

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

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Committee for Career Development and Diversity

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Prologue

This career guide booklet was originally inspired by a workshop entitled “*Career Pathways in Pathobiology for Physician Scientists*,” presented at the American Society for Investigative Pathology (ASIP) 2003 Annual Meeting at Experimental Biology in San Diego. This newest 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, linking 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 healthcare. 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 39 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 are 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 both clinical 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, Dia Pellerin, and Gina LaBorde of the American Society for Investigative Pathology.

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About the Author

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Professor Avrum I. Gotlieb, founding 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 was interim Vice Dean of Research, then Interim Vice Dean of 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. He authored the book "Planning a Career in Biomedical and Life Sciences: Making Informed Choices," published by Elsevier Inc. (2015).

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 Malcolm D. Silver, University of Toronto, and Frederick J. 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), 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, by ASIP with the Robbins Distinguished Educator Award, by the Association of Pathology Chairs with the Distinguished Service Award, and by the Canadian Association of Pathology with the President's Award.

What is a Physician Scientist in Pathology and Laboratory Medicine?

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 key 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 discovery 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 where these processes are disrupted. 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. The physician scientist is an excellent role model for high school and undergraduate university students and is able to convey the excitement and value of biomedical research to these groups.

Why Choose Academic Pathology and Laboratory Medicine?

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, especially precision medicine. 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 and guide therapy. Pathology and laboratory medicine are at the forefront of developing the knowledge platforms for precision (personalized) medicine.

By being at the crossroads of basic science and clinical medicine, pathologists and laboratory physicians are in the enviable position to

develop appropriate and useful *in vitro* and *in vivo* models to investigate the 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 reduced in communities.

Linking teaching & research

Medical students are exposed to numerous sub-disciplines during their training and eventually choose a specialty 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 robust opportunities and programs both in the medical student curriculum and as extracurricular activities to expose students to clinical aspects of pathology and laboratory medicine and to basic, translational, and clinical investigations in laboratory medicine and pathology. The most effective extracurricular programs are led by interested and motivated medical students under the guidance of faculty mentors. Departments should also consider having communications with undergraduate life science students who may be interested in research on the pathogenesis of disease, which then can continue during their medical training, e.g., MD/PhD, research electives, etc.

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 research and patient care.

- The core values of the specialty are research and education.
- The specialty is at the interface of clinical care and basic science.
- The specialty 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 understanding the pathogenesis of disease, in biomarker research, and in clinical practice.
- Clinical specialty and subspecialty training programs naturally link clinical education to research training.
- Clinical subspecialty training involves in-depth knowledge suitable for identifying important research questions to study.
- 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 specialty 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 a Physician Scientist Career For Me?

You have to carefully consider whether you have the interest and motivation to fashion a physician scientist career that 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. 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 healthcare. Mastering two careers in order to fashion one hybrid career as a physician scientist is particularly challenging. You are expected to achieve all the competencies required as a physician and as a scientist. 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 satisfy 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 healthcare.

As a physician scientist 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 opportunity for an interesting, rewarding and comfortable lifestyle.

At the crossroads of basic science & clinical medicine

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. Appropriate mentorship is very important and is worth investing time in meeting with mentors. 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

Modern health care needs physician scientists in pathology & laboratory medicine

adventure can be stressful and may initially not live up to expectations.

As you explore your career options, do not be concerned about expressing frustration and doubts as you work in the research environment. We all have them. Try to solve issues as they arise during your exploration of 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. If you feel things are getting better after a poor start in your initial research opportunities, you probably did make the correct decision in the first place.

Choosing a Training Path

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. Trainees should be offered flexibility to achieve the best training that suits their own background. As we move to personalized health care so should physician scientist training programs endorse personalized training.

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. 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 to bring you up to date. This additional postdoctoral training 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 up to 8 years to complete, which means that your PhD training needs to be focused. There is usually 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 path, however, usually 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 specific clinical training program. 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 as well as additional research time toward completing a graduate degree. It is important that you have adequate time for high quality clinical training and you achieve all your clinical competencies. The research component provides a solid research experience with quality outcomes including first-authored high-quality papers. The National Institutes of Health and the 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. The American Board of Pathology (www.abpath.org) has endorsed a Physician-Scientist Research Pathway for residents interested in research

Post-Residency Training

In this pathway, the trainee completes the residency program and then embarks on a formal research training program, sometimes 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 academic 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 toward 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 curriculum vitae (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 when choosing a program. Decide which route(s) you wish to fully explore. Do your homework thoroughly and look at several physician scientist programs to be able to select the best one for you. The fit must be right. Know the 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. Is the institution an excellent place to train in

academic pathology and laboratory medicine? 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 that provides opportunities for high quality research for trainees. A diverse mix of clinical 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 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? Are there core facilities? 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 programs available for trainees to train for academic careers?
- Does the institution support the concept of personalized training where possible?
- 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?

*Physician scientists
may look forward to
a dynamic career of
achievement
& reward*

- 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, health and 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:

You should discuss salary, benefits, as well as 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 that you need to fully understand.

