Report 3

The Blue Ridge

ACADEMIC HEALTH GROUP

Into the 21st Century:

Academic Health Centers as Knowledge Leaders

Contents

Introduction 1

The Forces Shaping Health Care 4

Knowledge as Capital 6

AHCs and Knowledge 8

A Knowledge Infrastructure 11

A Knowledge Culture 13

Knowledge Management Processes 15

Rising to the Challenge 16

IT in Support of AHC Knowledge Management 18

Managing an AHC Asset 21

Preparing AHC Professionals 24

A National Health Information Infrastructure 26

Partners in Knowledge 28

Conclusion 30

Appendix 1: Previous Blue Ridge Group Recommendations 33

Appendix 2: External Forces Shaping Health Care 35

Appendix 3: Possible Approaches for Knowledge Management 39

About the Blue Ridge Academic Health Group 42

About the Core Members 43

About the Invited Participants 47

References 49

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Into the 21st Century: Academic Health Centers as Knowledge Leaders is the third in a series of reports produced by the Blue Ridge Academic Health Group. The recommendations and opinions expressed in this report represent those of the Blue Ridge Academic Health Group and are not official positions of the University of Virginia. It is not intended to be relied upon as a substitute for specific legal and business advice.
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The Blue Ridge Academic Health Group

Mission

The Blue Ridge Academic Health Group seeks to take a societal view of health and health care needs and to identify recommendations for academic health centers (AHCs) to help create greater value for society. The Blue Ridge Group also recommends public policies to enable AHCs to accomplish these ends.

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The University of Virginia and Cap Gemini Ernst & Young U.S. LLC are founders of the Blue Ridge Academic Health Group. The University of Virginia convenes the group and serves as its locus of operations. Cap Gemini Ernst & Young U.S. LLC provides core funding and facilitation for the group.

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Most colleges and universities are attempting to respond to the challenges and opportunities presented by a changing world. They are evolving to serve a new age. But most are evolving within the traditional paradigms, according to time-honored processes of considered reflection and consensus that have long characterized the academy. The changes that have occurred in the university, while important, have not grappled with the extraordinary implications of an age of knowledge, a culture of learning, which will be our likely future.

– A University for the 21st Century, James J. Duderstadt, 2000

Introduction

Enabled by technological developments and accompanied by an economy undergoing fundamental changes, the knowledge age has arrived. Its impact is already evident in the nature, scope, and pace of competition among businesses, work of individuals, and expectations of the public. As this new era unfolds, organizations are assuming new roles, acquiring new capabilities, developing new business models, and interacting with consumers in different ways. Simultaneously, a flood of advances in the ability to preserve health and treat disease is creating exciting prospects and greater challenges for health care organizations and professionals and their patients.

At first glance it might appear that as institutions with a strong tradition of discovering and sharing knowledge, academic health centers (AHCs) would automatically become leaders of the health domain within the emerging knowledge economy. In fact, however, this leadership position is not assured. AHCs have been surpassed by other industries in the practices used to manage and leverage knowledge. They face growing competition in the discovery of new knowledge and are being challenged for the role of preferred source of health knowledge. Moreover, they must update their educational models for effectiveness in the digital era. Thus, AHCs need to attend to their organizational knowledge capabilities and to their role in the future health care environment.

AHC leaders face the pressing and pivotal question of how to position their organizations for future success. When current medical knowledge is ubiquitous and medical technology widely diffused, what added value can AHCs bring to the patient and student experience? As patients change their approaches to seeking and receiving health care services, how should AHCs adjust the preparation of health professionals? As research becomes more interdisciplinary, interinstitutional, commercialized, and is performed more often by research teams outside academia, how can AHCs remain attractive sites for researchers to ply their talents? As other organizations become more knowledge-focused and capable and technology blurs differences among organizations, what will preclude other organizations from developing innovative ways to provide the services traditionally provided by AHCs? More specifically, which knowledge management practices will contribute the most to AHC performance and to the goal of a value-driven health system? How much should AHCs invest to strengthen their knowledge capabilities?

