The Changing Biomedical Research and Health Care Environments: Implications for Basic Science Graduate Education and Research in Pharmacy

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Both the U.S. biomedical research environment and health care system are undergoing simultaneous change. Changes in these broad areas will impact professional education, graduate education, and research in schools of pharmacy. The aim of this paper is to demonstrate the need for re-examination of the mission and value of research and graduate education programs in basic sciences1 in schools of pharmacy. Reviews of recent U.S. biomedical research funding trends and the present status of U.S. graduate education in basic sciences is presented. These reviews are followed by a discussion of the mission and value of research and graduate education programs in basic sciences in schools of pharmacy in light of both the changing biomedical research climate and the changing mission of professional practice in our evolving health care system. The continued necessity and viability of traditional research and graduate education programs in basic sciences in schools of pharmacy is questioned. The discussion reviews contributions of basic science research programs to pharmacy education, pharmacy practice, and the national research enterprise followed by a review of contributions of graduate education programs. Finally, recommendations are presented to guide schools of pharmacy in discussion of future directions for research and graduate education programs in basic science.

INTRODUCTION

This paper raises questions regarding the mission and value of graduate education and research in basic sciences[1] in schools of pharmacy in light of the changing biomedical research and health care environments. Over the past decade, the mission of the pharmacy professional program has been extensively re-examined in response to the changing health care environment. The goal of this article is to similarly re-examine the mission and value of graduate education and research in basic sciences in light of the changing political and economic climate of biomedical research as well as in light of the changing mission of pharmacy practice in our evolving health care system. The points of view, questions, and data presented are intended to promote discussion among all of the many stakeholders in pharmacy education. Although, graduate education and research programs have made significant contributions to the profession of pharmacy, to science, and to society, changes in today's research, education, and health care environments are stimulating the need for evaluation of whether some of these programs have outlived their usefulness. In line with AACP's President Mary Anne Koda-Kimble's request to 'move off the trail,' this article is intended to challenge the status quo in pharmacy education. The data and perspectives presented are provocative and are intended to challenge the reader to envision a new organizational structure and paradigm for pharmaceutical education[2].

BACKGROUND

Current State of Graduate Education and Research in Basic Sciences in the U.S.

There are growing questions facing the graduate education enterprise in the United States. In the 1970s, graduate education in the humanities began to experience a collapsing job market which has continued for almost twenty years(1). The job market in the physical sciences began to deteriorate with the end of the Cold War and the shrinkage of the defense industry(2). More recently, the job market for biomedical scientists is also becoming more constrained. The April 1995 Committee on Science, Engineering, and Public Policy (COSEPUP) report entitled "Reshaping the graduate education of scientists and engineers'(3) describes the current climate of graduate education in science and engineering as a time of change. The end of the Cold War, the rapid growth of international competition in technology-based industries, and a variety of constraints on federal research spending have altered the market for PhD-trained scientists. Although the demand for scientists has remained strong (as evidenced by low and stable unemployment rates), the three areas of primary employment for PhD scientists—universities and colleges, industry, and government—are undergoing simultaneous change.

[1]For the purposes of this paper, basic science disciplines in schools of pharmacy are defined as the traditional areas of pharmacology, medicinal chemistry, and pharmaceutics. Toxicology and pharmacognosy are considered sub-areas of pharmacology and medicinal chemistry respectively. The fields of clinical, social, administrative and health services research are not included in this discussion.

[2]My educational background and current position have shaped and continue to shape my views of both professional and graduate education in schools of pharmacy. I received a BS in Pharmacy and a BA in French in 1989 from Purdue University and a PhD in Pharmaceutical Chemistry in 1995 from the University of California, San Francisco (UCSF). I am currently an assistant clinical professor in the Division of Clinical Pharmacy at UCSF and a Pew Health Policy Fellow at UCSF's Center for the Health Professions. In October, 1995, I had the opportunity to sit on AACP's Research and Graduate Affairs Committee (RGAC). Any opinions stated here are solely my own and not the opinions of the RGAC; however, my motivation to embark on this writing stemmed from our discussions.

