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Trends in MD, PhD Graduates Entering Psychiatry: Assessing the Physician-Scientist Pipeline

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Abstract

Objective—The goal of this study was to identify trends in MD/PhD graduates entering psychiatry, to compare these trends with other specialties, and to review strategies for enhancing the physician-scientist pipeline.

Methods—Data on 226,588 medical students graduating from Liaison Committee on Medical Education accredited programs between 1999 and 2012 (6626 MD/PhDs) were used to evaluate the number, percentage, and proportion of MD/PhDs entering psychiatry in comparison with other specialties (neurology, neurosurgery, internal medicine, family medicine and radiation oncology). Linear regression and multiple linear regression determined whether these values increased over time and varied by sex.

Results—Over the 14-years, an average of 18 MD/PhDs (range 13–29) enrolled in psychiatry each year. The number of MD/PhDs going into psychiatry significantly increased, although these gains were modest (less than one additional MD/PhD per year). The proportion of students entering psychiatry who were MD/PhDs varied between 2.9 and 5.9 per 100 residents, with no significant change over time. There was also no change in the percentage of MD/PhDs entering psychiatry from among all MD/PhD graduates. The rate of increase in the number of MD/PhDs going into psychiatry did not differ significantly from other specialties except for family medicine, which is decreasing. The rate of MD/PhDs going into psychiatry was higher for women, suggesting closure of the sex gap in 17 years.

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Conclusions—Despite the increase in the number of MD/PhDs entering psychiatry, these numbers remain low. Expanding the cohort of physician-scientists dedicated to translational research in psychiatry will require a multipronged approach.

Medical science advances at a dizzying pace, especially in neuroscience. The National Institutes of Health and other federal agencies have invested billions of dollars each year in basic and applied neuroscience research. However, to provide manpower for the staggering amount of translational research necessary to transform neuroscience findings into better approaches to diagnosis, meaningful new therapeutics, and preventative interventions, a major inflection in the physician-scientist workforce focused on brain disorders is essential (1).

The concept of translational research is broad and has been defined as promoting the integration of basic, patient-oriented, and population-based research in a multidirectional fashion. The fundamental goal is to promote the understanding of human health and disease to ultimately improve public health (2). Physician-scientists with dual training in clinical work and research are widely recognized as those best poised to translate basic science findings into clinical advances. However, the limited number of physicians conducting translational neuroscience research has been a growing concern (3). For example, in psychiatry, a 2000 survey found that less than 2% of U.S. psychiatrists consider research their dominant activity (4). Moreover, between 1992 and 2001, the number of psychiatrists pursuing post-graduate research training fell by 40% (1). To address this problem, the National Advisory Mental Health Council appointed a workgroup in 2007 to provide recommendations for developing and training a workforce capable of conducting psychiatric research. A key recommendation was to build a strong pipeline by recruiting outstanding physician-scientists, particularly MD/PhD graduates, into psychiatry (5).

In this study, we examined trends in MD/PhD graduates entering residency training in psychiatry to assess our success in recruiting the brainpower required to conduct translational research. We compared these results to other neuroscience-related specialties (neurology and neurosurgery) as they draw directly from a similar cohort of MD/PhD students who often have a background in neuroscience research. We also selected a small number of comparison specialties, including internal medicine, the specialty with the highest number of trainees; radiation oncology, the specialty with the highest proportion of MD/PhD trainees; and family medicine, one specialty with a low proportion of MD/PhD recruits, based upon National Resident Match Program (NRMP) data (6). We subsequently review the implications of these results, discuss progress in addressing previously proposed strategies, and identify additional opportunities for expanding the physician-scientist workforce in psychiatry.

Methods

Anonymized summary data from 226,588 graduates from LCME (Liaison Committee on Medical Education) accredited medical schools in the U.S. and Canada, including 6626 MD/PhDs, between 1999 and 2012 were obtained from the Association of American Medical Colleges (AAMC). The AAMC linked graduates from their Student Records System and

Graduate Medical Education Track system to identify each graduate's specialty. We calculated trend lines and confidence intervals for the total number of MD/PhDs entering residency training by year as well as the proportion of MD/PhDs among trainees entering residency training. We also calculated the total number and proportion of MD/PhD graduates entering *each specialty* by year; and the percentage of MD/PhDs entering each specialty from among all MD/PhDs by year. The proportion of MD/PhDs within each specialty was calculated by dividing the number of MD/PhD students entering each specialty by the total number of students entering each specialty. The percentage of MD/PhDs going into each specialty was calculated by dividing the number of MD/PhDs pursuing each specialty by the total number of graduating MD/PhD students. We created a summary plot for the annual rate of increase in number of MD/PhDs entering psychiatry, neurosurgery, neurology, internal medicine, family medicine, radiation oncology, and in total.

