The Road to Becoming a Biomedical Physician Scientist in Pathology and Laboratory Medicine

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This career guide booklet was originally inspired by a workshop entitled “Career Pathways in Pathobiology for Physician Scientists,” presented at Experimental Biology 2003, San Diego, CA and sponsored by the American Society for Investigative Pathology (ASIP). This new edition meets the even greater need today to train and employ physician scientists to lead discovery and translational research in academic Departments of Pathology and Laboratory Medicine in order to link clinical laboratory medicine with the highest quality of innovative and transformative research in human disease. ASIP is a professional society of biomedical scientists who investigate mechanisms of disease with an important objective of advancing the development of personalized medicine in clinical health care. ASIP thus fosters the professional career development and education of those interested in the study of mechanisms of disease, and thus is committed to advocate for the training of physician scientists.

I acknowledge discussions with numerous colleagues, trainees, and students over the past 35 years who shared their thoughts with me on this important topic. Their discussions on how to attract, develop, and nurture basic, translational and clinical investigators is much appreciated. I appreciate the mentors I have had who were willing and eager to devote time and energy to help shape my own career and those of many of my colleagues as we progressed through medical school, anatomic pathology subspecialty training, and research training.

I appreciate the assistance of Natasha Lowe and previously Sursattie Sue Sarju, Department of Laboratory Medicine and Pathobiology, University of Toronto, and Alta E. Wallington, American Society for Investigative Pathology.

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March 2013

ASIP acknowledges the financial support of the Intersociety Council for Pathology Information (ICPI) to produce this 3rd edition, which is posted at www.asip.org. Contact the ASIP for more information:

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Professor Avrum I Gotlieb, former Chair of the Department of Laboratory Medicine and Pathobiology (LMP), Faculty of Medicine, University of Toronto, obtained his BSc in Psychology and Physiology, with first class honors, (1967) and his MDCM (1971) from McGill University. He continued his training in medicine and anatomic pathology at the teaching hospitals of McGill University. He obtained his Fellowship from the Royal College of Physicians and Surgeons of Canada in Anatomic Pathology (1975) and certification from the American Board of Pathology (1976). He pursued research training in the Department of Biology, University of California San Diego with Professor SJ Singer, supported by a Medical Research Council Fellowship. He is currently Interim Vice Dean, Graduate and Life Sciences Education and Senior Academic Advisor to the Dean, Faculty of Medicine, University of Toronto.

Professor Gotlieb held administrative appointments in two educational areas in LMP; Coordinator of Graduate Studies and Course Director, Pathobiology of Disease, Undergraduate Medicine. An educational program initiated by Professor Gotlieb in 2000 was an innovative and unique undergraduate arts and science Specialist Program in Pathobiology. Professor Gotlieb has also been championing the role of physician-scientists in academic laboratory medicine.

Professor Gotlieb's research interests include atherosclerosis and valvular heart disease. He has published on blood vessel repair especially on the role of the cytoskeleton in endothelial repair and his research group studied how heart valve cells repair valves after they have been injured. He has published over 100 peer reviewed papers, and 35 reviews and book chapters. He edited three books, including the comprehensive textbook Cardiovascular Pathology, edited with colleagues MD Silver, University of Toronto, and F Schoen, Harvard Medical School. He has received peer reviewed funding from the Heart and Stroke Foundation of Ontario and the Medical Research Council (now Canadian Institutes of Health Research), CIHR.

Professor Gotlieb is past co-Editor of Cardiovascular Pathology, a journal of the Society for Cardiovascular Pathology dedicated to basic, clinical, and applied cardiovascular science published by Elsevier. He serves on the Editorial Boards of The American Journal of Pathology (AJP) and Laboratory Investigation.