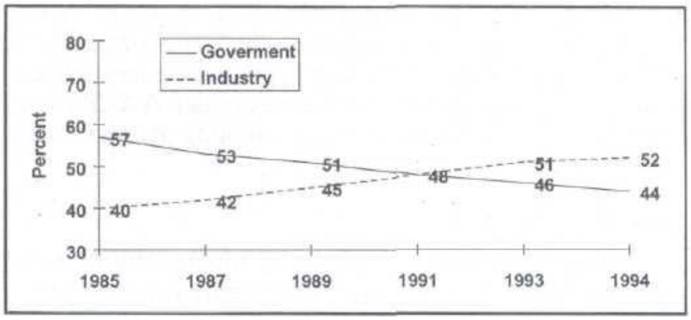

Fig. 1. Percent support for health R&D. Source: NIH Data Book, 1993, DHHS, Washington DC, (September 1993) p. 2.

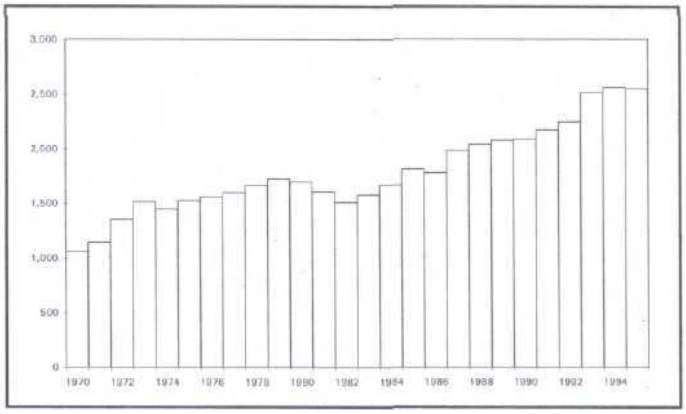

Fig. 2. NIH total appropriations (constant dollars in millions. Source: NIH Extramural Trends, FY 84-93, DHHS, Washington DC, (October 1994).

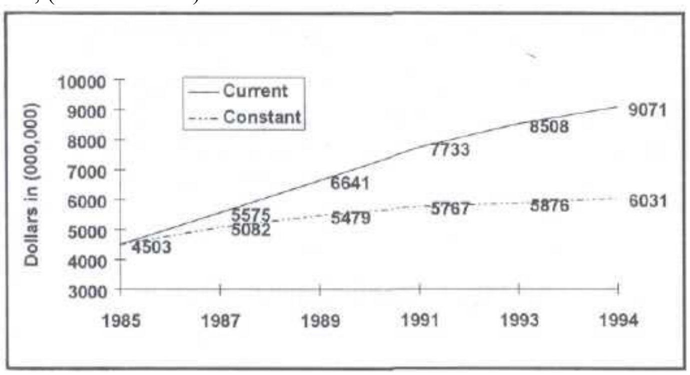

Fig. 3. NIH extramural grants, 1985-94. Source: NIH Extramural Trends, FY843-93. DHHS, Washington DC, (October 1994) p. 37.

Since the beginning of the post-war era, the National Institutes of Health has traditionally been the largest funder of medical research in the world. Only recently has private industry support for biomedical research eclipsed public support (Figure 1). Historically, scientists enjoyed plentiful and annually increasing federal research budgets which supported the creation of independent laboratories with a large complement of graduate students and postdoctoral fellows. But biomedical research now faces fundamental changes in the environment in which it has prospered over the past fifty years.

Growth in biomedical research funding, while it has increased in real dollars, has recently been relatively stagnant in constant dollars, compared to historical patterns. As Figures 2 and 3 indicate, there has been a growing national commitment to research, but the realities of inflation and budget reductions in federally subsidized activities are now impacting biomedical research. Moreover, increased com-

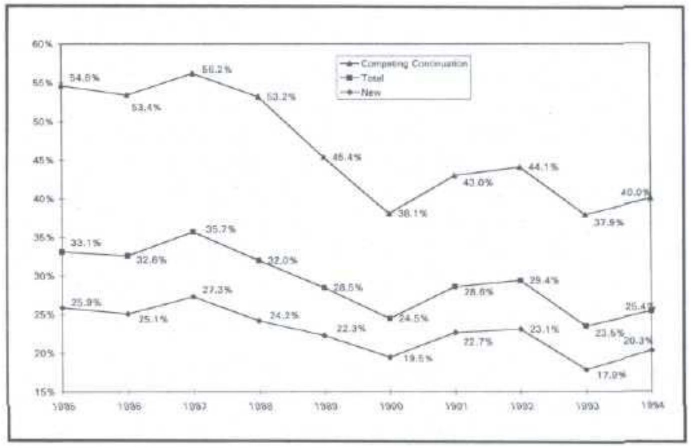

Fig. 4. Success rates for NIH competing research projects by type of application, FY1985-. Source: NIH Extramural Trands, FY 84-93, DHHS, Washington DC, (October 1994) p.12.

