The Physician-scientist Problem: A Human Resources Crisis in Life Science Research

KOBAYASHI Shinichi

Education, Culture, Science and Technology Research Service, Research and Legislative Reference Bureau, National Diet Library

Abstract

Human resources form the foundation of life science research. Concern over the falling number of doctors who go on to take careers in research in the basic medical sciences (physician-scientists) has been growing since Japan introduced a compulsory residency system in 2004. Training and securing an adequate number of physician-scientists is not only essential for advances in life science research, it is also the key to the future of university medical education, as well as to the health and medical care of the population and the advancement of the pharmaceutical and medical device industries. Universities have taken independent measures to address the problem, but the government has provided almost no policy support, and the repeated conflicts between the principles underlying the residency system and physician-scientist training show no sign of resolution today. As the life sciences evolve, research activities, medical education, residencies, and specialist training systems may face significant changes. Solutions to the problem must be considered from a broad, long-term perspective.

Introduction

The 29th General Assembly of The Japanese Association of Medical Sciences (JAMS) was held in April 2015. In the presidential address on 11 April, TAKAKU Fumimaro, sixth president of the JAMS, raised the issue of the drastically declining number of researchers in the basic medical sciences with medical-school degrees, as well as the human resource shortage in social medicine, noting that "Doctors working at hospitals are busy and cannot sustain research. The number of doctors transitioning from clinical to research careers has declined… The number of doctors who conduct research abroad and then continue basic research in Japan is also declining. Furthermore, the establishment of clinical research

education and a medical specialist system has drawn more students toward careers as specialists."[1] He went on to present data indicating that of all students entering graduate programs in the basic medical sciences at Japanese universities, the number of non-MDs (non-medical doctors) was steady, but the number of MDs (medical doctors; see Table 1 for detailed definitions) had been gradually declining. He pointed out three reasons for this decline in basic medical sciences researchers with MDs: the small number of research posts and resulting insecurity regarding career paths, the excessive busyness of medical workplaces and resulting difficulty of providing young doctors with research opportunities, and the nature of residency and specialist training systems. He further noted that "When the new specialist system begins in 2017, the number of doctors aiming to become specialists will increase, leading to concern that the number of researchers will decline even further."[2]

Approximately twenty years earlier, in 1996, Prof. TAKAKU (then president of Jichi Medical University) had raised a similar problem. At the time, the question of whether residencies should be made compulsory was already being debated, and while TAKAKU was not opposed to the idea, he argued that a number of issues must be overcome before this happened. He said that it was particularly important to ensure an adequate number of MDs entered the basic medical sciences, noting that this was already difficult in 1996 and predicting it would become more so if residency programs were made compulsory.[3]

The term "physician-scientist" refers to MDs who proceed to graduate study and become researchers in the field of basic medical sciences. The present paper refers to the decline in the number of physician-scientists and consequent need to train and secure an adequate number of such individuals as the "physician-scientist problem." Far from improving, the physician-scientist problem worsened after residency programs were made compulsory in 2004, as TAKAKU had predicted. Medical schools and academic associations became concerned about the issue, and universities have responded with diverse initiatives. However, policy responses have lagged. Government debate on the issue finally began in earnest after 2010, but no fundamental solution has yet been reached.

Why has the physician-scientist problem remained unresolved for twenty years? Today, people tend to look for quick fixes to issues of human resource training, and exit-oriented strategies for research and development. These attitudes are a matter of course not only with regard to medicine, but also concerning the social responsibility to train human resources and conduct research and development in a wide range of fields. On the other

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* Online sources cited in this paper were accessed for the final time on December 4, 2015.

1 "Basic research faces severe human resources crisis," *The Nikkei (Nihon Keizai Shimbun)*, 19 May 2015.

2 HASHIMOTO Keiko, "President Takaku calls for industry-government-academic-public alliance to meet societal needs: Presidential lecture warns of lagging research and ethics problems," 14 April 2015. m3.com website.

3 TAKAKU Fumimaro, "Introduction of a Compulsory Residency System," *The Journal of the Physiological Society of Japan (Nihon Seirigaku Zasshi)*, 58(6), June 1996, pp. 230-232.

hand, it goes without saying that life sciences research on human subjects is essential to supporting the practice of medicine in Japan over the long term. Because of this unique need to perform research on human subjects, securing physician-scientists with medical licenses is fundamentally important to life science research, so much so that it will impact not only medical research in Japan but also the future of health and medical care for the country's residents, as well as the prospects of related industries. By analyzing the physician-scientist problem, this paper seeks to clarify the issues inherent in Japan's doctor training and physician-scientist training systems. The following sections begin by providing a historical perspective on the nature of the physician-scientist problem and the reasons for its emergence and worsening severity. The paper goes on to describe university initiatives and policy measures, and review their outcomes. Finally, it considers why this problem has not yet been resolved in order to bring to light issues inherent in the physician-scientist training system.

Table 1 presents the definitions of important medical terminology used in this paper.

Table 1 Important terminology

Term	*Definition in Japan*
Basic medical sciences Social medicine Clinical medicine	The field of medical education in Japan is broadly divided into the basic medical sciences (basic medicine), social medicine, and clinical medicine. The basic medical sciences include anatomy, physiology, pathology, bacteriology, immunology, and other similar subjects. Social medicine includes public health, forensic medicine, etc. Clinical medicine is the study of internal medicine, surgery, and similar areas. It is possible for researchers without a medical license to enter the fields of basic medical sciences and social medicine.
MD (medical doctor)	The term "MD" is ambiguous, but a basic definition is an individual who has attended medical school and passed the National Examination for Medical Practitioners. In the United States, first-professional degrees conferred by professional schools of medicine and law use the term "doctor" (distinct from PhDs, which are research degrees attained after completing graduate school). The Japanese system follows the U.S. system in that individuals who graduate from medical school and pass the National Examination for Medical Practitioners are called "MDs." However, in the Japanese degree system, professional degrees were not distinguished from research degrees until the emergence of Juris Doctor degrees conferred by law schools, and therefore all individuals who completed doctorate programs in the medical field were formerly awarded a PhD in Medicine (or Doctor of Medicine) degree. To distinguish between PhDs with a medical license and those without, the former are sometimes called MDs while the latter are called PhDs. In the case of the MD-PhD programs described below, MD refers to an MD

	program (in Japan, at a medical school), while PhD refers to a PhD program.
Physician-scientist	Also called a "clinician scientist." Physician-scientists may work in basic medical sciences, social medicine, or clinical medicine, and university faculty who engage in research activities in addition to their clinical practice at a university hospital may also be broadly included in this category. The present paper focuses primarily on physician-scientists in the basic medical sciences, but also touches on those in social and clinical medicine.
Bed side learning Residency Specialized training	Today's physician training courses begin with six years in medical school. Students typically participate in clinical training called bed side learning during their fifth and sixth years. During this training, students rotate through each department of the hospital, improving their skills as a doctor and their familiarity with medical technology while engaging directly with patients. In addition to bed side learning in which students observe their supervising doctor caring for patients, there are also a growing number of participatory bed side learning programs in which students participate in medical care as part of a team. Students who have either graduated medical school or anticipate graduating take the National Examination for Medical Practitioners, and those who pass it will receive a medical license. Subsequently, those who plan to practice medicine complete a residency of at least two years. Residencies take place either at a university hospital or other designated hospital, and involve clinical training in a wide range of departments regardless of the doctor's intended future specialization. Doctors performing their residency are called residents. A standardized formula is used to match residents with hospitals, with the preferences of both parties taken into consideration. After completing a residency, doctors wishing to become specialists receive training in a specialized field of medicine. To distinguish this period of training from bed side learning prior to graduation, it is sometimes called post-graduation clinical training. Residencies and specialist training are sometimes called "first-stage" and "second-stage" residencies because of the order in which they take place.
Medical specialist	Doctors who have fulfilled accreditation criteria and training requirements in a particular field of medicine as established by the relevant academic association, and who have attained adequate knowledge and experience, are certified as specialists. Typically, specialists are certified by academic associations after completing at least five years of training including the residency period, and passing an examination or other qualifying standard. Doctors who supervise the training of medical specialists must also complete a designated training before being certified as a trainer by the relevant academic association. Because many academic associations established medical specialist systems, the subdivision of fields is not uniform, and quality assurance

	is not clear. A new medical specialist system is therefore planned for implementation in 2017. This new system will have two stages: certification in a basic field of medicine, followed by certification in a subspecialty. An independent organization will certify specialists, set standards for training program, and certify the programs of each academic association, thereby improving the quality of specialists and building trust in the system.
Clinical research Clinical study Clinical trial	Intervention studies performed on human subjects to diagnose, treat, or discover the causes of disease (such as the administration of medicines or use of medical devices to evaluate their safety or effects) and medical research performed through observation are broadly referred to as clinical research. Clinical research investigating the effects, safety, side effects, or other aspects of a medicine, medical device, or diagnostic treatment through application to a human subject is called a clinical study. Such a study performed with the goal of gaining approval for a medicine or device is called a clinical trial.

Source: Compiled by the author from various sources.

I The physician-scientist problem in context

1 *Discovery of the physician-scientist problem*

(1) The situation prior to the physician-scientist problem

The physician-scientist problem is an old problem that began well before implementation of the compulsory residency system in 2004. This section will for the most part trace the history of this problem chronologically.

In the 1990s, a range of issues related to graduate education—in particular, the need to increase the number of graduate programs—became one focus of higher education policy. Meanwhile, in July 1995, the Science Council of the Ministry of Education, Science and Culture compiled an interim report entitled *Training and Securing Researchers for the 21st Century* that examined trends in the demand for researchers. The report pointed out both that Japan was transitioning from an era of expanding demand to an era of uncertainty, and that the researcher population was aging while young researchers were in short supply. TAKAKU participated in these discussions as a member of the Science Council, and as head of the Medical, Dental, and Pharmaceutical Working Group, he led debates on problems surrounding the training and securing of graduate-school researchers, in particular those in doctoral programs in the medical field.[4] The 1990s were thus a period

[4] The Round-table on 21st Century Medicine and Healthcare (described below) was established under the Ministry of Education, Science and Culture in November 1995, and held discussions on

of growing concern over graduate-level training of researchers.

Building on the Science Council's interim report, *Japanese Scientific Monthly* published a special issue on training young researchers in April 1996. In the issue, University of Tokyo professor KUROKAWA Takahide wrote, "The number of medical students entering the basic medical sciences after graduation has fallen further in recent years. Although excellent individuals are entering the field from backgrounds other than medicine, it is surely a sign of dysfunction that medical students, who are particularly aware of the necessity of the basic medical sciences, are avoiding the profession… The broad development of basic research is necessary for the advancement of medicine overall, and it is also an important incubator of the seeds of new research."[5] He shared TAKAKU's awareness of the problem.

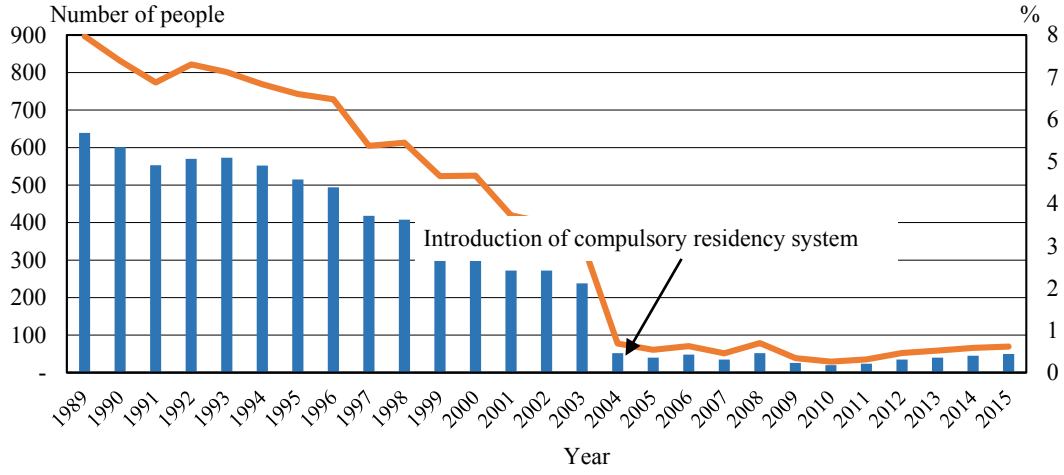

Figure 1 Changes in the number and percent (line) of medical school graduates who go on to graduate school

Source: Created using data from yearly *School Basic Survey reports*.

Data back up these arguments. A graph[6] presented in a report[7] by University of Tokyo professor SHIMIZU Takao shows that the percentage of students entering graduate programs in the basic medical sciences with a medical school degree was approximately

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the future training of human resources in healthcare-related fields and the desired state of university hospitals. TAKAKU was a member of the round-table.

