On the Road to Medical Science

A Guidebook for M.D./Ph.D. Applicants

Jeremy Cholfin
Medical Scientist Training Program
University of California, San Francisco

With Contributions from:
Miles Berger, MSTP, UCSF
Hosein Kouros-Mehr, MSTP, UCSF

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Introduction

I would like to start by saying CONGRATULATIONS. By simply picking up a copy of this guidebook or browsing this web site, you are beginning your quest toward becoming a medical scientist. Few are sufficiently driven or have the opportunity to pursue such a high-level of education that will span the course of many years. Initiative, motivation, and ambition will serve you well throughout the admissions process, medical and graduate education, and a career in medicine and the biomedical sciences.

But beware: this is not a journey for the faint of heart. The individual M.D./Ph.D. programs differ tremendously in various respects, but all require you to lead a double-life of sorts. Your education will incorporate the principles of both medicine and science, which can often seem at odds with one another. The training period is long, but efforts have been made to reduce the number of years to graduation. There are both physicians and scientists who share the opinion that one cannot do both medicine and science well. However, by all measures, the vast majority of those who received training through M.D./Ph.D. programs have journeyed onward to become highly successful physicians and scientific investigators.

Why this guidebook?

We decided to write a guidebook on M.D./Ph.D. admissions as a result of our experiences of applying to many of the nation's programs. When we began the admissions process, we were completely in the dark. Some of us didn't know these programs existed until well into our college education. Premedical advisors weren't much help and most of the other premedical students at our universities were seeking the M.D.-only. There was plenty of literature available on regular medical school admissions in the bookstores, but a dearth of M.D./Ph.D.-specific material. Sporadic sites scattered throughout cyberspace helped slightly, but the information was

usually geared toward one specific program and failed to give a holistic approach to the admissions process for M.D./Ph.D. applicants. Thus, it was truly trial by fire, with little guidance.

Confronted by the long and tedious admissions process, we were forced to search far and wide for information. How much less stressful the whole experience would have been if there was a good book to take you through the admissions process from start to finish, while giving you a little insight into the future. Why reinvent the wheel with every admissions cycle? A collection of helpful hints and suggestions, do's and don'ts, interview tips, stories from current students about their experiences, and so on, would have reduced the anxiety associated with applying and given us insight into issues pertinent to M.D./Ph.D. applicants. We decided to write this guidebook in the hope that we could save future generations from some of the hardships we had to endure. Or at least demystify the application process. If this book in any small way assists you in deciding whether M.D./Ph.D. is for you and gives you some insight into what it's all about, then we can rest easier at night knowing that we have helped others.

That being said, please do not rely on this text as a sole source of information. This guidebook is meant, in part, to act as a reference which can guide applicants through the admissions process. However, we also have interjected our own personal opinions, ideas, and quips throughout the text, in the hope that insights gained through experience will help you. Hopefully we have managed to strike a healthy balance between factoid and fiction, giving you ample material to continue your own investigations into the process, while providing some comic relief and wholesome entertainment value.

Into the new era: training medical scientists

In the past, if you were interested in the medical sciences, the typical route consisted of medical school, followed by postdoctoral research. Those interested in the basic sciences (i.e. understanding biological mechanisms) would attend graduate school and earn the Ph.D. However, due to the increasing specialization of scientific and medical fields during the latter half of the 20th century, scientists, clinicians, and lawmakers realized the need for specialized training in the biomedical sciences. To produce the next generation of physician-scientists who could bring scientific discoveries from the bench to the bedside, in 1964 the National Institute of General Medical Sciences (a division of the National Institutes of Health) created the Medical Scientist Training Program (MSTP).

Through the MSTP, students receive both graduate and clinical training, leading to the M.D. and Ph.D. degrees. Students typically receive full funding for their tuition and expenses, as well as a competitive stipend. Graduates from these and other non-MSTP M.D./Ph.D. programs have been steadily climbing the ranks at most academic medical centers and many are actively recruited for faculty or administrative positions. The growth of the biotechnology industry has also increased the demand for highly-trained medical scientists who can convert basic scientific discoveries into potential therapies for disease.

We are now at a time when the NIH is planning a dramatic increase in funding for the 30+ MSTPs, possibly doubling the size of the current programs. With major new commitments

by the federal government and universities to train the next generation of M.D./Ph.D.s, we are truly witnessing an explosion of medical science. There has been no better time to consider applying for M.D./Ph.D. programs.

Uniqueness of M.D./Ph.D. admissions

For a long time, M.D./Ph.D. aspirants had been lumped together with medical school applicants in the admissions process. The fraction of M.D./Ph.D. applicants is typically very small relative to those not pursuing a combined degree. At most schools, M.D./Ph.D. applicants must go through the normal medical application process. Applicants must also complete a separate M.D./Ph.D. application, which consists of MCAT scores, GPA, undergraduate institution, one or more essays, and additional letters of recommendation from those who can assess the applicant's potential for a career in research. Interview arrangements vary between programs, with some providing airfare, hotel accommodations, meals, and planned activities. M.D./Ph.D. applicants typically have many more interviews at each school than those pursuing the standard M.D. pathway. In addition, many unique factors come into play when making a decision on which program to attend.

You will see that there is considerable variation among programs in virtually all aspects of the application process, providing a formidable challenge for anyone who happens to want to write an M.D./Ph.D. guidebook. We have attempted here to focus our discussion mostly on aspects of the admissions process that are unique to M.D./Ph.D. applicants. By necessity, we have left out program-specific information that would swell the size of this text. Instead, we have chosen to convey general principles that apply to most, if not all, of the MSTPs and many of the nation's non-MSTP M.D./Ph.D. programs. We have done our best to give a fair assessment of the "average" program's requirements, expectations, application process, etc. For more specific information, we refer you to a list of web sites that we have included in the appendix. Remember, we serve only as your guides… it is YOU who must make the journey!

How the guidebook is organized

A quick glimpse at the table of contents will give you a pretty good idea of the layout of this guidebook. In the first few chapters, we discuss the interface between science and medicine and the purpose and goals of the MSTP and non-MSTP M.D./Ph.D. programs. We attempt to give you a reasonable sense of the pathway you are about to take. Then we guide you through the admissions process, focusing on general program requirements and M.D./Ph.D-unique elements of the application. As the interviews comprise an extremely important component, we attempt to provide both a general overview and specific advice with anecdotes that helped define each of our experiences during the process. We then discuss how admissions committees arrive at decisions, followed by the factors that will assist you in deciding between different programs.

We felt that leaving you at this point would be like leading you blindfolded toward the edge of a cliff. After all, there are various steps that you can take to prepare for the long journey ahead. During the program, there are ways you can make your life a lot less stressful. Hence, we have included advice on what to do once you are admitted to programs, including a discussion of the transition points between the medical and graduate portions of your training. We finish up

with a treatment of your available options after graduation and examples of successful M.D./Ph.D career pathways.

Again, it is our sincere hope that through this guidebook, we might save you some of the headaches we experienced as applicants and thereby make the admissions process more palatable. If you have any suggestions about the content or organization of this text, how it might be changed to become more helpful, or if you are interested in contributing your unique experiences, advice, or anecdotes, please feel free to contact us. Good luck, fair weather, and we wish you well on your quest to become a physician-scientist.

Medicine and Science

Miles Berger

The rewards of medicine come quickly and with relative ease; the rewards of science come slowly and with great difficulty. This, in the words of the director of the MSTP at a top medical school, is the difference between medicine and science. Of course this is a gross simplification, but it contains some measure of truth. Clearly, both laboratory research and clinical medicine require intelligence and hard work, but each has its own additional demands. Medicine also has a large psychological element: put on a shirt and tie and a white coat, and patients look at you with respect. Mentally, much of medicine is pattern recognition: seeing a set of symptoms in a patient, remembering that they constitute a given disorder (which you may recall from a textbook that you read years ago), and then giving the patient the appropriate medication and/or referring them to a specialist. Even if you are able to help a patient only marginally, simply by being a compassionate, thorough and thoughtful physician you will gather much respect.

In contrast, science is largely based on results: where you publish and how often. You can usually wear whatever you like in a laboratory, but only an investigator whose research resolves questions of importance and stimulates further thought and study will be accorded scientific respect. Scientific success, in addition to intelligence and hard work, demands both intellectual creativity and a spirit of delayed gratification and maturity. Unlike clinical medicine, with its emphasis on recognizing patterns of symptoms, science often involves developing new techniques to study unknown phenomena, recognizing connections between previously disparate ideas or fields of study, and having the maturity to wait until a study yields important results. In fact many important scientific discoveries were made after a long period of frustration and tedium.

So if science and medicine are so different, why pursue both in your education by completing an M.D./Ph.D program? There are three main reasons for doing so. First, studying science at the graduate level will make you a better physician even if you do not continuing doing research. Second, studying medicine will put science into a larger perspective and can help motivate your research even if you never practice medicine. Third, pursuing a career at the confluence of clinical medicine and scientific research can allow one to develop clinical treatments and to make scientific discoveries that would be unlikely to result from the work of either a pure clinician or a pure scientist. Physicians with scientific training have the capability to

take bedside observations into the laboratory for further study, as well as the reciprocal ability to apply laboratory findings to patient care. In other words, clinical medicine and laboratory research need not be mutually exclusive pursuits: rather, they can be pursued in a synergistic fashion.

However, it should be noted that most M.D./Ph.D. graduates eventually wind up choosing to pursue either laboratory research or clinical medicine as their primary focus, while devoting a minority of their time to the other or to administrative or other concerns. The reason for this is simple: it is difficult to be a good scientist or a good physician without spending most of your time on it. Of course, it is possible to spend 80-90% of one's time doing research and 10-20% seeing patients. This situation is common for many M.D./Ph.D.s or even M.D.s who run laboratories but have faculty appointments in clinical departments of medical schools. It is difficult to be a good doctor without doing it full time; a doctor who practices only part-time will simply not have the same pattern recognition as one who works full time. However, it is probably more difficult and certainly more rare to spend 80-90% of one's time seeing patients and 10-20% doing research, if only because it is difficult to get NIH or other research funding while devoting only a minority of your time to research.

