

Opinion Paper

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The genealogy of teaching clinical reasoning and diagnostic skill: the GEL Study

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Abstract: The genealogy of graduate medical education in America begins at the bedside. However, today's graduate medical trainees work in a training environment that is vastly different from medical training a century ago. The goal of the Graduate Medical Education Laboratory (GEL) Study, supported by the American Medical Association's (AMA) "Reimagining Residency" initiative, is to determine the factors in the training environment that most contribute to resident well-being and developing diagnostic skills. We believe that increasing time at the bedside will improve clinical skill, increase professional fulfillment, and reduce workplace burnout. Our graduate medical education laboratory will test these ideas to understand which interventions can be shared among all training programs. Through the GEL Study, we aim to ensure resident

readiness for practice as we understand, then optimize, the learning environment for trainees and staff.

Keywords: clinical reasoning; diagnostic skill; graduate medical education; resident wellness; training environment.

Introduction

When tracing the genealogy of graduate medical education in America, the lines of our educational ancestors lead back to the bedside. At the dawn of the 20th century, medical education took place in the presence of the patient. It was at the bedside where physicians learned clinical skills, initiated scientific inquiries, discovered disease pathology, and experienced patient suffering. But in this system of medical education, expertise and oversight were not evenly distributed. The 1910 report from Abraham Flexner that advocated vigorous improvements in medical education now seems frozen in time, as if those worthy recommendations were carved on stone tablets, reverent, transformative, and immutable.

Still, the American medical system evolved. Today's graduate medical trainees work in a training environment that is vastly different than a century ago. Noting this trend, and a need to modernize the graduate medical education experience, the American Medical Association (AMA) is supporting the "Reimagining Residency" initiative to find creative solutions to prepare 21st century trainees for the eventual practice of medicine. In answering the call from the AMA, the training programs at Johns Hopkins Hospital, the Johns Hopkins Bayview Medical Center, the Stanford School of Medicine, and the University of Alabama at Birmingham share a common genealogy that fosters a common commitment to reimagine residency for the 21st century learner.

Modern medical trainees, who hold the hopes of our future health care system, seem to possess a paucity of key skills that prepare them for practice. Whether it is residents'

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lack of time with patients [1] or increased time on administrative tasks bookended by the Accreditation Council for Graduate Medical Education's (ACGME) duty hour regulations [2]; whether it is residents' perceived lack of confidence in their clinical skills [3] or demonstrated lack of management and interpersonal communication skills in navigating complex care environments [4]; or whether it is residents' shouldering the burden of workplace burnout, [5] modern medical residents seem increasingly underprepared for the practice environment after training. The goal of the Graduate Medical Education Laboratory (GEL) Study, supported by the AMA "Reimagining Residency" initiative, is to determine factors in the training environment that contribute to resident well-being and clinical competence, and then test evidence-based interventions to improve wellness and skill. We hypothesize that if the training environment is restructured to allow residents to spend more time in direct patient care, and if trainees receive more opportunities for direct observation and feedback, then confidence, skill, and professional fulfillment will improve – with trainee burnout decreasing as a consequence. The promise of the GEL Study is rooted not only in its collaborative structure but also in its shared history.

History

The year was 1900 and changes were afoot in American medical education. European-trained physicians brought habits of bedside teaching stateside. In Baltimore, William Osler, who had spent over a decade teaching at his innovative residency education program at Johns Hopkins Hospital, summarized his philosophy of patient care when he wrote that "taking a lady's hand gives her confidence in her physician" [6]. The idea that being physically present would instill confidence in patients was not universally embraced in American medical education. Ten years later, when Abraham Flexner issued his summary report of all 155 North American medical schools, he praised Johns Hopkins School of Medicine as "a model for medical education" [7]. Not surprisingly, students from around the country flocked to Baltimore to study medicine. In the graduating medical school class of 1900 was Albion Walter Hewlett. His 5 years at Johns Hopkins "stimulated Hewlett's lifelong interest in clinical investigation" [8]. By the time he graduated, Hewlett had prepared for a medical career that would see him become a leading voice in cardiovascular research and the first chair of the department of medicine at Stanford University.