Professor Gotlieb is a former President of the American Society for Investigative Pathology (ASIP) and past President of the Canadian Society of Atherosclerosis, Thrombosis and Vascular Biology (CSATVB) and the Society for Cardiovascular Pathology (SCVP). He was a member of the Board of the Federation of American Societies of Experimental Biology (FASEB) and served as FASEB Vice-President for Science Policy. He is an elected Fellow of the Canadian Academy of Health Sciences and was honored by SCVP with the Distinguished Achievement Award and by ASIP with the Robbins Distinguished Educator Award.
A physician scientist is a unique clinician who is part of a small cadre of physicians who usually work in academic health science centers and have a high impact on health care through discovery, translational and clinical research, and clinical practice. A physician scientist in Pathology and Laboratory Medicine is a laboratory physician who is trained in both scientific biomedical investigation and in pathology and/or laboratory medicine, often with clinical subspecialty training. The reason to train physician scientists is dual. On the one hand, the physician scientist brings the rigors of scientific investigation into the patient care arena and on the other hand, the physician scientist's contact with disease brings clinically relevant questions into the research arena to drive investigations into pathogenesis, prevention, diagnosis, prognosis, and treatment of disease. Physician scientists form a core group who can instill the core values of academic laboratory medicine into medical students and young trainees. In addition, physician scientists are able to provide leadership in communicating information to the public and government on how biomedical science benefits healthcare.

Who better to study disease than those who know it intimately? Who better to provide clinical care than those who have a facility with problem solving, hypothesis testing, and critical thinking? Both clinical care and research benefit enormously from this cross fertilization of knowledge and critical thinking. In fact, it is not uncommon that normal biological processes become better understood due to the study of the pathobiology of disease. In addition, the physician scientist is perfectly suited to the role of a transmitter of basic and clinical knowledge, especially new and emerging knowledge. The linking of high quality teaching with innovative high impact research is a very powerful educational approach to prepare medical students and residents for self directed learning that will serve them throughout their career.

Health care is undergoing dramatic changes as biomedical research and technology allow us to critically explore prevailing concepts and discover new knowledge to advance new paradigms. The clinical tissue and human biologic material that pathologists and laboratory physicians see on a daily basis in their clinical practice provide intellectual inspiration and direction to investigate
mechanisms of human disease in novel and productive ways. In addition, much more consideration is being given to the social, cultural, and outcome parameters of health care delivery. Pathology and laboratory medicine have led the way in the past several years utilizing molecular, genetic and imaging technologies to chart the new frontiers of academic medicine - in teaching, research, and clinical care. In the clinical sphere, advanced laboratory technologies are being developed and adapted to diagnose disease earlier, more accurately and with a greater ability to predict outcomes. Pathology and laboratory medicine are at the forefront of developing the knowledge platforms for personalized medicine.

By being at the crossroads of basic science and clinical medicine, pathologists are in the enviable position of understanding how to develop appropriate in vitro and in vivo models to investigate complex mechanisms of human disease. The phenotypes arising from genetic manipulation are being thoroughly studied, including using imaging methods that effectively combine morphology and molecular biology, a powerful combination to understand genomic and proteomic function. Thus, laboratory physician scientists are in an excellent position to generate and effectively communicate new discoveries and state-of-the-art knowledge to the clinical arena. In fact, it is only through high quality research that health care costs will be controlled and the burden of disease will be reduced in the population.
Medical students experience numerous disciplines during their training and are required to choose a speciality to train in, often before they have had the opportunity to obtain sufficient information and exposure to make a truly informed decision. Departments of Pathology and Laboratory Medicine are well advised to develop opportunities and programs in the medical student curriculum to expose students to clinical aspects of pathology and laboratory medicine and to basic, translational, and clinical investigations in laboratory medicine and pathology.

By its very nature the discipline of pathology and/or laboratory medicine has distinct advantages in allowing a trainee to fashion a successful career as a physician scientist that embraces the best in research and patient care.

