University Senate

Proposed: February 7, 2014
Adopted: February 7, 2014
by voice vote with no dissent

RESOLUTION TO APPROVE AN M.D./M.S. IN BIOMEDICAL SCIENCE DUAL DEGREE PROGRAM (P&S)

WHEREAS, the medical profession needs more physicians with the scholarly training to keep apace with the explosion of information relevant to health care and to bring a critical and creative eye to the ideas and approaches behind medical advances; and

WHEREAS, there is a cohort of students who do not join M.D./Ph.D. programs but who are nonetheless poised to contribute substantively and creatively to medical scholarship and advances; and

WHEREAS, this program is designed to capture the intellectual energy and imaginations of such individuals and fill a distinct gap in the educational opportunities for potential leaders in academic medicine; and

WHEREAS, this program will provide unique opportunities for medical students to deepen their professional skills in biostatistics, epidemiology, and the cutting-edge advances in the field of their choice, whether in the basic mechanisms of disease, translational research, the social sciences, global or community health or medical education; and

WHEREAS, graduates of such a program will be positioned to compete more effectively for support of their research earlier in their careers; and

WHEREAS, the proposed program will not duplicate any existing program; and

WHEREAS, there is considerable interest among medical students in such a program;

NOW, THEREFORE, BE IT RESOLVED that the Senate approve the program leading to an M.D./M.S. in Biomedical Science dual degree.

BE IT FURTHER RESOLVED that the resolution be forwarded to the Trustees of Columbia University for their approval.

Proponent
Committee on Education

1. PURPOSE.

a. Describe the purpose of the proposed program and the professional and educational assumptions that underlie it.

The MD/MS dual degree program described here is specifically designed to enhance opportunities for the most motivated and talented medical students at Columbia University's College of Physicians and Surgeons (P&S) to engage directly and deeply in original scholarship in a medically relevant field of interest, and to pursue this interest with the rigor and depth of thinking that will prepare them to contribute to medical advances throughout their careers. The impetus behind the development of the MD/MS in Biomedical Science dual degree program has several sources. First, it is a response to the recognition that the medical profession needs more physicians with the scholarly training to 1) keep apace with the explosion of information relevant to health care, and 2) bring a critical and creative eye to ideas and approaches behind medical advances. Second, it reflects our awareness of several cohorts of medical students who do not join MD/PhD programs, but are still poised to contribute substantively and creatively to medical scholarship and advances. Some of these students are more patient-focused than those traditionally supported by MD/PhD programs, and some have developed keen scholarly and research interests during, rather than prior to, their medical school training. This program is designed to capture the intellectual energy and imaginations of such individuals and therefore fill a distinct gap in the educational opportunities for potential leaders in academic medicine. Third, it reflects a recognition that, with its superb faculty, student body and enlightened curriculum, Columbia P&S is in an ideal position to inspire and train many of the next generation's medical scholars and leaders.

The MD/MS program was originally inspired by Columbia P&S's experience with the Scholarly Project Program, a requirement in the MD curriculum since 2009, where all students in the final phase of their medical education spend four months in a mentored scholarly pursuit within one of six diverse tracks. These tracks reflect the breadth of medical practice and scholarship, and include clinical and basic research, narrative and social research, medical education, global and population health. The proposed MD/MS dual degree program markedly extends this opportunity by supporting the ambitions of particularly motivated and talented students to shift from an exposure to scholarly work, to active pursuit of original, hypothesis driven scholarship at a publication-worthy level.