5 KUROKAWA Takahide, "Training Young Medical Researchers for the 21st century," *Japanese Scientific Monthly (Gakujutsu Geppo)*, 49(4), April 1996, pp. 464-467.

6 This graph is said to be based on a 2008 report from the Council of the Heads of National Medical Schools of Japan, and is also presented in MEXT, "Reference Documents for the Council on Medical School Quotas Etc. Summary of Issues," 14 December 2011, p. 26. A significant number of documents refer to this data, but because the original report is not available, the details of the survey are unclear, and it is not possible to evaluate their accuracy. Because no other data exists that can serve as a substitute, this paper also refers to this source.

7 SHIMIZU Takao, *The Current Shortage of Researchers in the Basic Medical Sciences and Responses to the Problem* (Documents from the fourth meeting of the MEXT Council on Medical School Quotas Etc.), 11 March 2011, p. 19.

70% between FY1988 and FY1990, but fell by 40 points over the following 12 years to close to 30% in FY2002. In FY2004, with the implementation of the compulsory residency system, the figure broke 30%, and by FY2006 had reached the upper twentieth percentile. The government statistics compiled in the School Basic Survey do not include data as detailed as this, but they do allow us to grasp trends in the number of medical school graduates proceeding directly to graduate school (Fig. 1). Between 1989 and 1993, more than 500 graduates did so each year, but the number subsequently declined, and by 2003 it had reached 238. A clear break occurred in 2004, when compulsory residencies were introduced, and the figure fell to 52 individuals. Since then it has held relatively steady at between 20 and 52 individuals per year. The percentage of graduates shows a similar trend. That is to say, while some medical school graduates did still proceed to graduate studies, the proportion and number doing so declined steadily through FY2003. Abundant grounds therefore existed in 1996 to support the concern of TAKAKU and KUROKAWA over the declining proportion of MDs entering the basic medical sciences.

Both TAKAKU and KUROKAWA identified problems related to the appeal of research content and environments, as well as the financial burden of graduate school and uncertainties regarding future career opportunities as sources of this problem. On the other hand, when the Ministry of Health, Labour and Welfare's (MHLW) Subcommittee of Clinical Training under the Medical Committee of the Medical Ethics Council (below, "the Subcommittee of Clinical Training") addressed the physician-scientist problem as described further below, National Hospital Organization president KIRINO Takaaki pointed out that the number of MDs entering the field of basic medical sciences had been declining since the 1980s, and argued that the trend was not directly connected to implementation of the compulsory residency system. Describing the context at the time, he noted that "In the previous era, most clinicians at university went on to study the basic medical sciences and in some cases to write theses and gain recognition as PhDs… But in the late 1980s, molecular biology became popular, and the basic medical sciences lost their methodological monopoly. As a result, there was a fairly strong trend toward entering internal medicine rather than basic sciences, and a division arose between the basic medical sciences and clinical practice."[8] In other words, changes in the world of research also played a role.

(2) The advent of the compulsory residency system

The training of doctors after graduation from medical school began in Japan with the mandatory intern system (practical training system) introduced after World War II. In 1968, this system was changed so that medical school graduates took the National Examination for Medical Practitioners immediately after graduation, and after receiving their license

[8] "Proceedings of the 2013 Fourth Meeting of the Subcommittee of Clinical Training under the Medical Committee of the Medical Ethics Council," 18 July 2013. MHLW website.

completed a voluntary residency lasting at least two years. In 2004, the residency was made compulsory for doctors planning to pursue careers as clinicians.

Although residencies were not mandatory after 1968, the majority of doctors completed them. However, many remained at university hospitals or other affiliated hospitals, and it was not unusual for their training to be biased toward a few departments. There were other problems as well, such as doctors with a strong desire to become researchers who did not engage much in community medical care, and those who were poorly treated and had to take on additional part-time jobs. For these reasons, a plan to improve the system was discussed in the 1990s, primarily by a Ministry of Health and Welfare council, and the decision was taken to make residencies compulsory. Based on this decision, the Medical Care Act (Act No. 205 of 1948) and the Medical Practitioners Act (Act No. 201 of 1948) were amended through the Law to Amend the Medical Care Law (Act No. 141 of 2000).[9]

The amended Medical Practitioners Act stipulated that doctors devote themselves to two years of advanced clinical training, and that the completion of this requirement be recorded in the medical register (Articles 16.2, 16.3, and 16.4). It furthermore stipulated that doctors who did not complete the advanced clinical training would not be allowed to open clinics (Article 10). As a result, even if doctors graduated from medical school and passed the National Examination for Medical Practitioners, they were no longer able to open clinics unless they had completed their residency and had it recorded in the medical register. In addition, the Ordinance on Advanced Clinical Training as Stipulated in Article 16.2.1 of the Medical Practitioners Act (MHLW Ordinance No. 158 of 2002) positioned clinical training as a means for acquiring the basic abilities required of all doctors (Article 2). Due to these rules, even individuals who hoped to become physician-scientists had to first complete a residency and report it in the medical register in order to leave open the option of establishing a clinical practice in the future. Predictions emerged early on that this would lead to a drastic decline in the number of medical school graduates wanting to continue further to graduate school.

After residencies became compulsory, medical school professors grew increasingly concerned that doctors who completed their residency might no longer want to continue further to graduate school. In 2004, the Graduate School Division of the Ministry of Education, Culture, Sports, Science and Technology's (MEXT) Central Council for Education began discussing the nature of graduate education. During the separate discussions held in each field, the Medical Working Group expressed concern that "some feel that making residencies compulsory will put at risk the training of all medical researchers, not only those in the basic and clinical fields."[10] However, the new residency system had just been launched, and these concerns were not clearly expressed in the

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9 "Changes in the Physician Residency System," MHLW website.

10 "Proceedings and Distributed Documents from the Graduate School Division Healthcare Working Group (First Meeting)," 26 October 2004. MEXT website.

working group's summary documents or report.

The 37th Congress of Japan Society for Medical Education in July 2005 included a symposium entitled "Career Decisions After the First Stage of Residencies: The Path to Becoming a Physician-Scientist." Two years had passed since residencies became compulsory, and concern was growing over the career decisions of the first cohort of doctors to take part in the new system. "With the implementation of the new residency system, the number of medical school students continuing further directly to graduate studies in laboratories in the basic medical sciences is said to have drastically declined, with a few exceptions." Against this context, residents themselves participated in the discussions at the symposium. As one noted, "Under the old system, it was possible after obtaining a medical license to undertake a residency as a member of the senior medical staff, but the alternate path also remained open of heading directly to graduate school and becoming involved in basic research. However, under the new system, you are now required to complete two years of residency after obtaining your license, and if you don't, you are set apart in the medical register, so the reality is that almost all those who obtain a medical license undertake a residency." The resident added that "It seems that spending those two years training in a clinical setting puts you at a distance from the world of research… Looking back on my own experience as a resident, I'd say there's a ninety-nine percent chance I won't go into basic research." Furthermore, the resident mentioned that going to graduate school meant "I'd step away from the clinical environment and that makes me worry about lacking experience as a result," noting that "a lot of residents feel that same anxiety." [11]

The assistant to the head of the Medical Professions Division of the MHLW Health Policy Bureau participated in the symposium and pointed out that "Entering graduate studies in the basic medical sciences directly after graduating from medical school is in no way prohibited," arguing that under the new residency system, residents "are choosing their own career paths. It's not as if they are being forced to undertake a residency against their will." The assistant further argued that "The idea that the establishment of the new system has closed off the path to basic research is mistaken." This view did not correspond to the anxiety expressed by the residents themselves. However, it represents one extreme among the typical approaches to the problem of residencies and securing an adequate number of physician-scientists.

(3) Discovery of the physician-scientist problem

In 2006, immediately after the first cohort of doctors finished the new residency requirement, Kyushu University professor NAKAYAMA Keiichi published a

[11] MATSUO Osamu and HORIUCHI Saburo, "Career Decisions after the First Stage of Residencies: The Path to Becoming a Physician-Scientist," *Japan Medical Society: JMS*, (108), October 2005, pp. 18-21.

comprehensive article on the physician-scientist problem.[12]

NAKAYAMA wrote that due to advances in research beginning in the late twentieth century, "Integrated approaches to medicine have emerged which view the human body as a single living organism and attempt to analyze it at the molecular, cellular, individual, and group level." He argued that medicine was beginning to truly function as a science, and was developing rapidly as a result. Since that was the current state of medical research, the basic medical sciences and related fields of clinical medicine would naturally have an important role to play. Yet this was the same era in which fewer doctors were proceeding to graduate school. NAKAYAMA identified the increase in doctors wishing to become specialists and "the transition to universities prioritizing graduate schools that began in the late 1990s" as the causes of this trend.[13] Due to this transition, admission quotas for graduate schools rose, causing "the prestige of a PhD in Medicine to rapidly drop," and the merits associated with advancing to graduate school to disappear.

During the same period, residencies also became compulsory, leading to a large decline in the number of medical school graduates who continued further to graduate studies in the basic medical sciences. Not only that, but residents who had formerly stayed at university hospitals now dispersed to residency hospitals within communities, and as a result, there were not enough human resources left to support university research in the clinical medicine field. In the past, doctors had flowed back and forth between the fields of clinical medicine and basic medical research, leading some to transition from clinical to basic research careers, but this career path was now lost. Thus, the implementation of the compulsory residency system undermined the balance between research and clinical doctors virtually overnight.

NAKAYAMA argued that in an era when the contributions of physician-scientists in the basic medical sciences were essential, "The possibility has emerged that doctors may stop entering basic research altogether. In short, it will be impossible to avoid a decline in the number and quality of human resources in basic research fields, and of course research capacity will decline as well." In addition, "It will not be possible to educate outstanding doctors in the basic medical sciences," and therefore "sooner or later our capacity for clinical research will decline as well." The collapse of medical education was an even more crucial problem, and one that would take a long time to recover from. Ultimately, he argued, this would lead to health-related and economic losses for the population as a whole.

NAKAYAMA's article painted a clear picture of the physician-scientist problem and

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[12] NAKAYAMA Keiichi, "Will Medical Schools Collapse?! Compulsory Residency System Devastates Research and Education," *Doctor's Magazine,* (79), June 2006, pp. 17-22.

[13] "The transition to universities prioritizing graduate schools" refers to the strategic focus on graduate education underway at influential national universities at the time. Universities transferred faculty affiliation from undergraduate to graduate research departments to demonstrate their emphasis on research, and changed some assistant and associate professor positions to professor positions to expand graduate faculty numbers. These organizational reforms led to increases in foundational financial support from the central government.

laid out the primary related issues. It was widely quoted and was influential. The advent of the compulsory residency system was not the sole cause of the physician-scientist problem, but it did provide the opportunity for many people to become aware of the problem. In subsequent years, the compulsory residency system would come into unavoidable conflict with the resolution of the physician-scientist problem.

2 *Lack of widespread recognition of the physician-scientist problem*

(1) The physician-scientist problem in subsequent years

Even before NAKAYAMA framed the physician-scientist problem as an issue of serious concern with regard to medical education and research, a sense of urgency was widespread among those involved with medical education, as the symposium referenced above suggests. However, awareness of the problem did not spread quickly to government bodies or hospitals and clinics. A 2007 report by the Subcommittee of Clinical Training recognized that stakeholders were concerned about the decline in individuals wishing to enter the field of basic medical research, in part due to the new residency system, but held that the advancement of the basic medical sciences was beyond the scope of the fundamental principles of the residency system, and was not a problem that should be addressed through that system; instead, the report argued that the MEXT should consider the problem, and that those managing the residency system would not become involved.[14]

Those involved with medical education responded to this lack of interest from government bodies by using the media to raise public awareness of the physician-scientist problem. In 2008, TOYODA Nagayasu, then president of Mie University, used data to argue that the new residency system was impacting not only the basic medical sciences, but clinical medicine as well, and that this system had caused the number of research papers published in the field of clinical medicine to decline, particularly at national universities outside of major urban centers. TOYODA pointed out that while the number of clinical research papers was increasing globally, the number from Japan alone was declining. He identified a number of causes: the emergence of a gap between influential universities and less influential regional ones caused by the government's prioritization of graduate school education; the incorporation of national universities in 2004, which led to reductions in operating expense subsidies for university hospitals and increased pressure to raise revenues; and the flow of residents in the new residency system to hospitals in large cities and designated hospitals offering better treatment rather than to university hospitals, which caused doctor shortages in university hospitals, increasing workloads for clinical staff and

[14] *Report of the Subcommittee of Clinical Training under the Medical Committee of the Medical Ethics Council (Ido Shingikai Ishi Bunkakai Ishi Rinsho Kenshubukai Hokokusho)*, December 2007. MHLW website.

reducing the amount of time and number of staff devoted to research.[15]