Graduates were divided into two groups based on whether they were or were not MD/PhDs. These groups were subsequently divided by specialty of entry as well as sex. Note that the AAMC data available for analysis were categorized as "sex" instead of "gender." Data tables published by the AAMC also use the categorization of "sex" so we have applied this same nomenclature for consistency. To determine whether a particular value (number, percentage, or proportion) increased over time, we conducted linear regressions (R Statistical Computing Environment Version 3.3, 2014) with time as an independent variable. To determine whether sex had an independent effect on the number of MD/PhDs entering each specialty over time, we also conducted two-variable multiple linear regression adjusting for this covariate. We estimated the closure time for the sex gap: dividing the sex disparity for each specialty at the end of the study (2012) by the difference in the average rate of increase for both sexes over the study period. We plotted the confidence intervals (forest plot) for the increase in number of MD/PhD residents on average every year. The New York State Psychiatric Institute Institutional Review Board determined that this study did not require human subjects review.

Results

Over the 14-year period, an average of 15,860 graduates from LCME programs enrolled in residency training annually. On average, 451 were MD/PhDs. The total number of MD/PhD graduates going into residency training increased over time. The proportion of residents with MD/PhDs also significantly increased from 2.2 to 3.3 per 100 residents.

During this same period, an average of 475 trainees annually enrolled in psychiatry programs and on average 18 were MD/PhDs (range from 13-29). Trend lines show that the total number of MD/PhD students going into psychiatry increased over time. The proportion of students entering psychiatry who were MD/PhDs varied between 2.9 and 5.9 per 100 students; however, there was no significant change over time. Accounting for 2.8-5.4% of all MD/PhD graduates, there was also no change in the percentage of MD/PhD students entering psychiatry over time (Figure 1).

We conducted the same analysis separately for each specialty of interest (Table 1). The total number of MD/PhD applicants increased for all specialties except family medicine, with only psychiatry, neurology, and radiation oncology showing a significant increment;

however, gains were modest with an average addition of fewer than two MD/PhD graduates per year. The percentage of MD/PhDs who entered a given specialty from among all MD/PhDs graduates increased significantly for neurology and radiation oncology, but decreased significantly for internal medicine. Family medicine, neurosurgery and psychiatry showed no change. However, the proportion of residents with MD/PhDs entering a given specialty increased for both internal medicine and radiation oncology. Over time, MD/PhDs were not more likely to go into neurology and neurosurgery than into psychiatry (Figure 2). Indeed, the confidence interval for psychiatry overlapped with that of all other specialties except family medicine, suggesting that differences observed between psychiatry and other specialties were not statistically significant other than for family medicine.

The timing of closure of the sex gap differed depending on the specialty. Overall, the sex gap will close in 30 years. For psychiatry, it will take 17 years from the last data point (Figure 3); for neurology, 13 years; for internal medicine, 31 years; for neurosurgery, 89 years. In family medicine, the number of women MD/PhDs reached parity in 2004 and the trend line suggests that the number for men is decreasing, though not significantly. In radiation oncology, the increase in the number of MD/PhD men far exceeds the rate of increase among the number of MD/PhD women, suggesting that, without a change in this trend, sex parity is unattainable.

Discussion

The increase in the number of MD/PhD residents entering psychiatry represents a positive trend in the physician-science workforce. Despite concerns that the centrality of neuroscience to psychiatry might not be apparent to trainees leading them to prefer sister specialties such as neurology or neurosurgery (7), these data suggest psychiatry is keeping pace in terms of the annual increase in the number of MD/PhDs recruited each year. However, the numbers remain low. In addition, the overall percentage and proportion of MD/PhD residents entering psychiatry remains unchanged, indicating there may be additional opportunities to appeal to MD/PhDs.