Each AHC must determine how to respond to these challenges in line with its own unique characteristics, in consultation with its peers, and in light of lessons from other industries. Nevertheless, a common set of elements that all AHCs consider will likely emerge as they grapple with their future. These include assessment of leadership, capabilities of health professionals and other AHC staff, the technical infrastructure, and standard practices and business models in use. In this and two future reports, the Blue Ridge Academic Health Group (the Blue Ridge Group) provides background on specific topics that cross these domains – knowledge management, e-commerce, and leadership. The Group's intent is not to offer definitive answers, but rather, to stimulate thinking, discussion, and action within AHCs.

In light of experience in other industries, the Blue Ridge Group chose to explore the role of knowledge within leading organizations, examine current AHC knowledge practices, and identify ways AHCs can realign their knowledge capabilities for greater benefit to those they serve. Through this report, the Blue Ridge Group seeks to: provide an introduction to knowledge management; share examples of how a variety of corporations are approaching knowledge management; encourage broader use of knowledge management within AHCs; and advance thinking about how knowledge is tied to the leadership role within the health community and is increasingly linked to success in the market. The recommendations presented in the report advocate action by AHCs in three areas: increased attention and resource allocation to managing their knowledge, preparation of health professionals for the knowledge economy, and participation in the development of a national health information infrastructure. A fourth recommendation encourages other health organizations to support the diffusion of knowledge management within health care (see Exhibit 1).

This report builds naturally on three themes of the two previous Blue Ridge Group reports (*Blue Ridge Academic Health Group 1998 and 1999*). First, change is inevitable for AHCs and AHC leaders should seek creative responses to the challenges confronting them. To be successful, the exploitation of internal resources will become as important as seeking increased external resources. Second, information and information management play a critical role in improving the performance and strengthening the viability of AHCs. Third, AHCs can demonstrate leadership for the rest of the health care industry by their actions and, in so doing, advance the development of our health system while preserving and expanding their missions of patient care, education, research, and public service.

The report also complements the recommendations from previous Blue Ridge Group reports (see Appendix 1). Knowledge management supports and is supported by enterprise-wide management. A knowledge management infrastructure can advance use of organizational performance measures. Moreover, managing knowledge contributes to the development of a value-driven health system by enabling the practice of medicine based on evidence, productivity enhancements, and adoption of innovative practices. Aggressive use of organizational knowledge and information technology can extend the range of ways that health care professionals and organizations interact with patients, enable patients to assume more control in managing their health, and support population health management.

Although knowledge management within AHCs appeared to be a simple concept, it proved to be more challenging than originally anticipated by the Blue Ridge Group. Unlike the topics of its previous reports, knowledge management (as described in this report) is not widely discussed within AHCs. Moreover, the Blue Ridge Group is not aware of any AHCs that are fully configured for optimal knowledge management as are organizations in other sectors of the economy. Although the general concepts surrounding knowledge management are relatively easy to agree with, the actual implementation is filled with difficulties, not least of which is the need to change individual and organizational behaviors. Knowledge management presents challenges similar to – but surpassing – those associated with information system implementation.

It is a field that is still developing (and in general is not well understood) and

might be viewed as a management fad by some members of the AHC community. At the same time, it is a field with a great deal of breadth and depth. Rather than address knowledge management broadly within AHCs, it would have been possible to focus exclusively on the application of knowledge management practices to a single issue, such as the emergence of and demands created by bioinformatics. Despite the challenges surrounding knowledge management, the Blue Ridge Group believes that it will prove to be part of the evolution of sound business practices and offers this report to increase attention of AHCs to the topic.

Exhibit 1. Recommendations

1. AHCs should explicitly manage their knowledge as an organizational asset to improve their performance and strengthen their ability to meet both the market and social needs of their immediate community or region and the needs of the broader health care community.
2. AHCs should help current and future health professionals acquire the skills needed to use existing organizational knowledge, prepare for the new demands associated with their professions in the digital era, and contribute to the new discipline of knowledge management as it evolves.
3. AHCs should actively participate in the effort to develop and manage a sound national information infrastructure for health.
4. Federal agencies, philanthropic organizations, and professional organizations should advance understanding of the role of knowledge in the future health system and support activities that will further diffuse successful knowledge management practices in health care.

