
THE PIVOTAL ROLE OF THE ACADEMIC HEALTH CENTER

by Gerard Anderson, Earl Steinberg, and Robert Heyssel

Prologue: Over the course of this century academic health centers (AHCs) have emerged as key players in the complex process of developing technology and moving it from the laboratory to the medical marketplace. Recent trends toward price competition and increased regulation in hospital reimbursement rates, however, threaten to eliminate traditional funding sources for research and development (R&D) in these institutions. Some reformers have proposed explicit federal funding that would substitute for AHCs' loss of revenue from other sources. In this paper Gerard Anderson and colleagues trace the evolution of AHCs and highlight their role in medical R&D. They warn that the imminent shift in funding sources could have serious consequences for the future course of medical innovation. The authors stress the importance of having a well-defined set of priorities and a clear understanding of the factors that foster innovation in AHCs. Anderson, a well-regarded expert in health care finance with a doctorate in public policy analysis from the University of Pennsylvania, is director of the Center for Hospital Finance and Management at The Johns Hopkins University in Baltimore. Earl Steinberg, a nationally recognized expert in technology assessment, is professor of medicine and health policy and management at Hopkins and directs the Hopkins Program for Medical Technology and Practice Assessment. He holds a medical degree from Harvard Medical School and a master of public policy degree from Harvard's Kennedy School. Robert Heyssel, a physician, is president emeritus of The Johns Hopkins Health System and The Johns Hopkins Hospital, having stepped down in 1992 after nearly twenty years at the helm. Heyssel received his medical degree from St. Louis University. He is a member of the National Academy of Sciences' Institute of Medicine and has had a long, distinguished career in medical practice and administration in both public and private sectors.

Abstract: Academic health centers (AHCs) now play major roles in the development, adoption, and evaluation of medical technologies; the provision of advice to other entities involved in medical innovation; and the education of current and future practitioners. However, recent and potential health care reform initiatives could make it increasingly difficult for AHCs to continue to play their historical roles in medical innovation. Policymakers are examining specific options that would explicitly cover the cost of some of these services but could take away some of the autonomy AHCs have enjoyed and could change the role of AHCs in technological innovation.

Academic health centers (AHCs) have played a critical role in technological development, clinical research, and clinical education. In the past they have been able to cross-subsidize these activities with patient care revenues because third-party insurers have been willing to pay higher prices for clinical care delivered at AHCs, thus creating a surplus.¹ However, price competition and regulation have begun to erode that surplus, thus compromising the ability of AHCs to cross-subsidize these other activities.

Health care reform is expected to exacerbate this trend. As a result, policymakers are considering the possibility of explicitly financing the threatened activities. President Bill Clinton's health reform plan, for example, would provide almost \$10 billion per year in explicit funding by 1999 to help AHCs pay for the training of physicians and nurses as well as to subsidize the incremental cost of operating an AHC. Because of the magnitude of this proposed expenditure, policymakers are expected to take a close look at the costs and benefits of services provided by AHCs.

As the debate progresses, some of the areas that are likely to draw considerable attention from policymakers, medical school deans, and hospital managers include the role of AHCs in developing, evaluating, and disseminating knowledge and technology; the educational mission of the AHC; and the role of the AHC in delivering patient care services.²

History And Structure Of AHCs

One issue that arises in the debate over health care reform is what constitutes an AHC. Unfortunately, there is no precise, universally accepted definition. The Association of Academic Health Centers (AAHC) describes an AHC as an entity that has an allopathic or osteopathic medical school, one or more other health professional schools or programs (such as nursing, public health, or pharmacy), and one or more teaching hospitals? Others use slightly different definitions. This leads to disagreement over just how many AHCs there are in the United States, although most lists place the number of AHCs in the range of 100-125.

