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The Rehabilitation Medicine Scientist Training Program:

Impact and Lessons Learned

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Abstract

Physician scientists are seen as important in healthcare research. However, the number of physician scientists and their success in obtaining NIH funding have been declining for many years. The shortage of physician scientists in Physical Medicine and Rehabilitation is particularly severe, and can be attributed to many of the same factors that affect physician scientists in general, as well as to the lack of well developed models for research training.

In 1995, the Rehabilitation Medicine Scientist Training Program (RMSTP) was funded by a K12 grant from the National Center of Medical Rehabilitation Research (NCMRR), as one strategy for increasing the number of research-productive physiatrists. The RMSTP's structure was revised in 2001 to improve the level of preparation of incoming trainees, and to provide a stronger central mentorship support network. Here we describe the original and revised structure of the RMSTP and review subjective and objective data on the productivity of the trainees who have completed the program. These data suggest that RMSTP trainees are, in general, successful in obtaining and maintaining academic faculty positions and that the productivity of the cohort trained after the revision, in particular, shows impressive growth after about 3 years of training.

Keywords

Rehabilitation; Research; Education; Funding; NIH; NCMRR

INTRODUCTION

The Problem

There is a shortage of physician scientists in the United States, and the total number has declined in recent decades, as indicated by the proportion of NIH grantees who were physicians, and the proportion of physicians who engage in research as their major professional activity.^[1-3] Physicians who have only an MD degree face additional challenges

in obtaining NIH funding, with first time NIH R01 applications from MDs consistently having less success than either applications submitted by an individual with a PhD or both an MD and a PhD.^[4] While important research is conducted by PhD investigators, it has been argued that physician scientists play a key role in the transfer of basic science knowledge into clinical research, and that, without them, the pace of translational research is likely to slow.^[5]

These continuing challenges have been attributed to a number of causes, including the rise of more molecular and cellular research, in which PhD scientists typically have more training, and the parallel decline in clinical research, for which physician scientists are better suited;^[1] a reduction in NIH supported post-doctoral research training of physicians;^[6] the perceived lack of research funding once trained; and increased clinical demands and debt pressures.^[7, 8]

While all of the forces affecting academic medicine generally also affect Physical Medicine and Rehabilitation (PM&R), they are particularly severe in this field. Numerous surveys of academic physiatrists demonstrate that the proportion spending greater than 50% effort in research pursuits is extremely small, ranging from 0% to 2% as of 1988, with the proportion spending more than 15% effort in research only about 5%.^[9, 10] A 1987 survey by the NIH revealed that PM&R had the second lowest percent of faculty of any clinical specialty serving as principal investigators on NIH or Alcohol Drug Abuse and Mental Health Administration (ADAMHA) grants.^[11] Even among a self-selected sample of fellows and junior faculty attending a research enrichment program in 2003, 69% reported having no time in research and 64%, no “protected time.”^[12]

With respect to departmental research funding, in 2002, Physical Medicine & Rehabilitation received \$15.4 million in NIH funding, significantly below that of specialties of comparable size,^[13] such as Pathology (\$498.2 million), Preventive Medicine (\$252.4 million), Ophthalmology (\$166.9 million), Otolaryngology (\$70.4 million), Dermatology (\$52.6 million), and Urology (45.4 million).^[14]

In 2004, four national PM&R organizations collaborated to hold a Research Summit to address the rehabilitation-specific barriers to research productivity, many of which apply to physician researchers in PM&R.^[15] Barriers cited to building greater research capacity included: (1) too few programs that provided intensive training in medical rehabilitation research; (2) lack of training funds from both government and private institutions; (3) scarcity of program models; and (4) inappropriate mentoring and standardized training curricula to prepare physiatrists to compete as researchers.

Indeed, rigorous research training is lacking for many of the brightest individuals specializing in PM&R. Until recently very few physiatrists had graduate training in a scientific discipline or research-oriented post-doctoral training, and there has been little support within the field for research fellowship training as a regular expectation of subspecialization. Even many department chairs lack substantial research experience which may limit their ability to effectively mentor residents and junior faculty toward competitive research careers.^[16] As the economic state of academic health centers has deteriorated, the

ability to support research from “excess” clinical revenues has become progressively more challenging.^[17] This means that chairs find it increasingly difficult to develop young faculty, and faculty members are increasingly dependent on extramural support if they wish to engage in research.