The Forces Shaping Health Care

Major challenges facing the health care community include providing insurance coverage to the entire population, measurably improving the health outcomes, and achieving high quality services consistently (*Blue Ridge Academic Health Group, 1999; Institute of Medicine, 1999*). To accomplish these objectives, health care organizations and professionals must manage the health of populations through evidence-based medicine, collaborative care, and chronic disease management. Simultaneously, they face new – and at times conflicting – accreditation requirements and greater public scrutiny in their handling of person-specific health information. Underlying all of these challenges is the need to manage and organize cohesively the ever-growing volume of health-related data and knowledge. Information systems and processes for managing and communicating knowledge to work teams and other key stakeholders have become cornerstones for health care organizations.

The health care environment is also being shaped by a series of interwoven external forces, including demographic trends, increasing consumerism, advances in telecommunications and computers, and changes in the nature of economic transactions (see Appendix 2 for discussion of these forces). For example, the increased connectivity of the U.S. population has begun to change the nature of patient interactions with health professionals and organizations by offering new tools to patients as well as professionals. An estimated one-third of the over 92 million Internet users seek health-related information (*Conte, 1999; International Communications, 1999*).

The world's largest medical database, MEDLINE, includes references from about 4,300 medical and scientific journals and a total of over 10 million citations. It handles over 16 million searches per month, with one-third of them being requested by non-health professionals (*National Library of Medicine, 1999; Lindberg, 2000*). Some physicians have begun to respond to electronic mail from both their patients and the general public (*Borowitz and Wyatt, 1998*), thereby improving ongoing communication between the patient and physician, in the first case, and providing a service that may or may not result in a referral, in the second. (In both instances, concerns about confidentiality, practicing medicine across state lines, and compensation arise.)

The Internet consumer health market is projected to reach $1.7 billion by 2003 (*Nash, 1999*). Web sites are a common feature for many hospitals and health systems, but they face stiff competition on the basis of both format and content from a wide variety of independent Web sites that provide updates on medical advances and information on specific conditions in user friendly formats. The most well-known sites have been developed and are maintained by firms whose primary function is to serve as managers or brokers of health information and knowledge for both professionals and the general public (e.g., WebMD, Mediconsult, Intelihealth, AmericasDoctor, drkoop) (*Miller, 1999*). These brokers bring greater interactivity to the use of the Internet for health and offer more options for customizing interactions. Health consumers can obtain virtual consults 24 hours a day, locate physicians in their area, check the compatibility of drugs they are using, learn about clinical trials, participate in specialized support groups, develop personalized health records, and fill drug prescriptions –

all via the Internet and without interacting with a traditional health provider organization (*National Research Council, 2000a*).

In general, however, the health care industry's response to the transforming economy is nascent compared to other industries where instantaneous communications and computing capabilities separate selling and the delivery of goods, reduce response time to customers, enable customization, and speed the diffusion of new trends within and across organizations and industries. The banking, travel, and retail industries have already developed the ability to provide services electronically and, in many cases, to improve upon them. They are using the capabilities offered by the Internet and other kinds of information technology to transform how they do business by extending their accessibility, making better use of their organizational information, using encounters with customers to gather new information, and using such information to develop new services.

These developments are influencing the general public's performance expectations for other industries, including health care. If some industries can become more accessible and flexible, provide streamlined services, integrate information, and offer greater value, why not all industries? And, although the pace of development may be mitigated somewhat by well-publicized shortcomings (e.g., temporary unavailability of Web sites or inability to fill orders placed electronically during peak periods), the general direction is irreversible. Ultimately, success will gravitate to those who reliably deliver on these emerging criteria of high performance.

Far more dramatic changes are projected for the not-too-distant future. Ray Kurzweil (who worked on optical character recognition in the 1970s, voice recognition in the 1980s, and print-to-speech reading software in the 1990s) has predicted that in just 10 years, a $1,000 personal computer will be able to perform a trillion calculations per second. At that point, most text will be created using continuous speech recognition; routine business transactions (e.g., purchases, travel reservations) will most often take place between a human and a virtual personality; and intelligent courseware will be a standard means of learning (along with traditional classrooms). According to Kurzweil, things will really start to get interesting around 2029, when a $1,000 (in 1999 dollars) unit of computation will have the computing capacity of approximately 1,000 brains and direct neural pathways will have been perfected for high-bandwidth connection to the human brain. By that time, automated agents will be learning on their own and significant knowledge will be created by machines with little or no human intervention (*Kurzweil, 1999*).

