated that the world-wide provision of clinical chemistry laboratory facilities on the scale now existing only in the major developed countries would require a total professional work-force of some 800 000 pathologists, scientists and technologists.

Before considering the responsibilities of these three major groups, it may be helpful to review the scale and diversity of the work of the modern clinical chemistry service laboratory. From various published accounts of the development of clinical chemistry during the past 50-60 years,[7,8,9] the following important features may be discerned:

1. During much of this period, and certainly since the end of World War II, test workloads have grown annually by around 10-15%, or have doubled about every 5 years. There has been a growing tendency to measure the dynamic intermediates of metabolism in blood, rather than the 'spill-over' of the end-products of metabolism in urine. Increased knowledge of metabolic pathways has introduced into the test repertoire many assays of controlling factors such as enzymes and hormones.

2. A wide range of sophisticated analytical procedures are now routinely performed in the service laboratory. In many parts of the world the instrumentation and associated expertise to be found in the district general hospital laboratory are comparable to those found in the academic department or research laboratory.

3. While the increases in workload are partly attributable to the increased variety of tests performed, a high proportion of the total workload of the modern laboratory is comprised of a relatively small range of tests performed in large numbers.[6] This circumstance is associated with an increasing degree of mechanization of laboratory operations, including the use of automated techniques of analysis and computer-based processing of results.

The result of this great augmentation of the scientific and advanced technological aspects of clinical laboratory work has been an increasing dependence on non-medical professional staff, as expressed by Murray in the *SAMJ* in 1969:[10] 'The day when any doctor was completely self-sufficient is gone. No longer can he act as pharmacist, anaesthetist, obstetrician, laboratory technician, surgeon and physician all rolled into one. Not only has he become more specialized in a particular field of medicine, he has also become dependent on a vast array of paramedical personnel.'

Roles of the different professional groups

Recent proposals from the Royal College of Pathologists on the responsibilities of the senior medical graduate,[11] the science graduate[11] and the non-graduate technologist[12] working in the clinical chemistry service laboratory may now be considered.

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It is envisaged that the consultant chemical pathologist should devote a substantial portion of his time to the clinical aspects of the subject. While not normally including total clinical responsibility for patients in hospital beds, this should involve: (*i*) advising either directly or via junior staff on the investigation and management of patients, especially those with metabolic problems, by communicating daily with the clinicians on the wards, at case conferences, etc; (*ii*) providing an advisory service in chemical pathology for general practitioners; (*iii*) having the opportunity to undertake charge of all or part of one or more outpatient clinics for the investigation and management of patients with metabolic, endocrine or related disorders; (*iv*) preparing, in consultation with clinical colleagues, protocols for the efficient investigation of patients; and (*v*) initiation of and collaboration in research projects with a clinical bias.

The chief clinical chemist (denoted in the UK National Health Service as a 'top-grade' biochemist) should apply rigorous scientific methods to clinical laboratory problems, including: (*i*) critical evaluation of existing laboratory procedures and instrumentation, including quality control, and initiation of research and development to improve them; (*ii*) the development of new analytical methods; (*iii*) responsibility for advising on the choice, use and management of new analytical equipment both within and outside the laboratory; (*iv*) the provision of advice to other laboratory workers and clinical colleagues on such scientific aspects of laboratory work as computing and statistics; and (*v*) the investigation, in collaboration with clinical colleagues, of metabolic disturbances requiring a detailed understanding of metabolism and analytical chemistry.

The chief technologist should retain some active technical role to avoid isolation from his colleagues through exclusive concentration on administrative duties. The latter would, however, constitute his main responsibilities and would include: (*i*) the organization of the technical programme so that work patterns are efficiently maintained; (*ii*) the supervision of the performance of laboratory technical work and safety; (*iii*) the ordering of laboratory supplies and equipment and the proper care of equipment; and (*iv*) the development and supervision of the in-service training programme for technical staff.

The South African situation

In this country procedures for the registration of pathologists and technologists, together with nationally recognized qualifying examinations and defined promotional ladders, have existed for several years. The lack of corresponding facilities in respect of medical laboratory scientists has seriously retarded the growth of this professional group in South Africa. This becomes apparent on comparing the membership composition of the professional body for clinical chemistry, the South African Association of Clinical Biochemists, with that of the corresponding body in the UK (Table I).

