Reflections on the Current and Future Roles of Clinician-Scientists

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ABSTRACT: "Clinician-scientists" is an all-inclusive term for board-certified specialists who engage in patient care and laboratory-based (biomedical) research, patient-based (clinical) research, or population-based (epidemiological) research. In recent years, the number of medical graduates who choose to combine patient care and research has declined, generating concerns about the future of medical research. This paper reviews: a) the various current categories of clinician-scientists, b) the reasons proposed for the declining number of medical graduates who opt for a career as clinician-scientists, c) the various interventions aimed at reversing this trend, and d) the projections for the future role of clinician-scientists. Efforts to encourage students to combine patient care and research include providing financial and institutional support, and reducing the duration of the training of clinician-scientists. However, recent advances in clinical and biomedical knowledge have increased the difficulties in maintaining the dual role of care-providers and scientists. It was therefore suggested that rather than expecting clinician-scientists to compete with full-time clinicians in providing patient care, and with full-time investigators in performing research, clinician-scientists will increasingly assume the role of leading/coordinating interdisciplinary teams. Such teams would focus either on patient-based research or on the clinical, biomedical and epidemiological aspects of specific clinical disorders, such as hypertension and diabetes.

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The mission of medical education is to meet societal needs, first for practicing doctors, and second for other specialties such as research, administration, preventive medicine, public health and diagnostic laboratory medicine. In addition, there is general agreement that medical training should encourage graduates who wish to assume the dual role of clinician and scientist. However, in recent years the number of medical graduates, both in Israel [1,2] and abroad [3-6], who opt for a career combining patient care and scientific inquiry has been in decline, generating concerns for the future of medical research. Recent surveys have indicated that American residents rated research activity less highly in choosing role models [7], and that although most Israeli residents supported the required 6 month involvement in research, as many as 30% of them supported either eliminating it or proposing it as an elective [8].

In this paper, we review the current types of clinician-scientists and the difficulties that prevent them from fulfilling their role in patient care and research. We describe the reasons cited for the declining number of medical graduates who opt for a career of clinician-scientists, the interventions aimed at reversing this trend, and the projections for the future role of clinician-scientists.

CURRENT TYPES OF CLINICIAN-SCIENTISTS

There are three categories of clinician-scientists. The first refers to those who engage in biomedical (laboratory-based) research – mainly in the basic sciences such as biochemistry and cell biology, as well as T1 translational research, which is defined as "the transfer of new understandings of disease mechanisms gained in the laboratory into the development of new methods for diagnosis, therapy, and prevention" [9]. For example, T1 translational research devises therapies for animal models of induced or spontaneously occurring diseases. Biomedical research requires training in the methods of inquiry into one or more biomedical disciplines and access to laboratories with cutting-edge technology. The second category of clinician-scientists engages in patient-based (clinical) research. One type of clinical research is T2 translational research, which refers to the application of results from bench studies into practice by conducting trials on the efficacy and side effects of treatment interventions [9]. The third category of clinician-scientists engages in population-based (epidemiological) research, such as attempting to identify risk indicators of diseases. All types of patient or population-based studies require proficiency in inferential statistics and in the ethics of human research.

In Israel, research in the medical sciences is carried out mostly in universities and academic hospitals [10,11], and Israeli clinician-scientists have contributed extensively to

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clinically relevant knowledge in all three categories of clinical research [12]. Examples include the development of treatment for an experimental animal model and for patients with multiple sclerosis [13], identification of the gene mutation in familial Mediterranean fever [14], description of the manifestations of rhabdomyolysis [15], and well as studies on lipid metabolism [16], coagulation disorders [17] and risk indicators for ischemic heart disease [18].

POSSIBLE REASONS FOR THE DECLINING NUMBERS OF CLINICIAN-SCIENTISTS

The decline in the numbers of physicians who combine patient care and research occurs mostly among clinician-biomedical scientists. This decline has been blamed for the delay in translation of laboratory breakthroughs into new clinical applications [6]. In contrast, the amount of patient-based research has actually increased over the last decades, as evidenced by the increase in numbers of trials that evaluate therapeutic leads discovered at the bench [19]. Still, this increase does not appear to meet all needs. T2 translational research, which has involved as many as 60% of U.S. children with cancer, has been credited for the fourfold increase in their survival rates over recent decades. It has been suggested that this achievement may be reduplicated in other diseases by increasing the number of clinicians-epidemiologists, clinical trials, and patients involved in them [20].

