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Duties and responsibilities of laboratory scientists

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Abstract

The duties and responsibilities of laboratory scientists are still evolving. In this paper, I briefly summarize some of the classical duties and responsibilities of Clinical Chemists in the areas of research, education and service. Furthermore, I developed some general rules of success for younger laboratorians. It is clear that we are living in exciting times and Clinical Chemists must learn to adapt very quickly to the continuing changes in our discipline. The new developments in science and technology suggest that we are yet to realize the best times of this exciting profession. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Laboratory Medicine has contributed for centuries to the diagnosis of human disease [1,2]. Despite this, the duties and responsibilities of laboratory scientists and physicians are still evolving [3]. It may thus not be a mere repetition, my attempt to review briefly this subject in the 21st century. Obviously, most of the material that I will discuss is very well known to practicing laboratorians [4]. One of my ambitions is to use to this forum to explain to newcomers what it is that we do and, most importantly, provide them with some advice that may help them to enjoy successful careers. My background is mostly in Clinical Biochemistry and this presentation will be biased towards this discipline. However, I believe that the outlined principles will likely be applicable to other laboratory subspecialties as well. I should also caution the reader that this is a personal perspective and not a review of the literature. In fact, I do not cite much literature and I assume full responsibility for the ideas presented herein. Furthermore, I would like to stress that when using the term *clinical or medical biochemist* I do not make any distinction between these two types of specialists.

2. What is a laboratory scientist?

To put it by way of exclusion, I should say that a laboratory scientist is not exactly a researcher or a teacher or a manager or a clinical consultant, or an administrator or a physician but, at the same time, it is all of the above. Moreover, Clinical Biochemists can be separated into various categories by degree (MD vs. PhD), by duty (education, service or research) or by employer type (academic vs. nonacademic hospital, private laboratory, industry, government, etc.).

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These analyses suggest that our profession is extremely diverse, and it may be difficult to find many laboratory scientists with exactly the same duties. In the late 1980s and early 1990s, the notion was put forward by some of us that the duties and responsibilities of laboratorians, and especially of Clinical Chemists, can be successfully fulfilled by technologists and technical managers [5]. Unfortunately, the overzealous desire of hospital administrators to save money prompted them to adopt this principle. The consequences were job losses and lack of interest of young scientists to enter the field. This notion, underlined with the motto ''Clinical Chemists are useless, overpaid Supertechs'' has damaged severely the reputation of our profession, many professionals as well as the hospitals that adopted it. It is now very clear that this experiment was a failure and that the notion was erroneous. Over the last 3–5 years, we have seen the recovery of the profession from this shock and the rebuilding process, at least in Canada, is progressing with good pace.

However, what are the duties and responsibilities of laboratorians? These evolve around three major themes: Service, Education and Research.

3. Service

It should be remembered that the unique identity of a ''Clinical Chemist'' as a laboratory scientist is defined by the service component of the profession [6]. Without this, we would be generic researchers and educators, found in any Faculty of Medicine department.

In Table 1, I summarize some service responsibilities of laboratory scientists. It is clear that the responsibilities in service are very diverse. Clearly, laboratory technologists are not qualified or trained to perform clinical consultation, sophisticated quality assurance and control, detailed instrument evaluation, complex method development and evaluation, validation and trouble-shooting or are capable of introducing specialized programs (an example is given below).

Table 1
Some service responsibilities of laboratory scientists

- Clinical consultation
- Laboratory management
- Quality assurance and quality control
- Accreditation—manuals—documentation
- Cost containment
- Instrumentation selection and evaluation
- Method evaluation/validation/trouble-shooting
- Implement special programs (see example below)
- Survey of customer needs/satisfaction
- Information technology
- Staff selection and evaluation

Table 2
An example of specialized testing in Clinical Biochemistry[a]

- Maternal serum screening program
  Options:
  - 2nd Trimester only
  - 1st Trimester only
  - 1st and 2nd Trimesters combined
- Which biomarkers? (AFP, estriol, free beta HCG, ± inhibin, PAPP-A)
- ± Ultrasound
- Which interpretative algorithm? (at least 7 different ones)
- Requisition (clinical + demographic info)
- Research (patient consent)
- Interface (clinical chemist, ultrasonographer, geneticist, genetic counsellors)

[a] For more discussion, see text.

