Symposium

Basic science research in urology training

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ABSTRACT

The role of basic science exposure during urology training is a timely topic that is relevant to urologic health and to the training of new physician scientists. Today, researchers are needed for the advancement of this specialty, and involvement in basic research will foster understanding of basic scientific concepts and the development of critical thinking skills, which will, in turn, improve clinical performance. If research education is not included in urology training, future urologists may not be as likely to contribute to scientific discoveries.

Currently, only a minority of urologists in training are currently exposed to significant research experience. In addition, the number of physician-scientists in urology has been decreasing over the last two decades, as fewer physicians are willing to undertake a career in academics and perform basic research. However, to ensure that the field of urology is driving forward and bringing novel techniques to patients, it is clear that more research-trained urologists are needed.

In this article we will analyse the current status of basic research in urology training and discuss the importance of and obstacles to successful addition of research into the medical training curricula. Further, we will highlight different opportunities for trainees to obtain significant research exposure in urology.

Key words: clinician-scientist, discovery, translation, funding

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INTRODUCTION

Modern medicine is based on a long list of discoveries resulting from successful research. In the past, clinicians made the seminal advances in the field of medicine. Ignaz Semmelweis, an obstetrician, discovered that almost 20% of the obstetric patients were dying in the hospital due to childbed fever since physicians were not washing their hands after performing autopsies on women who had died of the same disease. This was long before germs were recognized as a source of disease. It took over 20 years for the concept to be accepted, largely due to the efforts of a surgeon, Joseph Lister, who popularized the idea that microorganisms caused disease.

The most important medical advances often come from physicians who ask "why?" and who go beyond clinical observation to explore the problem in a laboratory setting and then bring the answer back to the patient. In the 1970s, a 58-year-old man reported that he was fully potent within a year of radical prostatectomy. A young surgeon, Patrick Walsh, asked the question "why?", but did not stop there. He spent time looking at cadavers to determine the pelvic nerve anatomy with special emphasis on the branches responsible for erection. Walsh returned to the operating room with his new knowledge and radical prostatectomy surgery was forever changed, benefiting countless patients.

Most of the medical advances up to the 20th century were based on the clinical signs that were correlated to the disease itself. Clinical observation led to discoveries that were disseminated by published reports. During this period, many clinical conditions, disease associations, and syndromes were carefully described and cataloged. In contrast, many of the major advances in medicine today are coming from full-time researchers, and not from clinicians. However, scientific physicians have gained broad insight into both worlds and are therefore predestined to approach medical problems differently and to bring new techniques and treatments to the care of patients.[1]

The role of basic science exposure during urological training is a controversial topic that is relevant to urologic health, urologic research, and the training of new physician-scientists.

Involvement in basic research fosters critical thinking skills and the understanding of basic concepts of research. It also develops future physician-scientists in urology, who are needed for the advancement of the specialty.

If research education is not included in urology training, future urologists may likely contribute less to scientific

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discoveries in the years ahead. Nevertheless, only a minority of physicians in training are exposed to significant research experience, and the ranks of physician-scientists in American medicine have been decreasing over the last two decades. This is true even in urology[2,3] where fewer physicians are willing to undertake a career in academics and basic research. However, to ensure that the field of urology is driving forward and bringing novel techniques to patients, we clearly need to expose more trainees to research.[2,4,5]

CURRENT STATUS AND OBSTACLES TO SUCCESSFUL RESEARCH EXPOSURE

There has been a tendency over the last decade to reduce or remove dedicated research time during urology residency. Currently, only 18% of urology residency programs in the US offer a year of dedicated and relatively protected period of research time.[2] Often, there is still a significant clinical burden alongside research responsibilities. To counteract this development, leading urologists organized a roundtable discussion in 2005 at the University of Michigan.[6]

This Residency Review Committee (RRC) is exploring a curriculum that includes specialty rotations with an emphasis on specific areas based on the residents' interests. Some residency and fellowship programs are re-examining the role of science since it impacts training, believing that exposure to science is beneficial regardless of the path chosen by the physician entering practice, as the physician at the bedside is often the one making clinical observations that can lead to future discovery. It is the clinical observation that often sparks novel research strategies and leads to medical breakthroughs.