As mentioned, funding for rehabilitation research and rehabilitation research training has been another limiting factor. Until the last decade, federal research funding agencies had relatively little organized interest in rehabilitation research. Certainly they supported research that might be identified as relevant to rehabilitation, but the bulk of such research was directed at preventing or eradicating diseases that lead to disability, rather than attacking the issue of disability itself. Moreover, much federal emphasis was placed on a biomedical model, largely leaving out the environmental and psychosocial factors that are relevant to the enablement/disablement process.^[18]

In 1990, the NIH held a conference including leaders in many branches of rehabilitation, which resulted in the Report of the Task Force on Medical Rehabilitation Research.^[19] This report examined the scientific foundations of rehabilitation and ultimately concluded that a programmatic focus for rehabilitation research was needed within the NIH. This focus, established within the National Institute on Child Health and Human Development (NICHD) was the newly created National Center for Medical Rehabilitation Research (NCMRR), and it espoused a broader scientific framework than most other NIH institutes – the biopsychosocial model embodied in the International Classification of Functioning, Disability, and Health (ICF).^[20] This model suggests that many physiatric researchers need training not only related to certain body structure and function-level variables (i.e., impairment), but need also to be knowledgeable about related activity and participation variables that are impacted by them. Thus, mentorship models for physiatrists are often different and more multifaceted than models for other physician scientists.

The Rehabilitation Medicine Scientist Training Program (RMSTP) was launched in 1995 with the goal of building research capacity in academic departments of PM&R, and was designed with many of the above issues in mind. The RMSTP is a research career development program for physicians in PM&R who wish to have a particular type of research career – specifically, a career in research and academic medicine that allows them to direct their own ongoing research programs supported by extramural funding including funding from the NIH. While many kinds of research careers are possible, this particular form of research career is the most highly valued in academic medicine, and provides the opportunity for the most ambitious forms of research. It is generally agreed that it is difficult to sustain this type of competitive research career while spending less than 50 – 75% time in research, and that success of this type typically requires a long-term “apprenticeship” with a mentor (or team of mentors) who not only has advanced scientific skills, but also who is successful in this same type of career mold.

The goal of this article is to describe the RMSTP's philosophy and programmatic evolution, and to examine the productivity of its graduates in this type of career as a way of assessing its impact.

HISTORY OF THE REHABILITATION MEDICINE SCIENTIST TRAINING PROGRAM

In 1993, the shortage of psychiatric researchers was the focus of discussion and advocacy between the leadership of the Association of Academic Psychiatrists (AAP) and Dr. Duane Alexander, Director of the National Institute of Child Health and Human Development (NICHD), the NIH institute that housed the then new National Center for Medical Rehabilitation Research (NCMRR). These discussions continued through 1994, and resulted in NCMRR agreeing to issue a letter of invitation for a psychiatric research training program, supported by a K12 grant.^a There was a precedent for K12 grants of this kind in several other medical specialties (e.g., pediatrics, women's health, and male reproductive biology) which were experiencing similar shortages of physician scientists. The common denominators of these K12 grants were: 1) leadership of the program by an experienced physician scientist in collaboration with an academic professional society; and 2) delegated authority to the principal investigator of the grant to recruit, select, and oversee training of fellows rather than to have young physicians apply directly to the NIH for individual career development grants.

Dr. James Lieberman, then chair of the PM&R department at Columbia University, and the AAP responded to the invitation, and this application, after one revision, was funded by NCMRR for an initial 5-year cycle in 1995. During the first RMSTP funding cycle, a total of 9 fellows were selected and began their research training. Although some of the trainees supported by the initial RMSTP grant were highly productive, as the grant neared its end, the NIH program officers expressed concerns about the overall level of productivity of the fellows, and pressed the AAP to more clearly define the “value added” by having a centralized K12-funded program. This, in turn, led to a series of discussions between research leaders in the AAP and program officers at NCMRR/NICHD, which ultimately resulted in an altered letter of invitation issued in 2000. Because of the delays caused by these negotiations, there was a hiatus in the program between June 30, 2000 and September 1, 2001, although the NCMRR agreed to provide continued funding to trainees already in the program until they finished.