Recommendations for enhancing the pipeline for physician-scientists have included increased flexibility in clinical training to allow more time for research, coordinated research training with linkage to post-residency research fellowships, greater financial incentives through debt repayment and stipend supplements, and expanding the recruitment of women and underrepresented minorities (5,8–12). Within psychiatry, additional efforts to impact and shape perceptions of the field may also be important, given the stigma surrounding mental illness (13). At the same time, developing and supporting research training among non-PhD residents will be critical in expanding the pipeline as MD/PhDs have been estimated to comprise only 50% of the physician-scientist workforce with a medical degree (9).

So, what progress has been made in addressing these recommendations within psychiatry and what strategies might be expanded to enhance these efforts?

Flexibility and Coordinated Research Training

A recent review of MD/PhD graduates found that 68% were subsequently employed by academic medical centers, 4% by research institutes such as the NIH, 8% by industry, and 16% in private practice. Among those working at academic medical centers, 82% noted that they were involved in research (14). While these rates indicate a substantial return on investment for MD/PhD training programs, a lack of opportunities for ongoing research during residency training may contribute to the attrition noted among physician-scientists (15).

Psychiatry has a clear advantage over most other disciplines in terms of the flexibility of clinical training and the potential for coordinated research experiences. Within the four-year residency there are only 30 months of time-required clinical rotations (16), allowing up to 18 months for research related electives. In addition, the American Board of Psychiatry and Neurology allows residency training to be completed on a half-time basis (17), providing a pathway to maintain research efforts throughout clinical training (15). With funding from the National Institute of Mental Health (NIMH), several psychiatry residency programs have developed well-defined, multiyear research track programs with specific developmental milestones related to research goals extending into fellowship (18–20). For programs without formal research track programs, the NIMH also offers administrative supplements to fund MD/PhD-trained individuals in continuing their research efforts during residency and clinical fellowship training (21). Students with a research interest, as well as programs interested in attracting research-oriented residents, may not be aware of these unique opportunities.

Addressing Financial Challenges

Addressing financial challenges will likely continue to be important in recruiting psychiatrists into research. In a survey of senior psychiatry residents, those with high interest in a research career had less debt (22). While some individuals interested in research may have incurred less debt through participation in formally funded MD/PhD training programs, approximately 50% of trainees who indicated they would like to be principal investigators on grant-funded research projects did not have PhD degrees (22). Without debt concerns, medical students may be more likely to consider research careers.

Availability of more lucrative career options is a particular challenge to recruiting residents to research. While stipends for research fellows ranged between \$43,692–\$57,504 in 2016 (23), the average income for psychiatrists was \$200,220 according to the U.S. Bureau of Labor Statistics (24). These differences are compounded by the fact that the average medical student graduates with \$190,000 in debt, according to a 2016 survey conducted by the AAMC (25).

In response, some psychiatry programs have offered supplemental stipends through private foundation grants to incentivize trainees to pursue research fellowships after residency training (18). To help offset the rising cost of medical training, the NIH has developed loan repayment programs for those committed to research (26). In 2014, a Physician-Scientist

Workforce Working Group convened in by the NIH recommended expanding the loan repayment program “to more realistically reflect the debt burden of current trainees” (9).

Recruiting Women and Underrepresented Racial and Ethnic Groups

While the number of women entering medical schools was roughly the same as men in 2016-17 (27), the proportion of women entering MD/PhD degree programs remains relatively low, around 38% (28). However, compared to only 27% women in 1997, rates are increasing. In fact, the overall growth in MD/PhD students noted in between 1997 and 2005 was predominately due to an increase in women (3). Based upon our study, psychiatry and neurology are closer to reaching sex parity among MD/PhD recruits when compared to internal medicine, neurosurgery and radiation oncology.

Given it’s “controllable lifestyle” (29), psychiatry may be a particularly appealing field for women who are interested in pursuing research. Achieving work-life balance is important to women who often shoulder additional childcare and household responsibilities (30). However, the shift in the workforce towards specialties with a controllable lifestyle is not unique to women and may provide an important advantage for recruiting physician-scientists to psychiatry (29).

Although information regarding race and ethnicity of MD/PhD residents was not available in this study, students self-identifying as Black or African American made up only 2.8% of graduating MD/PhDs in 2016, with only 2.3 % identifying as Hispanic, Latino, or of Spanish origin (31). Recruiting underrepresented racial and ethnic groups to research will be key to both expanding and diversifying the physician-scientist pipeline (5,8,9,11). In response, the NIMH awarded administrative supplements to R25 grants in 2017 to support summer research experiences for medical students from diverse backgrounds.