Of course, there are arguments against doing an M.D./Ph.D.. First, some argue that since M.D.s can do laboratory research and many M.D.s run highly successful basic science labs, there is no need to do an also obtain a Ph.D. While it is possible to do good research as an M.D., a Ph.D. gives you a broader scientific base, will make it easier to get grant funding in early career stages, and will help you be a better physician because it will give you a better understanding of basic biology. While many M.D.s do good basic science research, also having a Ph.D. certainly makes it easier to do so.

Second, some argue that if you really just want to do research, there is no point in obtaining an M.D. This is partially true: if you really only want to do research, then getting an M.D. is a lot of extra work. However, M.D./Ph.D.s who do research are typically paid better than Ph.D.s, they have an easier time getting faculty positions, and they are typically accorded more respect in general. Additionally, medical school classes contain a great deal of human physiology and pathophysiology that is not taught in typical biology graduate programs; this gives M.D./Ph.D.s a broader understanding of human biology in addition to the specifics of their thesis research.

M.D./Ph.D. vs. MSTP

While the distinctions between M.D./Ph.D. programs blur along several lines, a division can be made between the programs that receive NIH funding for the Medical Scientist Training Program and the non-MSTP M.D./Ph.D. programs. In response to increasing specialization and the need for better integration between the basic and clinical sciences, the MSTP was created in 1964 to provide training in medicine and basic biomedical research, leading to the M.D. and Ph.D. degrees. Currently, more than thirty institutions receive MSTP funding to train the next generation of physician-scientists. These programs provide tuition and fees and a stipend (~$15,000-21,000 per year). MSTPs are regulated by the federal government and must follow certain guidelines set forth by national policy. For example, the NIH has recently pressured

several programs to reduce the time to graduation. Thus, NIH funding is contingent upon the maintenance of relatively high educational standards. These programs tend to be extremely selective and draw from a nationwide applicant pool of bright and talented individuals. Due to federal regulations, these programs are restricted to U.S. citizens or legalized nationals.

However, there are at least as many institutions that have formal or informal M.D./Ph.D. programs sponsored through institutional funding and training grants. Many programs provide full tuition and fees for their students, although some provide only partial funding. The level of financial support is highly variable, as is the level of oversight. In addition, a number of schools that receive NIH funding offer more M.D./Ph.D. spots than offered by their MSTP grant. Thus, there are MSTP-funded and non-MSTP spots at the same school. Many schools do not make a distinction between these students. International students can apply to these programs, although they cannot receive MSTP funding.

Some students attend medical and graduate school separately, thereby earning both degrees. The main disadvantages to this pathway are increased length of time, little integration of the medical and graduate training, and lack of funding during the medical years. However, there are various scholarships and grants available (i.e. from the Howard Hughes Medical Institute) to supplement the medical portion of the training. The graduate years are almost always funded by a combination of sources, including the student's research thesis advisor and department. Many foreign students enter U.S. M.D./Ph.D. programs via this route.

The choice of pathway often depends on several factors, including one's goals, choices early in an academic career, grades, MCAT scores, etc. Generally, the NIH-funded MSTPs are considered the most selective programs, but highly qualified individuals can be found at various non-MSTP institutions. The guarantee of funding throughout the medical and graduate training often makes the MSTPs the most appealing programs. Schools with MSTPs tend to run highly supported research programs in a multitude of biomedical (and non-medical) fields. However, many non-MSTP M.D./Ph.D. programs are located at prestigious universities throughout the nation and are well-supported.

Program of Study

A View of the Pathway: There and Back Again

It has been said that one of the top reasons for going through M.D./Ph.D. training is to postpone entry into the real world until the third decade of life. These programs truly represent scholastic longevity, as many who graduate from these programs remain in academics throughout their entire career. We sometimes like to joke that at our 10-year high school reunions, we'll likely be the few still in school.

M.D./Ph.D. programs are among the longest and most rigorous training programs in the world. Program length varies considerably between schools. During the past twenty years, there has been a trend of increasing time to graduation for M.D./Ph.D. students. This has paralleled the increase in time for graduate students to earn the Ph.D. According to available NIH statistics, the current average time to graduation from start to finish in MSTPs is 7-8 years. This includes the

four years of medical school and three or more years of Ph.D. work toward the thesis requirement. Recently, the NIH has pressured certain programs that had notoriously long training times to reduce the number of years students spend in the program. In particular, the Ph.D. phase needed to be condensed, as students were spending as much time as regular graduate students in laboratories, and hence taking as many as 8, 9, or 10 years to graduate.

The typical program of study includes the first two years of the basic medical sciences curriculum, followed by three or more years of graduate school and thesis research, and then the final two years of clinical clerkships. The transitions between the medical and graduate curricula are usually fairly abrupt, and there are not many avenues for easing the process. Programs vary in the level of integration between the medical and graduate years (see below). There are many exceptions to the traditional pathway, and programs are becoming increasingly flexible in terms of scheduling. However, most currently follow this general 2-3-2 pattern.

Years 1-2: Basic Medical Sciences

During the first two years, you are essentially a medical student, although schools sometimes often encourage you to pursue graduate courses, journal clubs, laboratory rotations, program retreats, and other graduate school requirements. Some allow you to place out of certain medical or graduate courses, depending on the degree of overlap. Laboratory rotations during the first two years are encouraged in many programs, and even required by some. This allows for earlier selection of a thesis laboratory, which can reduce the time to graduation.

Whatever flexibility is offered at a particular program, you will be exposed to a wide range of medical material during the first two years. You may have come into the application process with specific research interests, but realize that these may change during your first years as you are exposed to diverse fields under the medical curriculum. Some M.D./Ph.D students find themselves somewhat frustrated at the approach to learning during years 1-2. Medical classes require the absorption of huge volumes of information. Memorization tends to be emphasized, with the effect of scientific thinking being at the losing end. Innately curious M.D./Ph.D. students often find their questions regarding basic biological mechanisms deflected or relegated to “see me after class.” However, recent attempts have been made to increase the focus on problem solving and evidence-based medicine, which make use of the scientific method to a certain degree.

Some schools offer a seminar-style learning experience called “Molecular Grand Rounds” which typically involves the presentation of a clinical case and the relevant biological mechanisms. These seminars allow M.D./Ph.D. students to interact with each other and faculty, and highlight the interface between science and medicine through review of biomedical literature. Many schools have initiated similar programs, often at the behest of students in the program. In some cases, it is the students themselves that have initiated these seminars.

Typically, at the end of the second medical year, students take Step 1 of the U.S. Medical Licensing Exam (USMLE), also known as “The Boards.” Some schools allow students to do some clinical clerkships before starting the graduate years and thesis work. This can provide an

early introduction to clinical medicine and provide a context for integration with the basic sciences of the thesis years.

Years 3-5 (or more): Graduate School and Thesis Research

Over the next few years, M.D./Ph.D. students typically complete the graduate school requirements (coursework, rotations, exams, journal clubs, etc.), select a thesis laboratory, take the qualifying exam, and conduct thesis research. The number of years spent in this phase is highly variable, and is largely responsible for the overall program length.

Rotations are designed to allow you to "test the waters" without committing to one lab from the outset. Many students say that selection of your thesis lab is one of the most important choices you will make in your academic career. Research laboratories vary in terms of size, environment, level of funding, and other factors that you may want to take into account when deciding in which lab to pursue your thesis project. The best measure of how successful you will be in a particular laboratory is how well you get along with your advisor.

The goal of Ph.D. training is to produce a highly competent and independent investigator who is capable of seeking out answers to basic questions and eventually running a laboratory. Thus, some advisors (and programs) feel that the Ph.D. training must be of equivalent rigor to that obtained by regular graduate students. People say this often to alleviate potential concerns that M.D./Ph.D.'s are somehow receiving a "watered-down" Ph.D. Sometimes, however, it can be a warning sign that students typically take a long time to complete their thesis work in that particular laboratory. You must conduct your own investigations when selecting a thesis lab. It is important to ask for the opinions of people who have experience with the P.I., including current lab members or collaborators. Often, students who have rotated in a lab before can give valuable advice.

Recently, many programs have been urging M.D./Ph.D. students take the qualifying exam after their first year in graduate school so that they can begin thesis work earlier. The qualifying exam usually involves the defense of a thesis proposal and another proposal that is not related to the student's area of research. Of course, this varies between institutions. Thesis work consists of completion of the project and a successful defense before a committee consisting of your advisor and other faculty in related areas of research. Typically, thesis research warrants publication, and programs expect that you will have published before graduating.

Years 6-7: Clinical Clerkships

The final two years of M.D./Ph.D. training consist of the core clinical clerkships, subinternships, advanced courses, and clinical electives. This period allows you to decide what specialty of medicine (if any) you wish to pursue. Requirements vary between programs, but typically consist of specific 6-8 week clerkships in various areas, including medicine, surgery, anesthesiology, obstetrics and gynecology, pediatrics, neurology and psychiatry, family practice/ambulatory care, and other subspecialties. On typical clerkships, you admit patients, conduct interviews and physical exams, attend rounds, give presentations, and take classes. During subinternships, you are given more responsibility for patient care. Electives may give you

free time to pursue research or other interests. The requirements tend to be fairly rigid during the clinical years and thus there is often little flexibility in scheduling.

Transition Points: A Game of Ping-Pong

The transition between the first two medical years and the subsequent graduate training is fairly abrupt. It can be fairly disconcerting that many of your friends in medical school will go onto their clinical rotations, while you must spend several years in a laboratory before you reach that point. You marvel at the fact that they will one day be your residents or attendings.

After the thesis work, you are a budding researcher, trained to operate in the realm of science. Suddenly, you are thrust back into the hierarchical world of clinical medicine, where stress runs rampant, adrenaline is pumping, and you are at the low end of the proverbial totem pole. It has been years since you studied the basic medical science material and passed the boards. Many of your friends have graduated medical school and have gone onto residencies. You may find that some former classmates are your residents, which can be either a dream or your worst nightmare. Let's just say it's better to have friends than enemies. With expectations high and your clinical skills low, you may feel like a fish out of water at first.