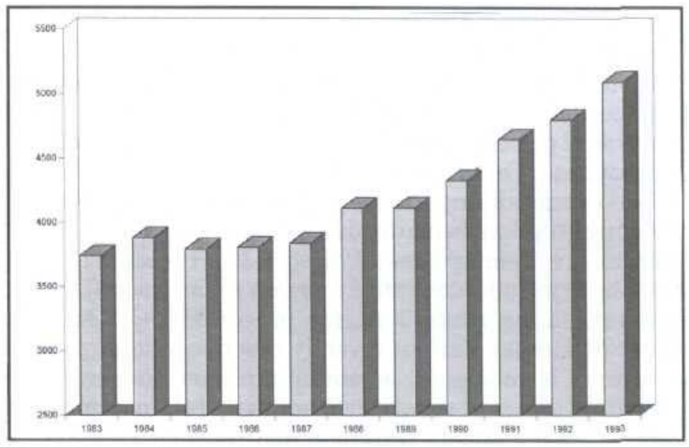

Fig. 5. Doctoral degrees in biological sciences awarded, 1984-1993. Source: Reshaping the Graduate Education of Scientists and engineers. Washington DC, National Academy of Sciences, 1995, Table B-20.

petition for research monies has further complicated the funding landscape, as demonstrated in Figure 4. Not all of the increased competition for research support demonstrated in Figure 4 comes from the failure of federal funding to keep up with demand; a significant contributor to the level of competition is growth in the number of investigators in the sciences reflected in Figure 5.

Two compelling indicators of problems for the science work force, particularly in academia, are the growing postdoc population and the declining grant approval rate. According to the NSF, while the number of graduate students in science and engineering increased by 26.7 percent between 1982 and 1992, the number of postdoctoral fellows at universities went up almost 64 percent during the same period, from 14,672 to 24,024(2). The postdoc increase indicates that thousands of young scientists are spending years in temporary positions waiting, essentially in an expanding holding tank, for permanent job openings. Figure 4 illustrates recent trends in grant approval rates. Of additional concern is the fact that the average age of R29 grant recipients (FIRST awards) has increased significantly. In 1986, 96.6 percent of all R29 grant recipients were under the age of 36; that figure precipitously dropped in 1993 to 28.6 percent(4).

Many recent PhD graduates are frustrated by their inability to find basic-research positions in academia(5-11). This frustration is justified by the statistics that describe current employment realities. There is a persistent long-term trend away from employment in traditional research and teaching positions and toward applied research and development and nonacademic employment. In 1977,51 percent of the 1969-72 science and engineering PhDs were employed in universities compared with less than 43 percent of the 1983-86 PhDs in 1991(3). The proportion of graduates going to industry rose from 26 percent to 35 percent over the same period(3). Today, reports indicate that there are far more seekers of jobs as basic science researchers in academe than there are available positions(2,3)- Fortunately, expansion in applied research and nonresearch employment has absorbed many of the still growing cohort of PhD graduates(2,3). However, there are worrisome indicators of weakness in the market, such as long delays in initial placement of new graduates in postdoctoral appointments or permanent positions, the fact that some graduates are employed or underemployed in positions that do not require doctoral training, and the increasing length of postdoctoral assignments. The August 1995 report entitled "The Production and Utilization of Science and Engineering Doctorates in the United States"(13) analyzes future supply and demand for science and engineering PhD graduates and predicts that as many as 22 percent of new doctorates could fail to find suitable employment. One of the conclusions of this report is that the U.S. is overproducing science and engineering PhDs. Among the current options being discussed in response to the changing market are training fewer PhDs(11-13), broadening PhD training to include alternative research career tracks(2-3,13), and revitalizing master's degree programs[3](2-3). As NIH Director Harold Varmus recently described, "the research enterprise is undergoing a painful transition from an era of growth to an era of steady-state activity"(14). In as much as basic science graduate education and research programs in schools of pharmacy are a microcosm of the larger national research enterprise, the health and status of basic science graduate education and research programs in pharmacy are in need of examination.