Israeli clinician-scientists have contributed extensively to clinically relevant knowledge in biomedical (laboratory-based), patient-based (clinical) and population-based (epidemiological) research

The declining numbers of medical graduates who choose careers as clinician-biomedical scientists and the growing need for clinician-scientists who engage in patient-based research have raised concern, prompting efforts to identify the reasons for this trend [6,21]. One cause is the economic constraints of the health environment. Unlike the period before 1965, today only a few teaching hospitals can afford research sections in their clinical departments [22], and financial pressures have eliminated the research experience from many residency programs. Constraints in salaries and support were identified as an obstacle to clinical research in Canada [23].

In recent years, the number of medical graduates who choose to combine patient care and research has been in decline, as the increasing bodies of knowledge in clinical practice and research have enhanced the difficulties in maintaining the dual role of a clinician-scientist

In Israel, as early as 1975, it was claimed that, although research appears to be an important area of doctors' interest, "...their progress is hampered by a poor climate for adequate funding" [24]. Indeed, between 1994 and 1997, the number of funding sources per investigator decreased from 2.6 to 2.2 [10]. In 1995, the government investment in medical research per Israeli citizen was $0.4 only, vs. $25 in The Netherlands and $74 in Denmark [11], and there were calls for a change in Israeli policy in medical research "from neglect to development" [25].

A second cause of the decline in the numbers of clinician-biomedical scientists is the changes that have occurred in undergraduate medical education. Because of the advances in biomedical knowledge, medical faculties can no longer provide students with a comprehensive introduction into the entire array of biomedical scientific disciplines, which formed the basis of the medical curriculum until the mid-1960s. In addition, adoption of the bio-psychosocial model of medical care has resulted in the biomedical sciences having to compete with the behavioral sciences for curricular time. Finally, the transition from deductive to evidence-based reasoning has led some faculty to even question the value of teaching the basic sciences [26]. All these reasons have limited students' proficiency in the biomedical sciences and in their preparation for a career as clinician-biomedical scientists.

A third cause for the declining numbers of clinician-biomedical scientists is the duration of training. A recent review of 24 North American MD-PhD programs found that, on average, they required 8 years to complete [27]. Adding 4 years of pre-med education and 4 to 6 years residency, the training of a clinician-scientist would total 15–18 years, thereby increasing the economic burden on young physicians. Indeed, long research training was one of the main barriers to career entry that were perceived by Canadian clinician-scientists [28].

Other problems that may be unique to clinician-scientists in specific countries have also been documented. For example, it has been claimed that physicians in Israel have shifted their priorities from involvement in academic activities to those involving personal and economic interests [1]. In some academic centers, promotion committees often value participation in epidemiological research less than involvement in biomedical research [20]. Other authors have raised ethical concerns, questioning whether the dual roles of clinicians and scientists are compatible [29].

All of these proposed reasons are certainly valid and worth addressing. However, since 2000, a number of authors have suggested an additional reason for the decline in the numbers of physicians reporting research as their primary career, namely, the difficulties in maintaining the dual role of clinicians and scientists.

CLINICIAN-SCIENTISTS: DIFFICULTIES MAINTAINING THE DUAL ROLE

We can all identify colleagues who excel in both patient care and research. Yet, as early as 2000, Sackett [19] argued that "the proportion of clinicians who identified themselves as [biomedical scientists]..., began to decline as the knowledge and skills they needed for success at the bench moved ever further

from those they needed for competency and safety at the bedside; ... Increasingly they have been replaced by PhD full-time researchers; and... their previous attractiveness as role models for medical students declined in parallel with their diminishing clinical skills, and many became more comfortable at the blackboard than at the bedside."

In a similar vein, Marks [30] argued in 2007 that "historically, [clinician]-scientists ... conducted teaching rounds in the hospital, and... were often avidly pursued as the most important sources of new knowledge... Now physician-scientists are rarely seen in the hospital; they are most often spotted at their desks tapping out yet another grant application. Most struggle to find the time to mentor students and clinical trainees, let alone to care for patients." Most participants in the 2009 survey of Canadian clinician-scientists that we quoted earlier, "found it difficult to balance the various obligations of being a staff physician with the pursuit of their research endeavors" [23]. Similarly, in 2010 Schafer [5] stated that "[T]he vast and dramatically changing bodies of knowledge in both [clinical practice and research]... have made it humanly impossible for any individual to attain even a semblance of mastery of much of it." Finally, Wilson-Kovacs and Hauskeller [31] quoted a British clinical-scientist who stated: "You're expected to do two jobs... There's no point trying to compete as a clinician, because you can't ...and there's no point trying to compete as a full-blown academic scientist ... because again you can't... What you have to do is pick the important things from both areas and apply them in the middle in an attempt to bring both areas together."