Building Earlier Connections and Addressing Perceptions of Psychiatry

Another approach to enhancing the pipeline of physician-scientists is to provide multiple “on-ramps” or opportunities for additional research training during medical school (10). In a recent survey, psychiatry residents interested in pursuing research were more likely to report research experiences during medical school (22). Providing short-term mentored research experiences within psychiatry through summer research programs, or senior electives is likely a strong investment (5,19,32). Several studies have demonstrated the important influence of mentorship on both specialty selection and the decision to pursue research as a career (33).

Expanding student exposure to exciting scientific advances in psychiatry may also address the perception that research is not integral to the practice of psychiatry (5). In a recent medical student survey, the growing role of neuroscience in psychiatry was cited as positively influencing applicant choice to pursue psychiatry (13). Building in integrated clinical case conferences linking neuroscience and clinical practice, focusing journal clubs on translational neuroscience, and discussing the underlying neuroscience of mental illness and psychiatric treatments within clinical settings are strategies that could enhance the link between neuroscience and psychiatric clinical practice (34).

One unique aspect of psychiatry is the stigma surrounding mental illness (8). Those interested in psychiatry are frequently challenged: “Why would you choose psychiatry?” A survey of psychiatry residency applicants found that “negative comments from colleagues, friends and family about choosing psychiatry was a deterrent” (13). Strengthening ties to neuroscience may also enhance the perception and “legitimacy” of psychiatry among medical disciplines and as a field of choice for physician-scientists.

Enhancing Research training for those graduating without a PhD

The 17% increase in the number of medical students enrolled in combined MD/PhD programs over the past decade (rising from 4549 students in 2007-08 to 5344 students in 2016-17) (28) is likely to expand the pool of physician-scientists considering psychiatry for training. However, there may be additional opportunities to “grow our own.” According to Rieder, the current model for combined MD/PhD training is inefficient. Graduates of MD/PhD programs often experience “a long separation from research, leading to a decline in research skills, distance from the knowledge base, and a need to retrain after residency” (35). In response, Rieder and colleagues developed an innovative program integrating PhD training within psychiatry residency (R25MH101074). This pilot program, if successful, may be a pathway to recruiting more physician-scientists into psychiatry.

Given the relatively low percentage of MD/PhDs across all specialties combined (less than 4% in this study), physicians without PhDs will remain an important cohort of physician-scientists to develop and support (3). Building research literacy for all residents (8) and a strong foundation in basic biomedical sciences is key to training and developing translational researchers. Research training opportunities during residency, when career decisions are not fully formed, may inspire more physicians to do translational research (8). Exposing residents to clinical research settings (18) and involving research faculty in residency training education and mentorship (8) may also foster research interests within translational science. Novel efforts to pair MDs with PhD researchers as a team might also help to address the much needed work in translational research (36).

This study has limitations. The data provided by the AAMC is somewhat incomplete since not all residency programs participate in the Resident Survey in GME Track, from which this dataset was drawn. In a typical survey year, approximately 95% of programs complete the Resident Survey. Regardless, this limitation should be consistent across the disciplines analyzed here. Other disciplines not assessed in this study (pediatrics, surgery, obstetrics and gynecology, etc.) may have experienced substantial changes in the number of MD/PhD graduates over this period based upon the “all specialties” data. This study did not explore this.

AAMC data do not include information on the content of the PhD and therefore, some MD/PhD students may have degrees in the humanities, less conducive to translational research. Data regarding whether the individual had future plans for a research or full-time academic position were also unavailable.

Also, data are limited to graduates from LCME accredited programs and excludes international medical graduates (IMGs) which make up a substantial proportion of residents

in the U.S. (for example IMGs comprised 20% of trainees matching into psychiatry in 2017) (37). International medical graduates with research training may be another source for increasing the physician-scientist workforce (5,12,38).

AAMC data evaluated in this study are only available through 2012 and may not capture the most recent trends in MD/PhD graduates and residency training. On average, between 2013-15, first year psychiatry residents included 32 graduates from combined MD/PhD programs (range 25-40) (39). Despite substantial variability, this represents a further increase in the numbers of MD/PhDs pursuing psychiatry. Additional research should continue to evaluate this evolving landscape.