Whether or not Kurzweil's predictions are totally on target, the major thrust of his hypotheses is difficult to ignore. Technological advancements will not only continue, but will do so at an accelerating rate of speed, with the ultimate impact being unavoidable for our society and economy. Organizations cannot afford to ignore the direction and magnitude of the forthcoming changes.

Knowledge as Capital

Competitive success has always been a function of a firm's knowledge about how to optimize its resources. Compared to other assets (i.e., land, capital, and labor), the role of organizational knowledge has grown over time. The current information-based, global economy has transformed this intangible asset into the primary source of wealth for firms and nations. Knowledge and information now are both raw materials and valuable products. Not only has the knowledge intensity of goods and services increased dramatically, but knowledge and information also play a critical role as organizations adapt to their ever-changing environment. The increasing speed of change in markets, staff attrition, growth in the scope of organizations, globalization of markets and firms, growth in networked organizations, and changing consumer expectations all place new demands on organizations that can be offset through management of information and knowledge (*Cole, 1998; Stewart, 1997*).

Organizational knowledge is typically tacit rather than explicit (*Bock, 1998*). It appears in unwritten rules, undocumented experiences, and uncaptured expert talent. This important resource tends to be local; taken for granted by those who possess it; not easily codified; and, therefore, often difficult to communicate. As the value of knowledge has grown, the transformation of tacit to explicit knowledge has become one of the most important challenges for organizations. It cannot, however, be met by technology alone. Knowledge transformation and diffusion is most likely to occur in an environment of trust through dialogue and interactive problem solving. Knowledge generally spreads when people gather and share stories or if they make a systematic effort to find it and make it explicit (*Nonaka and Takeuchi, 1995*).

Once knowledge is captured in a way that allows it to be described, shared, and deployed to do something that could not be done previously, it becomes an organizational asset or intellectual capital (*Stewart, 1997*). Unlike other assets that are easily accounted for and managed, the value of this asset resides in an organization's people, structures, and relationships. Simply spending more money on experts, information systems, or databases will not, however, increase intellectual capital. These actions must occur within an environment that is shaped by strategies that focus the allocation of organizational knowledge resources on clearly defined goals and that expects and enables colleagues to share and act on information, knowledge, and expertise.

Organizational efforts to develop such strategies and create such an environment are often described as knowledge management. Knowledge management initiatives generally focus on two fundamental objectives: enable knowledge sharing and use knowledge to generate value (*See Exhibit 2.*) Successful knowledge management initiatives underlie existing business processes; support specific business strategies and objectives; focus on solution of concrete problems; provide a range of tools that can be skillfully used by workers; and, most importantly, lead to action as a result of the new knowledge or insight gained.

A growing number of business leaders consider the ability to manage and act on organizational knowledge as essential to the success of firms (*Wah, 1999*). A diverse set of companies are strengthening and, in some cases, transforming themselves by focusing on, capturing, organizing, commu-

nicating, and acting on their organizational knowledge. These companies are succeeding in reducing costs, improving quality, streamlining processes, managing huge organizational changes, creating new products, improving productivity, and retaining critically important knowledge workers (S*tewart, 1997; Davenport and Prusak, 1998; McCune, 1999*). In essence, these companies are using knowledge to extend capabilities, strengthen relationships, and create value. Along the way, many of them have enhanced their company culture and sense of identity in order to drive substantial changes.

I have long believed in technology, what can be done, will be done. In every other industry and endeavor, information technology is revolutionizing how work is done. It has become or is becoming the X Factor. I believe it will do so in medicine too.

– The X Factor, Andrew Grove, Journal of the American Medical Association, October 21, 1998

AHCs and Knowledge

Although AHCs differ in many ways, knowledge is a core element of these organizations. Each of the AHC missions relies upon communication, application, and analysis of an ever-growing volume of complex information and knowledge. Sharing of information and knowledge among researchers, between clinicians, with patients, from teachers to students, from mentors to residents, and sometimes even across these lines is the cornerstone of daily AHC operations. AHCs have been gradually expanding their methods of sharing, developing, and applying knowledge as information technology evolves. To varying degrees and in a variety of ways, AHCs make information and knowledge more accessible for internal and external users, target how knowledge is presented, and insert knowledge into routine processes to improve efficiency or outcomes. Some AHCs are becoming more sophisticated in their use of knowledge as a means of interacting with potential or actual consumers.

