Executive Summary

Dr. Francis Collins, NIH Director, convened and charged the Physician-Scientist Workforce Working Group (PSW-WG) with analyzing the current composition and size of the physician-scientist biomedical workforce and making recommendations for actions that NIH should take to help sustain and strengthen a robust and diverse PSW. The need for the PSW-WG emerged from the recommendations of the Biomedical Research Workforce Working Group for strengthening the biomedical workforce. Its June 2012 report concluded that the training and career paths of physician-scientists were different than that of the non-clinician PhD workforce and that further study of this important segment of the workforce was needed.

Warning bells about the health of the physician-science workforce were sounded as early as 1979 when future NIH Director James Wyngaarden observed that the physician-scientist with a medical degree was becoming "an endangered species." He had observed that MD applicants for NIH project grants represented a progressively smaller fraction of all applicants than previously, while the corresponding fraction of PhD applicants had increased dramatically. In 1996, NIH established a committee headed by David G. Nathan to make recommendations about the perceived shortfall of clinician scientists. The Nathan Committee recommended creating new career development grants for patient-oriented research and loan repayment programs to help young physician-scientists pursue research careers despite an increasing load of educational debt.

In spring 2013, the PSW-WG met and established subcommittees to discuss issues confronting the physician-scientist workforce. To inform its deliberations, the PSW-WG directed quantitative analyses of NIH IMPACII and other relevant databases to answer key questions, and considered the findings from qualitative research based on focus groups and interviews with students, research deans, and early career investigators.

The PSW-WG defined physician-scientists as scientists with professional degrees who have training in clinical care and who are engaged in independent biomedical research. The PSW thus includes individuals with an MD, DO, DDS/DMD, DVM/VMD, or nurses with research doctoral degrees who devote the majority of their time to biomedical research. The PSW-WG recognizes that the primary goal of professional clinical education is the training of a skilled clinical workforce in the respective areas of practice, and that the portion of such professionals devoted to research will be small. However, findings which lead to advances in practice are driven largely by the work of investigators with a variety of degrees, of whom those with clinical training contribute essential knowledge and skills.

Key Findings

NIH is the primary funder of biomedical research and research training in the United States. The strength of the physician-scientist workforce reflects the nature of the nation's investment in this arena. NIH funding increased greatly in the late 1990s from $13.675 billion (1998) to $27.167 billion (2003). During this period, institutions expanded their research capacity and training programs, and the number of physicians and non-clinically trained researchers applying for NIH R01 grants increased. NIH's budget growth came to a halt in 2004 and has since remained static. After adjusting for inflation using the Biomedical Research and Development Price Index, the 2013 NIH budget was 21.9 percent below its

2003 level. The 2008 recession also reduced research funding from other sources, including pharmaceutical companies.

Size and Composition of the NIH-funded Physician-Scientist Workforce

It is difficult to obtain accurate numbers about the total size of the physician-scientist workforce because the data are considered proprietary by the pharmaceutical and medical device industries, and because data are not available on the number of physician-scientists whose research is funded by non-NIH sources. PSW-WG analyses indicate that there were approximately 9,000 physician-scientists in the NIH-funded workforce during 2008-2012, including 4,192 with an MD, 4,086 with an MD/PhD, 341 nurse-scientists, 253 veterinarian-scientists, and 161 dentist-scientists.

Though their percentage of the overall biomedical workforce has been steadily decreasing since the 1970s, the total number of physician-scientists with a medical degree has remained remarkably steady over the past few decades, with MDs and MD/PhDs each comprising about 50 percent of the physician-scientist workforce with a medical degree. At the same time the average age of entry into the independent workforce (marked by receipt of an NIH RPG) has increased steadily, as has the average age of the physician-scientist workforce.

Nearly three-quarters of the MD RPG awardees were white and another one in five were Asian. Although there has been significant growth for Asian and Hispanic awardees over the past decade, there has been less growth for African-Americans and Native Americans. The lack of diversity of the physician-scientist workforce is a source of very serious concern to the NIH and to the professions. Other groups are addressing these difficult issues; the PSW-WG did not attempt to duplicate their efforts, and endorses strong investment in improving minority participation in scientific leadership.

Female physician-scientists remain underrepresented in some segments of the NIH-funded physician-scientist workforce. For physician-scientists with a medical degree, the percentage of female MDs who are RPG grant holders has increased from 17 percent in the mid-1990s to 29 percent currently. However, for MD/PhDs, growth in women investigators has been slower, increasing from 17 percent in the mid-1990s to 22 percent at the present time. Among veterinarian-scientists who receive RPGs from the NIH, men outnumber women by about three to one, despite the fact that the overwhelming majority (90 percent) of students enrolled in schools of veterinary medicine are women.