The same year of Hewlett's graduation, on a small farm along Choccolocco Creek in rural Alabama, a country

doctor's wife gave birth to their second son. The doctor, like many in his generation, had studied under William Osler (who continued to mentor "his Alabama student" even after his training ended). The Alabama doctor returned to Baltimore several years later to visit his mentor, this time with both of his young sons. Upon meeting the boy and his brother, William Osler advised their father to "train those boys to be teachers of medicine" [9]. The youngest boy, Tinsley Harrison, did just that. He would go on to author the eponymous *Principles of Internal Medicine* textbook and become Professor of Medicine at the University of Alabama at Birmingham.

Genealogy

Osler, Hewlett, and Harrison promoted examinations of patients to inform, inspire, and ultimately ignite further study. "Medicine is learned by the bedside and not in the classroom", Osler would write. "See, and then reason and compare and control, but see first" [10]. Hewlett, too, would emphasize combining clinical care with scientific investigation among graduate medical trainees. He advocated that "the clinical department should be given the benefits of the closest possible association with the scientific departments" as a way to integrate scientific understanding in clinical care [11]. As Harrison reflected on his career, doubtlessly influenced by his father's association with Osler as well as his own experiences, he wrote in the introduction to the first edition of his *Principles of Internal Medicine* that the consummate physician should have "technical skill, scientific knowledge, and human understanding" [12].

With the rich history of medical education and scientific exploration rooted in patient examinations, when and how did graduate medical education push back from the bedside? And perhaps most important for today's learners, what can we do to close that gap? Viewing graduate medical education through the lens of these questions is both instructive and prescriptive.

Graduate medical education: leading up to the present

Near the end of the 20th century, the state of the American health system looked decidedly different than in 1900. The average length of stay for a patient admitted to a general medicine ward decreased during the century, leading to increased throughput [13]. Thirty years after President Lyndon Johnson signed into law the Social

Security Amendments of 1965 – creating federal health insurance for the elderly and indigent in the form of Medicare and Medicaid – President Bill Clinton signed the 1995 Documentation Guidelines for Evaluation and Management Codes, clarifying a formal way to chart that care. The new funding for medical care and the new coding from medical records soon influenced reimbursement, leading graduate medical education to begin emphasizing documentation. Did patients notice? Providers certainly did. Surveys of residents indicated declining time spent with patients in favor of more time spent documenting [14]. The introduction in the first decade of the 21st century of duty hour restrictions and the electronic health record (EHR) only exacerbated the problem [1]. Residents soon became more familiar with the digital representation of a patient (i.e. the “iPatient”) than the actual patient [15]. This time away from direct patient care fed feelings of burnout [16].

As time spent at the bedside decreased, fundamental skills that can only be learned in the presence of the patient declined. Many faculty found themselves unprepared to be effective teachers in what should be a hands-on educational environment [17, 18]. A shift in graduate medical education resulted, drifting away from clinical clues gathered from a focused patient encounter and toward a litany of diagnostic tests considered in a conference room. For US graduate medical trainees, formal assessments of clinical examination skills withered, further de-emphasizing the value of the clinical examination [19]. This decline in skill adversely affected patient care. Almost 50% of diagnostic errors in the outpatient setting can be traced to a mistake in the physical examination [20]. In a majority of these cases, the physical exam “mistake” is that the appropriate examination maneuver is simply not performed [21].

Considering the present challenges of graduate medical education through this lens of our shared history, we see opportunities for changes in the training environment that can augment clinical skills, reduce medical errors, and improve professional fulfillment in a way that is sustainable and meets the needs of our trainees.

Graduate medical education laboratory: preparing for the future

We believe that increasing time at the bedside will improve clinical skill, increase professional fulfillment, and reduce workplace burnout. Through the GEL Study, we aim to ensure readiness for practice for internal medicine residents as we understand, then optimize, the learning environment for trainees and staff.

Recent reports highlight the need for changes in the training environment. The National Academy of Medicine supports the ongoing need to evaluate the training environment [22]. The ACGME Clinical Learning Environment Review prioritizes a healthy learning environment as a source of well-being. Indeed, increasing numbers of specialties are including well-being milestones in their core competencies [23]. Over a 5-year period of assessments and intervention, the GEL Study will determine ways to more effectively train the 21st century clinician.