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References

1. Fenton W, James R, Insel T. Psychiatry Residency Training, the Physician-Scientist, and the Future of Psychiatry. *Acad Psychiatry*. 2004; 28(4):263–6. [PubMed: 15673819]
2. Rubio DM, Schoenbaum EE, Lee LS, Schteingart DE, Marantz PR, Anderson KE, et al. Defining Translational Research: Implications for Training. *Acad Med*. 2010; 85(3):470–5. [PubMed: 20182120]
3. Ley TJ, Rosenberg LE. The Physician-Scientist Career Pipeline in 2005. *JAMA*. 2011; 294(11):1343–51.
4. Kunik ME, Hudson S, Schubert B, Nasrallah H, Kirchner JE, Sullivan G. Growing our own: a regional approach to encourage psychiatric residents to enter research. *Acad Psychiatry*. 2008; 32(3):236–40. [PubMed: 18467482]
5. National Advisory Mental Health Council Workgroup on Research. Investing in the Future. 2008. Available from: http://www.nimh.nih.gov/about/advisory-boards-and-groups/namhc/reports/investing-in-the-future_42525.pdf Accessed November 2017
6. National Resident Matching Program, Charting Outcomes in the Match. Washington, DC: 2011. Available from: <http://www.nrmp.org/wp-content/uploads/2013/08/chartingoutcomes2011.pdf> November 2017
7. Goldenberg MN, Krystal JH. Undergraduate Neuroscience Majors: A Missed Opportunity for Psychiatry Workforce Development. *Acad Psychiatry*. 2017; 41:239–42. [PubMed: 28188505]
8. Abrams, MT., Patchan, K., Boat, TF. Research Training in Psychiatry Residency: Strategies for Reform. Institute of Medicine (U.S.). Committee on Incorporating Research into Psychiatry Residency Training. , editor. Washington, DC: The National Academies Press; 2003.
9. NIH RePORT. Physician-Scientist Workforce Report. 2014. Available from: <https://report.nih.gov/workforce/psw/index.aspx> Accessed November 2017
10. Hall AK, Mills SL, Lund PK. Clinician–Investigator Training and the Need to Pilot New Approaches to Recruiting and Retaining This Workforce. *Acad Med*. 2017; 92(10):1382–9. [PubMed: 28767499]
11. Sklar DP. We Must Not Let Clinician–Scientists Become an Endangered Species. *Acad Med*. 2017; 92(10):1359–61. [PubMed: 28952984]
12. Salata RA, Geraci MW, Rockey DC, Blanchard M, Brown NJ, Cardinal LJ, et al. U.S. Physician–Scientist Workforce in the 21st Century: Recommendations to Attract and Sustain the Pipeline. *Acad Med*. 2017 Epub ahead of print.
13. Weisenfeld L, Abbey S, Takahashi S, Abrahams C. Choosing psychiatry as a career: motivators and deterrents at a critical decision making juncture. *Br J Psychiatry*. 2014 Sep; 59(8):450–4.