The extent of research performed by an urologist in training has to correspond with the career path. For some, a short exposure will be sufficient to understand the concepts and the current problems in research, while for others the several years of research are required to learn good research practice and to initiate promising research projects. Learning how to critically evaluate published studies and presented data are the bases for a lifelong learning process regardless of future goals. Research also broadens the mind for new values – for example, while training for surgery, asking the trainees to do as they are told; laboratory work emphasizes generating new ideas and challenging the current dogma. Only research exposure can spark academic curiosity and the desire to answer clinical questions in urology, a key feature of a successful future career in academic urology.

With specialized training becoming more complex, and with the financial pressures of the healthcare system becoming greater, many residency programs have largely eliminated the research experience altogether. Due to changes in medical education programs as well as higher debts after completion of training, fewer physicians are choosing an academic career, and when they do, they may have only had a limited basic research experience. In their recent overview paper, Montie *et al.*,[6] identified four major barriers to research during urology training. These are money, time, space, and mentorship.

Research funds

A potential reason why residents do not pursue an academic career in urology might be the perception of unattractive financial rewards in academics. This is of major concern to US students, where over 80% of medical students graduate with significant debt (the average is 135 000 US $).[7] In general, financial rewards are an understandable attractant and academic medicine has less financial rewards than private practice. On a personal level, this draws many physicians away from basic research. Further, it seems that social rewards for excellent surgery are higher than for excellent research.

There are also financial problems at the departmental level. Changes in medical revenues have made it more difficult for urology departments to support the salary of research residents. Therefore, research time is often not considered part of the 5-year commitment to the hospital to support clinical residency training. In the US, some institutions have successfully secured government training grants (e.g. NIH Basic Science Training Grants T32). These programs can offer institutions a stable funding source to cover research stipends, allowing two years of protected research time. This research experience usually lays the groundwork to future grant applications for federal and private research funding. However, it is becoming more and more difficult for a medical scientist to successfully compete for these awards as they usually have too many other obligations.

There is also concern regarding the ability of urologic physician-scientists to compete with full-time researchers. This situation is becoming even harder with the decreasing budget for governmental research funding.[8-10] At the federal level, the research funding power is at the lowest it has been in over a decade, and the average age of researchers receiving their first NIH (National Institutes of Health) grant keeps increasing. If less than 20% of research projects are funded, many physicians see the struggle for grants as a waste of time and resources, and tend to spend their time in clinics and operating rooms. A skilled mentor leading these young scientists is needed to motivate them to write grants and to risk the possibility of rejection to obtain the rewards of pure research.

There are many initiatives underway at the American Urological Association (AUA) to promote the careers of physician-scientists. Additional programs are being instituted, some in collaboration with the NIH. Currently, the AUA offers an early-career salary award which pays salary support up to 200 000 US $ for over 5 years.[11] In

addition, Robert Starr, MD, a physician who has led his own research efforts for years and someone who understands the challenges of the clinician scientist, was recently appointed as the director of the National Institute of Diabetes and Digestive and Kidney Diseases – National Institutes of Health (NIDDK – NIH). This may lead to increased government support for the early-career physician-scientists.

Research time

Urology is becoming more and more complex, and as a result, the training of a urologic surgeon is becoming more demanding. After completion of residency, many urologists commonly take additional time to hone their surgical skills in fellowships. Therefore, research time during residency is often seen as a luxury.

Research can be performed before and during residency, during a fellowship, or within a masters or PhD program. Looking at careers of nationally competitive physician-scientists, 'single dose' research experience is seldom sufficient to establish a successful research career later on. This makes it clear that one year of research time is not sufficient to initiate an academic career. However, it might be enough time for a urologist with plans to join a community practice to appreciate research methodology, biostatistics, and critical reading of medical literature. This will not only make them better physicians and participants in clinical trials, but also support and provide sympathy for the development of physician-scientists. If dedicated research time is not available, these skills might be gained in a structured clinical curriculum during residency. Faculties trained in data analysis, statistical design, and clinical research are therefore needed.

However, if two years of research, e.g. during a MD/PhD program or a research fellowship, is feasible, the student should have collected enough data to successfully submit a smaller grant that will allow him to continue the research in a fellowship or a junior faculty position.

Before residency

Most medical school curricula have removed laboratory experience from medical training. Therefore, extra time is needed to get meaningful exposure to medical research during this step of education. However, it is often not possible for the student to grasp the big picture. The lack of medical understanding and immaturity makes the success fully dependable on a strong and guiding mentor, but there is no better time to spark interest in research.