Methods

Time motion assessments

Bringing trainees back into the presence of their patients first requires knowing where they have been. We aim to digitally map how residents spend their time through a series of unobtrusive “no-touch assessments”. Whether on wards or in clinics, EHR time logs provide time-stamped data to understand when and where a resident is interacting with the computer. More granular EHR data can help investigators understand EHR efficiency and time spent on certain areas of indirect patient care [24].

For example, during ward months, hospital-based real-time location system (RTLS) data can help track resident geography. Infrared pulses from RTLS badges ping off sensors throughout the hospital, allowing a clear view of a resident’s location [25]. When the EHR time-stamped data is merged with RTLS data, patterns begin to emerge as to how residents spend their workweek on wards and how much of that time is devoted to direct versus indirect patient care.

Workload assessments

Added to these continuous tracking systems will be a resident-level view of in-patient and out-patient workloads. Examining residents’ call schedules, an illness severity score for the patients they serve, and the frequency of paging and telecommunications during any given call shift will map work-related stressors. A rotating subset of residents will have physiologic measures of stress monitored using biometric wrist bands [26]. With these objective but discreet “no-touch assessments” in place across four separate residency programs, additional measures of residents’ workload, which actively involve the trainees, can begin.

Survey assessments

Residents' perceptions of their workload and the stress it causes are critical to understanding the learning environment. Residents will be sent monthly surveys to gather longitudinal data on burnout and fulfillment [27], work stress [28], and duty hour compliance. These "low-touch" survey assessments should yield vital insights with minimal trainee time commitment, yet the risk of "survey fatigue" can still dampen enthusiasm for resident survey participation. The GEL Study will employ a "regret lottery" strategy, similar to the effective method used in the Individualized Comparative Effectiveness of Models Optimizing Patient Safety and Resident Education (iCOMPARE) study, to improve survey completion rates [29].

Clinical reasoning assessments

Each resident can also participate in an interactive "Global Morning Report" (GMR): a peer-reviewed teaching case series of the Human Diagnosis Project that assesses clinical reasoning and provides feedback on diagnostic accuracy and efficiency [30]. GMRs will provide longitudinal assessments of clinical reasoning skill that can then be correlated with other aspects of the learning environment.

Clinical skills self-assessments

Even with periodic glimpses across a sample of residents at each program, more in-depth information will be needed. A "higher-touch" level of engagement necessitates a less frequent approach. End-of-year surveys, both unique to each program and standardized across all four programs, will be administered. A survey to assess attitudes and confidence in clinical skills, as well as residents' interpersonal tendencies and team learning environment, will inaugurate each academic year. An online medical knowledge assessment paired with an online simulated patient assessment (from Blaufuss multimedia) will evaluate cardiac skills.

Reimagining residency interventions

Methodology

However, if the GEL Study only involved assessments, we would betray our future as much as our past. Using the data gathered from formative assessments, we will build

a model that relates the modifiable attributes of the training environment to the primary outcomes of professional fulfillment and burnout, and the secondary outcome of clinical skills. In the first year of this model, we aim for a more granular understanding of the learning environment factors that affect professional fulfillment and skills. The various assessments (time-motion assessments, workload assessments, resident self-assessments, and clinical reasoning and skill assessments) allow ways to identify areas of modification in residency training. Simultaneously, the first year of the GEL Study solicits input from resident focus groups, feedback from resident interviews, and planning committees from each site to help inform the design phase of each intervention. By year 2 of the GEL Study, our model involves implementing a series of interventions (focused on enhanced time with clinical education in the presence of the patient) to improve resident fulfillment and clinical skill, which we hypothesize will reduce burnout.

One advantage of the survey methodology, which undergirds the planning and implementation phases of the GEL Study, allows for gathering longitudinal data on burnout that can be directly correlated to the other objective metrics (such as resident schedules, resident workload, patient acuity, and time at the bedside). Each year of the GEL Study, these surveys will capture a multi-institutional view of how hundreds of residents experience their training environment.