A new application was submitted in October, 2000, with Dr. John Whyte as Principal Investigator. The application responded to the challenges encountered during the first grant cycle, and to the “value added” question, with a series of significant program design changes, summarized in Table 1. The most significant change was the decision to recruit potential applicants up to 2 years before they would apply for funding (pre applicant phase) and to engage them in an intensive “grooming” process that would help them to sharpen their research interests, design an optimal career development plan, identify a mentor, and develop a detailed research plan prior to submitting their application for funding. This, along with lengthening the funding period, was intended to enhance their productivity during training so that they could obtain additional funding prior to completing their training and, hence, increase their chances of maintaining substantial protected research

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^aA variety of individual and institutional mentored career development grants, provided by many NIH institutes, are identified with the letter “K,” in contrast, for example to research grants, designated by “R.”

time after completing the program. Additional changes included allowing greater flexibility in the scientific domains of potential training, in line with the biopsychosocial model, increasing the training stipend and allowing supplemental clinical activity to reduce the economic disincentives, and more aggressively engaging members of the RMSTP Advisory Board and PM&R Chairs and Residency Program Directors in the program.

The K12 grant application was re-funded in September of 2001, with placement of the first new set of trainees planned for July, 2002. The Principal Investigator began the grooming process for residents at the AAP meeting in February of 2001, accepted applications from potential trainees in September of 2001, and started supporting them in July of 2002. Based on feedback from workshop participants, funded trainees, department chairs, and NIH program officials, the revised RMSTP was generally viewed as highly successful. As a result, a renewal application was submitted, in response to another letter of invitation, with only minor design changes and the program was refunded for a third cycle in September, 2006, without interruption. In the third cycle, the number of training slots was increased from 6 to 8, and at least one slot was to be earmarked for a pediatric physiatrist, which had been identified as an additional priority in terms of the field's research capacity. During the second funding cycle, Dr. Michael Boninger was invited to assume the role of Associate Program Director, and took on an increasingly prominent role not only in providing content at the annual research mentorship workshop, but also in periodic conference calls held with trainees between annual meetings (see below).

In the following text we describe the current program structure in more detail, and we examine data on trainee productivity both in general, and comparing the initial and subsequent program designs, in order to supplement subjective assessments of program outcomes.

CURRENT PROGRAM DESIGN

The current RMSTP involves 3 phases: Pre-application phase (grooming to prepare a competitive funding application), Phase I (the period of NIH-funded mentored research training) and Phase II (the beginning of independent research with continued contact with the program), each of which is described below. Ideally, potential applicants for funding are identified nearly 2 years before they must submit their funding application, to maximize their planning time during the pre-application phase. Because individuals may enter funded training anytime between completion of their residency, and 5 years after completing their final clinical training (whether residency or clinical fellowship), the stage at which they enter the pre-application pathway varies. For those who wish to begin training immediately after residency, entering the pre-application pathway in the PGY2 year is encouraged, but PGY3 applicants are also accepted. Regardless of when an applicant wishes to begin funded training, involvement in the pre-application pathway 1 – 2 years in advance is strongly encouraged, though not required.

Pre-application Phase

Department chairs are asked to nominate residents, fellows, or junior faculty for entry into the pre-application phase of the RMSTP, based on their interest in and potential for a

research career. From the trainee's perspective, entering the pre-application pathway during their residency is ideal, since they can select their first job environment with optimal research mentorship in mind. Those who enter as junior faculty are constrained by the mentorship resources that are available where they are already located and may have to contend with the absence of initial research support and protected time at the beginning of their career. The RMSTP Advisory Board reviews nominations and selects 6 – 8 new individuals who are invited to attend the annual meeting of the AAP, including the mentorship workshop designed specifically for them. The emphasis of the mentorship workshop is on understanding the overall chronology of preparation for a research career, identifying and narrowing an area of scientific interest, locating local mentors who can assist in further refinement of interests, and searching for a primary mentor for the fellowship. Representative topics addressed in the mentorship workshop for pre-applicants are listed in Table 2.