- 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 formal and informal opportunities to learn to achieve personal resilience?
- 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 for yourself and your partner or family?

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 suitable community is important for the family, even if you stay in a location for only a few years. Do you need day care or schools? What university programs and/or employment in the community 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

Be well prepared for interviews & visits to prospective training institutions

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 with the supervisor is of paramount importance. Whether the supervisor is a physician scientist should not be an issue. The trainee needs to be sure that the supervisor understands and is willing to support and accommodate the training of an MD to become a scientist as well. This reflects the notion of personalized training needed to develop the career of a physician scientist. 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 well with yours. The working relationship you have with your supervisor is very important to the success of your program.

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 an informed choice.

A true interest in scientific investigation, especially but by no means exclusively in human biology, and patient care are essential for success as a physician scientist. Since the

training is arduous, a nurturing, stimulating and supportive environment that considers personal resilience for trainees is essential. Some programs allow you to rotate through a few laboratories before you finalize the choice of a supervisor. This is very useful. Role models and mentors are required to advise and guide, not only during training but also at the junior faculty level.

- 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 and/or 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?

Searching for Your First Job

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 scientific collaborators and visiting lecturers, and through other informal means. Networking is very important. At least sixty to seventy percent of positions that are filled include word of mouth recruitment. The larger your network is, the more opportunities you will know about, often before they are advertised. 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. Remember the search committee will be receiving many applications to review. Identify your role in publications, especially multi-authored ones. Do not mix abstracts with publications. List chapters, books, and 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. Discuss with your current supervisor what research you may take with you. It is not useful to compete directly with your current supervisor. 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

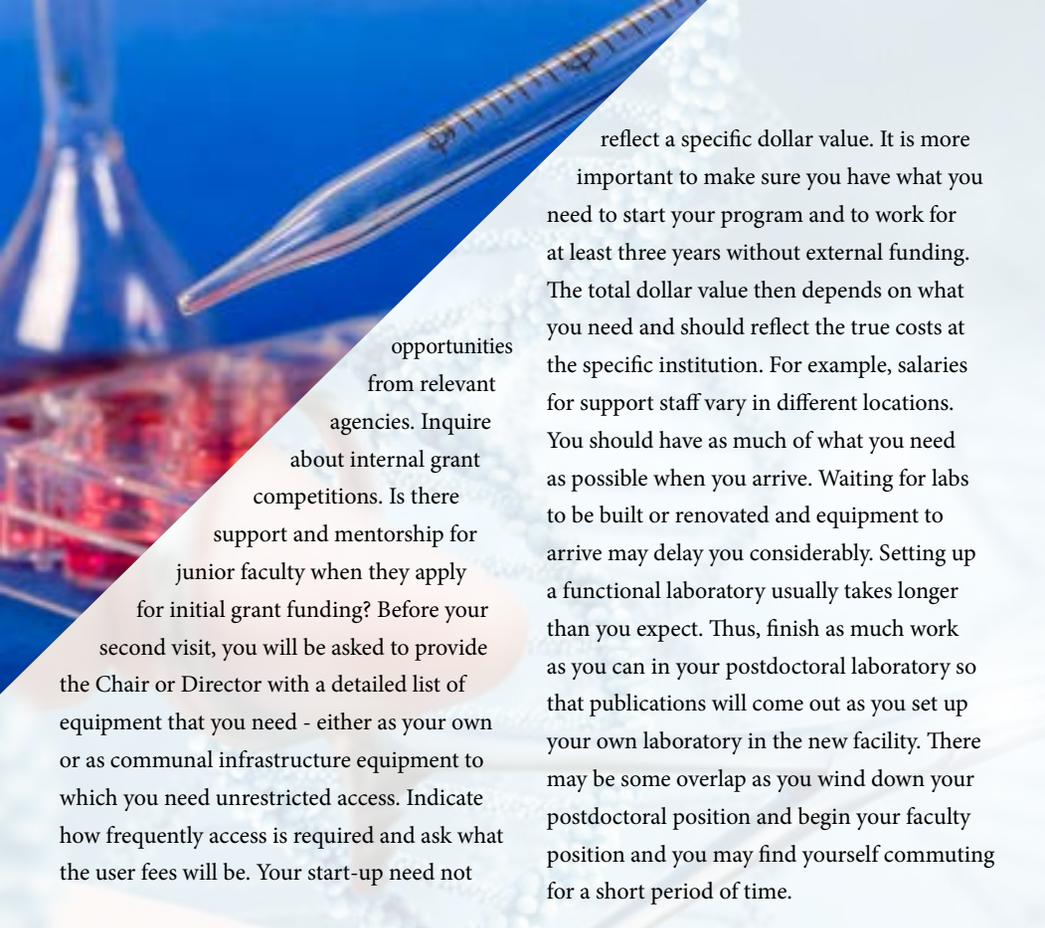
in many cases teaching experience is limited during your training period. You will present a seminar so search committees and interested faculty and students will be able to view your organizational and presentation skills firsthand and see how you handle a discussion of your work during the question period. Make sure you bring the appropriate format to present your talk to avoid a technical problem arising during the presentation. Offer to check the audiovisual equipment beforehand.