Mission of Graduate Education and Research in the Basic Sciences in Schools of Pharmacy

The Commission to Implement Change in Pharmaceutical Education included the following statement in its description of the overall mission of pharmaceutical education: "Pharmaceutical education is responsible to the profession and to society for generating new knowledge about drugs, drug products, drug therapy, and drug use through the conduct of basic and applied research. It promotes the pharmaceutical sciences by fostering graduate education and research within its schools and colleges. Pharmaceutical education is responsible for both professional education and graduate education for research"(15). In 1990, the AACP House of Delegates endorsed this statement when it adopted the Commission's views on the mission of pharmaceutical education.

In a statement related to the value of graduate education and research in schools of pharmacy, the 1988-89 RGAC made the following recommendation. "AACP recognizes and strongly supports the primary function of the colleges and schools of pharmacy as being professional education, and recognizes that graduate education should not compete with, but complement, professional education. However, AACP recognizes that in order to maintain a high level of excellence in professional education, research, graduate education and/or scholarly activity of the faculty is essential. AACP should take an active leadership role in promoting pharmaceutical graduate education and research."

[3]For more information on some of these areas, also see Science's Next Wave World Wide Web site: http://sci.aaas.org/nextwave/.)

DISCUSSION

It seems reasonable to assert that graduate education, research, and/or scholarly activity of faculty is necessary for the maintenance of a high level of excellence in professional education in pharmacy. The essential question seems to be what types of graduate education, research and/or scholarly activity in the pharmaceutical sciences are likely to promote a high level of excellence in professional pharmacy education today and in the future? Several smaller questions are associated with this key question. For example, given that the primary mission of schools of pharmacy is the training of practitioners and given that the nature of pharmacy practice is rapidly evolving, what changes, if any. should be made in research programs in the pharmaceutical sciences? How are the pharmaceutical sciences defined and should their definition be broadened to include greater emphasis on clinical, social, administrative, and health services research disciplines? Given the changes in employment trends for biomedical scientists, should graduate education programs in basic sciences be strengthened or downsized? Should schools of pharmacy change as a whole or should changes be tailor-made based on an individual or school by school basis?

To lessen the complexity of the discussion, research in the basic sciences is discussed separately from graduate education in the sections that follow. Although graduate education cannot exist without research, research can exist without graduate education. The first section addresses the contributions of research to the profession of pharmacy and the national research enterprise. The second section reviews the contributions of graduate education. In addition, a third section of recommendations is included in order to guide schools of pharmacy in discussion of future directions.

Contributions of Basic Science Research Programs

What are the contributions of research programs in basic sciences to professional education? How significant are these contributions? Are the contributions essential and unique or are there other means of achieving them? There are primarily two ways in which basic science research departments are seen to contribute to the mission of the pharmacy profession. The first is that the faculty in these departments provide instruction in basic science coursework to the professional students. The second is that the graduate education and research enterprises in basic sciences create directions and opportunities for the professional enterprise. In addition to contributions to the profession, basic science research programs make contributions to the overall national research enterprise.

Teaching. Historically, faculty in basic science departments in schools of pharmacy have been responsible for teaching a portion of the course requirements in basic sciences to professional students. This organizational structure was established during the post-World War II era of academic expansion and made sense during that period. Does such an organizational structure still make sense? Firstly, it is not clear that the vestigial basic science course requirements that evolved from that era are still critical and relevant considering the recent change in the mission of pharmacy practice to the provision of pharmaceutical care. Secondly, for the basic science course work that is essential, it may be possible for professional students to receive their education without the presence of research enterprises in these areas in schools of pharmacy.

Given the many recent changes in pharmacy practice. the relevance and necessity to clinical practice of many traditionally taught basic science courses is changing. It is unclear whether some of the basic science courses in the professional curriculum are still necessary. As pharmaceuticals move from small molecules to include products of biotechnology, and as the profession of pharmacy moves away from dispensing and into the areas of delivering pharmaceutical care and working in interdisciplinary health care teams to cost-effectively manage drug therapies, there seems a greater need for courses in molecular biology, genetics, economics, information management, health policy and health services research. The fact that institutional variability exists around basic science course requirements is one indication that some basic science courses may not be strictly necessary. For example, some programs require course work in physical chemistry while others do not. Basic science courses that are inconsistently required across schools and that no longer appear relevant to practice seem to be reasonable courses to consider for elimination in order to make room for course work in new areas that better meet the current needs of the changing professional practice mission.