In the process of selecting and guiding recent applicants, several themes have emerged and have been incorporated into the workshop curriculum. These “lessons learned” relate, to one degree or another, to the fact that many PM&R residents, although they may have excellent clinical mentors, have not been exposed to, or socialized in the processes required for a competitive extramurally funded research career. In contrast, PhD students, and physician trainees in more academically competitive specialties are typically immersed in a culture that models the gradual progression from student to research fellow, to junior investigator, to laboratory director. As a result, many applicants initially describe their research interests in terms of a patient population (e.g., “I want to study spinal cord injury”). In contrast, the RMSTP seeks to train physician scientists in a domain of science, and those domains do not map cleanly onto specific patient populations. That is, neuroplasticity, bladder physiology, skin metabolism and repair, psychological adaptation to loss, etc., can all be relevant to the population with spinal cord injury, but may also lead to interesting investigations in other populations over time. Thus, a major focus of the pre-applicant phase has been to help individuals define what kind of *scientist* they wish to be, rather than what kind of *physiatric specialist* they wish to be (although applicants do, indeed, need to consider what clinical work will interweave most productively with their research careers).

In addition, some pre-applicants enter the program hoping to find support for conducting clinical trials about a particular treatment of interest. This is understandable considering the tremendous need for a treatment evidence base in PM&R. However, although clinical trials require expertise in trial design, they typically draw upon other scientific domains to deliver promising treatments to be studied, to understand the phenomena being treated, etc. Moreover, clinical trials tend to be problematic in generating the kind of rapid productivity that is needed, realistically, to ensure ongoing extramural support at an early phase (typical clinical trials are largely administrative until their final stages). Therefore, the RMSTP encourages trainees to defer large clinical trials until after their Phase I training but, for individuals intending to conduct clinical research to acquire the tools and preliminary data (e.g., relevant natural history data, “dosing” studies, etc.) that they will need to conduct a long-term program of research that may generate many clinical trials during their careers. Thus, the goal of the training phase is to develop them as scientists, not to help them conduct a particular study.

After the initial workshop, the Principal Investigator of the RMSTP meets quarterly by teleconference between annual AAP meetings with small groups of pre-applicants in order to help them maintain forward movement toward the funding application. Department Chairs and Residency Program Directors are encouraged to provide adequate flexibility and elective time to assist participants to develop their applications, and some of the resident pre-applicants take a month-long elective with their would-be mentor, to maximize progress in their planning.

In the fall of each year, applications for the funded Phase I of the RMSTP are accepted from PGY4 residents and junior faculty hoping to begin training the following summer. The applications are modeled on the individual K (mentored research career development) grant applications required by the NIH, and include two key components: a career development plan in which applicants spell out their intended future career goals and the formal (e.g., courses) and informal (e.g., participation in laboratory meetings, supervision in grant writing, etc.) training elements that will help them achieve those career goals; and a research plan, in which applicants propose a 3-year research agenda that is intertwined with the work taking place in their mentors' laboratories. These applications are reviewed by the RMSTP Advisory Board and the most competitive applications are awarded the available funding slots for the coming year (generally 2 – 3 slots each year). Those not selected for funding are allowed one revision, and/or are encouraged to revise their applications as individual K award submissions to the NIH.

RMSTP Phase I

Phase I of the RMSTP program is typically 3 years in duration, contingent on satisfactory progress, and is the only phase of the program that is primarily funded by the NIH. NIH support includes up to \$75,000 salary support for 75% research time, fringe benefits, up to \$10,000 for research supplies, and funding to travel to the annual AAP meeting. Continued attendance at the mentorship training workshop provides additional centralized mentorship to maximize productivity in terms of publications and grant applications during training. Key workshop topics addressed to individuals in training (Phase I and II) are shown in Table 2.