The dual degree program described here will provide unique opportunities for medical students, still in the formative stages of their careers, to integrate scholarly and medical training. They will deepen their professional skills in statistics, epidemiology, and in the cutting edge advances in the field of their choice, whether in basic mechanisms of disease, translational research, the social sciences, global or community health or medical education. They will hone their critical thinking and investigative abilities to a higher level than that achievable in the standard MD curriculum. In completing this more demanding program, MD/MS dual degree graduates will have gained the confidence in their scholarly skills required to undertake a life-long career in research. They will have acquired the foundational knowledge and skills that will facilitate their development as consummate research professionals. Indeed, we anticipate MD/MS dual degree recipients will expand markedly the number of P&S graduates whose careers encompass medically relevant scholarship and who assume positions of leadership in the medical and health professions.

b. How does the new program relate to ongoing programs? Will it replace any existing program(s)?

There is no equivalent dual degree program at Columbia; this will be a unique addition to the current opportunities offered to P&S medical students. The program does, however have an historic precedent at Columbia P&S, which offered a Doctor of Science degree from 1931-1981. Although this doctoral degree was specifically designed to enhance scientific training of physicians at a more advanced stage in their clinical education, it serves as another inspiration for the development of this MD/MS dual degree program, which reflects a growing recognition of the value of scholarly training at the earliest stages of medical education.

The MD/MS program will join distinct but related opportunities for medical professionals to pursue joint degrees, including the MD/PhD, MD/MPH and MD/MBA programs and an MD/MS in Biomedical Informatics[1]. The scholarly interests of an MD/MS student could overlap with aspects of scholarship supported by these other programs. However, the purposes and meanings of the degrees would not be equivalent. In general, each specific Master's degree confers a well established and specific disciplinary credential that the MS cannot and medical students will be advised accordingly.

Like the MD/PhD program, the MD/MS program will focus on developing a medical student's abilities and skills to pursue original scholarship. The MD/PhD degree, and the sustained scholarly experience it supports, provides individuals with the in depth research experience and the credentials to move seamlessly from residency and subspecialty training into an academic faculty position. Experience has shown, however, that most MD/PhD's who pursue clinical training on graduation from medical school require an additional 2-4 years of post-doctoral training to reconnect them with advances in their field that occurred during their clinical training. In contrast, the dual MD/MS degree program outlined here will enable a subset of our most highly motivated and talented MD students to take the same graduate courses in statistics, epidemiology, basic (e.g., genetics, cell and molecular biology, immunology), and applied medical sciences (e.g., clinical pharmacology, human transplantation biology, applied bioengineering, narrative medicine, global and community health, medical education), as PhD and MD/PhD students, and thereby develop the same professional perspectives and goals as individuals obtaining a PhD in these disciplines. Thus, while P&S MD/MS graduates will not have the depth of research experiences of MD/PhD students, or the professional credentials of joint MD/MPH, MD/MBA, or MD/MS in Bio-informatics graduates, they will have completed a series of demanding graduate courses, and developed a similar mindset, a similar level of confidence in their research skills, and a similar research ethos as their PhD counterparts.

NEED

Why is the proposed program needed locally, statewide, or nationally?

As described above, P&S's new curricular emphasis on medical scholarship has presented us with an opportunity to more rigorously develop the scholarly and research prowess of more of our best students, providing the medical community with physicians uniquely poised to 1) engage in and lead clinical research efforts, 2) become influential participants in lay and professional discourses about medical advances, 3) shape our heath policies, globally, nationally and locally, and 4) educate society and health professionals about best practices and advances.

We anticipate several important professional benefits of the program. The MD/MS program and its graduates will help address a national concern that the number of physicians who can participate directly in the generation, translation and application of new knowledge, who are familiar with both scholarly and medical cultures, is declining[2,3]. Importantly, a recent study[4] indicates that "participation in at least one year of research during [medical school] was among the strongest predictors of faculty appointment for both men and women". Given that extended engagement in rigorous and original scholarly pursuits is the cornerstone of the MD/MS degree, the experience should both favorably dispose students to and prepare them for positions in academia and beyond, where they can advance medical practice and therapy, education and policy.