Needless to say, this ping-pong process can be fairly disconcerting. However, some efforts have been made to ease the transition points. As mentioned above, students can pursue some clinical clerkships before starting graduate training. Additionally, some programs allow students to pursue longitudinal clinical experiences throughout the graduate years to maintain contact with medicine while conducting thesis research. This often consists of a weekly outpatient clinic in a medical area of interest. Moreover, some programs offer a period of re-orientation to the clinics upon completion of the thesis. Nevertheless, students still find the transitions fairly difficult at first, and each requires a period of adjustment.

Admissions Criteria

"What do I need to get in?" This is a question commonly asked by many premedical students, including M.D./Ph.D applicants. When we started the application process, several of us had interacted with current M.D./Ph.D students or faculty possessing both degrees. To us lowly undergraduates, they seemed like gods at the time—insurmountable mountains of knowledge, mysterious and mythical, possessing a level of motivation, experience, and smarts that could only be characteristic of the most advanced form of human intelligence. How in the world could puny peons like us possibly compare to these unearthly beings? So the thinking went…

Now that we have gone through the process, we have learned a simple axiom: you can either be intimidated or you can do the intimidating. First, it should be emphasized that no single criterion will get you in—it is truly the whole package. M.D./Ph.D. programs seek highly qualified individuals with a genuine passion for science and medicine. They look for maturity, dedication to research, and evidence that you have thought through the reasons you want to pursue this difficult pathway. Admissions committees know that M.D./Ph.D. programs aren't for everyone. It takes certain characteristics to become a successful physician-scientist. They are

very conscious of students who show even the slightest bit of doubt about commitment to research, as attempts are made to screen out for students looking for the "free M.D."

Grades

A certain level of academic achievement is necessary to be a successful applicant. Factors such as breadth and strength of college coursework, grades, and grade point average (GPA) provide a measure of work ethic and the ability to be a successful student in future studies. While there are usually no specific cut-offs for many school's admissions, it becomes increasingly difficult to get into programs with lower GPAs. Generally speaking, you should aim for at least a 3.5 average, with a higher GPA depending on other parts of your application (i.e. MCAT scores). This, of course, is not a steadfast requirement and there are probably applicants admitted with lower averages. Improvement over time, post baccalaureate/graduate coursework, and other post-undergraduate education is also taken into account and encouraged for students lower GPAs.

Standardized Test Scores

Medical College Admissions Test (MCAT) scores are usually required and the Graduate Record Exam (GRE) is optional. Average MCAT scores tend to be higher for M.D./Ph.D. applicants/students than the M.D.-only medical applicant/student. At several top programs, MSTPs have average total MCAT scores in the 35-36 range. However, students fall both above and below this score. High scores on the physical and biological sciences sections are probably emphasized more than those on the verbal or writing. Again, there are no steadfast cut-offs here and a weakness in one area can be counterbalanced by strengths in others.

Choice of Major and Coursework

There is no specific college major requirement for M.D./Ph.D. applicants, although most tend to have a solid scientific background. The basic course requirements parallel those of regular medical school admissions (i.e. biology, general and organic chemistry, physics, calculus, English, etc) with more emphasis on the sciences. Courses taken in the quantitative basic sciences (i.e. biochemistry, thermodynamics, calculus-based physics, differential equations) are recommended, although not necessary. Graduate-level courses in macromolecular structure, genetics, biophysics, and other subjects may be helpful in showing academic rigor and preparing you for future graduate study.

Research Experience

The M.D./Ph.D. admissions committees are looking for high-octane students that are extremely motivated to pursue a career in research. Successful M.D./Ph.D. applicants usually have provided evidence of sustained scientific-based laboratory investigation. Most have at least two years of research experience, often with a leading role on a self-directed long-term project. This means more than simply working with a postdoctoral fellow or graduate student. The level of autonomy given to you in the lab is very important. You may have participated in several summer projects. Alternatively, you may have worked continuously for multiple years. Some of us contributed to a variety of small projects, while others worked on one or two large ones. There

is no set formula. You must show a contribution of intellectual creativity in designing and running experiments, analyzing the data, forming conclusions based on the results, and presenting the work in some fashion. In other words, you must have learned and practiced the scientific process.

Communication is a critical skill in the scientific world. Attendance at conferences, poster sessions, and seminars can help demonstrate your interest, while also expanding your knowledge base. Often, applicants have written some abstracts and have presented at professional or student research conferences. Research publications can be a big plus, especially if you are the first or second author. There will always be an occasional applicant or two with a paper in *Nature* or *Science*. However, the vast majority of applicants do not have publications, as it is uncommon for undergraduates to have sufficient time or opportunity to contribute a significant body of scientific work. Communication extends beyond the written word, however, and you must be able to clearly and concisely describe your research verbally. Formal presentations given at conferences and informal practice with your advisor or other lab members can help prepare you for interviews.

Extracurricular Activities

While grades, test scores, and research experience comprise a hefty portion of the admissions committee criteria, they often are not sufficient to differentiate between highly qualified applicants. This may sound surprising, but the committees are keenly aware that there is more to life than academics. Therefore, they look for clinical experience, volunteer work, community service, athletics, unusual talents, and other activities or qualities that can demonstrate multidimensionality. M.D./Ph.D. education is a long process, so committees want to make sure you have found the balance between academics and other aspects of your life.

Personal Attributes

Despite the stereotyped image of science as dry and boring, qualities like creativity, curiosity, and passion about research are necessary attributes of a successful scientist, and thus are sought by M.D./Ph.D. admissions committees. They expect a certain level of maturity and confidence. You must be able to handle uncertainty, as this is part of science. A demonstrated ability to overcome obstacles is golden. Often, this can be described in your letters of recommendation. Whatever your background, it is vitally important for you to be able to convey your independence, creativity, and passion by showing an interest in your own work and that of others.

In summary, M.D./Ph.D. admissions committees seek highly qualified individuals with outstanding potential for a career in medicine and biomedical research. However, don't be intimidated by the hype! Besides academic qualifications and research experience, it is really your ability to convey your innate curiosity and drive that will determine whether and where you are admitted. In other words, half of it is what you've already accomplished; the other half is still up to you.

Women and Underrepresented Minorities

Diversity is highly prized in the medical and scientific professions. Input from a broad range of backgrounds, perspectives, and experiences can facilitate scientific advances and enhance both medical education and patient care. Women and minorities are traditionally underrepresented in M.D./Ph.D. programs, for various reasons, including past discrimination, lack of opportunity, and other societal factors. Women face an especially tough battle in pursuing the M.D./Ph.D. career track, as the long duration of the programs may interfere with family planning. However, there are many examples of both men and women who successfully complete these programs while simultaneously handling marriage and child rearing.

A major initiative of the NIH is to increase the number of underrepresented minorities and women in science and medicine. Therefore, MSTPs actively seek to recruit qualified students from disadvantaged backgrounds. Several NIH-supported programs (i.e. MARC, MBRS: visit www.nih.gov) allow minority students to conduct research during the high school and college years. This has effectively increased the pool of qualified minority students by preparing them for future graduate study. Women and minorities are highly encouraged to apply for MSTPs and non-MSTP M.D./Ph.D. programs.

Application Process

"The early bird catches the worm."
-Anonymous

One of the most important aspects of the application process is to accomplish tasks in a timely fashion. This means taking the April MCAT, sending in transcripts early, and starting to work on your essay, including the personal statement. While it is not necessary to send in materials on the earliest possible date, it is to your advantage to be early throughout the whole process, including finishing the primary and secondary applications. The earlier you secure letters of recommendation, the better. You should even start writing the infamous "M.D./Ph.D. essay" that will focus on your motivations for the combined degree and previous research experience and accomplishments. This helps expedite the admissions process. Chances are that you'll be granted interviews at an earlier time.

That being said, we want to emphasize that you really need to send in your application materials WHEN THEY ARE READY. The application process is about presenting yourself in the best possible light. This means taking the time to revise and polish your essays, making sure grades are properly reported on transcripts, tidying up secondary applications, and ensuring that you are giving yourself the best possible chance by starting off on the right foot. Therefore, we recommend that you don't rush and do a poor job, but take the time to really think about your responses to questions and to describe your research and motivations for the M.D. and Ph.D. degrees. After all, Rome wasn't built in a day.

As other premedical texts cover the basics of the admissions process in great detail, here we will be approaching the subject from a perspective relevant to M.D./Ph.D. applicants. For more detail on the specifics of the AMCAS and other components of the application, we refer you to the AAMC web site: http://www.aamc.org/students/start.htm

AMCAS: Laying the Foundation

The first step is to complete the primary application using the American Medical College Application Service. Most American medical schools with M.D./Ph.D. programs take part in this centralized service. It is designed to be a standardized application that is submitted to all of the medical schools to which you choose to apply. Currently, the latest version is online (to the chagrin of many premedical students). Given the fluid nature of Web media, the application will likely evolve considerably over the next several years.

A new addition, highly relevant for M.D./Ph.D. applicants is the section that includes checkboxes relating to combined degree interests. Medical schools will now see that you are applying M.D./Ph.D. even before they decide to send out secondaries. The catch is that there are separate M.D. and M.D./Ph.D. boxes, and thus the applicant must decide early on whether to pursue M.D./Ph.D. or M.D.-only. It is presently unclear as to how this will effect admissions, but it is unlikely that schools will discriminate between types of applicants in this initial process (UCSF does not, for example). There is pressure from M.D./Ph.D. programs to find out how many applicants are applying this route, and thus AMCAS is likely to make revisions in the coming years. For example, the following questions could very well make their way onto the AMCAS application:

1) Briefly state how a combined degree would satisfy your career goals.

2) Please describe your research experience including the nature of the research problem and your role on the project.

A major decision to make at this point is to how many schools you should apply. We recommend that you first do some research by browsing various schools web sites and seeing 1) if they have an M.D/Ph.D. program, 2) if the M.D./Ph.D. program is an MSTP (visit http://www.nigms.nih.gov/funding/mstp.html), 3) the procedure for applying. Schools vary considerably in their requirements and application procedures. You should also think if you could actually see yourself at that particular school. For example, if you don't like frigid weather, your research interest is in a particular field, or you want to apply to programs with particular strengths, that might narrow the field. Don't apply to programs you really would not attend. It will be become obvious that you aren't interested.