- The core values of the speciality are research and education.
- The speciality is at the interface of clinical care and basic science.
- The speciality is at the interface of translational research and clinical care.
- Pathologists and laboratory physicians are the custodians of human biologic material and thus have an understanding of how to use this material to generate new knowledge in the pathogenesis of disease, in biomarker research, and in clinical practice.
- Clinical subspecialty training programs link clinical education to research training.
- The specialty is highly involved in providing the knowledge base for the practice of personalized medicine.
- Pathologists and laboratory physicians have the training to carry out anatomical, biomedical and molecular analyses of animal model systems, an essential tool to study human disease.
- The clinical practice of pathology and laboratory medicine requires numerous skills that are identical to those required in basic, translational, and clinical research.
- Pathology and laboratory medicine is a high-intensity, knowledge based speciality and requires constant self-learning to provide high quality patient care, similar to the requirements of a research investigator.
- There are many interfaces that are available between pathology/laboratory medicine and industry especially in the pursuit of prevention, diagnosis, prognosis, treatment and understanding of disease.
Is the Physician Scientist Career for Me?

You have to carefully consider whether you have the interest and motivation to fashion a physician scientist career, which should fit your own intellectual, biomedical, lifestyle, cultural, and research goals.

Training to be a physician scientist is long and at times difficult and thus requires careful planning. Mastering two careers in order to fashion one hybrid career as a physician scientist is particularly challenging. The successful physician scientist is generally an individual who is intelligent, very highly motivated, hard working, efficient, and an excellent problem solver, who likes to be challenged by difficult problems. Often numerous failures will precede the experiments that ultimately provide data that satisfies your curiosity and leads to a high impact well cited journal article. Thus instant gratification is not on the menu but a high tolerance for frustration and failure are. Once you accept this, the rewards are numerous. You are at the forefront of your field. You create the literature and are a consultant with unique knowledge. You are invited to share your expertise and knowledge with colleagues at scientific meetings and at universities and hospitals and you make important contributions to health care.

You are in the dynamic world of academic medicine where inquiring minds are constantly searching for scientific truths. Your work has impact on clinical care, either directly or indirectly. You yourself have an interesting and comfortable lifestyle.

To make informed decisions about career choices, it is important to have exposure to active physician scientists. A good way to do this is to spend time in the laboratory of a physician scientist and participate actively in a project course, a summer student program or a work placement. Immerse yourself in the program so you get full value. If you work in a large laboratory, you may get to spend little time with the busy principle investigator physician scientist. More junior physician scientists with smaller laboratories may be able to offer a better first look at a physician scientist career. Discussing career choices with knowledgeable career counselors, current trainees, and junior and senior faculty is very helpful. Remember that in the final analysis it is your choice to make. Also no choice is irrevocable so if you start and you see you are not having fun, reassess your choice. But remember to give yourself a chance. Embarking on a new adventure can be stressful and may initially not live up to expectations. If you feel things are getting better after a poor start, you probably did make the correct decision in the first place.

Do not be concerned about expressing frustration and doubts. We all have them. Try to solve issues as they arise during your exploratory adventures into the world of the physician scientist. Don’t only focus on the failures but identify the successes you have as you prepare to make your decision to follow the rewarding path of the physician scientist.
The objective is to complete dual training either at one institution or at two or more institutions. How you accomplish your training may be the result of a carefully crafted career plan or by simply taking advantage of opportunities that appear as you follow your path of training. Usually it is a combination of planning and serendipity. Never lose sight of your ultimate goal and realize that there are several different pathways that will get you there. Your own personal circumstances are important in determining the steps you take along the way. Remember that although the end is important, the journey must be pleasant, fun, and as direct as possible so that you do not become a perpetual trainee. In some programs the trainees are offered flexibility to achieve the best training that suits their own background.