In addition, MD/MS students who have focused on basic, social, clinical, and translational research pursuits are likely to help address the "divide between clinical research and clinical practice" that has been recognized as one of four key problems facing efforts to advance medicine[5]. This gap has been attributed in part to deficiencies in scholarship experience. The emphasis on the methods of effective scholarship in the core didactic portion of the MD/MS program (e.g. Biostatistics and Epidemiology) should enhance the ability of MD/MS physicians to participate in translational endeavors and clinical trials that lead to innovative developments in clinical practice, policy, and education.

MD/MS students who have pursued original scholarly interests in population and global health, health policy, education or narrative medicine should also be influential participants in furthering important conversations about health care practices and are likely to be at the forefront of shaping health care policy.

MD/MS graduates should also be well poised to engage in collaborations that are fundamentally important for inspiring, realizing, and evaluating advances in medicine. While the volume of medically relevant information increases faster than most can assimilate, the connections between medicine and other scholarly efforts have multiplied into rich, complex networks. Innovation and progress in the health sciences depends now more than ever on the ability to work across medical professions and across scholarly disciplines. Even a cursory perusal of articles published in top medical journals, including The New England Journal of Medicine (NEJM), Lancet, and the Journal of the American Medical Association (JAMA), reveals that many significant studies are collaborative efforts among physicians and other scholars in diverse fields, including epidemiology, bioethics, health policy, engineering, history, statistics, economics and more. With the increased breadth of training and enhanced exposure to diverse scholarship that distinguishes MD/MS graduates, they should be in an excellent position to facilitate communication and joint efforts between disciplines and among scholars.

We also anticipate an added national benefit to the program, which should allow its graduates to compete successfully for research funding earlier in their careers. The average age that individuals receive their first independent NIH grant is a surprising 42 and is increasing, particularly for MD and MD/PhD investigators (http://grants.nih.gov/grants/new_investigators/). Because this MD/MS program integrates scholarly training with medical education throughout the curriculum, it allows students to maintain professional momentum in both medicine and research. In addition, because the MD/MS training explicitly emphasizes writing and critical thinking skills that are the foundation for successful grants, graduates should be in a position to seek out and compete successfully for national funding at the earliest stages of their careers -

helping buck what has become an unsettling trend in funding demographics.

In sum, the MD/MS program will enable medical students interested in academic and/or research careers to gain sufficient research experience in their discipline of choice, to develop confidence in their abilities as investigators and to determine whether it suits their career aspirations. It will deepen their understanding of unsolved problems in medicine and health, thereby stimulating them to question conventional wisdom about these problems during their residency training. It will encourage development of habits of mind that will lead them to design research projects relevant to their clinical experiences. It will increase student sophistication in selecting mentors and educational programs for post-residency research training. We anticipate that the program will also stimulate many students to seek research fellowships in their chosen medical specialties at the end of their residencies that lead them to lifetime careers in research. And for all participants, it will deepen their understanding of the scholarly basis of medical practice.

CURRICULUM

How many points and/or terms of study will be required for the degree?

We have developed a curriculum with at least 32 points, which includes core and elective courses, introductory and capstone seminars, and a 12 month-long scholarly effort where a student generates original work, and drafts, edits and revises a Master's thesis that takes the form of published scholarship in the field of interest.

Ten of the 32 credits originate from the basic science and clinical courses taken during the Fundamentals phase (first three semesters) of the P&S medical school curriculum, specifically Molecular Mechanisms of Disease (4 points), the Body in Health and In Disease I (3 points) and the Body in Health and In Disease II (3 points). The majority (22+) of the 32+ credits derive from a collection of non-overlapping, graduate level courses in research methods and responsibilities, seminars, and advanced scholarly study.