Formative skills assessment

The cornerstone of our intervention package is a formative clinical skills assessment where trainees encounter actual patients with real disease while being observed by faculty. The Assessment of Physical Exam and Communication Skills (APECS) program developed at Johns Hopkins is modeled after the high-stakes summative MRCP (UK) Practical Assessment in Clinical Examination Skills (PACES). During APECS, residents practice their physical exam skills and then receive real-time feedback and coaching from experienced faculty [31]. Using a five-station carousel comprised of eight patients (seven real patients and one standardized patient), residents are asked to perform a focused history and/or physical examination in the presence of two faculty members. They then present findings and engage in a discussion about differential diagnosis and clinical judgment before rotating to the next station. At the end of the assessment, residents receive hands-on feedback from the faculty preceptors about each case. Interventions of this type educate faculty as they prepare to be examiners and educate trainees as they receive personalized feedback [32, 33].

Inpatient

Informed by our model, the GEL Study will work to restructure the inpatient experience of bedside rounds, improving the amount of time spent with patients and their families. Borrowing from models that offer “choreography” and team member assignments at the bedside [34] and a collaborative approach of family-centered rounds should increase the amount of direct observation, feedback, and modeling that occurs during rounds.

Outpatient

In the outpatient arena, the GEL Study will consider interventions that prepare residents for practice. Although the majority of patient medical encounters occur in the ambulatory setting, education in the outpatient training environment for medicine residents is undervalued and underemphasized [35]. The sub-optimal ambulatory learning environment has been associated with resident dissatisfaction with outpatient medicine and declining numbers of residents pursuing outpatient general medicine careers [36]. By evaluating the factors associated with professional fulfillment and clinical skills, we aspire to design outpatient educational interventions to more effectively prepare future residents for ambulatory medical practice. One place to start is using a clinic-based in-room precepting analogous to the inpatient bedside rounding.

Clinical encounter

Finally, all residents need to be prepared with fundamental interpersonal and teaming skills to employ in any patient interaction after residency. Such skills transcend pathognomonic physical findings. Working with the innovative Stanford Presence 5 program, all residents will learn foundational practices of intentional preparation, active listening, shared agenda-setting, and empathy [37, 38]. With these tools in hand, residents can more readily prepare for the current and future practice of medicine.

Conclusions

The goals of the GEL Study are ambitious but important. Formative research will identify factors in the training environment that affect resident wellness and clinical skill. Subsequent evaluations will focus on interventions

that modify those critical factors. It is an idea that can only be achieved through collaboration. The success of our aims requires cooperation among medical educators from the Johns Hopkins Hospital, the Johns Hopkins Bayview Medical Center, the Stanford School of Medicine, and the University of Alabama at Birmingham. But as ambitious as our aims may seem, the cause is greater still – and we can learn from our shared history of excellence.

Even with new ways to diagnose disease and deliver medical care over the last 120 years, clinical education must remain patient-focused and scientifically based. Flexner’s report wrote of the need for “scientific medicine...[to] brush aside all historic dogma...to undergo rigorous cross-examination”. Osler described the scientific discipline that physicians use to train the mind as an “incalculable gift” [6]. His academic descendants, such as Albion Walter Hewlett, applied those disciplines to set a standard of excellence in graduate medical education. A contemporary remarked that Hewlett’s “heart was in the clinic and the laboratory. To bring them closer together was his ideal” [8]. That ideal of the clinician-scientist never seemed to leave Tinsley Harrison, either, and he passed those lessons along both at the bedside and in the foundational internal medicine text that bears his name.

And so, too, is the ultimate aim of the GEL Study: to better care for patients by understanding how we, as teachers in graduate medical education, can better care for residents. The training environment is fertile ground for academic study. We aim to apply the same scientific method to graduate medical education that we do to medical discovery. We are armed with the hypothesis that increasing time at the bedside will improve clinical skill, increase professional fulfillment, and reduce workplace burnout. Our graduate medical education laboratory will test these ideas to understand which interventions can be shared among all training programs.

With our collective history and common goals, we expect this collaboration will prepare a new generation of physicians for the 21st century and beyond. We also expect that our findings will lead to a sea-change in the way we understand and approach graduate medical education.

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