In the UK a substantial number of senior clinical chemists work outside academic hospital departments in district general hospitals, and will have qualified, following their first B.Sc. degree course, through one of the several M.Sc. courses offered by university departments. Subsequently, full professional maturity will be denoted by their obtaining such higher qualifications as the M.C.B. (Mastership in Clinical Biochemistry) or M.R.C. Path.

TABLE I. MEMBERSHIP OF THE SOUTH AFRICAN AND UK ASSOCIATIONS OF CLINICAL BIOCHEMISTS (1981)

	South Africa	UK
Medical graduates*	**53 (54,6%)**	**341 (18,3%)**
Science graduates		
Doctorates	**24 (24,8%)**	**528 (28,3%)**
Bachelors/Masters	**20 (20,6%)**	**997 (53,4%)**
Total	**97**	**1 866**

*With or without additional scientific qualifications.

In South Africa clinical chemists, besides being fewer than chemical pathologists, are heavily concentrated in academic or associated research departments; their avenue towards qualification will be the research-based doctorate in philosophy, while the ultimate career objective for many will be the coveted title of associate professor!

While a slavish imitation of the practices of another country is as undesirable in medicine as in any other field, it is noteworthy that not only immigrants or visitors to this country but also professional spokesmen in South Africa have expressed dissatisfaction with these disparities. The President of the South African Association of Clinical Biochemists, Prof. S. M. Joubert,[13] has eloquently championed the cause of the non-medical clinical chemist: 'If the role of the technologist has been clearly recognized, I fear the position of the non-medical professional man has been almost ignored: there is certainly no recognized national staffing structure; their positions within departments differ from centre to centre; training requisites are poorly defined in that they come from Agricultural Faculties, Science and Biology Faculties and Departments of Medical Biochemistry attached to Medical Faculties. In employment they find themselves variously in academic posts, research posts, professional officer posts, and so on. In short, nothing which offers identity, status or standing, forever the poor relation slotted into something for which they were not intended and often seeking promotion and identity through some *ad hoc* arrangement; all this in utter disregard of their great and invaluable contributions, indeed their indispensable services. *There is no greater need in the whole of chemical pathology than immediate attention to the training, identity, staffing structure and position of the medical biochemist.*'

Training and qualification

Some idea of the type of knowledge and experience required by the senior clinical chemist can be gained from the list of responsibilities associated with this post. The four main areas in which knowledge has to be instilled by appropriate training and subsequently assessed by examination are: (*i*) technical and analytical aspects; (*ii*) scientific, in particular biochemical and physiological aspects; (*iii*) clinical aspects; and (*iv*) organizational aspects.

It is possible to envisage two main educational pathways for the clinical chemist:

1. An early specialization in the disciplines of the clinical laboratory is obtained through a first-degree course in 'laboratory medicine'. Such a course would provide a groundwork in all branches of clinical pathology during the earlier years, with progressive specialization towards a single branch (i.e. clinical chemistry) to be studied in the final year. Subsequently a higher academic qualification (M.Sc. or Ph.D.) would be obtained by dissertation, followed later by a higher professional qualification in the form of some local equivalent of the M.C.B. or M.R.C. Path.

2. Specialization is delayed until after the completion of a first-degree course in more 'general' subjects such as chemistry or biochemistry. Subsequently, entry into clinical chemistry is through a higher academic qualification (M.Sc. or M.Sc. (Med.)) involving extensive course-work with possibly a short research project; this course-work would be confined to the single topic of clinical chemistry. At this point the two pathways converge, leading to the attainment of the higher professional qualification as outlined above.

These two routes have been referred to as the 'specialist pathway'[14] and the 'general pathway';[15] since the final objective is

specialization in both cases it might, however, be preferable to denote them as the 'early specialization' and 'delayed specialization' pathways.

