ORIGINAL RESEARCH

A Comprehensive Research Curriculum to Prepare Physician-Investigators: Design, Implementation and Early Outcomes

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Abstract
The Cleveland Clinic Lerner College of Medicine (CCLCM) was established as one of three tracks in the Case Western Reserve University (CWRU) School of Medicine Program to prepare physician investigators through rigorous, comprehensive, longitudinal research training in a five-year undergraduate medical education setting. The curriculum includes specific research activities and dedicated research time, which culminates in a masters-level thesis. The track has an administrative structure to facilitate student access to research-related opportunities. Basic scientists and clinicians participate in all curricular activities thereby fostering communication across the clinical medicine/research divide. The track features a centralized, portfolio-based assessment system. In this track, students submit portfolios to demonstrate their progress toward mastering nine competencies including research. A comprehensive program evaluation is in place to monitor the curricular impact on students. Results show that the CCLCM track has attracted a subset of students interested in research careers. Two cohorts of students (n = 56) have graduated. The Promotions Committee determined that all graduates successfully met the performance standards for the research competency. These graduates scored above mean USMLE Step 1 subscores in biostatistics and epidemiology. They successfully completed a research thesis where approximately 60% of the topics addressed basic science and translational research. Over 40% of graduates also obtained a masters degree concurrently with their medical degrees. Furthermore, 23% of CCLCM graduates received competitive awards to support their medical school research activities. Recommendations are included to expose students to research in multiple venues to create and sustain a passion for rigorous problem-solving. Conclusions offer lessons learned from our experience.

Introduction
Three decades ago, James Wyngaarten \(^1\) described clinical investigators as an “endangered species.” By that point in 1979, the steep decrease in the number of physicians applying for R01 support from the National Institutes of Health was already striking \(^2\) and has continued to decline to the present day. \(^3\) In fact, by 2008 PhDs receiving R01 awards outnumbered MDs by five to one. \(^4\) At the same time, the median age of MDs who received first-time awards had increased to more than 50 years of age, indicative of a later research career start and presumably a shorter overall research career. \(^3\) Moreover, the rate of MD attrition after a first R01 award still exceeds the corresponding rate of PhD attrition. \(^5\)

Why do fewer physicians pursue research careers than a few decades ago? One factor has been a divergence between medical school and graduate school as scientific advances overload the curricula of each. In medical education, time devoted to hands-on research experiences has been sacrificed to accommodate the content expansion of topics such as biochemistry and cell biology. Meanwhile, in graduate education, the clinical application of research has become increasingly remote as training focuses more on research methods and experimental design. This divergent training has created a cultural divide between clinical medicine and basic science research. A second factor in the decreasing number of physician investigators is that

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clinicians and basic scientists are trained to approach problem solving in dissimilar ways. Basic science proceeds in incremental, hypothesis-driven steps guided by abstraction from previous data. Conclusions are delayed until all evidence is collected and carefully weighed. In contrast, in the clinical setting, a physician is faced with the immediate needs of the patient and must proceed in the moment based on patterns of symptoms that may represent an incomplete picture.

Several approaches have attempted to bridge the divide between research and medicine. MD/PhD programs provide intensive training in both medicine and research by juxtaposing two separate curricula. These programs have been quite successful at training investigators who are competitive for R01 funding and who continue in research activities throughout their careers. However, the combined program length is typically 8 years and may be a deterrent to entering a research career. Funding awards from private or government sources such as the Howard Hughes Medical Institute (HHMI) Medical Fellows Program, the Doris Duke Clinical Research Fellowship, and the National Institutes of Health (NIH) Clinical Research Training Program have encouraged a year of research training for medical students, with the intent to recruit the best and brightest to clinical and translational research. Furthermore, mentored career development (K series) awards were introduced in the late 1990s to encourage the development of research skills in physicians interested in pursuing research later in their careers.

The Association of American Medical Colleges (AAMC) created a Clinical Research Task Force (CRTF II) in 2006 to recommend strategies to increase the number of medical students pursuing translational and clinical research careers. The CRTF II recommended that every physician should have mentored research experiences during medical school and residency. The Task Force further recommended that the Liaison Committee on Medical Education (LCME) and the Accreditation Council for Graduate Medical Education (ACGME) should adopt clinical and translational research as a core competency for all trainees. This has been adopted by the LCME and now LCME-accredited medical school programs must demonstrate that clinical and translational research curricula are included in their programs (LCME standard ED 17A). Finally, the CRTF II recommended centralizing clinical and research initiatives to foster collaboration between basic science and clinical medicine.

The Cleveland Clinic, an academic medical center with strong clinical research and an active basic science research faculty, provided an excellent venue to prepare physician investigators. In 2002, the Cleveland Clinic and Case Western Reserve University (CWRU) affiliated to develop the Cleveland Clinic Lerner College of Medicine (CCLCM). CCLCM was established as one of three tracks in the CWRU School of Medicine Program: the traditional University Track; the CCLCM; and the Medical Scientist Training Program (MSTP) Track. Program governance has been described in detail. Graduates of the CCLCM track are awarded MD degrees from Case Western Reserve University with a special qualification in biomedical research. Two years elapsed between affiliation of the institutions and the matriculation of the first cohort of students to the CCLCM track in July 2004.

A review of the literature identified several schools that have integrated research into the medical school curriculum. Members of the curriculum development team at CCLCM met with leaders of the Harvard Medical School Health Sciences and Technology (HST) program, a flexible, preclinical curriculum that emphasizes a rigorous, scientific, quantitative approach to basic science and requires a thesis based upon original scholarly work for graduation. The information from the HST and other programs, in addition to clarifying the specific characteristics of a successful physician investigator, provided guidance to the development of the CCLCM track.

The Executive Dean of CCLCM charged the track’s curriculum committees to identify specific learning objectives. The Research Education Committee (REC), composed of both basic scientists and clinical researchers, delineated program goals as follows:

1) Develop the knowledge base and critical thinking skills for clinical and basic science research
2) Develop the skill sets required for clinical and basic science research, and
3) Impart knowledge of the ethical, legal, professional, and social issues required for responsible conduct of clinical and basic science research.

This paper presents a comprehensive model for rigorous, longitudinal research training in an undergraduate medical education setting. Early outcomes and lessons learned based on the first two graduating cohorts are presented.