In addition, the Associate Program Director meets approximately quarterly by teleconference with Phase I trainees, to offer guidance during the year. Concrete targets are set and reviewed with respect to timing of data collection and of manuscript and grant submissions during Phase I. (See Table 3) Trainees are also provided with opportunities to talk about difficulties encountered in their research and clinical activities or other job related concerns. By the second and third years of Phase I, all trainees are expected to submit abstracts of research to present at the annual AAP meeting either in a special session reserved for RMSTP papers, or as freestanding paper award recipients. The overall emphasis during Phase I is ensuring productivity in terms of data collection, publications, and grant applications, in recognition of the fact that the best way to ensure continued protected research time after Phase I funding ends is to have additional funding either in place or on the horizon so that the trainee's chair will be highly motivated to continue the "investment."

RMSTP Phase II

Phase II lasts for an additional 2 years, in which participants no longer receive salary or research support from the RMSTP, but continue to receive travel funds to attend the annual mentorship workshop and AAP meeting, and participate in an annual teleconference approximately midway between annual AAP meetings. In these years, the emphasis is on development of an increasingly independent research program with extramural support, requiring continued emphasis on grant-writing, negotiations for internal departmental support, and structuring clinical work to maximize research productivity. Phase II trainees increasingly serve as training mentors for the more junior attendees at the mentorship workshop. Five years after initial funding, the RMSTP is formally over for trainees, although they continue to be invited to attend an annual teleconference, and are encouraged to remain active in the program as faculty, as well as to become integrated into the AAP in various capacities.

In addition to their work with the RMSTP applicants and trainees, the directors of the program also provide consultation to department chairs about approaches to recruiting and nurturing young investigators, make information about academic positions available to the RMSTP trainees, and conduct regular “marketing” of the program to department chairs and residency program directors (as well as directly to residents and junior faculty) to encourage ongoing support for the program, and active nomination of potential trainees.

OVERALL OUTCOMES OF THE RMSTP

Data reported on the career progress of RMSTP participants were gathered through May, 2008. Since the program's inception, 22 individuals have been selected for funded training. No trainee has been involuntarily terminated from the program, but one trainee resigned after about 16 months of training. Of the 21 individuals who have remained in training, 4 are currently in Phase I, 5 are in Phase II, and 12 have completed Phase II.

Those trainees who complete Phase I (i.e., those who are in the unfunded Phase II, or have completed it) can be viewed as having begun their independent research careers. Of the 17 trainees who have arrived at this point, 100% hold academic titles (15 in departments of PM&R and 2 in related divisions). Ninety-five percent (95%) have received at least one extramural research or training grant as Principal Investigator, and 100% have published original data in the peer-reviewed literature. Within 5 years of starting the program, these 17 trainees were awarded 9 NIH grants totaling more than \$3.8 million, 2 VA grants of more than \$600,000, 7 institutional grants of more than \$300,000 and 30 other grants totalling \$1.2 million. Of the individuals who completed Phase II at least 5 years ago, 56% have been promoted to the rank of Associate Professor. In addition, these individuals have received at least 8 national awards such as the Association of Academic Physiatrists Young Academician Award (3), the Licht Award for best paper published in the Archives of Physical Medicine and Rehabilitation (2), the Best Research Paper Award in PM&R Education and Research (2) and the Athena Outstanding Research Award (1).

“VALUE ADDED” BY THE RMSTP

We have argued that the early selection of residents, annual mentorship workshop, quarterly teleconferences, and centralized system of goal setting and review constitute the “value added” that the NIH requested. But what is the evidence for this? Below, we discuss two sources of evidence: qualitative and quantitative evaluations from the participants in the program; and objective measures of the academic productivity of program participants.

Program Evaluation

At the completion of each annual mentorship workshop, pre-applicants and funded trainees complete an evaluation of the workshop using numerical ratings ranging from 1 (worst) to 5 (best), and are also invited to provide feedback and suggestions for program improvement verbally and as well as anonymously in their written evaluations. These comments did not address their individual primary mentors, but rather the overall structure and training experience provided by the RMSTP. The evaluations were turned in to the Program Coordinator who tabulated them and abstracted prose comments for review by the Program Directors. The overall numerical ratings for the workshop evaluations between 2002 and 2008 ranged from 4.21 – 4.60, computed over all participants and all workshop topics. A selection of prose comments is included in Table 4. Admittedly, we have not included all the prose comments, nor have we randomly selected them. We have selected mainly relatively global evaluations (which were overwhelmingly positive) rather than highly specific comments (e.g., about lengths of specific programs, teaching format, speakers, etc.) which included both positive and negative comments. These evaluations pertain only to the second and third funding cycles, since there was no similar program to be evaluated in the initial funding cycle.