Residency

If research exposure is early in residency, it could help to define career direction and allow the resident to plan suitable next steps. This also allows the resident to continue to be involved with their area of research over a longer period of time during their residency training. Further, it is easier to excite urologists about research early in their education. Of course, some argue that research should be performed in the later years of residency, in close apposition to the fellowship. This could enhance the ability to gain the preliminary data needed for successful grant applications and smoothen the path to a first academic appointment. Finally, previous research experience of an applicant is a major criterion used during selection at many competitive fellowship programs.

Masters/PhD programs

Throughout the United States, several universities offer the opportunity to earn a Masters or PhD by adding two years of research time at the beginning or mid-portion of residency or medical school. These students must successfully complete the structured course work and finalize their research by writing a Masters or PhD thesis. This significant extra effort allows an in-depth education, and is most suitable for urologists who anticipate beginning academic careers in basic and clinical research.

Fellowship

Many residents perceive that, after completing their first residency program, they have insufficient operative expertise in many disciplines. Therefore, almost half of all graduates apply for an additional fellowship. This additional training can be used to gain surgical skills in a specific subspecialty preference or to develop scientific skills and techniques, either in the laboratory or in clinical research. This is also an excellent opportunity to learn grant writing techniques and gain the necessary research credentials for individuals deciding to pursue a research career. There is a clear trend to subscribe to more subspecialty fellowships. Many of the fellowship programs are adding a research experience.

Research space

The third major barrier is the availability of laboratory space. This space is ideally provided by the institution and dedicated to resident research. This might be a constraint in many academic facilities. Further, many part time faculty researchers might not have access to suitable research laboratories to support resident research.

Mentorship

The presence of educated mentors is a key to integrate research into an educational program.[2] It is unreasonable to expect faculty members to provide appropriate mentoring and research opportunities to urologists in training if they do not have extensive expertise in basic research. Urology institutions must continue to evolve and infuse their urology residency programs with a culture of research opportunities to foster better mentoring of urologists in pursuit of a research career. Then, these new members of the research community will be prepared to provide adequate mentoring to the next generation of physician-scientists. A recent article highlighted that ideally, one or more PhD-carrying

faculty member should lead the basic research endeavors of a urology department.[5] Basic scientists and physicians can mentor different aspects of a physician-scientist's training. Interaction with a successful mentor who has a track record of meeting the conflicting demands of both clinical practice and medical research is extremely important.

THE FUTURE IS BRIGHT

Many current physician-scientists with successful, balanced careers demonstrate that patient care and high-quality research are not mutually exclusive. However, it seems to become more and more difficult to successfully compete in both areas. In the clinic, there is a pressure to increasepatient encounters and their billings, while research funding is becoming unstable and highly competitive. It is becoming apparent that the medical makes it harder for physician-scientists to be productive.

However, in urology, we will have to make a concerted effort to make sure that physicians are mentored and encouraged to participate in this fruitful process. Some estimates show that the sum of all of the scientific knowledge gained in just the last decade is equivalent to the sum of the knowledge gained in the prior century. In addition, advances in communication technologies such as the Internet, email, e-texts, web-conferencing, world-chip cell phones, and satellites have contributed to an almost instant dissemination of information. There have been major technological leaps in laboratory equipment, assays, genomics, proteomics, and metabolomics that have expanded our scientific limits beyond what we thought possible just a few years ago. Just two decades ago, it would have taken an entire lab of very experienced scientists a decade to clone a gene. However, recently, the entire genome was cloned in a period of a few years. Science has developed so rapidly over the last decade that many researchers feel like the field of bioinformatics did not develop fast enough to account for all the data being generated. Many scientists feel that the amount of data is overwhelming our ability to analyse it efficiently and to follow through with clinically significant strategies. Still, the technological leaps in science make it possible today for scientific discoveries to be made rapidly, and there has never been a better time for physician-scientist to make an impact on disease. The reason that discoveries usually proceed rapidly, with the right clinical questions, physician-scientists have the potential to significantly benefit our patients.

In conclusion, the ideal process for a physician-scientist to achieve discoveries is not one from the bench to the bedside, but rather from the bedside, to the bench, and back to the bedside. Furthermore, it is a translational research which drives the field of urology forward.

Exposure to research principles is a benefit to all urologists, regardless of future practice. The ability to critically appraise urologic literature and a general understanding of research principles and biostatistical methodology is required. Further, these skills are needed to successfully practice medicine in accordance with evidence-based medicine principles.

A concerted effort in the field of urology is needed to ensure that physician-scientists are mentored and encouraged to participate in basic and clinical research. This is an important path to ensure that the field of urology progresses and brings novel techniques to patients.

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