All MD/MS students will perform their year of Master's scholarship and thesis development after their Major Clinical Year (MCY) and after they take the USMLE Step 1 Board exams. Students who meet all the requirements to pursue the MD/MS degree in an accelerated, four year period, will be allowed to perform at least ten months of research during the sixteen month Differentiation and Integration (final) phase of medical school, *after completing at least one clinical subinternship*. They will be required to perform a total of at least four, rather than the traditional seven, subinternships and clinical electives. Discussions with Columbia's peer medical institutions, who are working together to establish the standards for competency based clinical training, have revealed that students who take time for research are much better prepared if they re-familiarize themselves with clinical practice just before entering residency. Therefore, we will require students in the accelerated program to organize their schedules so that they also engage in at least one subinternship or clinical elective after completing their 10-12 months of research.

We recognize that it is critically important to be thoughtful when proposing courses that count towards two degrees. The only points that are counted for both degrees arise from three courses in the Fundamentals curriculum, which is delivered during the first year and a half of a medical and dental student's education. This curriculum provides two essential elements that support its inclusion among the credit total for this unique MD/MS dual degree program. First, the courses in

this first year and a half provide unifying, relevant core classroom experiences for the MD/MS students, whose scholarly pursuits after this phase will vary widely. Opportunities to interact and develop connections will foster intellectual communication among those with distinct expertise and interests. Second, the knowledge gained from these courses is directly applicable to, indeed necessary for, the intellectual process that will underlie the development of a thesis question and study. In the absence of this grounding in medical science, the MD/MS would lose meaning; this is not a stand-alone Master's program. The three, intensive, semesterlong courses that will count towards the MD/MS pursuit (Molecular Mechanisms of Disease, the Body in Health and in Disease I and II) are also part of the dental student curriculum, and we hope they will have the opportunity to enter this program in the future.

Every other element of the curriculum is a unique addition to a medical student's academic development and repertoire.

Because a large body of medical scholarship relies both directly and indirectly on biostatistics and epidemiological principles, students engaging in research and scholarship at the highest level need to have an excellent foundation in these disciplines. Although medical students are exposed briefly to principles of biostatistics and during the Fundamentals curriculum, it is important to recognize that this exposure is cursory and does not provide students with the background needed to apply these fundamental research perspectives to the critique or generation of meaningful scholarly work. When asked what, if anything, was missing in their academic foundation, every student who had performed a year-long scholarly experience, mentioned Biostatistics. Our experience with the group of fifteen students who enrolled in the pilot year (2013-2014) of our new Medical Scholars Seminar Course (which will be required for the MD/MS program) has plainly shown that those few students who had found the time to take Mailman's Introduction to Biostatistics course were noticeably more prepared to analyze and critique scholarly data and conclusions, both within and outside their field of interest. Epidemiology is given more attention in the third semester of the Fundamentals curriculum. However, there is a strong sense among students and faculty in Mailman's Epidemiology department, that even this exposure still does not prepare students to critique or to generate scholarship with the depth or sophistication required for original research. The P&S Education leadership is now considering revising the Epidemiology curriculum and may mount a new and more relevant version in the Fundamentals phase. For this reason, we have added an option for MD/MS students who have sufficient Epidemiological background for enrolling in another graduate level course that provides a scholarly foundation in the field of their interest (with MD/MS Advisory Committee approval).

Nonetheless we feel strongly that we would be doing most students a distinct disservice if we did not require substantive training in these two fields.

Secondly, it is important to distinguish the thesis work that MD/MS students from that performed as part of the Scholarly Project Program. As described above, the Scholarly Project program offers students a short-term exposure to high quality medically relevant scholarship, as well as a unique opportunity to participate in the process. Students are required to select a mentor and fill out a 3-5 project proposal form on-line that describes project intent and approach. This proposal must be approved by mentor and Scholarly Track Director. At the end of their four months of work, which does not need to be contiguously organized, all students are required to hand in a capstone paper that describes their investigation in the context of current literature. This paper can be considered comparable to a paper required at the conclusion of an entry-level

graduate course that emphasizes exploration of the primary literature. While original, hypothesis driven scholarship is certainly welcome, and while some students perform superb publication worthy work – an effort at this level is not required. More importantly, the paper and research effort is not subject to the kind of scholarly critique – from self and others – that is characteristic of the kind of thesis work that is integral to this Master's program.