Separate from the issue of the changing professional mission and its impact on curricula, the organizational framework or infrastructure in which pharmacy students are instructed in essential basic science courses may no longer make as much sense as it has in the past. With the end of an era of academic expansion, the university infrastructure is displaying excess capacity in many settings. Coupled with the changes occurring in academic health centers, the increasing number of nontraditional faculty appointments. and the blurring of scientific disciplines, it may be more effective for professional students to receive instruction in many basic science areas without the existence of pharmacy school-based basic science research programs. For example, basic science requirements in professional programs might be met though courses offered by other university departments outside of schools of pharmacy, by a few pharmacy faculty (trained outside of schools of pharmacy) hired primarily for teaching, or even by a smaller core group of research faculty who teach across schools through video conferencing[4]. Large institutions with medical centers may already have the resources to teach courses in areas such as medicinal chemistry and pharmacology in other university departments. In many schools of pharmacy, clinical pharmacy departments already teach pharmacology as it relates to therapeutics, and it is conceivable that these departments could be asked to expand their teaching load and integrate all course work in pharmacology. Conversely, a few teaching faculty (such as pharmacologists or synthetic organic chemists) could be hired in areas such as pharmacology and medicinal chemistry to serve primarily as lecturers for courses tailored to the specific needs of pharmacy students.

Practice. In addressing contributions to the profession, the research enterprise in basic sciences has also created directions and opportunities for the professional enterprise. Historically, physical pharmacy had greater relevance to professional practice in the time of the apothecary before the pharmaceutical industry supplied stable and fully packaged pharmaceutical products. In pharmacy practice today, physical pharmacy has much less direct relevance. More recently, however, research advances in the area of pharmacokinetics have had clinical relevance and a direct role in shaping the practice of the profession. In what other ways is the research undertaken in traditional departments of medicinal chemistry, pharmaceutics, and pharmacology shaping the future of the profession of pharmacy? It may now be the case that high quality research programs in clinical, social, administrative, and health services research would provide more valuable contributions to the professional mission.

The National Research Enterprise. Regarding overall contributions to the national research enterprise, many clinical pharmacy faculty and pharmacy practitioners assume that the basic science research programs have a critical and essential research role in areas such as drug discovery and development. However, most research efforts in schools of pharmacy overlap substantially with much larger, more established and recognized fields. Pharmacology was long established as a discipline (1860s) before becoming a core department in schools of pharmacy. Much of traditional medicinal chemistry overlaps with the field of synthetic organic chemistry and much of pharmaceutics overlaps with materials science and engineering fields (or more recently with areas of biochemistry and pharmacology). In a time of shrinking resources, the value of the contributions of schools of pharmacy to the broader national and international fields of which pharmacy departments are a subset needs to be re-examined. Indicators of quality and measures of value that are currently used by the general scientific community seem reasonable to use for evaluation of basic research programs in schools of pharmacy. If level of NIH funding received is used as an indicator, it is found that in fiscal year 1994, extramural NIH awards to 57 schools of pharmacy totaled $87,651,960. Of those awards, $77,311,685 were made to 25 schools (source: NIH/DRG/ISB/SAES). Roughly one third of pharmacy schools (25/75) accounted for 88 percent of all NIH funding received by schools of pharmacy. Additional indicators of quality might include comparisons of schools of pharmacy with other disciplines in number and types of publications, number of citations, and number of faculty who sit on NIH study sections. It may be useful to eliminate or reduce programs found to be of poor quality in order to re-allocate departmental resources in ways that better serve the profession.

[4]To some degree, basic science requirements are already taught outside of schools of pharmacy given the fact that most professional pharmacy programs are 1+4, 1+5, 2+3, or 2+4 programs. It is notable that schools of pharmacy do not generally try to teach courses in calculus, physics, English, and general chemistry, even though these are all course requirements of professional pharmacy students. Instead, professional students are required to take a list of prerequisites before they apply for admission to pharmacy school. Some schools require one year of course work while other schools require two years or course work prior to admission to the professional program. The distinction between the prerequisite science courses that professional students take before admission to schools of pharmacy varies from institution to institution and seems arbitrarily based on the interests and availability of research faculty. The amount of institutional variability in basic science courses required prior to admission to pharmacy schools seems to argue against the necessity of a large, essential group of professional student core course offerings taught uniquely by basic science faculty in schools of pharmacy.