These are some options:

**PhD followed by MD**
This pathway provides for a strong research background before entering your MD program. A PhD in the biomedical and related sciences should provide you with a strong background in scientific investigation and an in-depth focus in one specific area. Exposure to science that relates directly or indirectly to understanding the pathogenesis of human disease is most helpful. The PhD degree provides you with a unique perspective as you carry out your medical training. It enhances your ability to focus on medicine as a discipline that relies on hypothesis testing in abnormal human biology. Whatever your PhD was about, you bring to your medical training the academic rigor of investigative work that focuses on in-depth knowledge, thorough understanding of experimental design and effective critical analysis. Your graduate courses and thesis work provide excellent training to carry out critical analysis of the medical literature to guide diagnosis and treatment of your patients. The difficulty is that in most MD programs, you will be away from the research milieu and will need some further research training at the end of your MD or residency training. This may be in the area of your PhD research or you may have identified new areas of interest during your clinical training.

**MD/PhD**
These are traditional programs that integrate research and medical training without sacrificing the quality of either. In most cases, the programs demand defined times when only one of the programs is intensely studied, however there is usually some integration between research and clinical activities. The program usually takes 7 to 8 years to complete which means that your PhD training needs to be focused. There is a shorter time between completion of the PhD and
initiation of independent research as a faculty member when compared to obtaining a PhD before medical school. This program however needs some postdoctoral training at the end of the MD/resident training before embarking on an independent faculty position. These MD/PhD programs each have a limited enrollment and often provide generous financial support during the full program, for both the PhD and the MD components.

Physician Scientist Training Programs

These are usually programs that combine residency and research training. The motivation to do research and the choice of a research topic is often influenced by the clinical training in medical school. This type of program presents the opportunity for clinical training to drive research training. You may be able to apply elective time in your clinical component toward completing a graduate degree. It is important, however, that you have adequate time for high quality clinical training and that the research component provides a solid experience with quality outcomes including first-authored high-quality papers. The National Institutes of Health, and National Cancer Institute in particular, have developed special grants for physician scientist training programs. For more information, see www.nih.gov. For information about residency and fellowship training programs in Pathology and/or Laboratory Medicine, visit the ICPI website at www.pathologytraining.org.

Post Residency Training

In this pathway, the trainee completes the residency program and then embarks on a formal research training program, often leading to a PhD. This route usually involves research training during a research fellowship. The major advantage of this route is the proximity of the research training to the start of independent practice, allowing the trainee to "hit the ground running" at the end of training. These programs may also provide for research funding for a few years while starting an independent faculty position. Some trainees elect to do research training outside a formal graduate program in a research lab. The primary drawback of post residency training, especially for those without a prior research background, is that it often means a shorter duration of formal training in research, as the personal and financial disincentives towards spending extra years pursuing a PhD vs. beginning clinical practice become an issue for some. Depending on the quality of the post-residency research experience, this route may not necessarily be disadvantageous; though for some, it may make competition for initial grants more difficult, at least in the short term, since their CV may not reflect enough high quality work. Biomedical research is highly competitive, so taking up your first faculty position with a strong CV is of great benefit.
Choosing a Training Program

Be well informed choosing a program. Decide which route(s) you wish to fully explore. Do your homework thoroughly and look at several programs to be able to select the best one for you. The fit must be right. Know what type of research you wish to do; basic biomedical science, translational research, public health, social sciences, biomedical engineering, health administration and others. Know what you want out of the program. Do you suit the program and does the program suit you? Speak to as many trainees as possible to get a consensus opinion. You will find some trainees who are satisfied with everything and some who can see no good in anything in the program. What you need is a balanced view and to get this you need to ask probing questions and try to get specific answers, not general impressions.

Medical schools and hospitals differ and you should be very familiar with the philosophy of each of their training programs. How important is research for the faculty as a whole? Does the curriculum facilitate research opportunities during medical school and during residency programs?

The clinical part of the training is provided by numerous clinical staff, often in their own areas of expertise. You are exposed to so many teachers during medical school and residency training that your individual experiences will end up being mixed, some very good and some less so. The program director and the resources available are important in establishing and maintaining a high quality clinical program. A diverse mix of cases, strong subspecialty expertise with dedicated teachers, and strong opportunities for clinical-pathological correlations are important in establishing the quality of the clinical experience.