However, a word of caution: don't eliminate too many options at this point. It is better to overshoot the number of schools to which you apply. Often it takes actually the firsthand experience of visiting the school (i.e. on interviews, revisit weekends, etc) to determine if you would attend. M.D./Ph.D. applicants traditionally apply to fewer schools than their M.D.-only counterparts, usually somewhere in the range of 10-15. Perhaps this is because they have stronger academic records. Or maybe there are fewer schools in which they are interested. The point is that you'll have to decide to how many you will apply by assessing the strength of your academic record, research experience, letters of recommendation, and other factors.

Given that the AMCAS is a primary application received by medical schools, and is NOT a graduate school application (or M.D./Ph.D. application for that matter), we suggest that you save detailed descriptions of your research for the M.D./Ph.D. applications that come with secondaries. Instead, write essays such as the personal statement with medicine in mind. It is fine to talk about science and your research background, but remember that medical school admissions committees read these essays and may be a little worried if you present yourself as only interested in science. You might mention something about the interface of science and medicine in your essays, but the main focus should be on the experiences that have led you on the path to becoming a physician. Remember, there are no steadfast rules and individual experiences have been highly variable. Usually it is best to present yourself as a thoughtful individual with a passion for both medicine and science. You will be required to carefully bridge the dichotomy between degrees many times over throughout the application process (not to mention in your career as a physician-scientist). So tread lightly and use your common sense.

Secondaries

So, you have finally finished the primary application and have gotten to breathe a big sigh of relief. Enjoy it because when secondaries hit your mailbox, you'll be taking on a full-time job. Not only will you be required to fill out the multitude of medical school secondaries, but you'll have to complete the additional enclosed M.D./Ph.D. applications. This is by no means a trivial task. Although you will be tempted to make a half-hearted effort here, don't forget that the secondaries are at least as important as the AMCAS application.

Schools differ in their procedure for sending out secondaries. Some screen applicants based on the primary application, but others automatically send a secondary to all who use AMCAS. Secondaries typically ask for additional information, including essay-style responses to profound questions such as "What makes you special?" They typically want additional personal information, volunteering hours, research experiences, etc. Don't take these questions lightly. It is best to work on one application at a time, in a thorough manner. You will see that secondaries get exponentially easier to complete with each additional one, as you can cut and paste essay responses. Some secondaries ask if you are applying M.D./Ph.D. Others ask to specify either 1) M.D., 2) M.D./Ph.D. only, or 3) both. There usually isn't a disadvantage to specifying the third option, but if you select the second, you probably won't be considered for just the M.D. if you don't get in for the M.D./Ph.D. program. Yet other secondaries don't ask you to specify, and simply include an additional application specific for M.D./Ph.D. applicants. You are still required to fill out everything, including the secondary.

Frankly, the process of what to fill out is somewhat confusing for M.D./Ph.D. applicants. Most secondaries are fairly straightforward, even if applying M.D./Ph.D. However, some do not have an integrated process, and thus you must apply separately to both the medical and graduate schools. We recommend that you check with your schools of interest for the proper procedure. Also, if you have any questions, feel free to give the program administrator a phone call. Unlike M.D.-only admissions officers, M.D./Ph.D. administrators deal with a limited group of applicants each year. Consequently, they are considerably less stressed and often more willing to go the extra mile for you.

The M.D./Ph.D. Application

The M.D./Ph.D. application that is typically included with secondaries will most often ask for your personal and contact information, coursework, MCAT scores, GPA, research awards, publications, names of research advisors who are writing your letters of recommendation, and an essay describing your past research experiences, your career goals, and why you want to pursue an M.D./Ph.D. program.

Don't simply repeat the AMCAS section for awards and honors, but do include items relevant to research. The idea is to convey a sense of research accomplishments. As far as we're concerned, no award is too big or small to list. Some will be recognized nationally (i.e. Westinghouse, Howard Hughes, etc), but others you'll have to explain during interviews if asked.

As for publications, there are many different formats in which you may have presented your work. The best situation would be to have one or more manuscript publications in scientific journals, with full literature citations. You could even include reprints with the application, if available. However, most applicants do not have publications. Many have abstracts which can be cited using the appropriate format. Also, research presentations or conferences attended can be listed if you presented work either in lecture or poster format. These are not technically publications, but would be of interest to admissions committees because they show experience in various forms of scientific communication.

The M.D./Ph.D essay should discuss primarily your interest in science, but also some information on your medical interests. Be sure you know why you want both degrees and provide evidence to back up your assertions! It is critical that you show your development as a potential scientist through concrete examples. You want to convey a sense of maturity. We recommend that you weight your discussion on the side of science, as you had the opportunity in the AMCAS application to talk about medicine. It is highly recommended that you treat this essay with care equivalent to that you showed with your personal statement.

Try to describe your research experiences from a larger perspective. Admissions committees don't want to hear about making buffers, doing PCRs, running gels, etc. Instead, they are looking for evidence of critical thinking, level of contribution to a project, independence in the laboratory, scientific participation (i.e. conferences, presentations, seminars, etc), and knowledge of the scientific process. Most importantly, they want to see that you can communicate complex scientific topics in a manner that an educated person (i.e. not an expert in the field) can understand. Avoid unnecessary use of acronyms and abbreviations and try not to sound too technical. You'll get a chance later in interviews to explain the project(s) in gory detail (if they ask you to do so).

It is usually a good idea to have several people read your essay to help you revise. This should include those familiar with your particular projects (i.e. your advisor, postdoctoral fellows, graduate students, technicians, etc). Never underestimate the value of revision.

Again, take your time on the secondaries, but try to be as efficient as possible. The ealier you turn them in, the faster you'll be granted interviews. However, the response time varies considerably, so don't panic if the schools take a while to get back to you. Usually, postcards are included with your secondaries to notify you when all materials have been received. If you are unsure, bypass the M.D. admissions office and call the M.D./Ph.D. program directly to ensure the completion of your file.

Letters of Recommendation

Schools ask you to send letters of recommendation, which is typically done using a specialized service or premedical committee at your school. If you have graduated already, you may have to ask your professors to send letters directly to individual programs, along with evaluation forms included with the M.D./Ph.D. application. You will often be required to send separate sets of letters for the medical and M.D./Ph.D. applications. We recommend that for the latter, you seek letters from those who can best assess your potential for a career in research.

Admissions committees desire an outside perspective on the applicant's strengths and weaknesses. Try to get letters from professors who know you well. In the laboratory, often the day-to-day contact is not with the principal investigator (P.I.), but a postdoctoral fellow or graduate student. Though P.I.s are usually very busy, attempts should be made throughout your laboratory experience to meet and talk about your projects and career goals. The amount of personal contact you receive will depend on several factors, including the size of the lab.

How do I ask for a letter, especially if I fouled up in the lab? Take Jeremy's experience as an example:

> I started working in a lab during my freshman year of college and one of the first things I had to do was make a stock solution of ethidium bromide (a known mutagen). My P.I. was in the lab at the time and therefore I was really nervous. I was kind of shaking and ended up spilling half the bottle of purple powder all over the balance and weighing area. My face went bright red and I could sense every member of the lab staring at me. Fortunately, my P.I. noticed my embarrassment and was compassionate enough to actually helped me clean it up himself. I thought I was a goner for sure! Despite this incident, I ended up working in that lab during all four of my undergraduate years and I have no doubt that my advisor's glowing letter was instrumental in helping me get into several M.D./Ph.D. programs. Now when I look back at my trials and tribulations, missteps and mishaps, bumbling and clumsiness in the lab, I just laugh. Don't take it too seriously. In the beginning, everyone knows that you are new and still learning. People honestly don't think about it as much as you think they do. I'd say that if you have contributed something meaningful to the lab and your advisor can write about your hard work, dedication, and potential, then you will likely receive a great recommendation.

If you want to talk with your research advisor, a good way to go about it is to knock on the door and ask if there is a good time to meet. Be up front and convey what you want to discuss. The best thing to do when seeking a letter is to ask directly: "Do you think you would be able to write a strong letter of recommendation for me?" Your advisor will most likely give you an honest answer. Make sure you supply a curriculum vitae (c.v.) and a personal statement that outlines your interests, experiences, and goals. You should meet and discuss your interests and goals, which will give your advisor more to write about in the letter.

You absolutely want the best research letter possible. A factor to consider also is the status of your advisor in the scientific community. A letter from a well-known P.I. who publishes well will probably give you an advantage in the process. However, most applicants do not come from big-name laboratories. What is most important here is the quality of your letters, not necessarily who writes them. Of course, a letter from a P.I. is usually weighed more heavily than one from a postdoctoral fellow or graduate student. However, an additional letter from a postdoc with whom you have worked closely could offer additional and perhaps more personal insight.

Whoever you get to write your letters, make sure you give them sufficient time to make them great. Usually a month is the standard waiting period. Don't ask the day before the letters are due, when your P.I. has a huge grant due the same day. Faculty usually run extremely tight schedules and will grow very impatient with pushy students demanding letters.

The key to obtaining successful M.D./Ph.D. letters is to choose people who can describe your research accomplishments, ability to succeed in research training, and potential for an excellent career in science.

Interviews

Overview

You may have thought that the most strenuous, time-consuming, and mind-bending process was far behind you after taking the MCAT, completing the primary and secondary applications, and begging your professors and research advisors for those glowing letters of recommendation. Unfortunately, as you reach the top of this first series of hills, you suddenly see the awesome summit of a mountain before you. That mountain is the infamous interview process.

From your paper applications and letters, the admissions committees will have formed a picture of your academic strengths and perhaps some of your outside interests and personality characteristics. But as we all know, an applicant may look great on paper, but in real life be a complete zero. Hence, we have an interview process that attempts to screen out for malignant personalities, inability to hold a conversation or communicate effectively, and unclear or uncertain goals or potential.

The interviews provide more than a simple screening process, however. Your interviewer becomes your advocate (or worst enemy) on the admissions committee during their meetings. At the interview stage, applicants are more or less on even ground, as you have already made the first cut, and therefore MCAT scores and GPA tend to be de-emphasized. Instead, the interviews provide a forum to personally assess the applicant's personality, interests, goals, and motivations. Interviewers want to see if an applicant can communicate effectively, expand upon items written on the paper application, think critically, and discuss relevant ethical and moral issues. In effect, they want to see if you are truly a three-dimensional person who shows signs of maturity and a potential for a career in science and medicine.