In a 2008 newspaper article, Tokyo Medical and Dental University professor TANAKA Yujiro warned that doctors were avoiding graduate school as a result of the new residency system, and argued that in the future licensed doctors might not only stop pursuing research careers but also cease teaching medicine at universities altogether. He also described the MD-PhD program (described further below) established by Tokyo Medical and Dental University and the university's efforts to engage students in medical research early on. However, even when students expressed an interest in research, they did not select the MD-PhD program for financial reasons such as living expenses or tuition fees. He pointed out that in the United States the government paid the living expenses and tuition fees of students in similar programs, and argued that the Japanese government should provide similar support.[16]

During this period, universities implemented various initiatives to address the physician-scientist problem (described below), but the government took little action. In response to issues raised by the MHLW Committee for the Implementation of the "Vision for a Secure and Exemplary Healthcare System,"[17] the MHLW joined with the MEXT to establish a Committee to Consider the Residency System in September 2008. The aim of this committee was to discuss "the nature of the residency system, including the continuity of pre- and post-graduation doctor education, from the perspective of improving the quality and effectiveness of doctor training." In February 2009, this committee presented a summary of its opinions.[18] The group had discussed responses to the maldistribution among doctors among hospital departments and localities, and described the plight of university hospitals, noting, "National universities have management problems that make improving the treatment of doctors or increasing staffing difficult. Doctors at university hospitals are extremely busy with patient care, and the only reason they are also able to engage in education, research, and even support of community healthcare is their

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[15] TOYODA Nagayasu "'Selection and Integration' is a Double-Edged Sword: The challenge for regional universities," in *Grumbles of a Regional University President (Aru Chiho Daigakucho no Tsuboyaki)* (Mie University) 2010, pp. 84-85. The book is based on a collection of blogs published between 10 January and 18 January 2008. TOYODA made nearly the same point in 2007, although he did not refer clearly to the residency system at that time. TOYODA Nagayasu, "(My Perspective) University Hospital Functionality will Decline If Action is not Taken," *The Asahi Shimbun (Asahi Shimbun)*, 20 July 2007.

[16] TANAKA Yujiro, "(Points of Debate) Medical Research and Education in Crisis: Government has a Duty to Secure University Doctors," *The Yomiuri Shimbun (Yomiuri Shimbun)*, 6 March 2008.

[17] An interim report on issues under discussion by this committee stated, "From the perspective of effectively training better doctors, a joint MEXT-MHLW commission should be immediately established to plan the implementation of concrete measures to improve the residency system, including coordination between pre- and post-graduation training of doctors." *Interim Report of the Commission on Implementation of the 'Vision for a Secure and Exemplary Healthcare System,'* 22 September 2008. MHLW website.

[18] Committee to Consider the Residency System, *Summary of Opinions on the Residency System Etc.*, 18 February 2009. MEXT website.

foundational sense of mission and responsibility that leads them to exert extraordinary effort." On the other hand, the report also included the opinion that "The residency system is said to be negatively impacting the advancement of the basic medical sciences, but this is an issue that should be addressed through the MEXT's MD-PhD program or other such initiatives." The latter opinion echoed the argument expressed in the Subcommittee of Clinical Training report of over a year earlier (described above). Based on the findings of the committee report, the 2010 review of the residency system made standards for residency programs more flexible, toughened the standards for community medicine training and residency hospitals, and decided to set upper limits for recruiting residents for each prefecture.

However, the view that the physician-scientist problem was an educational issue unrelated to the residency system remained firmly entrenched, and the MHLW continued to exhibit a lack of interest in helping to address the problem.

(2) SHIMIZU Takao, Dean of the Graduate School of Medicine and Faculty of Medicine at the University of Tokyo, raises the issue

Around the same time, SHIMIZU Takao, dean of the school of Medicine at the University of Tokyo, began to raise the physician-scientist issue and describe it in detail based on the results of a study[19] by the Subcommittee on Research Promotion and Graduate School Education of the Council of Heads of National Medical Schools of Japan, with which he had been involved.

In July 2009, SHIMIZU wrote a newspaper article aimed at the general public on the shortage of physician-scientists, noting, "The mass media warns the public about the current medical crisis on a daily basis, broadcasting stories about municipal hospital closures and the shortage of perinatologists and emergency physicians. The MHLW, too, has finally started to take action. But in the midst of all of this, there is another forgotten crisis." He went on to describe the problem, referring to data from the Council of the Heads of National Medical Schools of Japan study: "University staff reductions have targeted the basic medical sciences, and the number of faculty in this field has fallen by 10% in the past ten years. Furthermore, the number of licensed doctors proceeding to graduate school in the basic medical sciences has fallen by half, and the number of MDs on university faculties has fallen drastically (just 15% of assistant professors and research assistants are MDs). If this situation continues, MD faculty and physician-scientists are likely to disappear altogether in ten or twenty years." SHIMIZU described the University of Tokyo's independent initiatives to address the problem, but argued that such efforts had limited

[19] As noted in footnote 6, it was not possible to obtain a copy of the report on this survey. The subcommittee released the results of the same survey in October 2010, but that document was not available either.

power, and called for proactive support from the national government.[20] His frustration with the government for failing to address the problem was evident.

Subsequently, the Council of the Heads of National Medical Schools of Japan presented a petition[21] to the prime minister and other officials arguing that the introduction of the new residency system had directly triggered the collapse of the medical system. It furthermore argued that "The shortage of physician-scientists in the basic medical sciences, social medicine, and clinical medicine who hold a medical license is a serious problem. Ten years from now, it is highly likely that it will not be possible to secure medical faculty capable of teaching and conducting research in the basic medical sciences. Research in the basic medical sciences undergirds the quality of medical care, and the collapse of basic medical sciences research in Japan will soon bring about a decline in the quality of medical care in this country. If this happens, it will take decades to recover, no matter the measures taken. To avoid this situation, it is essential to take immediate, concrete measures to promote the training of physician-scientists, which begins in medical schools. Moreover, government funds should be used to provide scholarships and other financial resources necessary for implementing these measures, which are essential for securing the quality of health care for the people of our country." In 2010, academic associations in the life sciences presented a similar petition to the government.[22] The Science Council of Japan's Committee on Basic Medicine also published a report on the physician-scientist problem, including proposed countermeasures.[23] However, the government still did not take action.

SHIMIZU took part in the fourth meeting of the MEXT's Council on Medical School Quotas Etc. (11 March 2011), at which he presented detailed, data-based information on the physician-scientist problem.[24] He argued that while the shortage of physician-scientists tended to be obscured by the problems of doctor shortages and maldistribution, it posed a major threat to medicine. If the shortage continued, he warned, basic medical sciences faculty with medical school degrees would nearly disappear, leading not only to the collapse of medical education and the stagnation of basic medical sciences research, but also to the decline of clinical research and translational research,[25] negative impacts for Japan's pharmaceutical and medical device industries, and even severe negative impacts to the health and longevity of the Japanese people. Based on the results of the Council of the

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[20] SHIMIZU Takao, "(My Perspective) Physician-scientist Shortage Demands Bold Investment in Training," *The Asahi Shimbun (Asahi Shimbun)*, 29 July 2009.

[21] Council of the Heads of National Medical Schools of Japan, "Petition from the Council of the Heads of National Medical Schools of Japan," 22 October 2009.

[22] The Physiological Society of Japan et al., "Petition regarding Revitalization of Training and Research in the Basic Medical Sciences," 17 February 2010. The Physiological Society of Japan website.

[23] Science Council of Japan Committee on Basic Medicine, *Report: Outlook for the Basic Medical Sciences* (Outlook for Japan: Proposals from the Sciences 2010), 4 April 2010.

[24] SHIMIZU, *op. cit*. (6); "Proceedings of the fourth meeting of the MEXT Council on Medical School Quotas Etc.," 11 March 2011. MEXT website.

[25] Translational research links the outcomes of basic research with applications in industry and clinical medicine.

Heads of National Medical Schools of Japan study, he pointed out that the percentage of graduate students in the basic medical sciences with MDs had fallen from 70% in 1988 to 30% in 2004, and that the physician-scientist shortage was worsening even now.

As for the primary causes of the problem, he identified several inherent to the field of basic medical sciences itself, such as poor conditions, a scarcity of research posts, and concerns that research funding would not be directed toward the field in the future, as well as a number of other factors, including the inability of senior doctors to provide their younger counterparts with research opportunities because of the busyness of the clinical environment and the consequent difficulty of transitioning from a clinical to a research career, as well as the difficulty of the timing for young doctors to shift to research, given the new system that made first-stage residencies compulsory and second-stage residencies necessary for obtaining qualifications as a specialist, by which time doctors were around 30 years old, and if they pursued additional certification as a resident trainer or subspecialist, it would last through their late 30s. To resolve the shortage of physician-scientists, SHIMIZU argued that it was urgently necessary not only for universities to reform their medical education programs, but also for academic associations to revise the specialist system, and for the government to increase research funds, improve conditions for physician-scientists, establish physician-scientist program, and reform the first-stage residency system. He explained that by "physician-scientist program" he meant special programs such as MD-PhD programs or physician-scientist training programs capable of systematically training approximately 200 individuals per year to become researchers or faculty in the basic medical sciences, and called on the government to fund student scholarships (in the sum of approximately three billion yen per year) and other costs such as program expenses (approximately two billion yen per year).

These points were, in essence, no different than those he had made a year and a half earlier in his newspaper article, or those that the Council of the Heads of National Medical Schools of Japan and other associations had made in their petitions to the government. In fact, in FY2008 the MEXT had launched a policy to increase admission quotas at medical schools, and in FY2010 it had established a physician-scientist category within the quotas. The details are described below, but the national quota was in the end limited to 40 students, and universities were required to provide financial support to these students on their own, making this less than a proactive countermeasure by the national government. Ultimately, despite the efforts of the Council of the Heads of National Medical Schools of Japan and other groups, the government did not take meaningful action. Universities and students would have to wait until FY2012 for financial support from the national government.

(3) A stream of proposals

After SHIMIZU's presentation to the Council on Medical School Quotas Etc., various groups continued to present petitions and proposals regarding the physician-scientist

problem. The Science Council of Japan's Joint Subcommittee on Medical Education, made up of the Committee on Basic Medicine and the Committee on Clinical Medicine, presented a proposal on the issue[26] in July 2011, which argued that the number of physician-scientists was declining drastically not only in the basic medical sciences but also in the field of clinical medicine, stating, "The introduction of compulsory post-graduation residencies has caused medical school graduates to disappear from basic medical sciences programs, and according to one study, nearly 90% of basic medical sciences researchers feel that education and research are in a state of crisis. At the same time, the number of doctors in the field of clinical medicine with no research experience is increasing, and the number of individuals capable of performing translational research in the future is declining drastically. In other words, human investment is being neglected in the fields of both basic medical sciences and applied medicine, and the reality is that we are now facing a crisis." One of the proposals that the subcommittee made was to "establish a roadmap for medical researchers." "We hope that this roadmap will be consistent at the government level and will result from a cooperative framework including the Ministry of Education, Culture, Sports, Science and Technology, which has jurisdiction over graduate education, and the Ministry of Health, Labour and Welfare, which approaches physician training from the perspective of welfare administration." As noted above, those overseeing the residency system viewed the physician-scientist problem as unrelated to that system, producing a sense of detachment, but the subcommittee nevertheless expressed hope that the MHLW would commit to addressing the problem.

The Council on Medical School Quotas Etc. to which SHIMIZU had presented his report issued its *Summary of Issues* on December 15, 2011.[27] One of the topics listed was "Strengthening the training of doctors (physician-scientists) who will carry out research and innovation in the basic medical sciences in the future." In addition to describing the current situation, the document took a step toward acknowledging the need to consider a policy response to the problem, noting, "Some feel that doctors wishing to pursue a research career have concerns about research funds and posts. It is desirable for the government to work with industry and research institutions to consider solutions to these issues."

In December 2011, the Association of Japanese Medical Colleges published observations and proposals[28] related to its 2007 *Doctor Training Grand Design*.[29] This document pointed out that despite the pre-graduation measures being implemented to

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[26] Science Council of Japan Committee on Basic Medicine and Committee on Clinical Medicine Joint Subcommittee on Medical Education, *Proposal for Improving Medical Education in Japan*, 28 July 2011.

[27] *Council on Medical School Quotas Etc. Summary of Issues*, 15 December 2011. MEXT website.

[28] The Association of Japanese Medical Colleges, *Grand Design for Reviewing and Reforming Physician Training: A Proposal from the Association of Japanese Medical Colleges in the Context of Collapsing Community Healthcare and the Globalization of Healthcare*, December 2011.