**Quality of the Program:** What is the quality of the institution as a whole? What is the quality of the medical school, the teaching hospitals, the research, and the clinical care and teaching? Speak to as many trainees as possible so that you can obtain several opinions about the program. Try to get a sense of the level of contentment within the Faculty since a happy faculty tends to be much more inclined to create a healthy exciting environment for clinical training and research training.

**Infrastructure:** What is the financial situation and the research infrastructure at the institution as a whole and in the department you plan to train in? Is major equipment readily available? Does your potential supervisor have the infrastructure he/she needs to carry out first class research?
Academic Program:

- Is there a clear description of the program available to trainees?
- How well do research and clinical training blend?
- Are there seminar series and visiting lectureships organized for trainees and faculty?
- How good is the library and the associated information technology?
- Is there a critical mass of trainees in the program and in the institution as a whole?
- Does the program provide opportunities for formal presentations of research?
- If a graduate program is pursued, is there a strong policy with respect to student advisory committees and student mentoring?
- Does the program have well defined policies on training and graduate education, e.g. ethical conduct in research, intellectual property guidelines, publication policy, invention policy, safety policy, code of behavior on academic matters, graduate supervision policy and guidelines, etc.
- What is the time to completion for the program?

Personal Issues: Do not be concerned about discussing salary, benefits, book and travel allowances with potential supervisors and program directors. Discuss holiday time, meeting time, sick time, benefits and health insurance. These are all important issues.

- How is funding arranged?
- Are you expected to apply for competitive internal and/or external funding?
- Does the program have an effective mentorship program and career counseling?
- Are there institutional housing arrangements?
- What is the quality of trainee experience at the hospital, the university and in the community outside the training sites?
- Does the location allow you to have the quality of life you desire?

Living in an attractive environment makes life pleasant for the trainee and the family. Explore housing issues. Involve your family in the decision making. If you have a spouse (partner) and a family, make sure their needs are well met. If the family is not happy, the trainee will have an added burden. A community for the family is important, even if you stay in a location for only a few years. Do you need day care or schools? What university programs are available for partners? Institutions should have dedicated individuals to help with information on available services and relocation issues. If you need to train for two careers, make sure the institution is able and willing to provide for the academic needs of the couple.
Institutions are becoming much more aware of this need and should be willing and able to discuss this with you. It is very important to make the training journey fun, so keep this in mind when making your choices.

Choosing a Supervisor/Mentor

The research program is delivered in a very different fashion from that of clinical programs. The one-on-one relationship is of paramount importance. Choosing a supervisor is a very important task. In most cases, supervisors are not assigned by the program; instead trainees choose from a list of faculty. When choosing a research supervisor, visit the lab and talk to the current trainees. Review the supervisor's CV, especially publications and grants. The quality and impact of the publications and the size of the grants are most important. Personalities are important, so learn about your potential supervisor's personality and make sure it will mesh with yours. The working relationship you have with your supervisor is very important.

- How does the supervisor run the laboratory and the research program?
- How much contact time do you want with your supervisor as you train?
- How often are formal meetings held with supervisors?
- What peer support is there?
- Is there sufficient space and equipment?
- Are journal clubs part of the laboratory activity?
- Are there visiting scientists presenting seminars and interacting with students?
- How does your supervisor regard physician scientist trainees?
- What is the track record of the potential supervisor as a physician scientist/mentor?
- Do students finish their program in a timely fashion?
- Does the supervisor provide feedback in a timely manner?
- Do students publish first-authored high quality work?
It is indeed important to have a frank open discussion with a potential supervisor so that your questions are answered and you have the information you need to make a choice.