Following the AAHC's definition, AHCs did not really come into being until the twentieth century. At the beginning of the twentieth century, for

example, it was uncommon for biomedical research, clinical education, and patient care to occur within the same institution.⁴ The Johns Hopkins University, which opened its medical school in 1893, was the first institution to integrate research, education, and clinical hospital practice.⁵ In 1910 the Flexner Report strongly encouraged medical schools to integrate their clinical education, research, and patient care functions, a charge that all medical schools have heeded. In the same year Columbia University and Presbyterian Hospital reached an agreement to affiliate, forming the first academic health center through the merger of existing institutions. Most of the growth of AHCs occurred in the period following World War II, when policymakers in Washington decided to expand the number and size of medical schools, invest heavily in biomedical research, adopt a generous payment system for services provided by hospitals and physicians, and adopt other regulatory and financing initiatives that have encouraged the expansion of AHCs.⁶ Given these policy initiatives, it is not surprising that AHCs have played a pivotal role in the evolution of the U.S. health care system over the past fifty years.

The relationships among teaching hospitals, medical schools, and the other components of AHCs vary. The majority of AHCs are a part of a parent university in which the hospital and the medical school are under common ownership. Duke, Stanford, Vanderbilt, and most state university AHCs have this type of organizational structure. A handful of AHCs are associated with health science universities rather than with comprehensive universities—Thomas Jefferson and Hahnemann in Philadelphia and New York Medical College are examples. In other AHCs the medical and associated professional schools are part of a parent university, but the hospital component exists as a separate corporation. Washington University Medical School/Barnes Hospital in St. Louis, Harvard Medical School and its associated Boston teaching hospitals, Cornell University Medical College and New York Hospital, and The Johns Hopkins University School of Medicine and Johns Hopkins Health System and Hospital are all examples of this type of arrangement.

All AHCs have three things in common: (1) a faculty that is heavily involved in biomedical and clinical research (for example, it is common for AHC faculty members to receive 75 percent or more of their salary support from research grants); (2) a commitment to patient care that is highly specialized (tertiary or quaternary care); and (3) a major commitment to pre- and postdoctoral teaching, which is fulfilled by a large faculty, most of whom spend only a small amount of time in teaching activities. AHCs have a student-to-faculty ratio that is approximately two to one.⁷ This concentration of faculty, students, and staff, and their interest in developing new knowledge and applying it to improve patient care, accounts for the major

impact AHCs have had on medical innovation over the past half-century.

An Overview Of Academic Health Centers

While nearly all medical schools, teaching hospitals, and professional schools are members of at least one AHC, separating out the entangled alliances among such institutions can sometimes be very difficult. For this reason we first examine separately the financial underpinnings of the two major components of AHCs: medical schools and teaching hospitals. The other professional schools, which may play a major role within an AHC, generally have a much smaller financial impact, are less likely to be affected by health care reform since they are less dependent on patient care revenues, and play proportionately smaller roles in medical innovation.

In the academic year 1991-1992, there were 126 allopathic medical schools that enrolled 65,539 medical students and employed 80,086 full-time faculty.⁸ Their total revenues were \$23.1 billion, with total expenditures of \$22.4 billion.⁹ A comparison of the expenditure categories and sources of revenue suggests that medical schools are cross-subsidizing education with funds received for patient care. Research appears to be self-supporting, accounting for 22.9 percent of medical school expenditures, with revenue from research grants, contracts, and indirect cost recovery representing 25.5 percent of revenues. However, this may simply be an accounting artifact, since revenues and expenditures for most grants and contracts must balance exactly. Current accounting systems are not able to identify the costs associated with unsponsored research or cross-subsidies from teaching hospitals for sponsored research, the time spent preparing grant applications, and the other costs associated with operating a research enterprise.

Education consumes 34.2 percent of medical school expenditures, but revenues from tuition, fees, and grants for teaching and training account for only 6.4 percent of medical school revenues. In contrast, expenditures related to patient care services consume 22.5 percent of spending but account for 35.7 percent of medical school revenues. This simple comparison of expenditures and revenues can be misleading, however, since the distinction between research, teaching, and patient care activities in AHCs is often blurry. For example, medical students, residents, and postdoctoral clinical fellows all perform patient care activities, although they are at AHCs for educational purposes. In addition, some sources of revenue, such as state and local governmental appropriations-which account for 11.5 percent of revenues-do not fit precisely into any single revenue category. Likewise, certain types of expenditures, such as operation and maintenance of plant-3.6 percent of expenditures-do not fall precisely into a single

research, education, or patient care category. Thus, the magnitude of apparent cross-subsidies is sensitive to how such funds are allocated to revenue and expenditure categories. The numbers do suggest, however, that medical schools are heavily dependent on patient care revenues for financial viability, and anything that affects those revenues could jeopardize their ability to perform other functions.