[29] The Association of Japanese Medical Colleges, *Doctor Training Grand Design: A Proposal from the Association of Japanese Medical Colleges*, September 2007.

ensure the future supply of researchers in the basic medical sciences and to develop research-oriented attitudes in doctors, such as the placement of medical school students in research laboratories, the number of basic medical sciences researchers not only remained low, but with the introduction of compulsory residencies and the invigoration of specialist training, the number of MDs entering medical graduate programs was declining drastically. The document went on to describe countermeasures such as the establishment of MD-PhD programs (described below) and other physician-scientist training programs, as well as the use of admissions office entrance exams to select students interested in research careers when entering medical school. With regard to graduate study in clinical medicine as well, it called for the cultivation of physician-scientists, specialized doctors, and advanced medical specialists oriented toward research, and for close ties during physician-scientist training between the basic medical sciences and clinical medicine in order to encourage clinicians to become basic medical sciences researchers.

After lodging the 2009 petition mentioned above, the Council of the Heads of National Medical Schools of Japan prepared a document in January 2012 entitled "The Current State of Medical Education at National Universities and Ideas for Improvement: A Proposal from the Council of the Heads of National Medical Schools of Japan," and presented it to the general public, relevant government authorities and institutions, and national universities with medical schools.[30] The document provided a detailed description of the current state of physician-scientist training, noting for instance that the number of clinicians interested in research was falling in the field of clinical medicine as well, and that the severity of the problem varied from university to university. The document then argued that each university should discuss which countermeasures were necessary and feasible. With regard to the resources needed to carry out these reforms, the document called for each university to "make what efforts it could on its own, and call on the government for financial support to cover any shortfalls, for instance through increases in subsidies for operating expenses."

As the above examples demonstrate, despite the expanding sense of crisis among those connected to university medical schools, a path toward resolving the physician-scientist problem remained difficult to identify. In particular, even though resolving the problem would inevitably require coordination with the residency system, the MHLW, which had jurisdiction over that system, continued to take the position that the physician-scientist problem was beyond the scope of the residency system.

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[30] Council of the Heads of National Medical Schools of Japan, *The Current State of Medical Education at National Universities and Ideas for Improvement: A Proposal from the Council of the Heads of National Medical Schools of Japan*, January 2012.

3 *The collision of the residency system and physician-scientist training*

(1) The debate is reignited

Since the introduction of the new residency system in FY2004, the MHLW has conducted a review of the system approximately once every five years, and revised it in FY2010 and FY2015. As noted above, the physician-scientist problem received little attention during the discussions on the residency system held in advance of the 2010 revision. However, during the 2015 review, the situation had advanced to the point where it was impossible to ignore the problem.

In preparation for this second review of the residency system, the MHLW established a Working Group to Evaluate the Physician Residency System, the goal of which was to gain an understanding of the system's implementation and impacts on community health care, and identify points of debate. In February 2013, the working group published a *Summary of Issues*[31] which raised "the relationship with physician-scientist training" as one point of debate. Specifically, the summary mentioned "graduate school research during the residency period" and "the fact that some feel residents should concentrate fully on their residency throughout its duration, in light of the basic principles behind it and the goals to be achieved, while others see the need for a flexible system that allows residents to specialize in research at an early stage if they so desire" as issues requiring consideration. The document summarized the primary opinions expressed in the working group, including the view that "The main reasons for the declining number of physician-scientists probably relate more to working conditions and other work-environment issues than to the residency system"; in other words, as in the previous review, these individuals felt that the physician-scientist problem was unrelated to the residency system. Others felt that the philosophy behind the residency system should receive priority, arguing that "According to the basic principles of the residency system, it is essential to focus on the residency throughout its duration, and not necessarily appropriate for doctors to enter graduate school during their residencies," while still others felt that in light of the physician-scientist problem, a more flexible approach to the residency system should be permitted. This latter group argued that "Once doctors have completed required subjects and sufficient electives and entered the elective period of their studies, it would be best to allow them to engage in clinical research or similar pursuits," and "In relation to attainment targets and time spent on the residency, we feel the issue is one of defining the scope of doctors' obligation to devote themselves to the residency."

A review of the working group's proceedings[32] reveals a powerful clash between different opinions on the physician-scientist problem. On the one hand were those who felt

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[31] Working Group to Evaluate the Physician Residency System, *Summary of Issues*, 8 February 2013. MHLW website.

[32] "Proceedings of the Tenth Meeting of the Working Group to Evaluate the Physician Residency System," 19 December 2012, MHLW website.

the residency system should be prioritized; as one participant said, "The issue of entering graduate school during the residency period has come up… I have discussed this both personally and with the Council of Four Hospital Organizations, and I am strongly opposed to it. The reason is that even if the individual puts in the time necessary for the residency itself, preparation and review are also required. Residents must rotate through a wide range of departments in a very short period of time, and in order to polish their skills within that period, they must spend additional time after work preparing, reviewing, and researching various topics. The idea that it would be fine for someone to enter graduate school at the same time and conduct research after their duties are finished is not valid. Ultimately, I want these doctors to be focusing on their residencies." On the other hand, some participants called for the research problem to receive more attention. A member of this camp stated, "The Japan Medical Association…feels somewhat differently. The desire to conduct research is based on internal motivations, and we believe that is precisely what creates the future of health care and medical science… We do not think it is necessarily positive for our country that opportunities for this internally motivated search for truth should be stolen by the need to focus solely on a residency for two years… There may be few such individuals…but my opinion is that we should secure a path forward for each of them, and therefore I think it is a major loss to cut some individuals off completely for two years." The role of the working group went only as far as summarizing points of contention, so after this report discussions shifted to the Subcommittee of Clinical Training.

(2) Clashing principles

At the fourth meeting of the Subcommittee of Clinical Training, in July 2013, participants discussed the relationship with physician-scientist training, which had been brought up in *the Summary of Issues*. The meeting minutes[33] reveal that the debate was even fiercer than it had been in the working group. Those who prioritized the philosophy behind the residency system argued that "The current concept is for doctors to concentrate fully on their residencies for two years. That is why part-time jobs are not allowed. How can you prohibit part-time jobs but at the same time argue that since there are graduate programs for working adult students, they should do graduate school research? We have to be very clear about our position with regard to this point." They furthermore stated, "If we look back…at why the residency period was set at two years, I think the reason this system was established was so that in the course of those two years doctors could acquire the skills and abilities that the public expects from all individuals who hold a medical license… I don't think that is different for researchers versus doctors who are not researchers… I can't help but feel the notion that we should change the system because it will be too late for doctors to begin basic research is a problem of an entirely different type."

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[33] "Proceedings of the 2013 Fourth Meeting of the Subcommittee of Clinical Training under the Medical Committee of the Medical Ethics Council," *op. cit*. (8).

In response, those calling for greater attention to physician-scientist training pointed out that one problem with the residency system was that completing the residency was a requirement for opening a clinic, and since even physician-scientists in the basic medical sciences were sometimes compelled to change directions and open a clinic, they could not avoid completing the residency requirement; therefore, the system required fundamental rethinking. Others argued that the system should be rethought because many of its goals could now be attained before graduation due to recent reforms in university medical education. In response to this, one participant responded, "I think that is incorrect. I think there is a difference between having a license and operating responsibly, and not doing so." Proponents of reform then described specific efforts on the university side, going as far as to say, "The kind of play-doctoring that happens in the first stage of the residency program can largely be accomplished through university education. I have no idea why, when Japan is suffering so much, everyone would be putting off and putting off getting their degree until later and later, and making these arguments that are of no use whatsoever to our country." They could not make those unconnected to universities understand their points about the relationship between residencies, physician-scientist training, and medical education reform, and the debate continued without consensus.

During this process, a participant suggested that one reason for the lack of consensus lay in the response from the MHLW. Looking at the *Summary of Issues* prepared by the working group, this individual said:

> The fact that a committee member would say, at this point in time, 'Based on the basic principles of the residency system, it is essential to focus, and not necessarily appropriate for doctors to enter graduate school during their residencies' is in itself surprising. In fact, when the residency system was launched in 2004, I had a major conflict with the Ministry of Health, Labour and Welfare. I said can we create a graduate program for working adult students. The Ministry said no way. When I asked why, they told me this. Doctors must focus on the residency when they are residents, and any talk about doing research at the same time is outrageous. But the ministry has also clearly said that work hours for residents are from 9 to 5. In that case, after 5, it should be fine to go to NOVA (leading English conversation school in Japan) by the train station and study English. It should be fine to go to the gym by the station and go for a swim. It should be fine to go drinking in Ginza. But if they're going to go drinking in Ginza, then it would certainly be better to have them go to the university at night and immerse themselves in basic research. That would surely produce better doctors. I got them to tentatively agree with me, and now some universities have created graduate programs for working adult students, so residents can do that kind of thing. In a sense, the universities are providing a service and increasing their flexibility. Plus, since these universities are navigating between complex laws and regulations to implement all these ideas, they will really

be in a tight spot if we start complaining about what they're doing.[34]

An employee of the MEXT who attended the section meeting similarly stated:

> Today, it is my understanding that the system is, in reality, operating with some flexibility with regard to the obligation of doctors to devote themselves to the residency, but I don't think that has been put into writing and made known to all universities. At the very least, I would like to see things clarified in that way.[35]

While the MHLW accepted in practice that residents could use their time outside of the residency to attend graduate school, so long as they fulfilled the requirement to devote themselves to the residency, it did not publicize this practice by putting it into writing or any other means. These comments made clear the structural issues behind the continuous clash between the principles of the residency system and the university efforts to train physician-scientists, as well as the reasons no consensus could be reached in the debate, and no conversation leading toward resolution could be advanced.

(3) A step toward making the residency system more flexible

The Subcommittee of Clinical Training published its report[36] in December 2013. In contrast to the previous review of the residency system, this report clearly addressed connections with physician-scientist training, noting the existence of the physician-scientist problem and the countermeasures taken by universities. It described the warnings that the declining number of physician-scientists would lead to a shortage of professors and a decline in the quality of medical research; the efforts of various universities to train physician-scientists by offering scholarships or establishing integrated undergraduate-graduate programs; the addition of a physician-scientist category in expanded medical school admission quotas; and the creation of special programs enabling residents to conduct graduate research so long as they achieved their residency attainment targets and conducted their research outside of residency time. The report also acknowledged that it was possible to enter a graduate program while a resident. In addition, the report stated that the residency system should be revised to take a more flexible approach[37] to those who suspended their

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[34] *ibid*.
[35] *ibid*.
[36] *The Subcommittee of Clinical Training under the Medical Committee of the Medical Ethics Council Report: Review of the Physician Residency System*, 19 December 2013. MHLW website.
[37] The basic approach to suspending residencies was laid out in "Section 17: Suspension and Reinstatement of Residencies" of Enforcement of Ministerial Ordinances on Residencies as Stipulated in Article 16.2.1 of the Medical Care Act (Circular Notice of the Health Policy Bureau of the of the Ministry of Health, Labour and Welfare No. 0612004 of June 12, 2003), which stated, "Administrators of residency programs and the Residency Oversight Committee have a responsibility to have residents finish their residencies within a time period determined in advance,

residencies midway through. This was expected to expand the options available for training physician-scientists. However, the report also warned, "In addition to taking measures related to the residency system, it is also desirable to greatly improve the research environment, for instance by improving working conditions, establishing career paths, and ensuring research sites for clinicians who decide mid-career that they would like to focus on research."

Based on this report, the residency system was partially revised. An attachment[38] to an April 2014 notice[39] from the Director-General of the MEXT's Higher Education Bureau stated with regard to the acceptance of residents into graduate programs, "Residents have an obligation to devote themselves to their residency, but those who appropriately achieve the residency attainment targets may enter a graduate program outside their residency hours." The MHLW launched a web page titled "Q&A on Physician Residencies (For Physician-Scientists)."[40] In response to the question, "Can I enter a graduate program in basic research during my residency?" the web page described the process for suspending a residency, and stated that "Residents have an obligation to devote themselves to their residency, but those who appropriately achieve the residency attainment targets may, through their own efforts, use their time outside of residency hours to enter a graduate program. Please consult carefully with your hospital and graduate school, as some schools have designed basic research programs that do not interfere with residencies, for example by scheduling coursework on days off and evenings." Over ten years after the new system was established, the Ministry had finally announced publicly that it was possible to undertake graduate study during the residency period.

The administrators of the residency system thus faced the physician-scientist problem head on, and at the very least officially acknowledged the various university initiatives to train physician-scientists. However, for those on the university side, this did not represent an advance in training physician-scientists. They had merely escaped their long confrontation with unproductive logic and finally reached the stage at which consensus seemed possible.

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and should not treat the suspension of residencies lightly." However, this was deleted on 31 March 2014.

38 "(Attachment) Important Points for Universities Regarding Residencies." MEXT website.

39 Revision to 'Enforcement of Ministerial Ordinances on Residencies as Stipulated in Article 16.2.1 of the Medical Care Act' (Notification) (Circular Notice of the Higher Education Bureau of the Ministry of Education, Culture, Sports, Science and Technology No. 171 of 16 April, 2014). MEXT website.