14. Brass LF, Akabas MH, Burnley LD, Engman DM, Wiley CA, Andersen OS. Are MD-PhD programs meeting their goals? An analysis of career choices made by graduates of 24 MD-PhD programs. *Academic Medicine*. 2010; 85:692–701. [PubMed: 20186033]
15. Dzirasa K, Krishnan RR, Williams S. Incubating the Research Independence for a Medical Scientist Training Program Graduate: A Case Study. *Acad Med*. 2015; 90(2):176–9. [PubMed: 25406610]
16. Accreditation Council for Graduate Medical Education. ACGME Program Requirements for Graduate Medical Education in Psychiatry. 2017. Available from: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRs_2017-07-01.pdf Accessed November 2017
17. American Board of Psychiatry and Neurology. Frequently Asked Questions. 2017. Available from: <https://www.abpn.com/faqs/#faq-87> Accessed November 2017
18. Arbuckle MR, Gordon JA, Pincus HA, Oquendo MA. Bridging the gap: supporting translational research careers through an integrated research track within residency training. *Acad Med*. 2013 Jun; 88(6):759–65. [PubMed: 23619070]
19. Back SE, Book SW, Santos AB, Brady KT. Training physician-scientists: a model for integrating research into psychiatric residency. *Acad Psychiatry*. 2011; 35(1):40–5. [PubMed: 21209406]
20. Gilbert AR, Tew JD, Reynolds CF, Pincus Ha, Ryan N, Nash K, et al. A developmental model for enhancing research training during psychiatry residency. *Acad Psychiatry*. 2006; 30(1):55–62. [PubMed: 16473996]
21. The National Institute of Mental Health. NIMH Administrative Supplements for Physician-Scientists. Available from: <http://www.nimh.nih.gov/funding/training/administrative-supplements-for-physician-scientists.shtml> Accessed November 2017
22. Silberman EK, Belitsky R, Bernstein CA, Cabaniss DL, Crisp-Han H, Dickstein LJ, et al. Recruiting Researchers in Psychiatry: The Influence of Residency vs. Early Motivation. *Acad Psychiatry*. 2012; 36(2):85–90. [PubMed: 22532195]
23. National Institutes of Health. Ruth L. Kirschstein National Research Service Award (NRSA) Stipends, Tuition/Fees and Other Budgetary Levels Effective for Fiscal Year 2016. Available from: <https://grants.nih.gov/grants/guide/notice-files/not-od-16-047.html> Accessed November 2017
24. Bureau of Labor Statistics. Occupational Employment and Wages. May, 2016. Psychiatrists Available from: https://www.bls.gov/oes/current/oes291066.htm?_sm_au_=iHVZMwPZWFnN1F5F Accessed November 2017
25. Brin, DW. Taking the Sting Out of Medical School Debt. *AAMC News*. 2017. Available from: <https://news.aamc.org/medical-education/article/taking-sting-out-medical-school-debt/> Accessed November 2017
26. National Institutes of Health. Extramural Loan Repayment Program for Clinical Researchers (LRP-CR). 2014. Available from: <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-105.html> Accessed November 2017
27. Association of American Medical Colleges. Applicants, first-time applicants, acceptees, and matriculants to U.S. medical schools by sex, 2007–2008 through 2016–2017. Available from: <https://www.aamc.org/download/321470/data/factstablea7.pdf> Accessed November 2017
28. Association of American Medical Colleges. Total M.D.-Ph.D. Enrollment by U.S. Medical School and Sex. Available from: https://www.aamc.org/data/facts/enrollmentgraduate/161898/tot-mdphd_enroll-school-sex.html Accessed November 2017
29. Dorsey ER, Jarjoura D, Rutecki GW. The Influence of Controllable Lifestyle and Sex on the Specialty Choices of Graduating U.S. Medical Students, 1996–2003. *Acad Med*. 2005 Sep; 80(9): 791–6. [PubMed: 16123455]
30. Barfield WL, Plank-Bazinet JL, Austin Clayton J. Advancement of Women in the Biomedical Workforce. *Acad Med*. 2016; 91(8):1047–9. [PubMed: 27306970]
31. Association of American Medical Colleges. M.D.-Ph.D. Graduates of U.S. Medical Schools by Race/Ethnicity. 2015–2016. Available from: <https://www.aamc.org/download/450638/data/factstableb13.pdf> Accessed November 2017
32. Balon R, Heninger G, Belitsky R. Medical School Research Pipeline: Medical Student Research Experience in Psychiatry. *Acad Psychiatry*. 2006; 30(1):16–22. [PubMed: 16473989]

33. Sambunjak D, Straus SE, Marusic A. Mentoring in academic medicine: A systematic review. *JAMA*. 2006; 296:1103–1115. [PubMed: 16954490]
34. Ross DA, Travis MJ, Arbuckle MR. The Future of Psychiatry as Clinical Neuroscience: Why Not Now? *JAMA Psychiatry*. 2015; 72(5):413–4. [PubMed: 25760896]
35. Rieder, R. Combined psychiatry residency and PhD training at Mount Sinai. 2014. Available from: https://projectreporter.nih.gov/project_info_description.cfm?aid=8689177&icde=36661023&ddparam=&ddvalue=&ddsub=&cr=3&csb=default&cs=ASC&pb=all Accessed November 2017
36. Moskowitz J, Thompson JN. Enhancing the clinical research pipeline: training approaches for a new century. *Acad Med*. 2001 Apr; 76(4):307–15. [PubMed: 11299141]
37. National Resident Matching Program. Results and Data 2017 Main Residency Match. Available from: <http://www.nrmp.org/wp-content/uploads/2017/06/Main-Match-Results-and-Data-2017.pdf> Accessed November 2017
38. Puljak L. An overlooked source of physician-scientists. *J Investig Med*. 2007; 55(8):402–5.
39. Association of American Medical Colleges. MD-PhD Residents, by GME Specialty. 2015. Available from: <https://www.aamc.org/data/448484/b4table.html> Accessed November 2017