As primary knowledge repositories for AHCs, health sciences libraries have been at the forefront of acquiring access to and making available the knowledge needed by AHC professionals. The shift from print to digital media is enabling libraries to bring knowledge closer to the actual site of work for more convenient and faster use. In addition, health sciences libraries have used their knowledge resources and staff expertise to support a variety of communities important to, but not physically part of the AHC. For example, medical student preceptors are often provided access to online knowledge sources. The North Carolina AHEC is building upon this concept by providing preceptors access to a customized library and creating a virtual faculty lounge for them (*North Carolina AHEC Program, 1999*).

A wide range of information and knowledge needed by AHC staff or their customers is increasingly available online (e.g., institutional policies, medical school applications, residency opportunities, lectures, expertise of faculty within the institution) (*Johns Hopkins Medicine, 1999a and 1999b*). In some cases, this material is formatted for a specific target audience. For example, as part of an effort to create better patient services, billing, and scheduling, Emory Health System is developing a Web site for the general public that will offer information on wellness, disease management, clinical trials, and how to access services at Emory (*COR Health LLC, 2000; Emory Health System, 2000*). In other instances, AHC staff are using information and knowledge that are readily accessible to improve processes (e.g., use standard templates in preparing grant proposals or make online image databases available to assist faculty in preparing lectures) (*University of Virginia, 1997; Johns Hopkins Medicine, 1999c*). Clinical information systems now include clinical alerts and reminders and real-time access to most current medical knowledge to ensure that complete data are collected, to assist clinicians in making sound decisions, and to minimize adverse events (*Bates et al., 1998; Hunt et al., 1998; Sackett et al., 1998*). Vanderbilt University formats clinical protocols for residents to load into Palm Pilots, thereby providing immediate access to important knowledge.

In addition to disseminating knowledge through traditional mechanisms (e.g., classrooms, rounds, publications), AHCs have begun to offer online education opportunities for students, residents, professionals,

and patients (Sikorski and Peters, 1998; University of Virginia Health System, 2000a and 2000b). AHCs have also begun to repackage the knowledge generated within their institutions for other users to meet specific market needs and to form partnerships that combine knowledge bases or establish more effective knowledge distribution channels. For example, Johns Hopkins publishes the Johns Hopkins Family Health Book and established a Web presence for its knowledge in the form of Intelihealth (Intelihealth, 1999; Johns Hopkins, 1999). A consortium of midwest AHCs established a Web site to provide specific information resources selected by librarians and information professionals (Health Web, 2000). Another group of AHCs formed webEBM to assist clinicians and patients in making informed decisions through the use of evidence-based clinical guidelines (webEBM, 2000).

Centralized, longitudinal clinical databases derived from clinical records enable AHC faculty to study patients over time or across populations while maintaining patient privacy. Such databases enable a clinical researcher to focus on questions of immediate concern to a particular population and to use the results to inform clinical practices in a fairly short time frame or to compete for extramural research funding (*Duke University Medical Center, 2000; University of Virginia Health System,1999*). Through an IAIMS grant funded by the National Library of Medicine, the University of Chicago is promoting collaborative and translational research by linking basic researchers with clinicians through a series of databases including "individual research interests, gene sequences, genetic maps, antibodies to the proteins encoded by the genes, patient data, and patient slides in the pathology service" (*University of Chicago, 1999*). It is now easier to disseminate and access information about clinical trials and resulting protocols. Patients from a broader area can also participate in these studies (*National Library of Medicine, 2000*). Similarly, biomedical researchers can more easily submit their findings or access the discoveries of other researchers via a government established mechanism for management of research results related to human genome or use computational tools provided by the National Center for Biotechnology Information (*National Center for Biotechnology Information, 2000*). Several universities have established technology transfer offices to manage their intellectual property assets (*Stanford University, 2000; UNC-Chapel Hill, 2000*). These offices assist faculty in obtaining research support from corporate sponsors, license discoveries developed by faculty and staff, and develop agreements for sending university materials to scientists at other institutions.