Impact of the Program Redesign on Academic Productivity

Assessing the impact of the RMSTP on academic productivity is complicated by the fact that, even under the best of circumstances, achieving research independence is a long and incremental process and many funded trainees are currently still in training or too recently finished with Phase I to realistically have large amounts of funding. A comparison of the recent funding cycles to the initial cycle is further complicated by the fact that the participants in the initial cycle have had the longest interval in which to develop their careers. We have attempted an objective comparison by assessing productivity for all RMSTP trainees with respect to the year post-selection, which necessarily requires censoring the data on more recent trainees at an earlier time point. In order to do this, annual reports submitted by all RMSTP trainees were reviewed. The trainees were divided in those who completed their training during the initial funding cycle, and those who were trained under the subsequent program design. The data extracted included the following for each year post-selection: 1) number of publications (peer reviewed publications, any level of authorship counted); 2) number of grants funded (federal, state, and private sources, as Principal Investigator, excluding pharmaceutical company funding), and 3) dollar amounts of grant funding (the total grant dollars were counted in the year the grant was awarded). Comparative data are displayed in Figure 1. The productivity data reflect the careers of 9

individuals from the first cycle, and 13 from the second cycle, although the sample size for the second cohort drops to 10 in the 4th year and 8 in the 5th year due to censoring.

As can be seen in Figure 1, and in more detail in Table 5, the two cohorts show similar levels of productivity during the first 2 years after the onset of training. However, beginning in the 3rd year and becoming more pronounced over time, the trainees in the second cohort demonstrate superior productivity. This is particularly true for the number of grants, in which the newer cohort shows a steady increase in the number of grants over time, whereas the earlier group shows a slight decline and plateau with a low rate of grant activity. With respect to the size of grants received, the difference between the 2 groups appears later, particularly at 5 years, and, as shown in Table 5, is particularly pronounced at that point with respect to NIH funding and “other” funding sources. Although longer follow up would clarify whether this difference continues over time, that possibility is quite plausible. In general, the ability to obtain large grants that employ many other staff members, is dependent on demonstrated success in previous projects of the same nature. Thus, expansion of grant funding is to be expected when an investigator invests sustained effort into programmatic research.

DISCUSSION

The RMSTP, funded by the National Center for Medical Rehabilitation Research (NCMRR) is making significant progress in addressing the shortage of physician researchers in the field of PM&R by providing the funding, structure, and mentorship for a successful research career. Fellows in the initial grant cycle completed a program that did not involve the structured annual mentorship workshop or intensive centralized mentoring system. Even without this structure, the performance of previous trainees is impressive. Many of these former fellows are now in positions in which they can serve as mentors for new trainees in the RMSTP and other research training programs. They continue to be productive in extramural funding and peer-reviewed publications.

The analysis presented has several limitations. First, the data are self-reported and have not been independently assessed for accuracy. Second, RMSTP is a small program that does not lend itself to statistical analysis, because of the different time intervals of the 2 cohorts and the likelihood that a highly productive or unproductive individual in either cohort could therefore skew the results. However, inspection of the data indicates that fellows who trained or are in training under the restructured RMSTP program have demonstrated increased productivity starting in the 3rd year of the fellowship compared to the earlier fellows. This productivity is likely related to the formalized instruction and mentorship provided to these physicians as early as the PGY-2 year of residency, and to the guidance they received in structuring their career development plan and launching their training immediately after funding. It is reasonable to expect that they will continue at a high level of productivity in their future research careers, and be able to serve as sophisticated research mentors to future generations of academic physiatrists.