We suggest that clinician-scientists will increasingly assume a role in interdisciplinary teams that focus either on patient-based research or on the clinical, biomedical and epidemiological aspects of specific clinical disorders

REVERSING THE DECLINING NUMBERS OF CLINICIAN-SCIENTISTS

Attempts to reverse the declining interest in a career combining patient care and biomedical research have addressed the problems of economic constraints and training duration [3,30] by funding research [32] and by introducing various streamlined, shorter training programs [33,34] There have also been attempts to reduce the duration of residency training programs with a substantial exposure to clinical research [35,36]. These attempts are certainly important. Yet some authors have emphasized the difficulties in maintaining the dual role of a care-provider and investigator [5,19,30,31] and have proposed new paradigms for the future purpose and function of clinician-scientists [3,30,37].

PROJECTIONS FOR THE FUTURE FUNCTION OF CLINICIAN-SCIENTISTS

Patient care and research compete for the time of clinician-scientists. Therefore, we believe that – as already suggested by Zemlo et al. [3], Marks [30] and Leibovici and Paul [37] – for further advancement of clinical research, the role of the various types of clinician-scientists should be redefined. This redefinition is subject to controversy. On the one hand, it was argued that the complexities of patient care and research have made it impossible for any one individual to attain mastery in both fields [5], and that the dual model of a single individual who is a master of both patient care and biomedical research belongs to the past. Similarly, others have claimed that "[T]he future vigor of medical research will depend on even closer partnerships between physicians and PhD investigators" [5]; that, rather than by ad hoc collaboration, epidemiological and biomedical research will be carried out by multidisciplinary teams of clinicians and basic scientists [6], whereby basic scientists with either MD and/or PhD degrees would perform the biomedical investigation of the clinical problem under consideration, while clinicians would carry out research involving patients. Indeed, during the last decade, interdisciplinary research is a priority of funding agencies [38].

On the other hand, it has been argued that clinicians and scientists differ in language, culture and professional environment in the sense that "scientists ask more questions, while clinicians focus on pragmatic answers" [39]. It has even been claimed that "clinicians are afraid of biology, while biologists are in awe of clinicians" [31]. A survey of clinician-scientists revealed varying views on the value of interdisciplinary health research, including the belief that the current support of such research by funding agencies leads to the creation of artificial teams and limits scientists' freedom [38].

Consequently, we live in an era of uncertainty, with the possibility of several future models of clinician-scientists. Some of them may choose to maintain the traditional dual role of single academics involved in patient care and research – either alone or in ad hoc collaboration with other clinicians and scientists. A second model would consist of patient- or population-based research, whereby clinician-scientists with a combined training in epidemiology and in general surgery/medicine/family practice would coordinate various types of research, including T2 translational studies. Finally, a third model consists of multidisciplinary centers of excellence for research and care of patients with specific diseases, such as hypertension, diabetes, disorders of coagulation or rheumatoid arthritis/autoimmune disorders. In such centers, clinician-scientists would serve in outpatient clinics, provide consultations for treating inpatients, and carry out laboratory- and population-based research on the disease of their expertise. Clinician-scientists would lead, coordinate and participate in research by bridging the chasm between the cultures of clinical practice and medical research.

The unique expertise of clinician-scientists places them at the intersection between medical care and scientific research. Some sociologists consider clinician-scientists to belong to an

emerging new medical discipline that is distinct from other disciplines [40]. Future needs will define the boundaries of this discipline and the training and function of clinician-scientists. We concur with the view that this function will mainly involve participating/coordinating/leading multidisciplinary biomedical and epidemiological research, rather than competing with full-time clinicians in providing patient care and with full-time investigators in performing laboratory-based, patient-based or population-based research.

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"Who owns the patent on this vaccine?" asked journalist Ed Murrow. Replied Jonas Salk (1914-1995), American medical researcher and developer of the polio vaccine, "Well, the people, I would say. There is no patent. Could you patent the sun?"

"Not that I want to be a god or a hero. Just to change into a tree, grow for ages, not hurt anyone"

Czeslaw Milosz (1911-2004), Polish (Lithuanian born) poet, writer, and diplomat. He won the 1980 Nobel Prize for Literature