Scheduling

The fun begins with interview scheduling and finding faculty that you would like to meet. Unlike medical school interviewers who are largely faculty or students on the committee chosen at random, M.D./Ph.D. interviews are set up quite differently. Typically, you will have 1-2 medical school interviews and 1-2 formal M.D./Ph.D. interviews. At many schools, you also have the opportunity to meet with faculty in your field of interest for informal interviews. In many ways, the interview process is about you finding which programs you will consider when the time to make decisions arrives.

You should visit the medical school web sites and related links (see Appendix C). Valuable research information is often buried among the sites of the various graduate programs offered. There are often links to individual faculty pages, which contain brief descriptions of their area of interest, ongoing projects in the lab, references to publications, contact addresses and numbers, and other useful information. If you have a specific area that you are interested in, that will narrow your search considerably. You may already be familiar with specific researchers through your experience during college or post-undergraduate education, in a research laboratory, or by word-of-mouth. Literature searches using PubMed can be performed from the National Center for Biotechnology Information web site (http://www.ncbi.nlm.nih.gov). Try to find articles of interest written by faculty with whom you could potentially work. If you interview with them, it will be very impressive if you can intelligently discuss one or more of their papers.

M.D./Ph.D. programs will try to coordinate interviews with the medical school so that they fall on one or two days. Programs vary considerably in how they schedule applicants. Some have single days in which they interview most, or all, applicants to their program. Others schedule several groups of applicants together, so that they can provide special meals and accommodations on specific dates. Yet others interview applicants individually. Some programs offer interview dates that will conflict and you may be forced to reschedule. Don't worry, as this happens occasionally, despite the relatively small number of M.D./Ph.D. applicants. At some schools, you will meet and interact with M.D.-only applicants, while at others you will be isolated from them and interact only with other M.D./Ph.D. applicants.

We recommend that you schedule interviews for early in the admissions cycle (i.e. October-January). Some schools have a rolling admissions system that gives preference to earlier applicants. However, many of the top M.D./Ph.D. programs are not on rolling admissions and

thus it is not as critical to interview early at these places. Each program has a specific application due date that may or may not be distinct from the regular medical school application deadline. Be sure to check with the programs to which you are applying to ensure that you meet all requirements.

The programs also vary quite a bit in terms of providing meals and accommodations. Very few pay for airfare or other transportation, but many will put you up in a hotel or student housing and will provide meals. Programs often have slush funds they use for recruitment. Don't be afraid to inquire. Unlike interviews, most programs will fully fund return visits after you have been admitted. However, for interviews, be prepared to spend quite a bit of money for travel and meals.

The Interview

You'll soon be making trips to a number of different schools and will likely experience a barrage of tightly scheduled interviews. The first couple of interviews will be nerve-wracking. After a few, you will progress to a sense of competency. After several, you will start to experience annoyance with the repetition. Ultimately, you will end up wishing you could have just tape-recorded your responses and played them when needed. Believe us, by the time you are finished with the process, you will feel like you will never want to interview again. This is not really a result of the interviews being all that difficult, but that you are asked the same questions during every interview, at every program.

A typical formal M.D./Ph.D. interview ranges from thirty minutes to one hour in length and consists of questions on the following topics:

1) Your personal background and items on your application.

2) Why you want to get both the M.D. and Ph.D. degrees (and why not one or the other).

3) Your research project(s), experiences, etc.

4) Career goals and interests.

It is critical that you are on time for your interviews, even though the schedules are packed densely. Faculty members appreciate punctuality, as their time is valuable. Despite one's best efforts, however, Murphy's Law seems to inevitably take effect during the interview season. Hosein's experience shows us that nightmares do come true:

> My eyes slowly open and I notice that the clock reads 9:15 AM. Another gorgeous day, I think to myself, forgetting that I'm sleeping on an old couch 3000 miles away from home. I'd spent 9 long hours on a plane the day before and was greeted at the Oakland airport by an old high school friend, who was kind enough to let me crash in his dorm at UC Berkeley for a few days so I could take care of some business. I get up from the worn-down couch, stretch my sore back, and

breathe a long sigh of relief as I realize that I'm no longer in snowy Maryland but in warm California. I try to recall what business I'm here for and my mind draws a blank. Then it suddenly hits me like a freight train.

My M.D./Ph.D. interview at UCSF starts in 45 minutes, and I'm way across the bay in Berkeley! My heart drops as I realize that I've overslept by a whole hour and a half.

Oh God.

Immediately I begin to panic, not knowing what to do. I run to the shower but quickly turn back as I realize that I'll need to take a cab into the city. So I yell at my friend to wake up and call a cab, and he replies by mumbling the names of sorority houses. After forcing him to wake up and call a cab, I dash to the shower and manage to get dressed in an astonishing 8 minutes (a new record for sure). With shoes untied and tie in hand, I sprint to the taxi and instruct him to drive as fast as possible into the city…the faster he travels, the bigger his tip. He responds with a sharp thrust on the pedal, and we begin to soar onto the freeway and head for the foggy emerald across the bay.

It seems that things will work out. We cross the bridge and head over to UCSF's Parnassus Campus with the time being 10:05 am. No sweat, I tell myself as I try to put on my tie in the bumpy cab. The assurance only lasts for a few seconds, however, once I realize that the cab driver is lost and has no freaking idea how to get to UCSF. The panic consumes my body once again. The cab driver sees my panic and begins to panic himself, so he stops in the middle of the road to ask directions from pedestrians. As cars behind honk wildly, I close my eyes and heave a desperate sigh for what seems an eternity.

I arrive at UCSF at 10:15 am, feeling that my life has ended. Luckily, I had brought a map of the campus and knew how to get to the Clinical Sciences Building, where I was to meet a professor for an hour-long interview. I make a quick dash into the restroom to make sure my tie is straight, then run over to professor's office and, after collecting myself, knock on the door. A middle-aged woman opens the door and cheerfully greets me despite the fact that I'm nearly 20 minutes late for the interview. Her ultra-kind disposition dissolves my panic away, and the interview (all 15 minutes of it) goes incredibly smoothly.

The moral of this story is that one must always carry an alarm clock during the interview process. Well, actually, the real moral is that no matter what happens, keep your calm and relax. Most M.D./Ph.D. interviews are very laid back, almost informal, compared to interviews for the regular medical school. Albeit, M.D./Ph.D. programs may require significantly more interviews than medical schools (I had seven interviews at UCSF over a two-day period), and some of these interviews may be intellectually intense. Still, the focus of M.D./Ph.D. interviews is the research you've carried out, and no one should know about that better than yourself.

M.D./Ph.D. interviews tend to focus more on your research than anything else. This means you have to know what you set out to accomplish in the lab, what you actually accomplished, how you dealt with obstacles experienced during your project(s), and how you presented the results. This involves giving a clear and concise summary of your project. It is a good idea to have practiced in advance so that you feel comfortable speaking in the somewhat stressful interview setting. Often, your advisor or other members of the lab will be willing to help you iron out any wrinkles. They tend to be very familiar with scientific communication and can give excellent feedback and suggest possible areas of improvement. Some interviewers will be more familiar with your area of research than others. Expect to be quizzed if the interviewer is an investigator in the same field.

Not surprisingly, interviewers are usually very adept at probing an applicant's motivations, experience, and potential for a career in science. They can easily tell if an applicant's heart is really into science and medicine, or if someone is just trying to get into the program for the "free M.D." You should think quite a bit about your responses beforehand and during the interview. Always back up claims with solid evidence or examples from your past experiences.

Always remember that while some interviews may seem like grilling sessions, the interviewer is your advocate on the admissions committee. Therefore, it is good form to give thoughtful, intelligent responses to questions that may seem to challenge your work. Although you have no doubt put considerable effort into your research, come to interviews with an open mind. The interviewer may simply be trying to get a point across and see how you react to the new information. In science (as in medicine), the worst thing you can do is to become agitated or upset when confronted. Instead, try to give a reasoned response, which will show your maturity and critical thinking ability.

Beware, as you may be asked to think on your feet. Take Jeremy's experience as an example:

> I had one interview which was scheduled as "informal." This was the last in a series of interviews at five different schools in a three week period. I had already interviewed with several faculty members the same day. The interviewer began by talking rapidly about his research for about ten minutes straight. Exhausted from the previous several interviews and unfamiliar with this particular set of experiments, I felt my eyes slowly closing. Suddenly, the interviewer stopped in the middle of his sentence and inquired, "So, in this situation what experiment would you do?" What a jolt! After scrambling for a quasi-intelligent response and managing to conjure up some harebrained idea for an experiment, the interviewer voiced several potential problems with my approach. He then asked me to come up with alternative experiments. One-by-one, he shot down my ideas until finally I arrived at something along the lines of the approach his lab takes. After he was satisfied, he continued his rapid discussion, giving me more information. Then he abruptly stopped again and prodded me for more possible experiments. We went through this cycle every couple of minutes until the whole

hour had expired. It was one of the most intense interviews I had during the application process.

The interviewer will often finish the session by asking if you have any questions. It is a good idea to have several prepared in advance, so that you can show interest in the school and the program. Try to sound intelligent, but also try not to be confrontational or abrasive. After experiencing many interviews in which people all ask the same types of questions, you may be tempted to shout, "No, I don't have any questions and if I did I would ask!!!" Don't give into the temptation. You want to impress, not distress. So sit back, relax, and always try to moderate your responses.

In terms of the informal interviews, which consist of meetings with individual faculty of your choice, the key is to have some idea of the research that goes on in his/her laboratory. Try accessing the appropriate journal articles so that you can ask meaningful questions and discuss the research. Think about it from the interviewer's perspective: it is very flattering for someone to have read your work and seem excited about it. Faculty are typically very busy, so be sure to thank them at the end of the interview and emphasize how much you would like to work with them. They often are asked to write evaluations, which are considered alongside those obtained from the formal interviews.

Afterwards, it is good etiquette to mail notes to your interviewers to let them know you appreciate them for spending their time with you. While this may not affect admissions decisions, thank you notes certainly can't hurt and they are appreciated by faculty and student interviewers. It is not as easy to forget someone who shows a little bit of thankfulness and kindness.