40 "Q&A on Physician Residencies (for Physician-scientists)." MHLW website.

4 *The persistent physician-scientist problem*

(1) Stagnation after the plan for a Japanese NIH

Around the same time the Subcommittee of Clinical Training began debating the residency system, major changes were about to take place in research and development (R&D) policy in the medical field. In April 2013, the chief cabinet secretary submitted a plan for a Japanese version of the National Institutes of Health to the Industrial Competitiveness Council.[41] This plan consisted of an R&D strategy for the medical field initiated by politicians with the goal of unifying budgets connected to R&D. The plan was given concrete form in the *Japan Revitalization Strategy—JAPAN is BACK—* (cabinet decision, June 14, 2013)[42] and positioned as a policy goal. This strategy proposed measures such as creating a headquarters for medical R&D, establishing a comprehensive strategy for R&D, and unifying budgets related to R&D in the medical field. On the same day, the government also presented *The Healthcare Policy*.[43] This policy paper included human resources measures such as "training human resources capable of taking a business approach to matching needs and seeds (ideas for innovation) in medicine and nursing care," "pursuing the human resources and possibilities hidden in existing enterprises. Making human resources more fluid," and "responding to new demand by making use of paramedics etc." However, it did not mention human resources capable of carrying out basic research, or the physician-scientist problem.

In accordance with the *Japan Revitalization Strategy—JAPAN is BACK—* and *The Healthcare Policy*, an Expert Panel on Medical R&D was established in the Headquarters for Healthcare Policy in order to establish an overall medical R&D strategy, and in January 2014 this panel completed *The Plan for Promotion of Medical R&D*.[44] This plan noted the importance of basic research, stating that "In order to apply the outcomes of basic science to overcoming disease, it is of utmost importance to recognize the importance of broad basic research rooted in the unrestrained ideas of researchers, and to build this foundation. We must continue to promote this work moving forward." However, the plan was generally optimistic with regard to basic research, noting, "In recent years, China, Korea, and other developing nations have strengthened their basic research initiatives, and are rapidly catching up with Japan, the United States, and Europe. Although the international competitiveness of Japanese research papers in the basic life sciences and clinical medicine

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[41] SUGA Yoshihide, "Framework for a Japanese National Institutes of Health and MEJ (Medical Excellence Japan)," 23 April 2013. Prime Minister of Japan and His Cabinet website.
[42] *Japan Revitalization Strategy—JAPAN is BACK—* (cabinet decision, 14 June 2013). Prime Minister of Japan and His Cabinet website.
[43] *The Healthcare Policy* (agreement by relevant ministers, 14 June 2013). Prime Minister of Japan and His Cabinet website.
[44] The Expert Panel on Medical R&D, *The Plan for Promotion of Medical R&D (Report)*, 22 January 2014. Prime Minister of Japan and His Cabinet website.

is declining, our basic research remains highly competitive internationally." On the other hand, it noted that "Compared to basic research papers, the international presence of our clinical research papers is low and declining," and focused on the need to train human resources in the field of clinical research. These conclusions drew abundant condemnation and requests for change, primarily from academic associations,[45] most of which called for a greater focus on basic research and human resources development.

In May 2014, the Act on Promotion of Healthcare Policy (Act No. 48 of 2014) was promulgated. This act stipulated the obligation of universities and other research entities such as R&D institutes to train human resources, engage in R&D, and disseminate the outcomes of that R&D (Article 5). It furthermore established a central role for the government in "taking the necessary measures to secure, train, and improve the quality of human resources with the specialized knowledge needed to create new industries and engage in cutting-edge research and development in the healthcare field (Article 16)." However, the Healthcare Policy[46] that was approved by the cabinet based on this act only enumerated human resources including specialized doctors and support staff capable of taking a leadership role in clinical research and clinical trials; bioinformatics personnel; personnel capable of advancing the practical use of innovative drugs, medical devices, and regenerative medicine products; personnel with the specialized skills needed to meet the distinctive handling requirements of regenerative medicine products; personnel capable of taking a business approach to matching "needs and seeds"; and entrepreneurial support personnel. It did not address ordinary researchers in the basic medical sciences or clinical medicine.

Thus, the plan for a Japanese NIH, as well as the Act on Promotion of Healthcare Policy and the Healthcare Policy that implemented that plan, aimed to unify R&D in the medical field, but did not address either the basic medical sciences or basic research in the field of clinical medicine. In April 2015, the Japan Agency for Medical Research and Development was launched, representing a step toward unified distribution of research funding, but the Grants-in-Aid for Scientific Research that supported basic research at universities were not included, and remained under the jurisdiction of the MEXT. Human resources training, too, was advanced without consideration for the physician-scientist problem, and so this string of actions by the government did not contribute to resolving the physician-scientist problem.

(2) The persistent physician-scientist problem

As described in section I.3.1, the residency system was reviewed in FY2015, and plans are

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[45] For example, The Union of Japanese Societies for Biological Science, "Emergency Statement on Concerns Regarding Resource Allocation and Human Resource Training Processes in the Plan for a 'Japanese NIH,'" 11 June 2013.

[46] *The Healthcare Policy* (Cabinet Decision, 22 July 2014). Prime Minister of Japan and His Cabinet website.

in place to launch a new specialist training system in FY2017. Previously, academic associations had established their own specialist certification systems in an uncoordinated manner and with no clear guarantee of quality. To reform this situation, it was decided that the Japanese Medical Specialty Board should create uniform standards for evaluating and certifying programs for training and certifying specialists, as well as for certifying and re-certifying specialists and for educational programs and training facilities. Not only doctors but patients as well should welcome the fact that the new specialist system will raise the value of specialist certification. However, it is possible that this new system will further increase the number of doctors who wish to become specialists after passing the National Examination for Medical Practitioners. That is not the only concern. Currently, potential future faculty in the clinical medicine field are in some cases trained through graduate programs for working adult students that accept doctors in the midst of their specialist training at university hospitals etc., thus allowing graduate education and specialist training to occur in a unified manner. However, under the new specialist training system, educational programs will be standardized, and may lose their flexibility as a result, making simultaneous graduate study and specialist training difficult in practice, and maybe impossible. Hence, securing and training physician-scientists may become difficult not only in the basic medical sciences but also in clinical medicine.

In this way, time passed with no sign of a fundamental solution to the physician-scientist problem, and nearly two decades after TAKAKU pleaded for attention to the physician-scientist problem in 1996, he once again raised the issue in his presidential address at the 29th General Assembly of the JAMS in 2015.

II Responses to the Physician-Scientist Problem

1 *University initiatives to train physician-scientists*

While almost no policy responses to the physician-scientist problem have been implemented, medical schools—the sites of actual doctor training—have not stood by idly. Working within the restraints of the residency system, universities have implemented a range of innovative measures. The names and content of these measures vary by university, but they include MD-PhD programs, physician-scientist training programs, admission of residents as working adult students, and establishment of a physician-scientist category in admission quotas.[47] Fig. 2 depicts these initiatives in schematic form.

[47] For examples of physician-scientist training initiatives, see the following. Supervising Editor of the Subcommittee on Research Promotion and Graduate Education, "Physician-scientist training initiatives at medical schools nationwide," Council of the Heads of National Medical Schools of Japan website; the Association of Japanese Medical Colleges, *White Paper on Japanese Medical Schools and Universities* (yearly reports); "Special Report: Physician-scientist Training," *Acta*

Fig. 2 ① represents doctors who enter graduate school after completing their residency, in a typical case taking 12 years from first entering university to attaining their degree. ② represents doctors who begin their residency after completing their graduate studies, which also takes a total of 12 years from entering university to attaining a graduate degree and completing the residency. Although these are the most typical patterns, attaining a degree takes a long time, and some doctors who complete their degree before beginning their residency may feel concerned about starting the residency after spending 3 to 4 years away from a clinical setting. On the other hand, those who complete their residency before entering graduate school may feel unsure that they will continue to be interested in pursuing graduate study as many of their colleagues go on to specialist training. Both paths require a high level of commitment from the doctor him or herself. Many medical students fear uncertainty and may thus avoid pursuing graduate studies. To address this problem, universities have introduced the following initiatives.

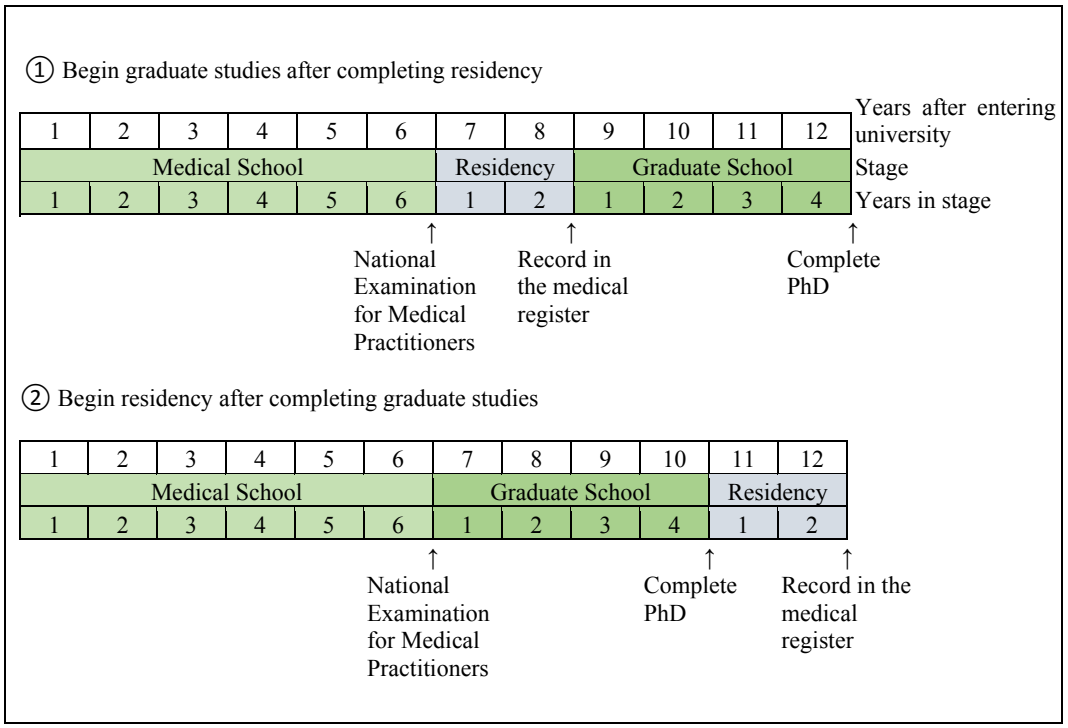

Figure 2 Types of Physician-Scientist Training Initiatives
Source: Created by the author from multiple sources.

Anatomica Nipponica (Kaibogaku Zasshi), 88(1 and 2), March 2013, pp. 3-28; YAMADA Kazuo, "Physician-scientist Training Supports Clinical Medicine: Osaka Medical College, Juntendo University Offer Separate Tests and Tuition Discounts," *The Nikkei Business Daily (Nikkei Sangyo Shimbun)*, 15 December 2014; NARAI Michiko, "Basic Medical Sciences Researcher Training at Four Universities: Securing Financial Support, Easing Anxiety over the Future a Challenge," 27 April 2015. m3.com website.