In summary, the role of the basic science research enterprise in making essential contributions to the teaching mission and to future directions and opportunities for the profession seems to be changing. It seems that in some cases. the current organization of the basic science enterprise may in fact be detracting from the primary mission of professional education and hampering the profession's responsiveness to the rapidly changing health care environment. In addition, during this time of increased competition for constrained federal and private research funding, it also seems important to re-examine the ability of basic science research programs in schools of pharmacy to remain competitive and continue to contribute to the advancement of the national research enterprise.

Contributions of Graduate Education Programs

Graduate education programs in basic science research departments make contributions to general scientific knowledge as well as train PhD scientists. In a time of a changing economic and political biomedical research climate(2-14). it seems reasonable to re-examine the role of existing programs. The number of PhD scientists being trained in the U.S. today is probably too large(11-13). Employment trends for recent PhD graduates from pharmacy schools have not been reported and it is not clear whether schools of pharmacy are collecting this data as well as information on recent and long-term trends regarding necessity of and length of postdoctoral appointments for their graduates. Such data, however, would be useful for shaping future graduate program curricula and size. National trends indicate that PhDs are experiencing increasing periods of tenure in graduate school, longer postdoctoral appointments, and difficulty finding permanent positions that utilize their training(2-13). Underemployment is on the rise and discouragement among students and postdoctoral fellows is high(2-13). Is graduate training in basic sciences in schools of pharmacy a special subset of the national training picture that is immune from current trends? If so, data is needed to prove this.

There is no a priori reason to predict that the job market constraints are any different for graduates from pharmacy programs. Traditionally, most PhD graduates from schools of pharmacy have been employed in academia or the pharmaceutical industry. Today, both academia and the pharmaceutical industry are downsizing. For example, medicinal chemists have historically competed for jobs with synthetic organic chemists and pharmaceutics graduates have competed for positions with materials science and engineering disciplines (or in some cases, areas of biochemistry and pharmacology). As the university system and pharmaceutical industry downsize, the market for scientists is shrinking and at the same time more competitive due to an overall increase in PhD graduates from competing disciplines. Some pharmaceutics programs have responded to the changing market by moving into formulations and development research for proteins and other macromolecules. But even in these instances, links with the biotechnology industry are not strong and it is not clear whether biotechnology companies look to schools of pharmacy as providers of graduates who can serve their industry's needs. For those graduate training programs that have incorporated more molecular biology, cell biology and biochemistry, the pool of individuals trained in these disciplines outside of schools of pharmacy is already highly competitive.

In addition, schools of pharmacy make a relatively small contribution to the total work force of PhD scientists and engineers. The number of PhD degrees awarded in schools of pharmacy has increased from 189 in 1972 to 317 in 1992. (The number of degrees awarded to U.S. citizens has decreased from 76.6 percent to 55.2 percent during this period.) Of the 317 degrees awarded in schools of pharmacy in 1992, 296 (93.4 percent) were awarded in basic science disciplines. Nationally, this compares to 6,059 PhDs awarded in life sciences. 6,496 PhDs awarded in physical sciences, and 5,696 PhDs awarded in engineering in 1993(3).

In summary, schools of pharmacy train only a small fraction of the PhD-trained scientific work force in the United States. Given the current downsizing of the university system and the constrained job market for PhD graduates, the time has come for schools of pharmacy to re-examine the necessity of and extent to which they should engage in graduate training in the basic sciences.

Recommendations

It would be both harsh and foolish to call for the abandonment of all graduate education and research programs in basic sciences in schools of pharmacy. Such a recommendation is certainly not wise considering that for many schools of pharmacy, the basic science departments are a seat of power and influence in the overall university setting in which they are located. Such a major restructuring would undoubtedly cause painful dislocation of faculty and, therefore, is unlikely to happen, lacking formidable outside pressure, since it would require that faculty currently employed in these areas elect to eliminate their own positions. Nonetheless, as has occurred in professional pharmacy practice, it seems the time has come for schools of pharmacy to give serious consideration to the mission and value of their basic sciences research and graduate education programs in light of the changes occurring in our political, economic, and health care climates. In health care, for example, the Pew Health Professions Commission recently recommended in its third report that the number of pharmacy schools be reduced by 20-25 percent by the year 2005 (16). What impact would downsizing of the pharmacy profession have on graduate education and research programs in the basic sciences? In addition, the competitive health care market environment is placing the future viability of the academic health center in question. How would the closure or significant downsizing of academic health centers impact graduate education and research programs in the basic sciences in schools of pharmacy? In order to navigate the rough waters that lie ahead both in health care and biomedical research, increased dialogue between clinical and research faculty in schools of pharmacy will be essential. Possible recommendations for schools of pharmacy to consider include:

1. Schools should realistically evaluate the strengths and weaknesses of their *basic science research programs*, the ways in which basic science programs are contributing to and detracting from the professional mission, and new organizational paradigms for professional education that best serve the evolving needs of the professional mission. The issues associated with evaluating whether basic science research programs should be strengthened, downsized, or eliminated are different for each institution and need to be considered on an individual basis. Schools should re-examine what course work in basic sciences is critical and explicitly relevant

to professional training and practice today. The organizational framework in which such course work is offered should be re-evaluated to determine to what extent instruction needs could be met by faculty and departments outside schools of pharmacy or by alternative organizational structures. Next, the quality and competitiveness of research programs in each school should be evaluated based on criteria such as amount of NIH funding received and number of publications in peer-reviewed journals (both inside and outside pharmacy). AACP might consider outlining a series of evaluation criteria including measures and indicators of quality as well as appointment of an external evaluations committee to assist schools in their self-evaluation process.

2. Schools should re-evaluate the mission and value of *their graduate training programs in the basic sciences*. As is the case for research programs, the issues associated with evaluating whether basic science graduate education should be strengthened, downsized, or eliminated are different for each institution and also need to be considered on an individual basis. The training contribution of each program should be examined. Currently, of the 57 schools which offer PhDs, 21 of them award almost 70 percent of all degrees. With few exceptions, these 21 programs are in schools at major research universities. Schools that are not training significant numbers of PhDs and/or that are at smaller institutions with less access to high quality interdisciplinary research efforts might consider closure of their programs. In those programs that are found strong enough and competitive enough to continue, reduction of the number of PhDs trained might be considered, thus, allowing for continuation of contributions to biomedical research without further contributing to the oversupply of PhDs. Data should be collected on recent employment trends for graduates and postdoctoral fellows trained in schools of pharmacy. The 1989 "Study Commission on Graduate Education in the Pharmaceutical Sciences: The Quest for Quality" provides useful background information on the status of graduate education in the mid-80's as well as a valuable point of comparison for today's programs.

   The 1980 AACP Argus Commission Report(17) also provides important past recommendations regarding the importance of quality research to pharmacy education. Both of these reports indicate a long-standing concern regarding the status and quality of scholarship and research in schools of pharmacy. Given the rapidly changing biomedical research and health care environments, it may be time to re-visit the issue of research quality in the basic sciences and its importance to the overall mission of pharmaceutical education. And finally, in addition to deciding whether to close or reduce the size of training programs, the level of research activity maintained and its structure must also be re-examined. For example, the current research system which is often dependent on the exploitation of inexpensive (and increasingly foreign-born) graduate student labor, primarily through appointments as teaching assistants, is unlikely to be sustainable.

3. Additional strategies for general consideration are that strong research and/or graduate education programs remain strong by identifying unique niches of interdisciplinary work and that high quality but less competitive programs form multi-school research consortia. Less competitive programs should consider dropping entirely out of the business of basic sciences research and re-allocating those resources in areas that better serve the interests and needs of the professional program. Lastly, consistent with the recommendations made in the third report of the Pew Health Professions Commission, schools should examine to what extent they should enlarge graduate education and research programs in clinical, social, administrative, and health services research(16).

CONCLUSION

Graduate education, research, and/or scholarly activity of faculty in the basic sciences may no longer play as large a role as they have in the past in maintaining a high level of excellence in professional education in pharmacy today. The graduate education and research enterprises in schools of pharmacy need to be responsive to both the changing nature of biomedical research and graduate education in the United States, and to the changing mission of the profession of pharmacy in our evolving health care system. In some cases, the interests that seem best served by maintaining the status quo in basic science graduate education and research programs seem to be those of the faculty invested in these enterprises. To be effective, however, faculty in the basic sciences need to serve the national research enterprise, the PhD scientists that they train, and the profession of pharmacy on which they ultimately rely for their existence. If only to assure the continued viability in schools of pharmacy of graduate education and research enterprises in basic sciences, the status and function of these programs should be re-examined in light of our changing biomedical research and health care environments. Hopefully, strategies will be developed to ensure that all departments in schools of pharmacy will be well-equipped to survive and thrive in the future.

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