An essential feature of your interviews is to clearly articulate in a succinct manner what your major accomplishments have been. The so called “elevator pitch” or “three-minute” thesis is a useful template to use. Then you need 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 both the department and the institution you visit. Review web sites. Be familiar with the research that is ongoing 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, whether your program fits well with the department’s research, teaching, and clinical care goals and objectives, and whether 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. Remember to follow up after your visit with acknowledgements to those you met.

Do not be shy to discuss salary, start-up funding and space, but that is usually done only in general terms on the first visit. 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? Before your second visit, you will be asked to provide the Chair or Director with a detailed list of equipment that you need - either as your own or as communal infrastructure equipment to which you need unrestricted access. Indicate how frequently access is required and ask what the user fees 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.

Launching Your Physician Scientist Career

Once you arrive at your new position, be prepared for some frustration. By being well informed 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 members who have just set up their laboratory are very useful advisors. We can all learn from someone else's experiences. Good luck!

Tenure, Promotions and the First 10 Years

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 operate 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 reality of the first five to seven years, depending on your institutional requirements, is to establish your physician 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 (or two grants from one funding source), and had renewals where appropriate. 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 that 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 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 in your early years, 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

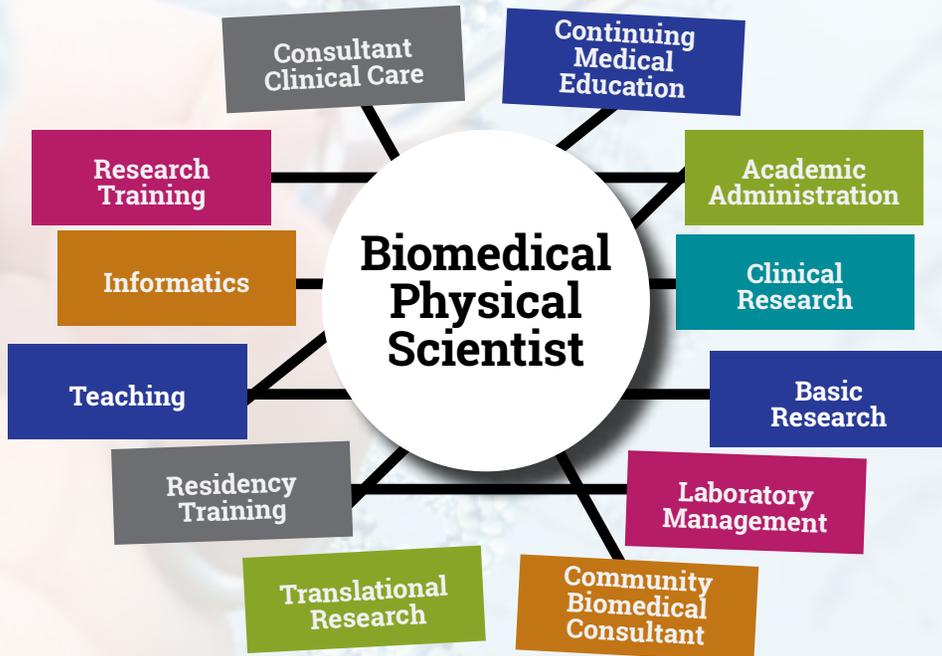
reviewing others is not a useful way to advance your career. Some amount of administrative activity is useful since everyone must pitch in to help administer the system they work in. But once again budget your time very carefully. If you are doing your share of administrative work in your department 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 will 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 and network with

colleagues. 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 that you have a very good chance of receiving. Seek reliable 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 Institutional Challenge to Train and Maintain Physician Scientists

Universities are challenged to create innovative sustainable education pathways to graduate physicians who are well trained in research. These pathways will be successful if they are dynamic and not rigid in nature, offer trainees choice in how their program is designed and carried out, provide competitive stipends, and adhere to realistic time to completion for the program. Thus the institutional goal is to provide “personalized training” for academic physician scientists to navigate their demanding program.

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 supervisors/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 offer excellent training programs that 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 discover mechanisms of disease and to translate basic knowledge to clinically useful information to diagnose, treat, predict prognosis, and prevent disease. Basic discovery research needs to be effectively supported to maintain a productive research enterprise.

Teaching:

Innovative teachers require the training to be able to link teaching to research and to state-of-the-art knowledge and technology. Opportunities to carry out research in education should be available.

Clinical Care:

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

These three academic pathways are all important. As the practice of modern academic medicine becomes more complex, it is not practical to demand in-depth expertise in all three pillars of academic laboratory medicine - research, teaching, and clinical care. A logical approach in today's biomedical world is to provide trainees the opportunity 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

Making the journey fun

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 each of the three pillars of academic laboratory medicine. 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.

Links & Resources



American Society for Investigative Pathology
www.asip.org

Laboratory Medicine and Pathobiology,
University of Toronto
<http://www.lmp.facmed.utoronto.ca/>

The Intersociety Council for Pathology
Information, Inc.
www.pathologytraining.org

American Association for Cancer Research
www.aacr.org

American Board of Pathology
www.abpath.org

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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