Teaching hospitals also engage in cross-subsidization. The Association of American Medical Colleges (AAMC) has identified 120 academic medical center hospitals. In 1991 these hospitals had total operating revenues of \$32.0 billion and total operating expenditures of \$31.3 billion.¹⁰ Assuming that all Medicare payments are related to patient care services, 98 percent of these revenues were derived from patient care activities.” Because it is common for research, education, and patient care to occur simultaneously in teaching hospitals, it is difficult to estimate the costs of research and education with precision.¹² However, multiple regression has been used to estimate the incremental cost of research and education on academic medical center hospitals.¹³ While the estimates vary depending on the functional form of the model, which variables are included in the model, and the specific year that is studied, a midrange estimate is that medical center hospitals are 10-20 percent more expensive than community hospitals because of research and education.¹⁴ In 1991 the incremental costs associated with graduate medical education and clinical research in teaching hospitals were approximately \$9 billion.

In summary, although the extent of cross-subsidization within AHCs cannot be quantified exactly and probably varies widely among AHCs, it is likely that patient care is heavily subsidizing both research and education in nearly all AHCs. This makes the research and education activities vulnerable in an increasingly price-competitive environment.

AHCs And Medical Innovation

The effects of AHCs on medical innovation are exerted through four roles: (1) developer of new technologies, techniques, and applications; (2) adopter of new devices, therapies, and procedures; (3) evaluator, engaged in the assessment of both emerging and established technologies and practice patterns; and (4) adviser to both the public and private sectors.

The developmental role. AHC faculties play a major role in the development of new drugs, devices, diagnostic techniques, and therapeutic procedures. Given that most progress in scientific research occurs in small, incremental steps, rather than major breakthroughs and that many innovations occur as a result of research done both inside and outside of AHCs, it is difficult to develop a list of medical innovations that are solely attribut-

able to work performed at AHCs.¹⁵ It is likewise difficult to identify important medical innovations that have no connection with work performed at AHCs. For example, much of the developmental work and early research on various types of organ transplantation, diagnostic imaging technologies, prosthetic joints, and gene therapy have occurred in AHCs. The availability of erythropoietin (a hormone used to stimulate production of red blood cells in patients who have undergone kidney transplantation for end-stage renal disease) and of other colony-stimulating factors (commonly used to stimulate the production of new white blood cells after existing white blood cells have been killed by chemotherapy) also is due in large part to basic science research performed in AHCs.¹⁶

In recent years economists have tried with limited success to quantify the economic benefits of academic research. Adam Jaffe investigated the extent to which university research is a catalyst for corporate innovative activity.¹⁷ Jaffe found that 1.3 drug and medical technology patents were registered by corporations for each \$10 million in university research expenditures during 1972-1981.¹⁸ In a 1985 survey of medium to large private drug companies, company executives reported that 27 percent of their new products commercialized between 1975 and 1985 could not have been developed without substantial delay in the absence of research performed in AHCs.¹⁹ These executives estimated that an additional 17 percent of their products were developed with substantial aid from recent academic research. The survey also suggests that the research and development effort in the drug industry relies more heavily on universities than research and development efforts in the information processing, electronic, chemical, instruments, metals, or petroleum industries.

Adoptive role. Given AHCs' research mission and the complex mix of patients whom they treat, it is common for them to be the first institutions to acquire and use new technologies, instruments, and drugs. Equipment often is given to AHCs by manufacturers for further development and refinement. Early adoption is a natural result of AHCs' search for new ways to diagnose and treat patients, industry's use of AHC faculty to advise them on promising ideas, and industry's desire to find sites where testing of technology can be conducted. The familiarity that AHCs gain with new devices during the evaluation process often leads to early and large-scale adoption of those devices by AHCs once the devices have been approved by the Food and Drug Administration (FDA). Computed tomography (CT) scanning, magnetic resonance imaging (MRI), catheterization of coronary arteries, and angioplasty are only some of the innovations that were adopted by most AHCs when these technologies were in their early stages of development.