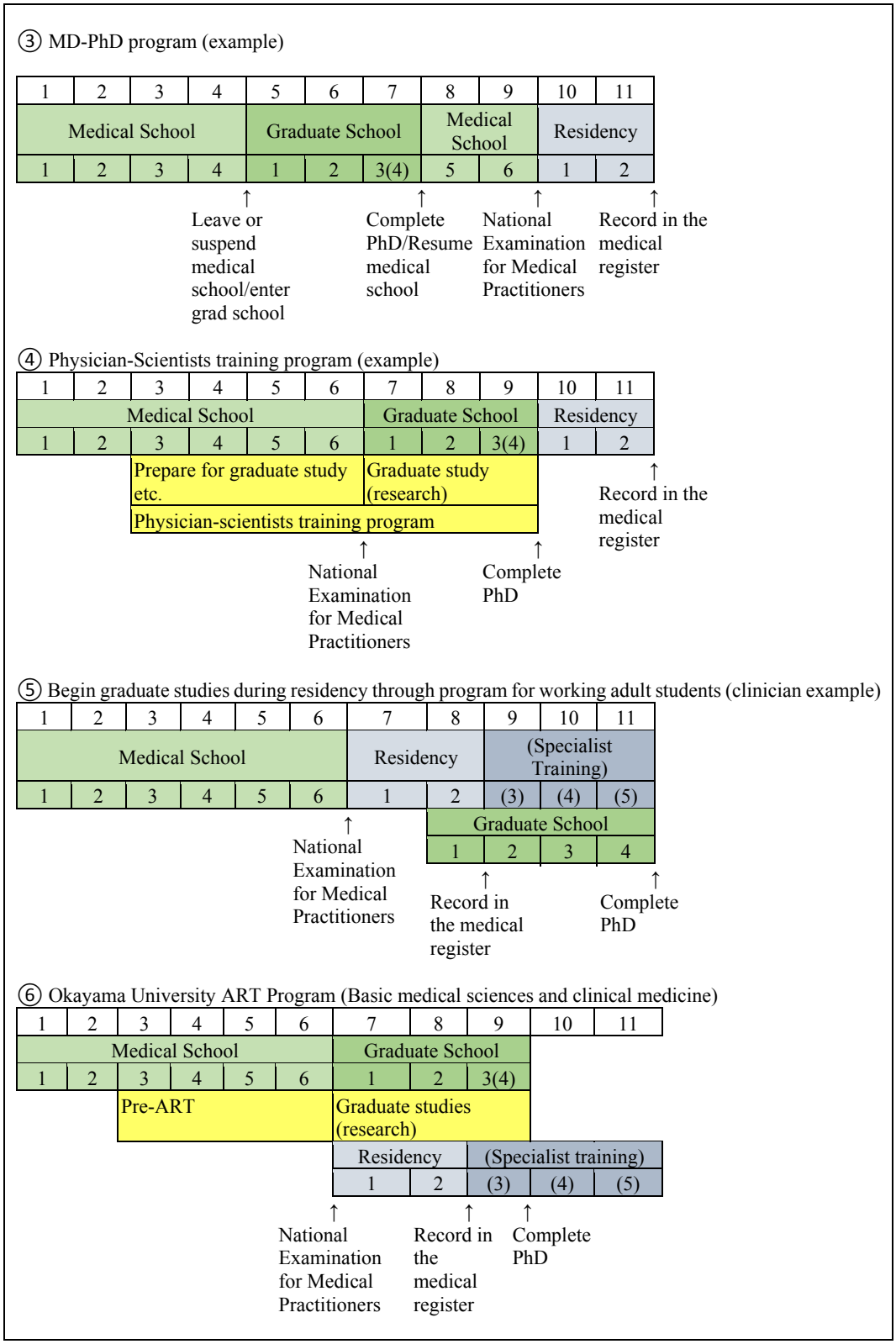

Figure 2 Types of Physician-Scientist Training Initiatives (Cont'd.)

(1) MD-PhD programs and early entrance to graduate programs

A number of universities began taking independent measures to address the problem even before residencies became compulsory in FY2004. These measures fall under the category of MD-PhD programs (Fig. 2 ③).

In 1999, the Round-table on 21st Century Medicine and Healthcare, established by the Ministry of Education, Science and Culture about three years earlier, published its fourth report,[48] which described systems for rapid training of physician-scientists. The report described American MD-PhD and DDS-PhD programs, noting that "The ordinary term of study at medical and dental schools in the United States is 4 years, after which graduates receive a professional degree of MD (Doctor of Medicine) or DDS (Doctor of Dental Science). However, programs also exist that enable outstanding students with an interest in research to undertake studies for a research degree of PhD (Doctor of Philosophy) simultaneously with their ordinary medical studies, thereby attaining both degrees within a period of 6 to 7 years." However, it was not possible to directly adopt the American system due to the different structure of Japanese medical schools. Furthermore, at the time, discussions were underway to consider making post-graduation residencies compulsory, and it was necessary to coordinate those efforts with graduate studies.

At this point, the idea emerged to make use of exceptions for early entrance into graduate school. Exceptions already existed in other fields allowing outstanding students to enter graduate school after completing their third year of undergraduate studies. However, no such exceptions had been established for medical or dental schools because of the eligibility requirements for taking the National Examination for Medical Practitioners. The round-table requested that the University Council of Japan create a graduate school early-entrance exception for outstanding medical and dental students who wished to pursue research rather than clinical practice. The round-table also noted that "If such an exception is created, students who make use of it will be treated as having dropped out of their undergraduate program and will not meet the eligibility requirements for taking the National Examination for Medical Practitioners. It is therefore desirable that universities take a flexible approach to such students, for instance by allowing them to reenter medical school at the clinical training stage so that they may easily meet the eligibility requirements if, after completing graduate studies, it becomes necessary for reasons related to research or due to a career change for them to obtain their license as a doctor or dentist." In other words, to allow for the training of physician-scientists primarily in the basic medical sciences and social medicine fields, the proposal called for a system in which students who completed a certain number of years of medical school would enter graduate school early, attain a PhD, then return to medical school and take the National Examination for Medical Practitioners. This would ensure that outstanding students

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[48] *21st Century Training Systems for Physicians and Dentists (Fourth Report of the Round-table on 21st Century Medicine and Healthcare)*, April 1999. MEXT website.

proceeded to graduate studies, and because it would enable them to complete a PhD in a short period of time, would also allow for the rapid training of researchers. They could then take the National Examination for Medical Practitioners and begin a residency, which the round-table hoped would prevent the problem of students losing interest in research during their residency. While the plan borrowed ideas from American MD-PhD programs, it was different in that it allowed students to begin early graduate courses midway through medical school and complete their research training first, ultimately aiming to shorten the period required for both research and physician training.

The Ministry of Education, Science and Culture's University Council of Japan responded quickly to the round-table's request by submitting a report[49] on the introduction of graduate school early-entrance exceptions for medical, dental, and veterinary students. The report stated that such students would be required to complete at least four years of schooling before entering graduate school, and noted, "Universities are expected to take a flexible approach to individuals who, due to reasons such as a change in career path, wish to attain a medical license etc. after entering graduate school through an early-entrance exception, for example by allowing them to reenter medical school etc." Based on this document, the School Education Act (Act No. 26 of 1947) and the Ordinance for Enforcement of the School Education Act (Ordinance of the Ministry of Education No. 11 of 1947) were amended in 2001, and the amendments took effect in FY2002.

Universities responded by making ample use of the graduate early-entry and medical school re-entry systems to establish early research training courses for outstanding medical students, referring to American MD-PhD programs as a model. These courses varied by university, but the goal of the typical MD-PhD program (Fig. 2 ③) was to train physician-scientists in the basic medical sciences and social medicine. After completing four years of medical school but before clinical training (bed side learning) began, students withdrew from or suspended their studies, entered graduate school, and aimed to complete graduate studies in just three years. After attaining a degree, they returned to medical school, completed the fifth- and sixth-year clinical training, graduated, and took the National Examination for Medical Practitioners. After passing, they began their residency. Universities made various efforts to incentivize outstanding students to enter graduate school, such as pressing alumni for donations to establish scholarship funds.

Table 2 shows the number of universities establishing MD-PhD programs and physician-scientist training programs (described below). Table 3 shows changes in the number of students entering MD-PhD programs at universities with such programs and at least one enrollee. It is evident that many universities established these programs in response to the introduction of the compulsory residency system. However, the number of universities introducing such programs and the number of students making use of them is

[49] Ministry of Education, Science and Culture University Council of Japan, *Reforming the Graduate Student Selection Process (Report)*, 9 August 1999. MEXT website.

by no means large. For instance, the University of Tokyo established its PhD-MD program in FY2002. In the course of ten years, 11 students enrolled, 6 attained a degree, and of those, 2 became assistant professors in basic medical science laboratories.[50]

Table 2 Number of schools with special programs aimed at training researchers

Year	*No. of schools respond-ing*	*Have one or more programs*		*MD-PhD program*		*Physician-scientist training program*		*Other*
		All schools	*National univer-sities*	*All schools*	*National univer-sities*	*All schools*	*National univer-sities*	*All schools*
2005	80	-	-	17	15	-	-	-
2007	80	-	-	17	16	-	-	-
2009	80	-	-	17	15	-	-	-
2010	80	-	-	21	18	-	-	-
2012	79	26	22	13	13	11	9	8
2014	80	33	23	14	13	13	9	10

Note: Dashes indicate years when the survey question was not asked. Until 2010, schools were asked only if they had an MD-PhD program or not, but starting in 2012 they were also asked if they had a physician-scientist training program. It is likely that the reason the figure for MD-PhD programs declined in 2012 is that in previous years, some schools had reported physician-scientist training programs as MD-PhD programs. Note that while the survey referred to such programs as "researcher training courses," the present paper uses the term "physician-scientist training programs."

Source: Based on data from the yearly *Association of Japanese Medical Colleges White Paper on the Medical Schools of Japan*.

(2) Physician-scientist training programs

The MD-PhD programs shown in Fig. 2 ③ require students to withdraw from or suspend their medical school studies to enter graduate school, so only students with a strong drive are likely to choose them. In addition, the typical fourth-year medical school student has no laboratory experience and no concrete image of what graduate research involves, and is therefore unlikely to choose such a program. In response, some schools launched initiatives for medical students in their third year or earlier aimed at inspiring an interest in research or instilling basic research abilities. These initiatives, which existed outside of the ordinary curriculum and were aimed at a wide swathe of students, included activities such as group reading of research papers, writing papers in English, and studying various research methodologies. In many cases these activities took place in small groups that also included senior students, which provided opportunities for them to mentor junior students. Students

[50] KIKKAWA Masahide, "Medical Scientist Training Program of the University of Tokyo," *Acta Anatomica Nipponica (Kaibogaku Zasshi)*, 88(1 and 2), March 2013, pp. 13-16.

Table 3 Changes in the number of students entering the graduate phase of MD-PhD programs (students per university)

Year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Hokkaido	-	-	-	-	-	-	0	2				
Tohoku	1	0	1	0	1	0			3	0	0	0
Gunma	0	0	0	0	1	0						
Chiba		5	5	5	5	5	4	5				
Tokyo	1	0	2	2	1	1	0	2	2	1	0	0
Tokyo Medical and Dental		4	2	1	1	1	2	2	2	0	1	1
Gifu							1	1				
Nagoya	-	-	-	-	1	0			0	0	1	0
Kyoto						1	1	1	0	1	0	0
Osaka			1									
Hiroshima									0	0	1	0
Tokushima	3	1	1	0	0	1	2	1	2	1	1	1
Kyushu			1	0	2	1	0	1	0	0	0	1
Kumamoto		0	0	0	0	0						
Kagoshima		0	0	0	1	0			0	0	0	0
Ryukyu							0	1	0	0	0	0
Sapporo Medical	-	-	9	14	6	11	8	16			2	1

Note: Only universities reporting at least one enrollee are listed. Some universities had programs but no enrollees. Dashes indicate years when a program did not exist, and blanks indicate no response. Note that individual universities were first asked to report the number of students entering the graduate portion of MD-PhD programs in the 2007 survey. This data was used to extrapolate the number for 2003.

Source: Based on data from the Association of Japanese Medical Colleges, *White Paper on the Medical Schools of Japan* (2007, 2009, 2010, 2012, and 2014 editions).

also joined laboratories, mainly in the basic medical sciences, where they learned experimental techniques, participated in experiments, and presented academic papers. In some cases, they were able to complete parts of the graduate curriculum while still undergraduates. These types of programs are called physician-scientist training programs (Fig. 2 ④).[51]

These programs did more than increase students' motivation to perform research and

[51] Enrollment in MD-PhD program is low, and these students likely receive individual instruction, but in physician-scientist training programs, organized activities are possible through group instruction.

develop research-oriented attitudes in doctors.[52] Students who studied research methodologies at an early stage and were recognized to have attained a certain level through activities such as writing and presenting academic papers also received preferential treatment during the graduate school selection process, such as exemption from taking written entrance exams. Because participants in these programs continued their ordinary medical school studies in parallel, they were able to take the National Examination for Medical Practitioners just as ordinary medical students did. However, participants postponed their residencies until after graduate studies. Because they had already prepared for graduate school, they aimed to complete their studies in just three years, then begin their residencies after attaining their degrees. By having students complete some elements of graduate education while still in medical school, these programs aimed to shorten the overall time required to attain a degree compared with typical cases (Fig. 2 ① and ②).

Most physician-scientist training programs either selected a certain number of students to participate each year or allowed interested students to register, then proceeded outside of the regular curriculum. Because the work load was significant, the possibility existed that some students would drop out, or finish the pre-graduate portion of the program but then decide to become a clinician instead of proceeding on to graduate school. In this sense, these programs did not manage program completion as strictly as MD-PhD courses, but rather attempted to guide medical students gently toward graduate school. However, even if students ultimately chose to become clinicians rather than to pursue graduate study, they would have a foundation in research that would likely serve them well in some clinical situations, and for those who did prove to have an interest in research, the threshold for taking that path would be lower. Furthermore, these programs could be applied to students interested in clinical medicine as well as the basic medical sciences, and therefore contributed to training physician-scientists in a wide range of fields.