Admissions Decisions

At last you have reached that glorious mountain summit that once seemed so far and out of reach. With hard work and dedication, however, you have managed to surmount the obstacles in your way. You have done all that can be done as far as the application process goes. Finally, you can breathe a huge sign of relief…

Now you must sit and wait. Believe us, as tough as the whole process was, it is more difficult in some ways to be at the mercy of the faceless, yet powerful, admissions committee gods who hold your fate in their hands. These almighty deities will weigh your strengths and weaknesses, pass judgment, and ultimately dictate the course of your life. The worst part is that the adcoms are not known for their quick decisions or expeditious notification. They will almost certainly test your resolve as you hound the mail carrier each day for that golden letter. Their power may even tempt you to go to such lengths as making animal sacrifices and other offerings. We suggest that you refrain from such behavior and instead focus on other things during the months you must wait. Remember, you have done all you can. Eventually, you will reap what you sow.

Selection Factors

It does help to have some knowledge of the admissions committees' criteria for decision making. The admissions process has a fairly stochastic nature, which you'll no doubt experience when you ask friends and other applicants to which programs they were admitted. Rest assured though that the choice of applicants is not entirely arbitrary.

Admissions committees look for certain characteristics in M.D./Ph.D. applicants. The regular medical school admissions process tends to emphasize the whole package, including extracurricular activities, unusual talents, unique experiences, and personality traits. Strong academic potential and an ability to develop rapport with others are sought qualities. Interpersonal skills are highly emphasized at the interview stage, above MCAT scores and GPA. Simply put, interviewers look for applicants who have the potential to become successful physicians.

To a certain extent, the same qualities are sought in M.D./Ph.D. applicants. However, the most highly emphasized aspect of M.D./Ph.D. admissions is one's research experience. Most successful applicants have worked multiple years in one or more laboratories. Some have taken a year off after college to pursue a full-time year of research, and consequently have publications. Others have presented at conferences and interacted with researchers in the field. The letters of recommendation represent a critical component to the application, as they provide a subjective assessment of the applicant's demonstrated abilities and potential to do well in a medical and graduate school class. The ability to communicate scientifically either verbally during the interview or in publications or presentations is essential. In addition, you must show your commitment to science, as some applicants who are undecided about whether to pursue the combined degree attempt to use these funded programs as a route to a "free M.D." You must demonstrate your motivation for pursuing both degrees. By applying for an M.D./Ph.D. program, you are attempting to take a difficult path traveled by few.

Acceptance, Waitlist, or Rejection

Given the multitude of highly qualified applicants competing for a limited number of spots, programs often have a difficult time making decisions. At a certain point, the admissions process becomes somewhat subjective, as there are few characteristics that can differentiate the top applicants. There are several hundred applications for these programs each year and the top schools interview a select group of around 60-80 applicants. Thus, if you are able to secure several interviews (we suggest 6 is the magic number), know your research well, and can hold a decent conversation, chances are you will be admitted to at least one program. It is very difficult to say exactly to which schools you will gain acceptance, however. You may have heard that there is a certain degree of randomness to regular medical school admissions. For M.D./Ph.D, multiply this by 100. You'll find that there is no rhyme or reason to where you or some of the people you meet on interviews will be admitted. Some of us, for example, were admitted to certain programs, while others didn't even get interviews at these schools. We each had multiple acceptances, but few of us got accepted to all of the same places. The best we can tell you is that arbitrary factors such as how well your interviewers liked you probably made the differences.

After waiting so long, there are usually four possible results in the M.D./Ph.D. admissions process: 1) **Nirvana** (a.k.a. acceptance), 2) **Limbo** (waitlist), 3) **Chaos** (M.D.-only acceptance), and 4) **Hell** (rejection). To make things more confusing, numbers 2 and 3 are not mutually exclusive, as you may be admitted by the medical school, but waitlisted by the M.D./Ph.D. program. You'll probably experience each of these results during the process.

The best to hope for is outright acceptance (**Nirvana**) at all of your top choice schools, but this rarely happens, even for those rare applicants with stratospheric MCATs and GPA, years of research experience in a Nobel Prize winner's lab, and first-author *Nature* and *Science* papers. Some applicants are admitted to more than one program. Multiple acceptances can feel great, but we recommend that you move to quickly narrow your choices so that you free up spots for other applicants. A good idea is to make a list or chart comparing your top programs. Often, it may take a revisit weekend to help you make your decision.

About **Limbo**: some programs refuse to call the waitlist a waitlist, as they feel this may in some way stigmatize applicants. However, all of the individuals put on the waitlists are absolutely qualified to be admitted, but programs can only offer a limited number of spots initially. Based on our experiences, if you are high on a waitlist at a particular school, chances are that you may be eventually admitted. There is quite a bit of shuffling that takes place as applicants make decisions and withdraw multiple acceptances to narrow their choice to one program.

Commonly, applicants end up in a situation in which they have been admitted M.D.-only at a particular school. They may be waitlisted for M.D./Ph.D. Alternatively, most programs will consider you for regular medical school admissions even if you are rejected from the M.D./Ph.D. program. Thus, a problem arises in which an applicant may be admitted to a higher ranked school M.D.-only and a lower ranked one for M.D./Ph.D. What do you do in this situation? Hence, we call this **Chaos**. One option is to go to the higher ranked school M.D. and reapply for the M.D./Ph.D. program the following year. In the next chapter, we discuss factors for choosing a school.

When all **Hell** breaks loose, we recommend that after punishing a punching bag or your pillows, you take a breather and think rationally about the situation. We all have to deal with rejection from time to time. All of us went through it during the M.D./Ph.D. admissions process. Although you may feel the sting of not being accepted at a particular school, it is important to consider that other programs may look at your application differently. Perhaps you had a bad interview. Or maybe your interviewer just didn't speak up enough at the admissions committee meetings. It is always difficult to nail down exactly WHY something like rejection happens. However, we suggest that you look at the positives and turn your focus toward other programs.

Despite our somewhat facetious appraisal of the randomness associated with M.D./Ph.D. admissions, we realize the serious nature of the process. After all, this is a life-altering experience that will determine the course of your career and even your non-academic life. Many of us were lucky to have several good choices in the end. However, we also know people who

were not so fortunate. It can be extremely frustrating when, despite your time, money, and effort spent, the results come up negative.

If you end up in the situation of having to reapply, the first step is to ensure that all aspects of your application are the best they can be. For example, low grades, GPA, or test scores need to be explained or improved. Your personal statement, M.D./Ph.D. essay, and letters of recommendation need to be glowing. During the extra year while reapplying, you should try and be as productive as possible. For example, you may choose to do research, volunteer work, or something else that will help bolster your application. Any publications should be mentioned. Furthermore, practice interviewing and be able to explain your research project and goals. You need to go into the process humble, yet confident. Additionally, apply earlier and to a larger number of schools the next time around to increase your chances. We personally know people who have applied multiple times and ultimately have been successful. An investment of additional hard work and dedication can often pay dividends.

Choosing a School

"The circle is now complete. When I left you, I was but the learner. Now I am the master."
–Darth Vader, *Star Wars: A New Hope*

My, how the tables have turned. After surmounting the admissions process and hopefully having been admitted to the program(s) of your choice, you now sit in the driver's seat as the master of your own fate. If you are one of those people fortunate enough to be in the position of deciding between multiple acceptances, then you will soon be making one of the most important decisions of your education and possibly even your career.

By now you have likely been to several schools on interviews, so you have had at least a brief opportunity to see firsthand the school facilities and to meet faculty and current students. You have probably read at least a portion of the ample literature given out by different programs, including brochures, booklets, and pamphlets. Thus, you should have already developed some idea of where you might see yourself spending the next seven to eight years of your life.

Most programs offer fully-paid return visits that will allow you to see more of the school, interact with current students, meet with additional faculty members, attend medical and graduate school classes, and take part in a variety of other formal and informal activities. Based on our experiences, during these return visits you will most likely get a "gut feeling" of where you fit best.

There are of course many factors that go into making a decision on what school to attend. Just as the admissions committees assessed you based on a host of criteria, we recommend that you approach your decision in a similar manner. M.D./Ph.D. applicants face unique circumstances due to the program length, balance of medical and graduate education, and specific researchers in fields of interest. Thus a combination of factors, influenced by individual preferences, must be taken into account to make a decision that is right for you.

Location, Location, Location

One of the most important aspects of deciding between the various programs actually has nothing to do with the programs whatsoever. Some questions to ask yourself are: where would you most like to live for the next several years of your education? Are you a big-city person? Or do you prefer small-town or rural areas? Most major academic centers (and consequently M.D./Ph.D. programs) are located in substantially populated cities, since in addition to medical education, these institutions provide needed medical care. However, there are many schools located in non-urban areas that provide an excellent educational experience.

What type of weather do you prefer: rain, blizzards, noreasters, tropical paradise, 72-degree year-round temperature, etc? Do you enjoy surveying restaurants, bars, or clubs? You should make yourself aware of the school's environment, proximity to stores, venues, and recreational facilities. If you enjoy the outdoors, you might look for hiking, rafting, skiing, and other available options. It may seem somewhat surprising, but most M.D./Ph.D. students, while very driven by their goals, also know how to get out and about and have a good time.

Housing arrangements and affordability of living can vary considerably between locations. While the stipend of MSTPs and non-MSTP M.D./Ph.D. programs provides a good level of financial support, how far the money goes will vary greatly depending on your location. Near some schools, students can actually afford to buy property, while at others they are limited to renting out studios, apartments, and flats. Other programs encourage campus housing for its students. How much space do you need to live comfortably and to study? Do you prefer communal-style living or are you more private?

The point of all this is that lifestyle plays a big part in student happiness. You don't want to be a workaholic during your medical and graduate education, and you'll likely want to get outside and enjoy life a little. You'll obviously have to figure out what fits you best. We emphasize that while it may seem that you could potentially "live anywhere" and force yourself through your education, you will be infinitely happier if you choose a place in which you can thrive not only academically, but emotionally as well.