A true interest in scientific investigation, especially but by no means exclusively, in human biology and in patient care, are essential for success as a physician scientist. Since the training is arduous, a nurturing, stimulating and supportive environment is essential. Some programs allow you to rotate through a few laboratories before you need to choose a supervisor. This is very useful. Role models and mentors are required to advise and guide, not only during your training but also at the junior faculty level. Despite the strenuous training commitment, the rewards are indeed wonderful. You do interesting and important work. You interact with exceptional individuals and you are at the forefront of medicine and science as you shape the foundations and directions of health care.
Once you are finished with your formal training, you search for your first position. You should have been exploring job prospects well in advance of completing your training. Initial contacts can be made at scientific meetings, with visiting lecturers and through other informal means. Your supervisor and other department members can be very helpful as well. Even if you are applying for a position at your current institution or at one you know well, treat it like an unknown entity. You now have to look at it from a faculty point of view and not from that of a trainee, which are very different perspectives. It does not hurt your cause to interview at several institutions so that you learn about the interview process and find out what each institution is offering. This is helpful in understanding how to rate an offer and how to frame your negotiations. Understand the market pressures in academic medicine so you can pursue appropriate negotiations.

In answering advertisements, provide a well presented CV that is clear and unambiguous. Identify your role in publications, especially multi-authored ones. Do not mix abstracts with publications. List chapters, books, other non-peer reviewed articles separately. Present a well thought out research plan that is not too long but is innovative in nature and feasible at the institute to which you are applying. Remember the search committee will be receiving many applications to review. You should let your referees know beforehand that they may be contacted and send them a CV and research plan so they understand your current situation and future plans. Referees should know you well and should be able to provide critical analysis of your work and how you work in a group. Collegiality is an important feature in choosing both faculty for departments and investigators for industry. If an individual hesitates when you ask for a reference, do not use them as a referee.

Search committees do expect to see letters from those who know you best, e.g. supervisors, former employers. If these are absent you need to explain why. If you have teaching experience, this is a plus but in many cases teaching experience is limited during your training period. You will present a seminar so search committees and interested faculty and students will be able to view your organizational and presentation skills firsthand and see how you handle a discussion of your work in the question period. Make sure you bring the appropriate format to present your talk so as to avoid a technical problem arising during the presentation. Offer to check the AV equipment beforehand.
An essential feature of your interviews is to clearly understand and be able to articulate what you want your job description to be. Even have it written down in your own notes. Know where you can be flexible and where you cannot. A tactic to be avoided is to modify your job description during your interviews to suit the need of the institution. This is not useful since it questions your motivation. An attitude that conveys the notion that "I will do anything to get a job at your institution" is not a strong selling point at all.

Know as much as you can about the department you visit and the overall institution as well. Review web sites. Be familiar with the research that is on going and know who is doing what. Know what the priority programs are in the department and at the institution. Identify potential collaborators before your visit by reviewing information on the departmental and institutional websites. Know who you will meet and review their work and publications. Even before you arrive, have a set of questions that you need answered in this first visit. Remember this is a first visit so not everything needs to be covered and specifics are not always necessary. Your main objective is to determine whether this is a suitable place to initiate and develop your career and to live. The search committee wants to know if you have what it takes to set up an independent productive research program, if your program fits well with the department's research, teaching, and clinical care goals and objectives, and if you yourself will fit well into the collegial group of faculty in the department. Show enthusiasm for the position and convey a sense that you are very interested in the position. This is best conveyed by demonstrating that you are well prepared for your visit.