One can cite numerous examples of valuable, professional expertise that can be used by clinical laboratories to set-up new programs. One classical contemporary example is the introduction of ''Maternal Serum Screening'' programs for prenatal diagnosis of Down syndrome and neural tube defects. A few years ago, this screening was performed on second trimester maternal serum, analyzed for alpha-fetoprotein, human choriogonandotropin and estriol. Nowadays, there is compelling evidence that first trimester screening may improve the detection rate and, at the same time, cut down on the rate of false positives. Others postulate that it may be necessary to run first and second trimester programs for best performance. The issue of screening for first or second trimester is complex because there is an array of new biomarkers, including inhibin and pregnancy-associated plasma protein A (PAPP-A) as well as modern ultrasonography. The decisions as to which tests should be done, with or without ultrasonography, are quite delicate. Furthermore, the generated data need to be interpreted with specific algorithms that will calculate the risk and then provide suggestions for appropriate clinical action (amniocentesis, abortion, etc.). Such algorithms have been developed by various researchers and companies (at least seven are commercially available

now), and the results obtained are not identical. Also, designing a requisition that will capture all the clinical, demographic and other information in an ethical manner is not easy. The implementation of such a program in a teaching hospital must take into account that research should be promoted with such samples, to discover new biomarkers for the future. To this end, it will be mandatory to obtain patient consent. Clearly, such a program will require the collaboration of the clinical biochemist, the ultrasonographer, the geneticist and the genetic counsellor. All these parameters are summarized in Table 2.

I conclude from this brief analysis that the Clinical Biochemist has major roles to play in the laboratory and participate decisively as a medical team player in delivery of high quality patient care.

4. Education

In the next paragraphs, I will summarize briefly some educational responsibilities of laboratory scientists [7,8]. In academic hospitals, Laboratory Medicine University departments rely heavily on hospital-based laboratorians to carry out the bulk of the teaching at the undergraduate (arts and sciences, medicine and other related sciences), graduate (MSc and PhD) and professional program levels (specialized training of laboratory professionals, including clinical chemists, clinical microbiologists, anatomic pathologists, etc.). Furthermore, academic laboratory scientists should participate in the organization and coordination of new courses. Nowadays, there are numerous opportunities for creating web-based and electronic-based media for teaching [9,10]. Laboratory scientists are also frequently called upon to organize workshops, symposia and conferences at the national and international level. Moreover, continuing education is now becoming an important part of maintaining certification and competence in many professions, including Laboratory Sciences.

These educational activities are further summarized in Table 3, underscoring the vast opportunities that exist in this area.

Table 3
Some educational responsibilities of laboratory scientists

- Teach at levels:
  - Undergraduate
  - Graduate
  - Professional programs (Diploma)
  - Technologists
  - Medical students
  - Physicians
- Organize and coordinate new courses
- Web-based teaching
- Organize workshops, symposia, conferences
- Continuing education

Table 4
Some research activities of laboratory scientists

- Method development and evaluation
- Lab support to clinical research (co-investigator)
- Individually funded
  - Graduate students
  - Post-Docs
  - Mechanisms of disease
  - Translational research
  - Basic research

Only limited by our imagination

5. Research

The research activities of laboratory scientists are summarized in Table 4. These include method development and evaluation, laboratory support to clinical research in which the laboratory scientist will be a co-investigator, as well as individually funded research which involves grants, graduate students, Post-Doctoral Fellows and projects related to mechanisms of disease, translational, as well as basic research. My opinion is that the research activities of laboratory scientists should only be limited by their imagination. Laboratory scientists should not restrict themselves to method evaluation and laboratory support of other scientists. This will assign us a secondary role that may not be highly respected by our peers.

6. What are the needs of hospitals for laboratory scientists?

This has always been debated by hospital administrators. My recommendation to nonacademic hospitals is to hire a full-time Clinical Biochemist for

every 500 hospital beds (approximately 90% service-related activity). For academic hospitals, my recommendation is for one Clinical Biochemist per 100–150 beds. These latter individuals will split their time between service, education and research. At academic institutions, where clinical consultation is important, my recommendation is to mix-up the staff so that medically oriented and science-oriented professionals are working together. I also believe that it is not a good idea for all laboratory scientists in one institution to pursue widespread research programs with external funding. It will be more important to have a team with expertise to carry out all three responsibilities (service, education, research) in an optimal manner.