Although a wide knowledge of activities can be found across AHCs, knowledge management activity within and across AHCs is uneven. Despite their wealth of knowledge, large pools of highly educated and motivated professionals, and increasingly robust information technology infrastructures, AHCs underutilize their knowledge. Knowledge enables academic success for AHC professionals, is needed for positive clinical results, and is the basis for ongoing research. It is not, however, a commodity in and of itself. It is not considered as a form of capital that ought to be maximized.

The typical AHC organizational structure (i.e., dominated by clinical departments) has been credited with inhibiting enterprise-wide management of revenues, facilities, and personnel. It also has limited evolution of knowledge management practices within AHCs, which have tended to be

localized and often individualized rather than viewed in terms of meeting organizational strategies. Knowledge management within AHCs is often piecemeal and ad hoc, sometimes initiated by the interests of a single faculty member rather than being the result of the decision to respond to a specific organizational need. Typically, knowledge gained during work processes is used for one purpose; rarely is it captured for subsequent application or transferred from one organizational domain to another to improve processes or stimulate new products, as is increasingly practiced in other industries. Just as AHC faculty and staff cross functional lines to perform their work, knowledge resources must be released from rigid organizational structures and made available to all staff who can contribute to or benefit from them.

AHCs tend to view organizational knowledge narrowly. In addition to the medical knowledge that is critical for patient care and basic science knowledge that supports research, knowledge exists on a wide range of topics related to patient preferences, suppliers, potential collaborators, work processes, and in-house experts that has only begun to be captured, managed, and leveraged to improve organizational performance. There is a great deal of tacit knowledge within AHC faculty and staff that could advance the strategic objectives of the organization, if it is identified and added to explicit knowledge bases.

As educators, clinicians, and researchers, AHC staff share knowledge on a daily basis with a variety of audiences. Sharing knowledge for purposes of educating students, treating patients, or disseminating research results is, however, very different from sharing knowledge to transform a business. Like other successful businesses, AHCs can find opportunities for innovation throughout their institutions – literally from the ground floor where support services reside, to clinics and patient care units, to classrooms, to research laboratories, to administrative suites. Within each of the missions and the accompanying administrative and support services, there are multiple points for gathering or applying organizational knowledge. At each stage of a work process there may be an opportunity to create greater value simply by making existing knowledge readily available to those who need it.

Today, the improvement of organizations and the information systems in them is not a matter of making more information available, but of conserving scarce human attention so that it can focus on the information that is most important and most relevant to the decisions that have to be made. ..... Information isn't the scarce resource; human time and attention is the scarce resource.

— Simon, H.A. 1997

A Knowledge Infrastructure

Often the most visible element of an organization's knowledge management initiative is the creation of a knowledge infrastructure or knowledge web. At its most basic level, the knowledge web connects staff with information and knowledge needed for their work and connects them to each other. A knowledge web builds upon and enhances the existing organizational technological infrastructure in at least two ways. First, the technological infrastructure is used to capture and, in some cases, to codify knowledge so that others can access it in the future. By making organizational knowledge readily available, the knowledge web eliminates redundant work steps and enables staff to focus on unique attributes of a task sooner. Second, it goes beyond support of transactions to support of relationships (among staff, between the organization and staff, and between the organization and its customers or suppliers) that generate value. As an added benefit, establishment of a strong knowledge web prepares the organization for introduction of e-commerce practices into its business.

In addition to a technological infrastructure and the actual content, the knowledge web encompasses processes for gathering, filtering, and disseminating knowledge; policies to guide the organization's development and use of knowledge; and designated staff to manage the knowledge web and support the organization's use of knowledge (*Bock, 1998; Davenport and Prusak, 1998*). To establish a knowledge infrastructure, an organization must address:

- **Content** to be included, determined in part by focus of the knowledge management effort (e.g., single unit, multiple units, or entire organization) and assessment of credibility and reliability of data and knowledge sources.

- **Processes** to be used to capture knowledge from professionals without adding substantially to their work, to filter new knowledge to determine usefulness to others, and to classify and code content so that it can be easily accessed by future users.

- **Policies** needed to manage issues surrounding intellectual property and in the case of health care, to safeguard patient privacy when knowledge resources come from patient data.