Strength of the Graduate and Medical Programs

Unlike M.D.-only applicants, those pursuing the combined degree programs have an additional component of education to consider. For M.D./Ph.D. admissions, a balance must be struck between the strength of medical education versus graduate training. Some schools provide excellent clinical experience and focus less on basic research. Others are more lopsided toward the research end. You'll have to investigate the specific programs in which you are interested to determine what best fits your career goals.

You may have specific research interests that will influence your decision on which school to attend. While most of the MSTPs and many non-MSTP M.D./Ph.D. programs offer a wide variety of scientific disciplines, it would be wise to choose a school that has a particularly strong graduate program in your area of interest. If there are specific faculty members with whom you would like to work, that can be an important deciding factor. Often, M.D./Ph.D.

programs will provide you with a list of investigators, research summaries, and publications. You probably have already talked with some researchers during interviews. The strengths of the various programs will become fairly obvious with a little exploration on your part.

However, the caveat is that your research interests may change over time, as you are exposed to the medical curriculum. Thus, don't hang on to your pre-conceived ideas too tightly. However, if the school is particularly well-funded for research, then you should have many options should you change your mind.

The U.S. News medical school rankings, although often quoted, do not take into account the uniqueness of M.D./Ph.D. and other combined programs. Although the rankings can be useful for purposes of comparison, they should be taken with a grain of salt. Conducted by survey, there is the potential for response bias, and the individual components used to measure strength of the medical schools are somewhat dubious. A better way to learn about the strengths of various programs is to do your own research. One way to do this is to ask many different faculty members for their perspectives on the programs in which you are interested.

Program Integration

One of the most formidable challenges of combined degree education is the incorporation of two distinct pathways that have at their root different goals. Thus, it is no surprise that the level of integration between the M.D. and Ph.D. phases varies considerably between M.D./Ph.D. programs.

Some schools offer classes or seminars specifically geared toward M.D./Ph.D. students. A current and popular example is "Molecular Grand Rounds" (at UCSF now called "Medical Sciences Grand Rounds"), in which students and faculty members present clinical cases with relevant basic science material. This gives M.D./Ph.D. students an opportunity to discuss disease-oriented basic research in the context of potential treatments and patient care.

In addition, programs attempt to integrate the M.D. and Ph.D. in other ways. Some encourage students to take graduate classes during the medical years. Others attempt to reduce the overlap between the medical and graduate curricula by allowing students to place out of certain courses. Longitudinal clinical electives provide students with the opportunity to maintain contact with medicine during the graduate years.

Despite these efforts, the medical and graduate portions of M.D./Ph.D. training remain two distinct entities at most schools. In making a decision, program flexibility is important in allowing students to tailor their education to their interests.

Program Length

While the average is seven to eight years, the duration of M.D./Ph.D. programs varies from school to school. Some have a notoriously long average time to graduation (i.e. nine or ten years). Others have administrators that push students out the door. In general, the more flexible programs graduate students in a more timely fashion. The variation usually arises from the length

of the Ph.D. phase of the training. Given the small sample size and tremendous variation in research interests of the students graduating at a particular school each year, you should be cautious in interpreting average program length. How much time you take to earn the degrees will depend more on you and your research advisor than on the particular M.D./Ph.D. program.

While we have attempted to highlight some of the factors significant to M.D./Ph.D. applicants, you may find that others not mentioned here are more pertinent to your specific situation. A decision on an M.D./Ph.D. program, like regular medical school admissions, comes down to assessing a range of factors in conjunction with your personal preferences. Chances are that you know yourself best. While input from friends, family, relatives, other applicants, etc. may be useful, you and you alone must make the final decision.

Dropping the M.D. or Ph.D.

Now that you have come so far and been admitted to an M.D/Ph.D. program, decided on a school, and perhaps even started classes, it seems that you have reached the pinnacle of admissions glory. M.D./Ph.D. programs are among the most competitive and difficult programs to get into, but what often goes unmentioned is the dropout rate. Although a fair amount of decision making went into the M.D/Ph.D. admissions process on the part of both the committee and applicant, for reasons both in and out of an individual's control, he or she may decide to forgo obtaining both degrees and opt for one or the other.

Factors

Extremely rarely is poor academic performance the reason for dropping out of an M.D./Ph.D. program. The vast majority of students admitted to these programs possess the intelligence and skills necessary to succeed. Occasionally, students experience various hardships (i.e. personal or family illness, death of relatives, etc) that dictate they postpone or drop out of the program (personal factors). These events are obviously beyond one's control and the timeframe cannot necessarily be predicted. Marriage is another factor that may affect one's decision to stay in the program.

Alternatively, there are academic reasons for dropping either the M.D. or Ph.D. portions of the combined program. Some students find that after two years of exposure to the vast amount of medical knowledge and some brief clinical experience, their career goals lie not at the bench of a laboratory, but in the arena of patient care. Most M.D./Ph.D. applicants possess clear-cut goals and specific scientific interests. However, over time some students will find that they are inclined to practice clinical medicine and wish to avoid spending the extra three or four years obtaining the Ph.D.

By contrast, there are individuals who find that after completing some preliminary laboratory rotations and taking medical courses, they do not wish to practice medicine and want a career solely in research. These students may drop out of medical school and opt for graduate training toward the Ph.D.

However, this latter scenario tends to occur less frequently than pursuing the M.D.-only. There are several explanations for this phenomenon. First and foremost, students who complete the first two years of medical school have only the two clinical years to go in order to graduate (time factor). Second, it is possible to do research with the M.D. but it is not possible to practice clinical medicine with the Ph.D. Thus, students who choose to pursue the M.D. can fully participate in both medicine and research, whereas Ph.D.'s tend to have sole research careers. Interestingly, a 1998 NIH review of the Medical Scientist Training Program suggests that M.D.-only graduates on average tend to have a tougher time securing grants and publishing than Ph.D. or M.D./Ph.D. graduates (http://www.nigms.nih.gov/news/reports/mstpstudy/mstp-print.html).

Payback

To our knowledge, MSTPs do not require payback of the stipend for students who drop out. However, certain non-MSTP M.D./Ph.D. programs may differ in this respect. You should check with the individual programs in which you are interested. However, be careful, as you don't want to appear uncommitted to the program during the admissions process. Some programs may have payback clauses that will make you financially responsible. A word of advice: programs do not take this situation lightly. They invest many thousands of dollars in your training to become a physician-scientist. Therefore, you should carefully consider your options before you are locked into a decision. Don't forget to look before you leap.

Exercise Caution!

We realize that no matter how much you plan, things may go awry that lead you to make career-altering decisions. Remember that admissions committees are highly attuned to sensing lack of commitment. If you are uncertain as to your goals or whether you really are interested in *both* medicine and science, we recommend that you think long and hard about applying M.D./Ph.D. We will guarantee that unless you are a very motivated and committed person, you will be miserable in an M.D./Ph.D. program and will risk not completing it. To summarize: Jumping the admissions hurdle shows that you are capable. It is up to you to finish the race.

Getting Prepared

After making your decision on which program to attend, there will no doubt be an indescribable glowing feeling that your future is beginning to take shape. Definitely take the time to bask in the natural high derived from the successes in life. However, once the effect has worn off a little and you have descended from cloud-nine, you can take several steps to prepare yourself for the long road that lies ahead.

There are basically two schools of thought on what you should do with the summer before you start the program. Some M.D./Ph.D. programs encourage (and some even *require*) you to do a laboratory rotation. The idea is that giving you an early start in the lab will expedite your decision on a thesis advisor, while also providing some interaction with other students who are on campus over the summer. Other programs discourage you from starting a rotation this early and instead recommend that you pursue other interests, as it will likely be your last chance before digging in for the long-haul. Many students use the time for traveling. For example,

backpacking in Europe tends to be popular. Whatever you choose to do with your time the summer before, make sure that you do take the time to catch up on rest, relaxation, and recreation. The next seven or eight years will not be easy and will require an immense amount of dedication (and sacrifice of sleep).

If you wish to begin a summer rotation, you will need to find a research advisor. This could be someone with whom you interviewed already, or another faculty member in your area of interest. It is a good idea to get in contact early (i.e. April or May) because labs tend to fill up quickly, especially if the particular faculty member is in high demand. E-mail or a phone call usually works fine, but if you're uncertain as to a specific faculty member, then you might try asking your M.D./Ph.D. program administrator if he/she could set up some meetings for you. Researchers tend to be very busy and have many commitments, but are usually more than willing to go the extra mile to talk with you. M.D./Ph.D. students have the reputation of being very bright, hardworking individuals and therefore are very desirable to have in the lab.

Retreats often take place near the end of the summer or beginning of fall and provide an excellent way for students to meet each other and faculty in their field of interest. Graduate programs usually have retreats that M.D./Ph.D. students can attend and the M.D./Ph.D. programs often sponsor retreats of their own. These activities will let you know who is working on what at your school and may give you ideas to incorporate into your future research plans.

Finally, it is probably a good idea to plan out a schedule for the next several years to ensure timely progression toward graduation (for an example, see Appendix B). Make sure that if you plan to take some graduate courses during your first two medical years, try to work out any potential time conflicts well in advance. Remember, *you* will be your strongest advocate in any M.D./Ph.D. program.

During the Program

The key to M.D./Ph.D. education, especially at programs that are less organized, is to take an active role. Failure to maintain responsibility for completion of requirements toward graduation will only increase the program duration. In our opinion (though it may contrast with some educators or current students), seven or eight years is long enough. Once you start the program, it is up to you to see that your education progresses in a timely fashion with as much (or as little) integration between the medical and graduate curricula as possible. While some program directors tend to be more forceful than others in terms of laying down the law, no one will be there to hold your hand at every step of the way. Therefore, you have to show the same, if not more, initiative and motivation that you demonstrated during the application process.

A good way to ensure a healthy progression through an M.D./Ph.D. program is to maintain contact with the director(s) and administrator(s). In other words, kiss up to the people in charge. Ok, maybe that is a little excessive. Rather, you should communicate with the director at least once a month and the administrator more often. In some programs, there are seminars, lunches, dinners, or other chances to meet formally. We recommend that you seize these opportunities, if not for the prospect of meaningful discussion of the pertinent issues relating to your education and career goals with people who have considerable experience, then at least for

the free food and drinks. Stipend, M.D./Ph.D. prestige, and all, you still are a starving student! Alternatively, you can make appointments or just drop by informally. Although usually very busy, most administrators are more than happy to take a moment and chill with an M.D./Ph.D. student.