7. Rules of success

In this paragraph, I will make a few comments regarding success which go beyond the well-known attributes of successful individuals, i.e. hard work, dedication, enthusiasm, etc. In science, and especially in laboratory science, the laboratorian has to stay abreast with the current "fashions" in science and technology. This will be important during interactions with physicians and other investigators. My suggestion is that the laboratory scientist goes to at least two scientific conferences a year, preferably one that is of a general nature (e.g. the American Association for Clinical Chemistry annual meeting) and one that is more specialized to the interest of the individual. Another way of keeping an eye into research developments in science in general is to subscribe and read one or more of the top multidisciplinary scientific journals, like "Nature" or "Science". From my own experience, I found that it is not so important to read the actual manuscripts of these publications but to scan the journal for new technologies (through advertising) as well as read the commentaries and other news that are presented on a weekly basis. There is almost nothing that is important in science and technology that is neglected by these publications. Nowadays, one can search with keywords thousands of publications through "PubMed" to keep up with what is going on in a specific area of research.

Table 5
Some rules of success

- Over and above the usual:
  - hard work
  - dedication
  - enthusiasm, etc.
- Upgrade your knowledge continuously:
  - 2 conferences/year (1 general, 1 specific)
  - Read journals such as Nature, Science
  - Medline, web searches
  - Stay abreast of current "fashions" of science and technology
- Develop a specific expertise which is recognized:
  - Regionally
  - Nationally
  - Internationally

Become Mister or Madam—Something

- Be recognized and known by your customers (clinicians)

Table 6
The "Nobody" rules

- Nobody will give you research space unless you prove that you "deserve" it.
- Nobody will give you protected time for research. You have to create it yourself.
- Nobody will likely ask you to design and co-ordinate a course. You must recognize the need yourself and then jump-in and do it.
- Nobody will ask you to write a grant but if you get one, your boss will be very proud.
- Nobody will ask you to be "distinguished" but if you can be, your hospital will love it.

Another important goal of academic laboratory scientists would be the development of a specific expertise which is recognized regionally, nationally and internationally. Characteristically, laboratory scientists who enjoy wide reputation are usually known as 'Mr. or Madam something'. These people are highly valuable and hospitals and other academic institutions compete to recruit them. At the hospital level, it is important that the laboratory scientist is recognized by his/her customers (clinicians). This can only be accomplished if the laboratory scientist attends Clinical Rounds and other similar activities on a regular basis. A summary of these statements is provided in Table 5.

Another important success rule that young laboratory scientists should consider is to show initiative in all aspects of the profession. In Table 6, I have assembled a set of rules which I call "The Nobody Rules". These rules aim to underline that it will be *our* responsibility to become successful, not necessarily our Boss' responsibility.

8. Conclusions

The duties and responsibilities of laboratory scientists are well known and they have been published repeatedly in job descriptions and professional journals. In my opinion, the issue is not what the duties and responsibilities are, but rather, how these can be fulfilled in a manner that helps the patient, the hospital and the university.

As I have indicated, we should not accept the notion that research in our discipline should be restricted to incremental technological advances and evaluations, or to a supportive role. On the other hand, if we were to be effective teachers, we must continually upgrade our knowledge, identify the new trends in technology and science and be prepared to accept (and even promote) changes. Since our profession and its areas of activity are evolving continuously due to technological advances, we should adopt a very flexible approach towards change. This will ensure that we will not be surpassed by our times; if we do, we may become redundant!

It is important for those who work at academic institutions to realize that this is a competitive environment which requires their involvement in academic work at all levels (including peer-reviewed funded research and high quality education). Simply, I will put it this way: ''Those who work at academic institutions must do academic work''.

Another important advice to our younger colleagues is to maintain throughout their careers high moral and ethical standards. Our profession requires extensive interactions with industry and our reputation and credibility can only be maintained if we are fair and our decisions are objective and free of biases and financial conflicts.

I hope that these recommendations, which are based on personal experience rather than analysis of literature, will help the young laboratory scientists to become successful in their field. By doing that, they will ensure that the future of laboratory science and medicine is bright. The new developments in science and technology suggest that we are yet to realize the best times of this exciting profession.

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