- **Resources** needed to support the knowledge infrastructure (e.g., dedicating staff to managing organizational knowledge, expanding existing information technology infrastructure, and ensuring that future information technology investment supports knowledge management objectives).

- **Services** provided by the knowledge infrastructure (e.g., defining shared services, offering integrated services to staff).

- **Relationships between and responsibilities of** knowledge management and information technology staff.

Firms may develop a knowledge infrastructure to support a particular kind of knowledge to be managed, to support a particular group of workers, or to resolve a specific organizational need, as has been done

by various companies. For example, to maximize the number of problems that can be solved with a single telephone call, technical support representatives at Dell Computer Corporation use a knowledge base that advises them on the kinds of questions to ask callers and guides technicians through problem solving (*McCune, 1999*). Hewlett Packard has established an electronic network to manage and distribute knowledge in response to customers' demands for rapid service. The system is used by 1,900 technical staff members whose job is to keep customers' systems up and running. Once a problem is reported, a description of the problem and its urgency are entered into a database. The database is updated as employees work in it so that if the problem is not resolved by the end of shift, it is sent to the next center with full information (*Stewart, 1997*).

Alternatively, a knowledge web may be designed to provide knowledge resources to the entire organization, as was done by Ernst & Young LLP (*Center for Business Innovation, 1996a*). The knowledge web supports 80,000 professionals and has been credited with improving their work experience and contributing to improved staff retention. It includes practice-specific knowledge bases, a catalog, a navigation taxonomy, search engines, a set of templates for use in adding new content, a database describing consultant skills, guidelines for ownership of content, and a standardized technology platform.

A key element of the Cap Gemini Ernst & Young knowledge web is the availability of filtered sets of online material containing essential knowledge a consultant needs to possess to work in a given area. The knowledge infrastructure includes a chief knowledge officer, a knowledge process committee, knowledge networks for each of the key consulting domains, a nd three knowledge-focused units. One unit focuses on creating new knowledge, another structures knowledge into methods and automated tools, the third gathers and stores the firm's acquired knowledge and external knowledge.

Just as with health care, the higher education enterprise is entering a period in which market forces could well lead to massive restructuring.

— A University for the 21st Century, James J. Duderstadt, 2000

A Knowledge Culture

For a knowledge infrastructure to be effective, the organizational culture must expect and endorse knowledge sharing (*McDermott and O'Dell, 2000; O'Dell and Grayson, 1998*). Enterprise-wide focus is essential for organizational success, but not easily achieved in environments where units traditionally have been autonomous. Employees may be accustomed to hoarding knowledge in the belief that such behavior protects their power or ensures their value to the organization. Organizations must also overcome broader cultural influences. Contemporary society values individuals with technical expertise and those who create knowledge over those who share knowledge. As a result, staff may be resistant to trying practices developed elsewhere. This situation is exacerbated by lack of awareness of what and how things are done elsewhere in the organization.

Thus, organizations seeking to manage knowledge need to attend to the nontechnical components of the knowledge management infrastructure and begin the gradual process of cultivating an organizational climate for sharing (see Exhibit 2). Supporting communities of practice is one way to foster a knowledge-sharing culture. Informal networks known as communities of practice are critical building blocks of a knowledge-based company because they provide the mechanism by which ideas, information, and new practices spread most easily throughout an organization (*Senge et al., 1999*). Communities of practice or formal work units provide natural boundaries for initiating projects that can then be replicated for similar groups, revised for groups with different needs, or expanded for the entire organization.

Based on research begun in the 1980s, Xerox has emphasized communities of practice in its knowledge management (*Murray, 1999*). Xerox identified a gap between the knowledge applied in the field by service technicians and information found in manuals. After studying how technicians interact with each other to share knowledge (i.e., tell war stories to teach each other to diagnose and fix machines), the Eureka system was developed to allow technicians to share their stories in the form of electronic tips. Field service representatives create and maintain the knowledge base by contributing tips that are validated by a formal review committee. By using a common documentation method to facilitate lateral communication, the system enables Xerox service teams around the globe to diagnose, solve, and prevent equipment problems. Equally important, other groups within Xerox now access and use the knowledge contained in Eureka to improve their work product. Engineering, manufacturing, and documentation units use the knowledge to improve design, production, user instructions, and technical manuals.