The institutional mission of the AHC encourages competition among

AHCs to be the first to adopt emerging technologies. For example, researchers want early access to medical innovations to compete for external research funding, faculties want to be able to attract the best students who want to be trained to use the latest technologies, and clinicians and hospitals routinely use new technologies to attract patients. While this competition for new technologies, students, and patients has propelled American AHCs to a leadership position in the world, it has negative repercussions as well. For example, competition can promote the diffusion of new technologies before they have been evaluated thoroughly.²⁰ Also, competition may stifle cooperation among AHCs, since in many ways they are competing with each other for research dollars as well as for students and patients.

Evaluative role. The AHC's evaluative role is critically important to effective and appropriate use of medical innovations. This role extends to both the evaluation of new technologies that have not yet diffused into medical practice and of technologies that already are used routinely but have not been carefully evaluated in all of the clinical settings in which they are used. Working with pharmaceutical companies and equipment manufacturers under protocols reviewed by the FDA, AHCs have traditionally been sites for many premarket (or Phase III) evaluations of the efficacy and safety of drugs and devices. Clinical evaluations of drugs and devices do not cease when they are approved for marketing by the FDA. Rather, both pharmaceutical companies and the federal government are increasingly supporting postmarketing (or Phase IV) studies of drugs, medical devices, and surgical procedures. Phase IV studies, which often involve very large numbers of patients, can provide insights into toxicities and limitations in effectiveness of drugs and other technologies that might not become apparent in Phase III studies, which tend to enroll many fewer patients and are conducted under controlled conditions.

One of the largest and most exciting new initiatives devoted to clarification of the effectiveness of medical technologies is the Patient Outcomes Research Team (PORT) program sponsored by the Agency for Health Care Policy and Research (AHCPR). This initiative funds multidisciplinary research teams (almost exclusively in AHCs) that are devoted to evaluating the comparative effectiveness of alternative technologies and strategies for managing particular clinical problems to define appropriate medical care from a societal perspective. Evaluations are conducted using expertise from a variety of academic disciplines, with data on cost, clinical outcomes, functional status, patient satisfaction, and patient preferences.

AHCs provide patients and patient care facilities for clinical studies; in addition, many clinical studies are designed in AHCs, and many new scientific methods for evaluating drugs, devices, and procedures are developed there. In some instances, entirely new analytical methods, such as

biostatistical techniques, are developed. In other instances, analytic techniques that have been used previously in other disciplines are adapted by AHC faculty for use in the evaluation of clinical practice. Examples include receiver operating characteristic curves, decision analysis, and cost-effectiveness analysis. These types of methodological advances are critical to progress in the evaluation of medical innovations.

Advisory role. AHC faculties also have a major impact on the content of research and development programs in both the public and private sectors. They identify the clinical need for certain drugs, surgical instruments, and diagnostic services and provide valuable scientific and clinical expertise during their early and later stages of development. After a drug or device is on the market, AHC faculty often continue to advise manufacturers on the design of more refined second- and later-generation drugs and devices that might be less toxic or more specific, or might provide some other clinical advantage. As their consultative activities have expanded, controversy has arisen regarding potential conflicts of interest because of simultaneous consultative and evaluative roles played by AHC faculty.²¹

Faculties at AHCs also help federal agencies, such as the National Institutes of Health (NIH), AHCPR, and the National Science Foundation, to develop their research agendas and play a primary role in critically evaluating the comparative merit of grant proposals submitted to these entities. AHC faculties also play a major advisory role for regulatory bodies such as the FDA, providing an impartial critical appraisal of the validity and strength of evidence regarding the safety and efficacy of new drugs and devices. AHC faculties also provide valuable input into the decisions that Medicare and Medicaid make regarding coverage of new drugs, devices, and procedures. Finally, faculties at AHCs also assist private insurers in making coverage decisions. Since 1991, for example, the national Blue Cross and Blue Shield Association has had AHC faculty members on its Medical Advisory Panel, which assesses available data to determine whether sufficient evidence has been accumulated to demonstrate the clinical value of particular medical innovations. Individual Blue Cross/Blue Shield plans then use these assessments in deciding whether to cover particular drugs, devices, and procedures. For some of these evaluative roles, faculties at AHCs are well compensated, while for other services they receive only a small honorarium.