It is worth noting that some universities attempted to steadily introduce as wide a swathe of students as possible to research, for example by making research ethics or other foundational research courses mandatory or by beginning their programs at an earlier stage. In addition, because this type of introductory education is also useful to students choosing MD-PhD programs, some universities included courses intended as preparation for MD-PhD programs as well. In these cases, the curriculum for students intending to enter

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[52] The MEXT established an Expert Panel on Medical and Dental Education to discuss the reform and strengthening of medical education and the desired state of graduate education, taking into consideration factors such as the introduction of the new residency system and the problems with community healthcare. In its *Final Report*, the council addressed "developing research-oriented attitudes in medical students" as one measure at the medical school stage to address the physician-scientist problem. The report defined "thinking like a researcher" as "having the aspirations, ethics, etc. expected of researchers," and gave examples of initiatives such as assigning medical students to research laboratories, so they would be able to become involved with real research while in medical school, and establishing programs that contribute to developing research-oriented attitudes in students. The Expert Panel on Medical and Dental Education, *Final Report*, 28 March 2007. MEXT website.

graduate studies early as part of an MD-PhD course split off at a certain point from the curriculum for those intending to enter graduate school after completing medical school through physician-scientist training programs.

Although the number of universities that have established physician-scientist training programs is not large (Table 2), these programs are about as widespread as MD-PhD programs. Some universities offer both type of program. As Table 4 shows, the number of participants in physician-scientist training programs varies by university, and because a significant number of participants likely drop out, the figures do not reflect the number of students proceeding to graduate school.

Table 4 New enrollees in physician-scientist training programs (students per university)

Year	*2011*	*2012*	*2013*	*2014*
Hokkaido	2	1	3	1
Gunma		1	1	1
Tokyo	39	47	25	27
Tokyo Medical and Dental	3	3	3	2
Yamanashi	3	10	9	13
Gifu	0	2	1	0
Shiga University of Medical Science	0	0	7	5
Okayama	-	-	1	11
Yamaguchi	0	2	52	41
Sapporo Medical	7	11	19	21
Keio	0	3	5	5
Juntendo	-	-	30	(45)

Note: The survey on which this table is based inquired about physician-scientist training programs starting with the 2012 survey. This survey refers to such programs as "researcher training programs" but the present paper uses the term "physician-scientist training programs." Dashes indicate years in which no program existed, and blanks indicate no response. Because some universities permit students to enroll voluntarily while others select participants, the figures cannot be compared. It should be noted that Juntendo University admits participants year-round, and the figure for 2014 indicates the number of enrollees between April 15 and July 11.

Source: Based on data from the Association of Japanese Medical Colleges, *White Paper on the Medical Schools of Japan* (2012 and 2014 editions).

(3) Resident enrollment as working adult students

Nontraditional students are widely enrolled in graduate programs. While schools have long accepted business people as working adult students and others from backgrounds other than

medical school, the enrollment of doctors as working adult students during their residencies has increased since residencies became compulsory. Some enroll as working adult students during the first or second year of residency (Fig. 2 ⑤) while others enroll during their specialist training (this includes cases in which students participate in specialist training programs at university hospitals while pursuing graduate study provided by the same university at the same time). Since research activities take place at the same time as the residency or specialist training, many enrollees are likely in the clinical medicine field. However, since no surveys have asked detailed questions about students' previous field of study, occupation, or enrollment type, it is unclear just how many students fit this description.[53]

As described above, doctors are required to devote themselves to their clinical training, particularly to the compulsory post-graduation residency. For this reason, the "Q&A on Physician Residencies" on the MHLW website originally only indicated that doctors could enter graduate school before or after their residency, and did not state clearly that they could take courses in the evenings and days off from their residency through graduate programs for working adult students. However, by contacting the ministry or through other means, individual universities confirmed that it was possible to accept residents as working adult students, and began to do so. Still, in quite a few cases, schools accepted only second-year residents because at the time of graduate school entry exams they were unsure what the students' residency situation would be, or because they felt students needed to adapt to the residency environment during the first year. Furthermore, to avoid having an impact on residencies, universities offered evening or weekend lectures or online courses.

Okayama University has established what it calls the ART program (Advanced Research Training program) (Fig. 2 ⑥).[54] By combining elements of physician-scientist training programs and working adult students programs for residents, the university hopes to balance residency and graduate study in an efficient human resource training system. In this program, medical school students begin the Pre-ART phase in their third year by taking a series of graduate courses as non-program students etc. After graduating from medical school, they begin their residency and their doctorate studies at the same time. Graduate lectures take place on weekday evenings and Saturdays during the day, outside the hours

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[53] Survey results indicate that as of FY2013, 93.8% of universities had established working adult students programs in medical fields, 71% accepted graduate enrollment of doctors in specialist training, and 56.1% of all graduate students were working adult students (not limited to residents and doctors in specialist training). The detailed breakdown of this data is not clear. HABUCHI Tomonori, "Graduate Schools and Research," in *2014 White Paper on Japanese Medical Schools and Universities* (The Association of Japanese Medical Colleges) 2014, p. 343.

[54] MATSUI Hideki, "ART (Advanced Research Training) is a New Graduate School Program for Training Physician Scientists," *Journal of Okayama Medical Association (Okayama Igakukai Zasshi)*, 121(3), December 2009, pp. 189-193. This article notes that the program was "established through close coordination between Okayama University and the MHLW Office for the Promotion of Post-Graduation Residencies."

covered by the requirement for doctors to devote themselves to their residency.[55] Starting preparations during medical school allows students to complete graduate school in a short period of time; the program is designed so students can complete both their PhD and their residency in as little as nine years after entering medical school.

2 *Measures taken by the Ministry of Education, Culture, Sports, Science and Technology*

(1) Increasing admissions quotas through the physician-scientist category

In FY2008, the MEXT launched a policy to increase admissions quotas for medical schools.[56] Under this policy, an admissions category for physician-scientists was created in FY2010. Universities that used high-quality educational and research resources to create hubs for physician-scientist training, consistently worked to train and secure outstanding physician-scientists, and fulfilled three conditions—cooperate with other universities; establish special programs (for more than twice the number of students added through the quota increase) that integrate medical school and graduate education with the goal of training physician-scientists; and establish scholarships to increase the number of physician-scientists—would be allowed to increase admissions quotas in the physician-scientist category. However, the increase in admissions quotas was limited to three students per university, and would last only through FY2019. The existing MD-PhD and physician-scientist training programs created by various universities fit the requirement for "special programs that integrate medical school and graduate education with the goal of training physician-scientists." Universities had also already taken independent measures to establish scholarships, so applying for the admissions quota increase was likely not overly difficult. As a result, the increases shown in Table 5 were approved, for a cumulative increase of forty spots in the physician-scientist category so far.

The scale of the physician-scientist category is small, but because it allows for the addition of admission spots at universities that are already training physician-scientists, it does not represent the total number of physician-scientists in training. Initially, rather than separating the physician-scientist category from the regular medical student category at the

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[55] This refers to the "Educational Method Exceptions" as stipulated in the Standards for Establishment of Graduate Schools (Ordinance of the Ministry of Education No. 28 of 1974). Article 14 of these Standards stipulates that "When a special necessity is determined to exist for educational reasons, graduate schools may use appropriate methods such as holding classes or providing research guidance at night or at other specified times or periods to educate students." Based on this, programs that are not night graduate schools (Article 2.2) but which conduct educational activities normally offered during the day at night, on weekends, or during the summer, etc. are called *chuya kaikosei* (day and night school systems).

[56] When increasing total admissions capacity, universities must obtain permission from (in the case of private universities) or submit a notification to (in the case of public universities) the MEXT. National universities must receive permission to change their mid-term plans. Policy guidance and restrictions take place through this process.

stage of university entrance exams and selecting applicants for this newly established physician-scientist category, the system tended strongly toward recognizing the existing system at each university. However, in recent years some initiatives have emerged to encourage physician-scientist training starting from the medical school entrance stage by connecting the process to medical school entrance exams.

Table 5 Changes in medical school admission quotas and physician-scientist quotas (number of students)

Year	*Total medical school admission quota*	*Physician-scientist category (new)*	*Physician-scientist category (cumulative)*	*Physician-scientists (new) by university (number of students in the physician-scientist category)*
2010	8,846	17	17	Tohoku 2, Tokyo 2, Tokyo Medical and Dental 1, Nagoya 2, Kyoto 2, Osaka 2, Yamaguchi 1, Nagasaki 1, Keio 2, Juntendo 1, Teikyo 1
2011	8,923	6	23	Tsukuba 1, Shiga University of Medical Science 2, Yamaguchi 1, Kyushu 1, Juntendo 1
2012	8,991	3	26	Nara Medical 2, Juntendo 1
2013	9,041	9	35	Tokyo Medical and Dental 1, Chiba 2, Saitama Medical 1, Juntendo 3, Kansai Medical 2
2014	9,069	4	39	Kobe 2, Hyogo College of Medicine 2
2015	9,134	1	40	Keio 1
2016 (anticipated)	9,262	0	40	-

Source: Created by the author using data from the MEXT's yearly press release, "Plan for Increasing Medical School Admission Quotas."

In its FY2016 entrance exams, Juntendo University will select students to fill its physician-scientist quota during admissions office entrance exams.[57] Through this program, "Students will be given priority in entering the special program for basic physician-scientist training after admission, and those who select a basic medical science researcher training plan after their fourth year will receive basic medical sciences researcher training loans (100,000 yen per month)." The aim of the initiative is to discover

[57] "2016 Medical School Entrance Examination for Applicants in the International Clinician and Physician-scientist Categories: Type A Special Admission Examination," Juntendo University website.

"students who want to carry out research as clinicians, in other words, to become physician-scientists," "students who want to use knowledge and experience gained at Super Science High Schools etc. to study medicine and healthcare, and in the future, to advance science and technology through medicine," and other similar individuals.

In its FY2016 entrance exams, the University of Tokyo's School of Medicine is recruiting approximately three students through its recommendation-based entrance exams. According to the application guidelines,[58] "In order to promote medical research that contributes to the elucidation of biological phenomena, the fight against disease, and the improvement of human health, [the School of Medicine] views its recommendation-based entrance exam category as a clinician scientist training category, and uses it to foster international scientists who will undertake cutting-edge medical and life-science research." The guidelines furthermore state, "In order to achieve this, we accept students with the desire and ability to make discoveries about unknown life phenomenon and carry out research that contributes to innovative healthcare. We develop research-oriented attitudes in doctors and give them research skills through research experience opportunities such as summer programs, and after they enter medical school, through participation in the PhD-MD program (a system for beginning graduate study while still in medical school)." As the document explains, recommendation-based entrance exams are linked to physician-scientist training. As a rule, admitted students participate in the MD Researcher Training Program (equivalent to the physician-scientist training programs described in this paper) in their third and fourth years of school, and subsequently advance to the PhD-MD program (equivalent to the MD-PhD programs described in this paper). While in graduate school, they are provided with scholarships.

(2) Financial support from the MEXT

The MEXT has implemented numerous policies and programs aimed at promoting reforms in university education, some of them targeted at the medical field. Medical schools etc. proposed plans in line with the aims of these programs and underwent a selection process involving a review committee or other mechanism, with the most outstanding plans receiving financial support for a set period of time. However, because none of these programs offered support for physician-scientist training, universities developed independent initiatives and secured their own funds as described above, for instance by lobbying alumni for donations for scholarships.

The program that the MEXT finally launched in response to the physician-scientist problem is called the "Training Physician-Scientists in the Basic Medical Sciences to Build the Foundation for Medical Advancement" program, which is part of the "Training Global

[58] "Application Guidelines for the FY2016 University of Tokyo Recommendation-Based Entrance Examination"

Physicians by Reforming Medical Education to Focus on Both Basic Medical Sciences and Clinical Medicine" program[59] initiated in FY2012. Against the backdrop of "declining numbers of doctors engaged in basic medical sciences research," this program "supports outstanding initiatives to create attractive physician-scientist training programs in the basic medical sciences at both undergraduate and graduate medical schools." Approximately ten undergraduate or graduate schools will be selected to receive about twenty million yen per year for a (tentative) period of no more than five years. Building on the initiatives implemented independently by various universities thus far, the program will provide financial support retroactively. Since the amount of funding is small and the time period short, however, this certainly does not comprise an adequate public-sector response to solving the physician-scientist problem, which for the most part continues to be left to the independent efforts of each university.

3 *Evaluation of various initiatives*

Initiatives to resolve the physician-scientist training problem on the ground at medical schools have been steadily building since around the time that residencies were made compulsory, and universities have now accumulated over ten years' experience. Recently, the challenges, impacts, and problems revealed as a result of the initiatives have become increasingly clear. Although no systematic evaluation has yet been conducted, the following points have been raised.