We recommend that you start looking for a thesis laboratory early on in your M.D./Ph.D. career. Program administrators frequently will encourage (or even require) you to participate in one or more laboratory rotations during the summers before or after your first year of medical school. Early rotations will allow you to test the waters of the labs in which you are interested. It is to your benefit to decide on a lab as soon as possible, so that you may get started on your thesis project and expedite the Ph.D. phase of your education. Of course, a decision on a thesis advisor should be made with great care, as this is the person that will make or break you in terms of science. Some labs are gigantic empires in which a student may be nothing more than a mere pawn. Others may harbor more nurturing environments for M.D./Ph.D. students. You may have to experience several to determine what will best suit your learning style (i.e. large lab with many resources, small lab with lots of one-on-one interaction, etc). The earlier you can make the decision, the better.

One thing that commonly happens in M.D./Ph.D. programs is that students become lost in the laboratory after the first two medical school years, especially if they haven't decided on a thesis lab. If you don't know what you want, don't expect anyone else to know the answer. Along the lines of the previous self-motivation discussion, we recommend that you be completely up-front concerning your goals and ambitions throughout the program and especially in the laboratory. Some advisors are notorious for keeping students around a long time. As an M.D./Ph.D. student, you don't want to be hanging around the lab for years, with no end in sight. You always want to keep a "heads-up" on the horizon so that you don't lose sight of ultimate career goals. This is especially true if you plan to go on to do a medical residency and postdoctoral fellowship. You will have ample time as a fellow or principal investigator to research and explore the questions in which you are most interested. It is important to remind your thesis advisor that you are in the training stage and when you feel you are ready to proceed (and have done the appropriate work toward the thesis), you must do so. Some programs have time tracking procedures in place. For example, UCSF requires a meeting with the thesis advisor every six months, with signed reports stating progress, as well as letters sent after 2.5 and 3.5 years to advisors with response required. These steps help ensure timely progress on the thesis.

After struggling through the long admissions process, perhaps you wish never to see or hear of it again. That is completely within your rights. However, we suggest that it is to your advantage to see how the process works from the inside. Therefore, you might try joining the admissions committee at your school (if they allow students on it). This will allow you to interview and evaluate applicants, interact with faculty and other students on the committee, and perhaps may generate some sympathy for the people on the other side. Do it for yourself. Do it for all the other potential M.D./Ph.D. applicants out there. At least do it for the free food!

Despite the above descriptions of how you can take charge and power through your education, we definitely don't recommend giving yourself an ulcer. Stop and smell the roses once in a while. Seven to eight years spent in total misery will not do well for your hair color or

facial wrinkles. Work hard, but also play hard. Take trips, go places, and enjoy time with friends, students, and significant others. Become part of the community—medical schools have various service projects in which you can make a difference. At many universities and in most cities, there are bountiful opportunities for theatrical, musical, artistic, and cultural enrichment. If that doesn't float your boat, you could always go for the local bars or clubs. Don't sit in the classroom or lab all day—get outdoors! Many programs (such as ours) are only a few hours away from natural wonders. Go hiking, camping, rock climbing, skiing, or snowboarding. Put that stipend money to some good use. We don't have to tell you how to have fun… as a certain shoemaker once said… JUST DO IT!

Post Graduation

At some point in the not-so-distant future, the day will come when you will don the robes of graduation and be granted the M.D. and Ph.D. degrees. What do you do afterward? Are you headed toward science, medicine, teaching, administration, or some combination? What are some of the chosen career paths of former students? The simple answer is that you can really do almost anything you want—within limits of course. Careers range from strictly basic science research to sole clinical practice, from academia to private industry or consulting. The degrees will make you highly marketable—your goals and ambitions will determine your career pathway.

The vast majority of M.D./Ph.D. program graduates (around 90% from most programs) pursue residencies in a medical specialty. In order to be licensed as a physician in the United States, you must complete residency and pass the appropriate medical board exam. Most commonly, the chosen fields are in some way conducive to the research interests of the student. Many residency programs provide time for residents to conduct research and some combine the medical residency with postdoctoral fellowship laboratory experience. Graduates with the M.D. and Ph.D. degrees comprise a relatively small group of highly trained medical scientists, with the potential to contribute to both the medical care and scientific investigation of academic medical centers. Consequently, M.D./Ph.D.'s have been extremely successful in obtaining some of the top residencies in the nation.

Alternatively, some graduates forgo clinical medicine and choose to focus solely on research by pursuing a postdoctoral fellowship. While people who opt for this pathway cannot practice medicine, they can enter the research world earlier in either academia or private industry. These graduates typically complete one or more fellowships before starting up their own laboratories. Occasionally, individuals are able to jump directly into academic or industrial careers without the postdoctoral work. Either way, building a scientific career is the prime goal.

An M.D./Ph.D. who finishes residency and ends up in the academic arena can combine various interests into a career, including medical practice, laboratory research, teaching, and administration. For example, Jeremy's former research advisor at UCLA combines each of these elements into his career. He sees patients during a half-day weekly specialty clinic, is an attending on the wards a month per year, runs a large laboratory that conducts both disease-oriented and basic biological research, writes grants and papers to secure funding and publish laboratory results, teaches portions of medical and graduate classes, attends several seminars and

conferences per year, and still manages to spend time with his wife and children. Certainly, this juggling act is not easy and requires an uncanny ability to multitask. This sort of career requires a division of time and labor that not all are willing to handle. However, an academic career offers a relatively large degree of freedom to explore new ideas and innovations. Laboratory space is provided by the university in exchange for scientific productivity. The hospital provides a base for patient care that can support one's medical interests. In essence, the academic medical center provides an excellent forum for the blending of medicine and science into a career.

Consider the following table that outlines some possible M.D./Ph.D. career pathways:

CAREER PATHWAYS OF M.D./PH.D. GRADUATES

Standard Academic Pathway (~90% of graduates):

M.D./Ph.D. → Residency → Postdoctoral Fellowship → Academic/Administrative Appointment

Non-Academic Career Pathways:

Medicine: M.D./Ph.D. → Residency → Private/Group Practice/HMO/PPO

Research: M.D./Ph.D. → Postdoctoral Fellowship → Industry

These are "standard" pathways, but are by no means the *only* ones available. The bottom line is that having both degrees offers you a large degree of flexibility in shaping your career. Recently, academic medical centers have applied pressure to increase the clinical responsibilities of physician-scientists (at the cost of less research) due to rising medical costs and decreasing reimbursement from insurance companies and health maintenance organizations. Despite this pressure, M.D./Ph.D.s typically are able to negotiate a specified percentage of protected time for research.

M.D./Ph.D.'s have been among the most successful groups at obtaining top academic positions, securing NIH research funding, publishing articles in high-impact scientific and clinical journals, and other measures of career success. A detailed study entitled "The Careers and Professional Activities of Graduates of the NIGMS Medical Scientist Training Program" conducted by the NIH demonstrates the success of the M.D./Ph.D. program (see the following link for more details: http://www.nigms.nih.gov/news/reports/mstpstudy/mstpstudy.html).

There will always be those who doubt the value of the extra years of education and training. Your challenge will be to act as a bridge between the often divergent worlds of medicine and science. Trained to tackle complex problems, you will be uniquely qualified to communicate effectively with both clinicians and researchers to translate basic biological and technical advances into breakthrough medical treatments and enhanced patient care. The road ahead will not be easy, but with dedication and an everlasting love for both science and medicine, you will ultimately find reward in your chosen profession.

Appendix A

Abbreviations

AAMC: Association of American Medical Colleges

AMCAS: American Medical College Application Service

GPA: Grade Point Average

GRE: Graduate Record Exam

HMO: Health Maintenance Organization

MCAT: Medical College Admissions Test

M.D.: Doctor of Medicine

MSTP: Medical Scientist Training Program

NIGMS: National Institute of General Medical Sciences

NIH: National Institutes of Health

PCR: Polymerase Chain Reaction

Ph.D.: Doctor of Philosophy

P.I.: Principal Investigator

Appendix B

Course of Study: Streamlining the Program

Years 1-2: Basic Medical Sciences

- Summer lab rotations before and after Year 1
- Graduate course requirements during the Years 1-2
- USMLE Step I

Years 3-5 (or more): Graduate School and Thesis Research

- 1-2 Clinical clerkships
- Remaining graduate courses, seminars, journal clubs
- Qualifying exam
- Full-time thesis research
- Longitudinal clinical experience

Years 6-7: Clinical Clerkships

- Remaining core clerkships
- Subinternships
- USMLE Step II
- Residency applications

Appendix C

Useful Web Sites:

M.D./Ph.D. Information

Online Resource created for the students by the students

http://www.MDPhDs.org

U.S. Medical School M.D. - Ph.D. Programs

http://www.aamc.org/research/dbr/mdphd/programs.htm

Medical Scientist Training Program Institutions (NIGMS)

http://www.nigms.nih.gov/funding/mstp.html

AAMC: Careers in Medical Research

http://www.aamc.org/students/considering/research.htm

M.D./Ph.D. Directors Association

http://www.aamc.org/research/dbr/mdphd/start.htm

The Careers and Professional Activities of Graduates of the NIGMS Medical Scientist Training Program

http://www.nigms.nih.gov/news/reports/mstpstudy/mstpstudy.html

UCSF Medical Scientist Training Program

http://www.som.ucsf.edu/som/education/admission/mstp/

Literature Searches

PubMed

http://www.ncbi.nlm.nih.gov/PubMed/

National Center for Biotechnology Information

http://www.ncbi.nlm.nih.gov

Interviews

Interview Feedback.com

http://www.interviewfeedback.com/

General Medical School Forums

StudentDoctor Network (SDN)

http://www.studentdoctor.net/

The Princeton Review

http://www.review.com/medical/

Advice Guide

"I WANNA BE LIKE MIKE" Premed Coaching - Michael Greger's Advice Guide to Med School Applicants

http://premed.edu/belikemike.html