Do not be shy to discuss salary, start-up and space, but that can be done in general terms. Do see the space offered. The real negotiating usually occurs on your second visit when details are very important. Investigate granting opportunities from relevant agencies. Inquire about internal grant competitions. Is there support and mentorship for junior faculty when they apply for initial grant funding? You will then provide the Chair or Director with a list of equipment that you need - either as your own or as communal infrastructure equipment to which you need unrestricted access. Indicate how frequent this access is and ask what the user cost will be. Your start-up need not reflect a specific dollar value. It is more important to make sure you have what you need to start your program and to work for at least three years without external funding. The total dollar value then depends on what you need and should reflect the true costs at the specific institution. For example, salaries for support staff vary in different locations. You should have as much of what you need as possible when you arrive. Waiting for labs to be built or renovated and equipment to arrive may delay you considerably. Setting up a functional laboratory usually takes longer than you expect. Thus, finish as much work as you can in your postdoctoral laboratory so that publications will come out as you set up your own laboratory in the new facility. There may be some overlap as you wind down your postdoctoral position and begin your faculty position and you may find yourself commuting for a short period of time.
Once you arrive in your new position, be prepared for some frustration. By being well informed however, you can successfully navigate through the pitfalls of setting up a new office, research laboratory, and clinical practice. A few months free of clinical duties and teaching is very useful in allowing you to set up your laboratory. Be very familiar with regulations - department, university, government, and funding agencies. Spending time reading guidelines is not what you want to do, however it will save you much grief and will speed up your set up. Be familiar with the regulatory guidelines and when in doubt seek information. Ask for advice. Identify administrators and faculty who can be most helpful to you during your start up period. Those faculty who have just set up their laboratory are very useful advisors. We can all learn from someone else's experiences. Good luck!
It is essential for you to be very familiar with the milestones you need to reach as your career evolves and as you progress through the ranks at your institution. You should have a very clear understanding of how the tenure process and/or the promotion process operates at your institution. It is too late to find out as you go up for tenure/promotion that you should have done this or that. The current realities of the first 5 to 7 years, depending on your institutional requirements, is to establish your clinician scientist program. Competing pressures exist between your research interests and your clinical responsibilities. Protected time devoted to your own research enterprise is critical. Seventy-five to eighty percent of your time is needed to become a successful independent well funded, productive biomedical investigator. Physician scientists have many activities to tend to, however not all are done by everyone, especially at the beginning of your career. The highest priority must be given to your research activities.

While each institution has its own requirements, there are several general principles to consider. As you approach tenure/promotion, you should have done some teaching and attracted high-quality graduate students and postdoctoral fellows. Teaching dossiers require student evaluations so make sure to collect these after each course you teach. You should have been awarded peer reviewed funding as a Principal Investigator from at least two funding sources and had renewals. Most scientists consider investigator initiated operating grants as the cornerstone of a successful research program, and an essential driver for new discoveries. Being a co-applicant of a multi-investigator program is indeed useful, but you must be very clear and transparent in showing how you yourself are making a major contribution to the program. Your research program should have progressed to a stage that high impact publications have been and are being accepted for publication. Quality should be placed well ahead of quantity. You should be establishing your name for a body of innovative high impact work which attracts attention from your colleagues. Publications should appear in the highest impact subspecialty and general biomedical journals. This interest should lead to invited lectures at national and international scientific meetings and to universities and institutes. Invited reviews in well recognized journals also indicate recognition in a field.

You may now be involved with research review as an external reviewer of manuscripts and/or grant proposals. You may, although this is much less likely, be asked to serve on a grant review panel. These review activities are time consuming so you must budget your time very carefully. Not obtaining your own...
grant funding because you are too busy reviewing others is not a useful way to advance your career. Some amount of administrative activity is useful since everyone must pitch in to help administer the system they work in. But once again budget your time very carefully. If you are doing your share of administrative work in your department as a junior faculty member, do not hesitate to decline a request to serve on yet another committee but indicate that once your time commitments change you are willing to take on new responsibilities. In the early years, focus your administrative roles both at your institution and externally to activities close to your research activity, e.g. graduate committees, scientific meeting program committees.

You are not working in a vacuum, so know the investigators in your field. Attend meetings, especially small meetings where it is much easier to meet your colleagues and discuss science. Social settings during a meeting are a very good venue to interact with colleagues. Promote your own trainee’s ability to attend scientific meetings with you. It is a very good investment of your funds.

It is very useful to apply for and receive personnel awards. It is confirmation of the high regard your peers have for you and your work. Applications are usually a time consuming process so focus applications on those awards which you have a very good chance of receiving. Seek much information about the application process so you understand how best to fill out the forms and what the agency is looking for in its awardees.