Both routes offer certain advantages and disadvantages. The graduate in one of the well-recognized academic sciences such as chemistry or biochemistry who later specializes in clinical chemistry will be at a disadvantage relative to his medical and technical colleagues through lack of knowledge of the basic principles or even the terminology of microbiology and haematology. On the other hand, the vocationally trained medical laboratory scientist whose undergraduate training 'includes most if not all of the sciences covered in medical training without the clinical practice'[14] will be something of a 'jack of all trades' without a depth of knowledge sufficient to distinguish him greatly from medical technologists trained at technical colleges. Although he may be able to start participating in the routine work of the service laboratory more quickly, his long-term potential would be limited by the superficial nature of his scientific knowledge. As observed by Marsden:[15]

'Given a good graduate (in some traditional science subject) familiarization with the techniques of the clinical laboratory ought not to be a problem. It will be interesting to see whether the graduates with degrees in medical laboratory sciences will be really outstanding. Laboratories differ in the ways they do things and there is a wider variety of instrumentation in use at present than for many years. Moreover, few educational institutions can afford the kind of machines now used in clinical laboratories.

'Given the choice of an upper second class graduate in physics or a third class graduate in medical laboratory sciences, I would pick the upper second class degree person every time!'

Nature and objectives of vocational training programmes

In the training of the clinical chemist, by whatever means, it is important to ensure that the final product is professionally distinguishable from the senior technologist. During recent years strenuous efforts have been made in this country to improve the standards of medical technology through such measures as the revision and upgrading of the syllabuses for the Final National Diploma, the provision of full-time technical college courses and the establishment of the School for Advanced Medical Technology at the South African Institute for Medical Research. It would be a waste of both time and money to introduce graduate medical laboratory scientists in competition for posts as senior technologists.

For this reason the stated objectives of the training programme put forward by the IFCC[4] appear rather narrow: 'Graduates (of the programme) would be expected to have advanced capabilities in such areas as method development and evaluation, quality control trouble shooting and minor repair of general laboratory equipment and general organization of workloads and technical staff. These duties would be carried out under the immediate direction of the laboratory director or qualified alternate.'

It is doubtful if any university department in South Africa offering an M.Sc. by course-work in clinical chemistry and describing the course in such terms in its prospectus would receive many applicants! There is too great an overlap with the responsibilities of the senior or chief technologist as given earlier — the product of such a course could be regarded as a 'graduate technologist'. Consequently, such an M.Sc. course should not be regarded as the final training of the medical laboratory scientist, but only as an intermediary stage during which familiarity with the work of the service laboratory is gained.

The introduction of a register for medical laboratory scientists, already achieved, and the provision of training and qualifying mechanisms (which should not present insuperable problems) will be pointless without the establishment of a professional ladder, the rungs of which would be properly designated posts.

Specialist qualification for the senior clinical chemist

In contrast to the Ph.D. or M.Med. (Path.) degrees awarded by a particular university, the specialist qualification should be available on a national basis. In the UK four professional bodies make up the Joint Examination Board for the Mastership in Clinical Biochemistry, namely the Royal College of Physicians, the Royal College of Pathologists, the Royal Society of Chemistry and the Association of Clinical Biochemists. In this country participation could perhaps be limited to the College of Medicine of South Africa and the South African Association of Clinical Biochemists. In addition to setting the actual examinations, the examining board should be concerned with the accreditation of laboratories for training purposes.

The setting up of a register for medical laboratory scientists will in future permit the South African Medical and Dental Council to exert powerful control over the professional lives of clinical chemists. The joint sponsorship of a specialist qualification would seem an ideal mechanism for the College of Medicine to instil its own influence into the training and qualification of the clinical chemist.

Conclusion

The need to improve the position of clinical chemists commensurate with their qualifications and responsibilities and to attract more scientists into this area has been most keenly felt by those closely associated with them, the medically qualified chemical pathologists.[16] It is the latter who will be most aware of the important contribution that the clinical chemist can make to improve standards of patient investigation in service laboratories. However exasperatingly slow the evolutionary changes brought about by his medical protagonists may seem, progress *is* being made. In the meantime, the clinical chemist must seek consolation in the philosophy of life propounded nearly two centuries ago by the Ayrshire poet, Robert Burns — a philosophy which some members of the medical profession seem often more ready to advocate for their non-medical colleagues than to adopt for themselves:

'For a' that, and a' that,
Our toils obscure, and a' that,
The rank is but the guinea stamp;
The man's the gowd* for a' that.'

*Gold.

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The opinions set out in this paper are those of the author and do not represent the official policies of the South African Institute for Medical Research or the Council of the South African Association of Clinical Biochemists.

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