The scholarly work that will be required of an MD/MS student is qualitatively and quantitatively distinct from a Scholarly Project. Students will have 1-2 years to consider and hone their project ideas, developing networks of colleagues, mentors, and interests as they go through the curriculum and participate in required seminars. Their research proposal will be presented, discussed, and refined over the course of a formal year long course and it will have to be approved by a standing advisory committee. Each student will perform scholarly work over an extended and continuous period and will participate fully in the culture, exchange and requirements defined by their particular mentor. Their thesis, which will be of a form and length comparable to the introduction and one chapter of a PhD thesis, will reflect the publishable output of their field of choice, and will also be drafted, discussed, and revised in a formal course. Finally, MD/MS will be required to present their work publically – in a national or regional meeting. Although we are very proud of a Scholarly Project effort, which has surpassed expectations, this program will allow some of the students whose talents and proclivities have been revealed by this effort, to achieve and contribute at a more sophisticated and influential level.

That the research efforts performed in the MD/MS program will be accepted *in lieu* of a Scholarly Project is not exceptional. Indeed, the Scholarly Project requirement is waived for all students who pursue dual degrees (e.g. MD/MBA, MD/MPH, MD/PhD, and PhD to MD), even if they do not perform an original research project, which is the cornerstone of this MD/MS program.

We also recognize that close attention must be paid to the design of a curriculum for the accelerated, four-year version of the MD/MS dual degree program, so that the student who graduates will have developed rigorous academic skills and high quality clinical skills expected of Columbia P&S graduates. As described above, all students granted permission to begin an accelerated program will be evaluated by distinct review committees at key checkpoints throughout their curriculum and must be approved at each interval to continue. Specifically, in order to be considered for the four-year option, students will need to formally apply by January 2 of their first year and must begin their thesis work with an approved mentor in the summer between their first and second years. All students given permission to pursue an MD/MS degree in this accelerated period must, of course, fulfill all requirements associated with the Master's curriculum that are in addition to medical school requirements.

All students in the four-year MD/MS program must fulfill all traditional medical school requirements associated with the first two and a half years of medical school: they will complete three semesters of the Fundamentals Curriculum (both a classroom and clinical experience), the full Major Clinical Year, where students receive their foundational clinical training, and will take their USMLE Step 1 Board Exams. The difference in curriculum will occur only at the Differentiation and Integration (final) phase of training, where students select clinical subinternships and/or electives that are relevant to their residency and specialty interests. We have worked closely with the Senior Associate Dean for Student Affairs, Dr. Lisa Mellman, and

the Associate Dean of Curricular Affairs, Dr. Jonathan Amiel, to determine the number of month-long clinical electives and subinternships students need in their final curricular phase (Differentiation and Integration) to prepare them to enter distinctive residencies with the high quality of clinical knowledge, sensitivity and acumen that we expect of all our graduates. Traditional MD students are required to take seven electives and subinternships. MD/MS students, *like current MD/PhD and PhD to MD students* (as well as the occasional MD student who successfully petitions the Deans to extend a research experience), will be required to take at least four. Discussions with peer institutions and residency programs also reveal that students who have not had clinical experience in the months before internship are at a disadvantage, so we will require students in both the four and five year MD/MS programs to take at least one elective or subinternship after defending their Master's thesis and in the final semester before graduating from medical school.

Clearly, the accelerated program will be a challenging course of study and only a small cohort will be deemed qualified at each review checkpoint. However, we feel it important to offer the option to the very ambitious and able, a few of whom we have recognized in our current classes. Appendix II includes a detailed description of the review process that will be applied to students in the accelerated program as well as a description of the distinctions among the four and five year MD/MS options and the traditional MD program.