The Many Interests of the Biomedical Physician Scientist
The very best physician scientists are required to generate and transmit new knowledge to fellow scientists, clinicians, and trainees. Physician scientists need to have an environment that rewards their motivation, their ability to unravel the mysteries of pathobiology, and that fosters innovative and transformative research.

High quality programs are required to provide the unique training that Pathology and Laboratory Medicine offers to study, understand, diagnose, treat, and prevent human disease. A stimulating intellectual environment with state-of-the-art resources and time dedicated to research are needed to launch physician scientist careers and support their productive growth, especially in the early stages of their careers. Universities, teaching hospitals, affiliated research institutes, granting agencies, (both private and government) and industrial partners need to actively support these academic initiatives and create capacity to train physician scientists and to support their mentors. All will benefit from having a strong core of physician scientists in the biomedical research and clinical community. It is indeed this group of investigators who form an essential component to achieve the goal of transforming medicine from curative to preventative.

Departments of Pathology and Laboratory Medicine across the globe require the very best faculty to successfully meet the challenges of the medicine that is practiced today and that will be practiced tomorrow. Universities, teaching hospitals, and research institutes need to develop training programs to train individuals along three interdependent pathways which support the three pillars of academic medicine - research, teaching, and clinical care:

**Research:** Excellent productive investigators need to be trained to acquire a knowledge base and the technical expertise to explore mechanisms of disease and translate basic knowledge to clinically useful information to diagnose, treat, predict prognosis, and prevent disease.
Teaching: Innovative teachers require the training to be able to link teaching to research and to state-of-the-art knowledge and technology, and to be able to carry out research in education.

Clinical care: Subspecialty clinicians need to be trained to produce consultants who are exceptional diagnosticians and who continuously push the limits of diagnosis through innovative use of modern biological concepts and state-of-the-art technology.

These three pathways are all important and since pathology sits at the cross roads of basic science and clinical medicine, Departments of Pathology are excellent training environments for physician scientists. As the practice of modern academic medicine becomes more complex, it is not practical to demand in-depth expertise in all the three pillars of academic laboratory medicine - research, teaching, and clinical care. A logical approach in today’s biomedical world is to develop excellence in one or two of the three pathways and to be competent in the others.

Thus training programs need to be adjusted to provide the very best opportunities to train future faculty along the excellent/competent paradigm. Training at the undergraduate, medical school, and postgraduate level need to be considered. An innovative program that was initiated at the University of Toronto is a Specialist Program in Pathobiology that teaches arts and science undergraduates to understand how the pathogenesis of disease is studied in humans and in experimental models. The 11-course program has promoted the interest of its graduates to pursue graduate and medical programs with focus in pathology and laboratory medicine. Departments would do well to adjust their academic resources to provide their academic faculty with career development and advancement that focus on these pathways, always demanding that innovation, new knowledge, and international recognition be the hallmark of excellence for all the three pillars of academic laboratory medicine.
American Society for Investigative Pathology  
www.asip.org

Laboratory Medicine and Pathobiology, University of Toronto  
www.lmp.facmed.utoronto.ca

The Intersociety Council for Pathology Information, Inc.  
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American Heart Association  
www.americanheart.org

Canadian Association of Pathologists  
www.cap-acp.org

Canadian Institute of Health Research  
www.cihr-irsc.gc.ca

Heart and Stroke Foundation of Canada  
www.hsf.ca/research

Medical Scientist Training Program (MSTP) Institutions  
http://www.nigms.nih.gov/Training/InstPredoc/PredocInst-MSTP.htm

National Cancer Institute  
www.cancer.gov

National Cancer Institute of Canada  
www.ctg.queensu.ca

National Institutes of Health  
www.nih.gov

PathologyJobsToday  
www.pathologyjobstoday.org

United States and Canadian Academy of Pathology  
www.uscap.org
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