Based on this initial assessment, the RMSTP appears to be having a substantial impact on the development of highly competitive physiatric researchers. The number of such

individuals to date, however, remains small, suggesting that ongoing support of a program of this type is critical. Ideally one might consider expanding the program to have a more rapid transformative impact on the field. However, experience in recruiting highly competitive candidates suggests that the supply is not substantially greater than the number currently being placed. Thus, expansion of efforts of this kind is dependent on the ability of the field to attract academically oriented medical students, and to more effectively engage residents with research interests and aptitude early in their training.

CONCLUSIONS

The RMSTP, advocated by leaders in the field and supported by the National Center for Medical Rehabilitation Research and the Association of Academic Physiatrists, has been successful in recruiting, training, and mentoring research physicians in the field of PM&R, and has filled all of its available slots with highly qualified physiatrists. The vast majority of fellows that have completed the program are now productive academic faculty who are contributing to the advancement of research in the field. The structured program encourages early productivity in acquiring grant funding and publishing peer-reviewed research papers. Although it is still too early to fully evaluate the impact of the program, we believe that the initial signs are encouraging and that, as these and other similarly trained physician scientists advance to academic leadership positions in the field, they can increasingly convey the impression that this type of academic progression is routine rather than rare in our field. Despite these apparent successes of the RMSTP, the need for a program of this type continues. Even if the current cohort of trainees were uniformly successful, this would amount to less than one such research faculty member for every 4 PM&R departments nationwide. This, coupled with the projected growing need for rehabilitation services by an aging population, demonstrates the need for a program like the RMSTP for many years to come.

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Figure 1 A-C.

Data on the average productivity for RMSTP trainees trained under the original program structure (shown with an "O"), or subsequent to the program redesign are shown (shown with an "X"). In each graph, the X axis refers to the year following RMSTP selection and funding. In Figure 1A, the average number of peer reviewed publications per trainee is shown. In Figure 1B, the average number of grants per trainee is shown. In Figure 1C, the average amount of grant dollars per trainee is shown.

Table 1

Comparison of the First and Subsequent RMSTP Funding Cycles

Program Feature	Initial Cycle	Subsequent Cycles
Initial contact with potential trainees	Near time of funding application	Up to 2 years prior to funding application
Pre-application "grooming" process	None	Pre-application pathway, lasting 7 – 19 months
Programmatic curriculum provided through the AAP	None	Annual mentorship workshop at AAP meeting, quarterly conference calls with program directors
Training focus	Basic science	Scientific domains appropriate to the chosen career path
Funding application content	Career development and research proposal "as specific as possible"	K-style proposal developed in collaboration with proposed mentor, specifying career development activities and research plan in detail
Default duration of NIH-funded training	2 years	3 years
Stipend level	\$50,000/year for full-time research involvement	\$75,000/year for 75% research involvement
Research expectation after training	Departmental commitment to support 75% research time	Goal of at least 50% research time, but not firm departmental commitment required
Role of Advisory Board	Review applications for funding	Review requests to participate in pre-application pathway, applications for funded training, teach and facilitate at annual mentorship workshop
Interaction with department chairs and residency program directors	Minimal	Annual mailing to both groups; involvement of Chair of AAP Council of Chairs on RMSTP Advisory Board; periodic AAP Newsletter articles about RMSTP

Table 2**Workshop Topics****Topics Addressed to Pre-Applicants**

Why Choose a Research Career?

Types and Models of Research Careers

Preparing the Phase 1 RMSTP Application

Finding a Mentor

Implications of Rehabilitation Models (e.g. International Classification of Functioning, Disability, and Health - ICF) for the Design of Research

Developing an Individualized Work Plan (facilitated small groups in which pre-applicants identify where they are, what they need to do to apply, and lay out a plan for accomplishing the necessary steps)

Themes from Individualized Work Plans (group discussion of each pre-applicant's work plan with feedback from all)

Topics Addressed to Trainees

Research and Publication Ethics

Job Hunting and Negotiating

Getting the Most out of People You Work With

Issues in Team/Translational Science

Planning to Maximize Progress and Productivity (facilitated small groups to discuss obstacles to productivity, generate solutions, and make action plans)

Themes from Productivity Discussion (group discussion of common productivity themes among trainees)