Other roles. While this paper's focus is AHCs role in innovation, it is also important to recognize their large commitment to various levels of education—ranging from undergraduate medical education all the way through graduate medical education, doctorate training in research, and continuing education for practitioners—and the impact of that education on the health care system. Medical education occurs today primarily in an

atmosphere of an intense search for new understandings of and approaches to human disease. Most medical teachers are active in research, and most are highly specialized. The impact on young people, including their career choices, of the milieu in which medical education occurs cannot be overstated. In addition, the AHC is the place where doctors-in-training first learn practice guidelines and develop practice styles.

In the current health care reform debate, policymakers are taking a close look at the mix of residency programs that AHCs are sponsoring. Only 19 percent of all residents are now in a primary care specialty (family practice, general pediatrics, and general internal medicine), while 81 percent are being trained as specialists.²² Out of a general belief that specialists are partially responsible for the rise in health care costs, the Clinton administration proposes to limit the number of specialists to approximately 50 percent of the residents completing their training. This is likely to have a profound impact on the patient care, educational, and research activities of the AHC, since residents are integral to most AHC activities.

AHCs' Investments In Medical Innovation

The multiple roles of AHCs require them to make major investments of time and money. Preparation of a grant application to NIH is estimated to cost approximately \$20,000, and federal regulations preclude recovery of these costs from the grant once it is actually awarded.²³ Given that NIH now approves only approximately 30 percent of all grant applications, AHCs are forced to set aside substantial amounts of "seed" money to cover the costs associated with performance of preliminary investigations and the preparation of grant proposals based on them.²⁴ The Johns Hopkins University School of Medicine estimates that it takes approximately three years for a new faculty scientist to be funded from external sources and that, during that interval, the university provides roughly \$400,000 for that person's start-up costs.²⁵

A second type of investment made routinely by AHCs involves provision of laboratory space and funds to support junior faculty and ancillary personnel to attract high-quality departmental chairs and senior faculty to a university. The cost of recruiting a senior faculty member or department chair can exceed several million dollars.²⁶

In addition to the sizable investments AHCs make to recruit faculty and to prepare grant proposals, AHCs have made large investments in plant and equipment to increase their ability to compete successfully for major grant funds. During 1980-1993, for example, The Johns Hopkins University spent \$241 million on capital projects at their Schools of Medicine, Hygiene and Public Health, and Nursing, while the Johns Hopkins Hospital

spent an additional \$350 million.²⁷

Developmental research performed by AHCs can be sponsored or unsponsored. In most sponsored research, a team of researchers develops an idea, writes a grant proposal to fund the research, receives funding following a peer review process, conducts the research, and publishes the results. This is a time-consuming process. The elapsed time from development of an idea to publication of the final results can be as long as ten years.

This time period can be shortened significantly if the project can be performed without external funding. Unsponsored research is relatively common in AHCs. For example, a surgeon may use additional operating room time to develop a new surgical technique, a radiologist may refine a new imaging procedure, or a group of clinicians may agree to evaluate a new use of an existing drug—all without an external source of financial support. While it is difficult to identify the precise amount or cost of unsponsored research, it is likely to be substantial and could be jeopardized in a price-competitive environment.

AHC Policy Development Regarding Medical Innovation

Despite the considerable investments that AHCs make in development, evaluation, and adoption of new technologies, there is no centralized entity within AHCs that sets policy with respect to these functions. Although frequently under the control of a chancellor or vice-president for medical affairs, each component of the AHC responds to a variety of financial and other incentives. As a result, individual faculty members within the AHC may have fundamentally different perspectives about the role of technology and technology assessment. The principle of academic freedom permits this diversity of opinion and makes it extremely difficult for the leadership in AHCs to have a policy-making role. Faculty members are likely to vary in the emphasis they place on altruism (what is best for society) and self-interest (what will benefit the individual researcher, school, or hospital) when making decisions regarding which projects to pursue.