Figure 1. MD/PhDs Entering Psychiatry

(A) Total number of MD/PhD students entering psychiatry by year (B) Percentage of MD/PhD students entering psychiatry (out of total number of MD/PhDs graduating) by year. (C) Proportion of MD/PhDs entering psychiatry (per 100 students entering psychiatry) by year.

Figure 2. Annual Increase in the Number of MD/PhDs entering Training by Specialty (1999–2012)

Line indicates 95% confidence interval. Note that the “All Specialties” category includes other specialties that were not part of this study focus.

Figure 3. Number of MD/PhD Applicants Entering Psychiatry by Sex

The difference in slope between male (0.29/year) vs. female (0.53/year) is statistically significant (2 Variable ANCOVA, Time + Sex, $p < 0.001$). Given the extrapolated gender difference at the year 2012 to be 4, gender parity should be reached in approximately 17 years.

Table 1

Number, Percentage, and Proportion of MD/PhD students going into various specialties between 1999-2012

Total Number of MD/PhD Students Entering a Specialty	Mean	Range	Annual Change			
			beta	se	t	p
<i>Psychiatry</i>	18.4	13-29	0.82	0.3	2.77	0.02 *
<i>Neurology</i>	19.9	8-39	1.56	0.43	3.64	<0.01 **
<i>Neurosurgery</i>	12.3	6-18	0.13	0.27	0.49	0.63
<i>Internal Medicine</i>	110.9	90-141	1.83	0.87	2.11	0.06
<i>Family Medicine</i>	6.9	2-11	0.12	0.16	-0.71	0.49
<i>Radiation Oncology</i>	20.4	4-32	1.9	0.31	6.04	<0.001 ***
<i>All Specialties[†]</i>	451.4	353-535	15.11	2.01	7.52	<0.001 ***
Percentage of MD/PhD Students entering a specialty out of total number of MD/PhD graduates						
<i>Psychiatry</i>	3.9%	2.8% - 5.4%	0.05%	0.06	0.78	0.45
<i>Neurology</i>	4.1%	1.8% - 7.0%	0.18%	0.08	2.21	0.05 *
<i>Neurosurgery</i>	2.6%	1.2% - 3.9%	-0.05%	0.05	0.99	0.34
<i>Internal Medicine</i>	23.6%	17.5% - 27.9%	-0.39%	0.16	2.47	0.03 *
<i>Family Medicine</i>	1.5%	0.5% - 2.9%	-0.08%	0.04	2.17	0.05
<i>Radiation Oncology</i>	4.2%	1.1% - 7.0%	0.28%	0.08	3.44	<0.01 **
<i>All Specialties[†]</i>	95.5%	90.7% - 97.0%	0.07%	0.01	5.97	<0.001 ***
Proportion of MD/PhD Students Entering a Specialty (per 100 residents)[‡]						
<i>Psychiatry</i>	3.9	2.9-5.9	0.05	0.06	0.89	0.39
<i>Neurology</i>	9.5	5.3-12.7	0.13	0.14	0.92	0.37
<i>Neurosurgery</i>	8.3	3.8-12.3	-0.17	0.17	-1.04	0.32
<i>Internal Medicine</i>	3.5	3.0-4.3	0.07	0.02	3.26	0.01 **
<i>Family Medicine</i>	0.5	0.2-0.7	0.01	0.01	0.78	0.45
<i>Radiation Oncology</i>	14.3	3.5-22.1	1.05	0.24	4.40	<0.001 ***
<i>All Specialties[‡]</i>	2.8	2.2-3.3	0.07	0.01	6.46	<0.001 ***

* p<0.05;

** p<0.01;

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Note that „All Specialties“ includes other specialties that were not part of this study focus.

Proportions were calculated by the number of MD/PhDs entering each specialty divided by the total number of students entering each specialty.