Topics Addressed to Both Groups

Scientific Autobiography (successful junior and senior scientists discuss their personal career trajectories)

Pathways to Success: Ways to get from Residency to Tenure

Balancing Work and Family Life

Personal and Scientific Obstacles To Productivity and Potential Solutions (20 minute panel, then 40 minute discussion)

Getting Ready for Promotion and Tenure (panel of PM&R chairs)

Grant Writing Strategies

Research Budgets

Table 3**Productivity Guidelines During Phase I****First Year**

Submit Institutional Review Board (IRB), Institutional Animal Care and Use Committee (IACUC) paperwork as need

Data collection begun within 6 months

Submit one first author and one subsequent author manuscript (If needed ask mentor for data to write up)

Small internal, foundation, or NIH (e.g., R03) research grant by end of year

Second Year

Continue data collection

Consider pilot data collection for next grant

Submit one or two first author and one or two subsequent author manuscripts

Apply for additional mentored career development (e.g., NIH K-series) award funding or large NIH research (e.g., R01) grant by end of year
(This decision is based on pilot data and productivity)

Third Year

Continue data collection

Consider pilot data collection for next grant

Submit one or two first author and one or two subsequent author manuscripts

Resubmit K award or R01

Table 4**Workshop Evaluation Comments**

This program has set my goals for the next ten years. I finally can go back to my program and know what I need to do to be a successful researcher.

The RMSTP program is such a valuable opportunity for guidance in a range of training we need to succeed with research. It really provides a huge jumpstart & introduces us to the culture of research as well as providing us with the questions & answers to take back to own institution. Thank you

My life has changed so much, I am so much happier because I can do something I really like (made possible by RMSTP).

Each time I learn new things. Specific guidance is particularly useful

The mentorship / advice is invaluable. Thanks

Good time to analyze thoughts with constructive criticism, learned great deal on financial aspects of research.

Very productive. Deadlines & concrete suggestions at each conference call are especially useful.

I can't imagine having started this career path without RMSTP.

Very useful as a PGY2 to start thinking about our research questions, options for mentor, definition of K12. Helpful to talk to others who have been through the RMSTP already

Excellent program, especially the one on one research planning.

Invaluable

Attending this program gave me hope because it showed me that there are people in PM&R who are very research oriented and who are willing to mentor and help residents such as myself actually get well situated. Even though I am at an "elite" PM&R program, there is little mentoring by the attendings toward serious research careers.

Thanks for investing in our careers.

Table 5

Grants and Dollars Received

	Phase I: NIH supported training						Phase II: Independent faculty					
	Year 1		Year 2		Year 3		Year 4		Year 5			
	Original	Revised	Original	Revised	Original	Revised	Original	Revised	Original	Revised	Original	Revised
Trainees	9	13	9	13	9	13	9	10	9	8		
NIH Grants ¹	1	0	1	0	0	0	1	2	0	4		
NIH \$	\$10,120	\$0	\$40,000	\$0	\$0	\$0	\$496,901	\$270,000	\$0	\$3,053,393		
NIDRR Grants	0	0	0	0	0	0	0	0	0	0		
NIDRR \$	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0		
VA Grants	0	0	0	0	0	1	0	0	1	0		
VA \$	\$0	\$0	\$0	\$0	\$0	\$10,000	\$0	\$0	\$653,336	\$0		
Institutional Grants	0	0	0	2	0	2	0	1	0	2		
Institutional \$	\$0	\$0	\$35,000	\$0	\$40,000	\$0	\$175,000	\$0	\$0	\$85,000		
Other Grants ²	2	2	2	2	2	4	1	7	1	9		
Other \$	\$12,000	\$64,848	\$55,000	\$20,000	\$30,510	\$303,386	\$206,182	\$306,170	\$60,000	\$677,528		
Total Grants	3	2	3	4	2	7	2	10	2	15		
Total \$	\$22,120	\$64,848	\$95,000	\$55,000	\$30,510	\$353,386	\$703,083	\$751,170	\$713,336	\$3,815,921		

¹ R01, R29, K08, and P60 grants² Grants from endowments, foundations, and medical societies