The establishment of MD-PhD programs (Fig. 2 ③) became possible only after early graduate school admission exceptions were applied to medical schools, and the financial foundation of these programs, which relies on the independent efforts of schools such as scholarship fundraising, remains fragile. As a result, there have been repeated calls for financial support from the government.[60] The "Training Physician-scientists in the Basic Medical Sciences to Build the Foundation of Medical Advancement" program represents the government's response to these requests, but the scale and length of the support offered cannot be called adequate. In addition, as observers have noted, "Only about 20% of medical universities have introduced MD-PhD programs, and the number of students making use of these programs is small."[61] Because the number of physician-scientists being trained through MD-PhD programs remains small despite the heavy burden on university staff, some see more promise in physician-scientist training courses (Fig. 2 ④) with more participants.[62] On the other hand, as graduates of MD-PhD programs have

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[59] "Call for Applications for the 'Training Global Physicians by Reforming Medical Education to Focus on Both Basic Medical Sciences and Clinical Medicine' Program." MEXT website.
[60] For example, Council of the Heads of National Medical Schools of Japan petition, *op. cit*. (21).
[61] INAI Kouki et al., "Graduate Schools of Medicine in Japan: The Status and Problems of Researcher Training," *Medical Education (Igaku Kyouiku)*, 39(5), October 2008, pp. 317-320.
[62] HABUCHI *op. cit.* (53).

pointed out, "Although most doctors who complete MD-PhD programs are working hard in the basic research field, few participants in MD researcher training programs go into basic research despite the higher overall number of participants in these programs."[63]

Physician-scientist training programs (Fig. 2 ④) have multiplied relatively recently, and high hopes exist for their further development. Many universities implementing them begin by gathering a wide range of students who may have an interest in research, then gradually winnowing them out. Because the initial stage targets some students who will not ultimately become physician-scientists, there is undeniably an inefficient aspect to such programs. For example, it has been reported that of ten students initially participating in this type of program at the University of Tokyo, only three proceeded directly to graduate school.[64] However, many universities anticipate that by giving medical school students research experience and developing research-oriented attitudes in doctors, they will have a higher likelihood of returning to research after their residency even if they do not go directly into graduate school, and if they do become clinicians or enter the clinical medicine field, they will help to link the basic medical sciences and clinical medicine.[65]

Regarding graduate programs that accept residents as working adult students, the relationship between these programs and the residency system was formerly unclear, and understanding of the system was confused. Today, by combining physician-scientist training programs or physician-scientist admission quotas with the graduate school system for working adult students and allowing students to undertake residencies and graduate studies simultaneously, plans have been proposed to shorten the time required to complete medical school, graduate school, and a residency from the standard 12 years to as little as 9 years.[66]

III Why won't the physician-scientist problem go away?

1 *Friction between residencies and physician-scientist training*

Although efforts to train and secure physician-scientists still have an experimental feeling to them, universities are taking various innovative measures and accumulating experience. Because each university has established different requirements and expects these programs to serve a different role, it is not possible to determine unilaterally which measures work best. Furthermore, because of the diversity in approaches to physician-scientist training,

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[63] NARAI *op. cit*. (47).
[64] KIKKAWA *op. cit*. (50).
[65] For example, *ibid*; TAKEDA Sen et al., "Initiation and Maintenance: The University of Yamanashi's Accelerated Life Science Program and the Kanto Four-University Consortium for Physician-scientist Training," *Acta Anatomica Nipponica (Kaibogaku Zasshi)*, 88(1 and 2), March 2013, pp. 9-12.
[66] Council of the Heads of National Medical Schools of Japan, "The current state of medical education," *op. cit*. (30).

related problems will not be resolved without flexibility in government systems. As the information presented above makes clear, the residency system constitutes the most extreme restraint that currently exists. The friction between the residency system and physician-scientist training is the result of multiple conflicts and discrepancies.

(1) The conflict between university staff and personnel at clinical and residency sites

First, university staff think about these problems differently than do those at clinical and residency sites. While securing physician-scientists is a major problem for those at universities, personnel in clinical settings and at residency hospitals view the training of clinicians as a bigger issue, while the physician-scientist problem should only concern universities themselves.

It is also important to note the major changes in medical school education that began around the time residencies became compulsory. Based on the fourth report of the Round-table on 21st Century Medicine and Healthcare, described above, an Expert Panel on Medical and Dental Education was established. The results of the panel's discussions were published in 2001 in *Improving 21st Century Medical and Dental Education: Rebuilding Undergraduate Education*, which presented specific measures to be implemented.[67] As a result, a model core curriculum was created, a common examination implemented, and reforms to clinical training advanced. A number of reviews and revisions followed. Recently, the so-called "2023 problem"[68] has surfaced, and reforms to the clinical training that occurs during medical school are being advanced in particular. As a result of these reforms, today's medical education includes many clinical elements, and has grown closer to residency. It is possible that once certain conditions are in place, some of the skills that those involved in clinical and residency sites believe can only be obtained through residencies may in fact be attainable through medical school education. Because doctors at clinical and residency sites outside the university do not fully understand these dizzying changes, consensus in the debate cannot readily be achieved.

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[67] Expert Panel on Medical and Dental Education, *Improving 21st Century Medical and Dental Education: Rebuilding Undergraduate Education*, 2001.

[68] In the United States, medical school graduates must pass the United States Medical Licensing Examination (USLME) before beginning a residency. Foreigners who wish to undertake a residency or otherwise engage in medical treatment in the United States must obtain a license by taking the USLME through the Educational Commission for Foreign Medical Graduates (ECFMG). In September 2010, the ECFMG announced that starting in 2023, those applying to take the test "will be required to graduate from a medical school that has been appropriately accredited…through a formal process that uses…globally accepted criteria." Because no Japanese medical schools have received international accreditation, immediate action is being sought. This is referred to as the "2023 problem." ECFMG, "ECFMG to Require Medical School Accreditation for International Medical School Graduates Seeking Certification Beginning in 2023," 21 September 2010.

(2) The estrangement of government from sites of medical education

The second source of friction is the different sense of the situation that exists in the government versus sites of medical education. University staff and academic associations predicted from a fairly early stage that the introduction of the compulsory residency system would worsen the physician-scientist problem. After the system was in place, they not only held symposiums and wrote articles in the publications of academic organizations, they also carried out surveys and presented petitions to the government on the subject. They also worked to publicize the issue through articles in newspapers.

However, the government took little action. The only measure implemented at a comparatively early stage was the introduction of early admission exceptions for graduate school, which enabled the establishment of MD-PhD programs. After that, the MEXT did not proactively implement any supportive measures; its only step was to launch a financial support program targeting physician-scientist training in FY2012. The MHLW viewed the physician-scientist problem as a university issue, and therefore declined to address it during reviews of the residency system for many years. Finally, during the preparations for the FY2015 review of the system, a vigorous debate on the subject led to the publication of a report in late 2013 that addressed the system's relationship to the physician-scientist problem. However, the ministry did not fundamentally reform the residency system or harmonize it with physician-scientist training; instead, it merely noted in clear terms that the problem existed, and reconfirmed and publicized the fact that residents were allowed to enter graduate programs as working adult students, which it had not proactively announced in the past. Today, responding to the physician-scientist problem remains the responsibility of universities, which must make independent efforts to address it.

(3) Lack of integration between the MEXT and the MHLW

The third source of friction is the lack of integration between the MEXT and the MHLW. When the University Establishment Standards were revised in 1991, the previous system of medical students taking two years of general education courses followed by four years of specialized medical education was changed to an integrated six-year system. OGAWA Akira, then president of Iwate Medical University, said that "By changing to a system of essential medical education rather than one of cramming information into students, this represents an attempt to make education more effective, cultivate adequate knowledge and skills, and train doctors with clinical ability at the time of graduation." On the other hand, he argued that the new residency system "views the current six years of medical school education as inadequate, and therefore requires an additional two years of training after graduation, meaning that eight years of medical education are now mandatory," noting, "It is hard to believe that these two policies advanced by the former Ministry of Education, Science and Culture and the former Ministry of Health and Welfare were put forth on the

basis of shared principles."[69]

In theory, medical education should be viewed comprehensively, from medical school to residency and specialist training, and even subsequent lifelong education, and optimized overall. The reality, however, is that reforms to medical education have been implemented separately from reforms to the residency system. Because government agencies have become isolated from one another, each has aimed to perfect and optimize its own part of the system, and this has caused the loss of flexibility in the system as a whole, intensifying rather than solving the problem.

(4) Residencies for all and physician-scientist training for a few

It is fundamentally difficult to operate a residency system that aims to target all or nearly all medical students and to be highly consistent, and at the same time to achieve physician-scientist training for a very few, as an exception to the rule. Even with regard to the problem of the residency system and physician-scientist training being fully compartmentalized, the two systems are not independent or unconnected. As long as it is taken for granted that physician-scientist training will occur as part of traditional university education, it will conflict with the residency system. Universities have responded by making efforts to offer courses on evenings, weekends, and holidays to serve the small number of residents pursuing research. However, the administrators of the residency system have continued to insist that even these efforts on the part of universities cannot be accepted under the principles and philosophy of the residency system, with the result that if exceptions are not made, physician-scientist training becomes almost impossible. If the residency side were to exhibit even a small amount of flexibility, physician-scientist training could be realized, but without flexibility, no consensus can be reached, and no solution to the problem found.

(5) Imperfections of an overly perfect residency system

Looking back on the history of residencies since the end of World War II, it is clear that the system design has undergone major shifts. From a compulsory intern system to voluntary residencies and then to compulsory residencies, each approach has experienced problems. There appears to be a pattern in which administrators attempt to create an overly perfect system that solves only the most immediate problems, only to find that the system causes new problems once it is introduced. The various conflicts that have arisen are not without relation to these policy swings.

Today the medical world is confronting a range of challenges aside from the physician-scientist problem, including the maldistribution of doctors among regions and specializations, and the internationalization of medical education. If various conflicts and disagreements continue against this difficult context, resolving problems related to the

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[69] OGAWA Akira, "The Merits and Demerits of Clinical Training System," *Trends in the Sciences (Gakujutsu no Doko)*, 12(5), May 2007, pp. 27-33.

residency system will become even harder. Rather than continuing these conflicts of philosophy and principle, all stakeholders need to pool their collective wisdom to find solutions.

2 *Problems faced by universities*

Among the obstacles preventing resolution of the physician-scientist problem are certain issues unique to universities. These issues have been raised from the start. Simply put, the need for medical schools and university hospitals to carry out research in the rapidly developing fields of basic medical science and clinical medicine, while still fulfilling their role of community healthcare as university hospitals against the context of poor staff treatment and a harsh business environment, represents a structural problem for these institutions. In particular, national universities faced the introduction of compulsory residencies at the same time that they were incorporated, resulting in drastic changes in their business environment. For a variety of institutional and policy reasons, the current financial situation of national university corporations can by no means be called satisfactory.

Within this situation, university hospitals must not only perform their original role as sites of clinical education, but must also serve a core role in community healthcare, and furthermore carry out advanced healthcare and clinical research. Securing a financial foundation for the university hospitals charged with fulfilling these diverse roles is a serious challenge, and ever since national universities were incorporated, their affiliated hospitals have faced difficulties related to financial operation and human resources management. The national university corporation system and government fiscal policies bear no small responsibility for these problems. This is a major obstacle standing in the way of fundamentally resolving the physician-scientist problem. Despite the significance of this problem, however, it falls beyond the scope of the present paper.

Conclusion

More than ten years have passed since the physician-scientist problem gained attention as a result of the introduction of the compulsory residency system. Today's medical school students and residents know only the current residency system. They likely also view the dearth of MDs advancing to graduate studies in the basic medical sciences as ordinary. Even if they hear about how things were in the past, they have no direct knowledge, and the majority no longer view career paths that once existed as realistic choices. Despite all the arguments that the root of the physician-scientist problem lies in the introduction of compulsory residencies, none of this is reaching present students.

From a long-term perspective, just as the increasingly scientific nature of healthcare

has created the need for physician-scientists in the life sciences, the increasing sophistication of the clinical environment is making necessary a different type of clinician. The growing need for clinical genetics specialists resulting from the development of genomic medicine is a typical example. In the past, specialists focused on specific areas of medicine, but today clinical genetics specialists are expected to apply their specialized knowledge of medical genetics to all areas of medicine through diagnosis, treatment, and genetic counseling. Because research in this field is advancing rapidly, it is difficult to clearly distinguish between research and clinical work. In this type of medical field, the traditional distinctions between physician-scientists and clinicians or specialists will soon become meaningless. While the distinctions between areas of medicine will not likely lose their meaning at sites of healthcare delivery, the question of how to position science-based specializations that cross the borders of various areas of medicine will certainly be an issue moving forward.

Today, as we move through this period of major changes in medical research and human resource training, it is vital to engage in constructive debate. With regard to both physician-scientist training and the residency system, we must not be tied down by the past, but rather take a broad, long-term perspective as we design new and better systems.

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ISBN:978-4-87582-828-0