In contrast, among nurse-scientists applying for and receiving RPGs from NIH, women outnumbered men by approximately nine to one, reflecting their numerical dominance in the profession. Among dentist-scientists, women received about one-third of the RPGs awarded, yet constitute only about one-quarter of the dental-research workforce.

Challenges Confronting the Physician-Scientist Workforce

Several challenges confront the physician who elects to pursue a research career. Increases in the cost of obtaining medical education can burden students with high amounts of debt, especially those who were not enrolled in an integrated MD/PhD program. The training required to obtain competency in clinical and scientific research continues to increase, resulting in a marked prolongation of the training process. The transition between finishing a clinical or post-doctoral fellowship and initiating an independent research position is a very vulnerable period in the career path of all physician investigators. Funding pressures have mounted with the decrease in NIH funding and physician-scientists are increasingly being asked to support a higher percentage of their income by seeing patients. Financial opportunities in

practice offer an attractive option for clinically-trained physician-scientists, who are also valuable as clinicians to academic medical centers, pulling them away from their investigative work and creating conflicting demands on time and energy.

Other challenges that particularly confront younger physician-scientists are finding ways to balance work/life demands, finding mentors who can support and guide early career investigators, and the increasingly time-consuming and demanding requirements to maintain clinical credentials.

Physician-scientists across all domains face similar challenges, although the extent of the challenges varies from discipline to discipline. The non-MD segments of the PSW have lacked a critical mass of scientific researchers due to the strong focus of veterinary, dental and nursing training programs on producing clinical practitioners. As a result, a major challenge among these segments of the physician-scientist workforce is a shortage of faculty members with scientific research programs who can serve as role models and mentors to students in training.

Nurse-Scientists. Nurses often obtain research training after several decades of clinical work, and thus begin their research careers later than other clinical researchers. This contributes to the shortage of nursing faculty to train the next generation of nurse-scientists.

Veterinarian-Scientists. The curriculum in veterinary schools of medicine does not typically promote the role of the veterinarian-scientist, reflected in the significant lack of investment and lack of critical mass of veterinarian-scientists. Students graduating from veterinary school carry a heavy load of student debt, which discourages pursuit of a research career that may pay less than clinical practice.

Dentist-Scientists. A significant concern in dental education is the number of vacant faculty positions. Other challenges include financial pressures on dental schools, leading to increased emphasis on clinical revenue generation and a decreased emphasis on research. As a result, the culture and environment within dental schools has led to a diminished pool of research faculty mentors for dentist-scientist trainees, coupled with a lack of understanding and support for the training and career development of dentist-scientist graduates.

Future Challenges. A number of forces outside the NIH pose great challenges to the future physician-scientist workforce, including dramatic changes in the economics of medicine and healthcare more broadly, rising educational debt, increasing length of training, growing regulatory burdens, challenges to the overall quality of Science, Technology, and Mathematics (STEM) education in the United States, and the changing demographics of students in medical, dental, and veterinary schools. Individuals who have obtained one or more degrees outside the United States also comprise a significant component of the physician-scientist workforce, which has not been adequately characterized.

Challenges Confronting the National Institutes of Health in Assessing the Health of the Biomedical Workforce

As part of its charge, the PSW Data Subcommittee reviewed, assessed, and assembled a wide array of data sources in order to describe the size and composition of the current physician-scientist workforce, as well as to evaluate the impact that NIH Research Project Grant (RPG) funding has on the workforce and its development. An important outcome of that investment is the identification, organization, and analysis of a large database of key information about the workforce, drawn not only from NIH's IMPACII database but also from key external organizations such as the Association of American Medical Colleges (AAMC). NIH now has the opportunity to utilize this data in an ongoing and systematic way to address

key biomedical workforce issues—now and in the future--that the agency as a whole, as well as individual NIH Institutes and Centers, must confront as it seeks to strengthen the biomedical research capacity of the United States.