Faculty members also are likely to vary in the importance they attach to safety, effectiveness, cost, patient satisfaction, and other criteria when they make their investment decisions. The fact that different criteria are used by faculty who play different roles at different stages along the innovation continuum is not surprising. On the one hand, the basic scientist may not even know the potential clinical value of a particular line of research and therefore may be unaware of its potential impact on clinical outcomes, health care costs, patient satisfaction, or other outcomes. On the other hand, the evaluator of an established technology will have access to this information when he or she performs the assessment. While it is possible for

the two persons at each end of the innovation continuum to be in the same academic department, their ability to communicate with each other may be limited because the criteria they use to evaluate projects are so different.

The Uncertain Future Of The AHC

In response to a variety of federal initiatives, AHCs have shaped the American health care system during most of the twentieth century. However, as the century draws to a close, there is growing concern that the American health care system in general, and the AHC in particular, has become too enamored with sophisticated technology, too oriented toward specialty medicine, and far too expensive. As a result, the emphasis on research and innovation within the AHC and the tendency for these institutions to adopt the latest and most expensive technologies, train specialists and subspecialists at the expense of generalists, and cultivate an environment that favors tertiary and quaternary care at the expense of primary care places them at odds with the direction in which health care reform appears to be heading. At the same time, AHCs will need to find new sources of funding for some of their activities because their traditional funding source—patient care surpluses—is eroding rapidly and could be nearly eliminated by health care reform.

A challenge for policymakers and AHCs will be to define the most appropriate roles for the AHC in the next century. One option is to allow the market to determine the services that AHCs will provide. If this policy direction is followed, it is likely that medical innovation will be slowed, since development, adoption, and evaluation of new and established medical technologies often are not self-supporting. At the same time, AHCs will want to stop training generalists, especially generalists in ambulatory settings, because they are considered unprofitable.

A second option is for payers to directly support some or all of the services that AHCs now provide. If this option is chosen, funds most likely will be targeted toward specific services, such as training of generalists and support of specific types of research, instead of the more open-ended funding that cross-subsidization from patient care revenues has offered AHCs in the past. The Clinton proposal to tie funding for graduate medical education to production of a specific mix of generalists and specialists is one example of a more targeted strategy for support of AHCs. Another option would be to directly place new technologies in AHCs and to make them the preferred sites for clinical evaluation of these new technologies. There is precedent in Canada and Europe for such an arrangement.

Regardless of the option chosen, it is likely that AHCs will have to adapt to a new health care financing system that provides them with less flexibil-

ity to cross-subsidize research and education with patient care revenues. As a result, the amount of unfunded and underfunded research will be reduced, and it will be more difficult for AHC faculty to develop medical innovations, as in cases where a surgeon uses an additional hour of operating room time to develop a new surgical technique, for example. Adoption of new technologies is also likely to be slowed since AHCs will have fewer resources with which to purchase all of the latest equipment. At the same time, it is likely that technology assessment efforts will be strengthened because of a reordering of priorities within AHCs and the availability of additional public and private funds for evaluation. Advisory roles will have to become more self-supporting; for example, compensation for service on NIH and AHCPR review panels will need to be increased.

Conclusion

The AHC, encouraged by federal initiatives, has played major roles in medical innovation and has been the focus of most basic and clinical research in this century. It is the place where most new technologies have been adopted and evaluated, where health care practitioners have been trained to use the most sophisticated equipment and the most innovative medical practices, and where most of the advisers to industry and government have been located. Traditionally, funds have been available for most services that AHCs wanted to perform, and many services, such as their developmental, adoptive, evaluative, and advisory roles, were partially supported by patient care revenues.

The roles of the AHC are likely to change in the twenty-first century. Traditional sources of financial support for AHC activities—namely, clinical revenues and federal research funds—are likely to be less plentiful. Explicit funding will be given for specific services that the public wants maintained. As a result, the supply of certain services, such as training subspecialists and providing inpatient care (particularly high-technology inpatient care), is likely to decrease as the demand to produce generalists and provide more primary care increases.

What role AHCs will play in the new environment is unclear. AHCs could shift their priorities in response to emerging societal preferences, or they could elect to concentrate on the activities they have performed in the past—research, tertiary and quaternary care, and the training of subspecialists. What is clear is that AHCs will need to define the roles they want to play and convince policymakers and others to provide the funds necessary to fulfill those roles. Policymakers will need to decide what services they are willing to fund and at what level. All of these decisions will influence the role of AHCs in medical innovation in the twenty-first century.

NOTES

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