Early Career Investment in the NIH-funded Physician-Scientist Workforce

NIH's investment in the training of physician-scientists has a significant return. The RPG award rates for first-time RPG applicants with a prior LRP or K award are much higher than for those without: For MDs: 44.1 percent vs 9.2 percent and for MD/PhDs: 60.0 percent vs 10.1 percent. Similarly, early career support for physician-scientists through the Medical Scientist Training Program (MSTP) has also been successful at bolstering the physician-scientist workforce. Close to 80 percent of a cohort of MD/PhDs with past MSTP Appointments (1980-1989) have applied for RPGs, and approximately 78 percent have been successful. Despite this track record, the number of new physician-scientists with a medical degree entering the workforce is now declining, as reflected in the reduced numbers of applicants for early career (K and LRP) awards over the last 5 years.

Analysis of AMA and NIH data demonstrate continued aging over the past decade of physicians engaged in research, which presage a significant decline in the PSW, especially as the current cohort of senior physician-scientists retires. Our key recommendations thus focus on the early stages of the pipeline, on enhancing the ability of the NIH to evaluate the relative effectiveness of its programs to build and maintain the pipeline, and on systematically collecting and reviewing data so the biomedical workforce can more easily and readily be assessed.

Recommendations

The following recommendations apply to all clinically-trained investigators, including veterinarian-scientists, dentist-scientists, and nurse-scientists.

1. **NIH should sustain strong support for the training of MD/PhDs.** MD/PhD programs (including the Medical Scientist Training Program [MSTP] program funded by NIH) have been successful in promoting the development of physician-scientists and should be continued.

2. **NIH should shift the balance in National Research Service Award (NRSA) postdoctoral training for physicians so that a greater proportion are supported through individual fellowships, rather than institutional training grants.** The number of individual fellowship awards for MD-PhD students (F30/F31 grants) should also be increased. The PSW-WG endorses the similar recommendation from the Biomedical Workforce Working Group that support for both pre- and post-doctoral PhD trainees and individual fellowship for MD/PhD trainees should be expanded. It is critical to obtain accurate long-term follow-up on trainees through all of these programs to assess comparative effectiveness. These results should guide future allocation of NIH funds to these various mechanisms.

3. **NIH should continue to address the gap in RPG award rates between new and established investigators.** Although NIH policies have narrowed the gap for new RO1 applicants, this problem remains significant and needs continued attention. A number of pilot approaches should be explored, and rigorously assessed, with the most successful given expanded support (also see #7 below).

4. **NIH should adopt rigorous and effective tools for assessing the strength of the biomedical workforce, including physician-scientists, and tracking their career development and progression.** NIH should collaborate with external organizations that also have a strong investment in workforce development to collect, monitor, and report on key indices related to workforce issues. Specifically, NIH should establish an ongoing workgroup of NIH employees and external partners to support the development of a Biomedical Workforce Dashboard application that provides real-time tracking of the career development and progression of the workforce. The Dashboard would be a tool that both NIH employees and the public could use to instantly answer questions related to important workforce issues at the agency or I/C level.

5. **NIH should establish a new physician-scientist-specific granting mechanism to facilitate the transition from training to independence**. This program should be similar to the K99/R00 program whose funding currently goes almost exclusively to individuals holding a PhD degree. This new grant program could serve either as a replacement or transition from existing K Awards for physician scientists, and should provide a longer period of support, potentially lengthening the R00 phase to 5 years (with an interim staff review at year 3). This new grant series, as well as K and all other training awards, should rigorously enforce protected time of at least 75 percent effort and provide sufficient salary support to make that possible.

6. **NIH should expand Loan Repayment Programs and the amount of loans forgiven should be increased to more realistically reflect the debt burden of current trainees.** This program should also be made available to all students pursuing biomedical physician-scientist researcher careers, regardless of particular research area or clinical specialty.

7. **NIH should support pilot grant programs to rigorously test existing and novel approaches to improve and/or shorten research training for physician-scientists.** These programs should include (but not be limited to) mechanisms to shorten medical and/or laboratory training, explore timing and spacing of the research and clinical components of post-graduate training, and other alternatives. New opportunities for training in informatics and social science research that address emerging needs of the health care system should also be evaluated. Those programs exhibiting the most promising results should receive expanded support.

8. **NIH should intensify its efforts to increase diversity in the physician-scientist workforce**. This Working Group recognized major deficiencies of the physician-scientist workforce with regard to diversity. The PSW-WG strongly endorses the previous recommendations of the preceding biomedical workforce Working Group and the Working Group on diversity, all of which should be extended to the physician-scientist workforce.

9. **NIH should leverage the existing resources of the Clinical and Translational Science Awards (CTSA) program to obtain maximum benefit for training and career development of early-career physician-scientists.** This process should include critical review and analysis of rigorous outcome data, as outlined in #7 above.