Novartis, a life sciences company created in 1996 through the largest merger in history to that point in time, has focused on creating a knowledge culture since its inception. Novartis' corporate objectives include: the "transmutation of accumulated knowledge into a corporate asset by exploiting the vast amount of knowledge across organizational boundaries; providing easy, rapid access to a global knowledge base; eliminating time and space constraints in communications; and stimulating associates to experience the value of knowledge sharing" (*Probst, 1998*). Accordingly, the company designated knowledge managers, established

advisory committees and knowledge networks, and created a series of awards for innovative research both within and outside the company. Novartis' knowledge activities include: using its knowledge about consumers to shape its research and development of nonprescription drugs; routinely scouring the work done by small innovative companies who cannot afford to develop their ideas to maximum potential; and developing partnerships to increase its knowledge base on health, safety, and environment issues (*Novartis, 1999*).

The exponential growth of technology in the first two decades of the 20th century matched that of the entire 19th century. The exponential growth of technology in the first five years of the 21st century will inevitably, inexorably, match that of the entire 20th century.

— The Age of Spiritual Machines, Ray Kurzweil, 1999

Knowledge Management Processes

The most tangible results from knowledge management activities often arise from efforts to harvest, transfer, and apply organizational knowledge. Hoffman-LaRoche, a Swiss-based international pharmaceutical company, used a knowledge management initiative to reduce both filing and Food and Drug Administration approval time for new drugs. Roche successfully improved its performance in application preparation and approval time by mapping its existing knowledge and prototyping the application process to determine what knowledge customers need to have and how to create that knowledge. The application for a new indication for one drug resulted in a reduction in filing time from a projected 18 months to three months and approval time from a projected three years to nine months, at an estimated savings of $1 million per day (*Center for Business Innovation, 1996b*).

British Petroleum (BP) seeks to "make the reuse of existing knowledge a routine way of doing business and to create new knowledge to radically improve business performance" (*Wah, 1999*). BP's Peer Assist Program has proven to be highly effective in transferring knowledge within the organization (*Ernst & Young LLP, 1998a*). After initial research and data analysis, new project teams identify issues needing clarification. They call on experts within the company to form a group that meets with the project team for one to three days to identify possible solutions to the issues. Invited experts participate willingly, even though the task is in addition to their regular job. They view the invitation as an honor and an opportunity to see what is happening in another part of the company.

A project is not complete at BP until those involved have articulated lessons learned, action points for the future, and quantification of key internal measures during completion meetings. Business lessons that emerge from facilitated team sessions are translated into best practices and are added to the corporate knowledge database. In addition, approximately one-quarter of BP business units have knowledge guardians who help their teams harvest newly created knowledge (*Wah, 1999*).

The World Bank is using knowledge management techniques to streamline its work processes. It has adopted a new approach for responding to technical questions (e.g., education strategy development). Rather than assembling a study team to visit a country and write a report, which usually takes months, a project manager contacts a community of practice within the bank asking for advice. Responses come from bank staff and partners around the world, enabling a report to be produced quickly and added to the bank's knowledge base on development issues. Over 100 communities of practice contribute to the knowledge base, which is envisioned to ultimately be available to anyone via the Internet (*World Bank, 2000*).

Another class of knowledge management activities focuses on increasing the knowledge of the organization. KPMG LLP, a consulting firm, is using a Web-based curriculum on Internet studies to ensure that all staff in its consulting division, from administrative assistants to senior partners, have the necessary skills to respond to the emergence of the Internet as a major business force. The 50-hour course is offered online, includes a pretest and final exam as well as virtual lectures, and is updated every 90 days. Within three months of its availability online, 95% of KPMG's domestic workforce had taken the final test. KPMG has also developed higher-level courses for interested staff (*Balu, 2000*).

Rising to the Challenge

How AHCs respond to the challenges of defining their role, building new capabilities, becoming more responsive, and developing new models for their clinical, educational, and research enterprises will determine their influence in the health system of the 21st century – nationally and globally. The Blue Ridge Group believes that AHCs can become leaders within the health community by establishing themselves as premier knowledge managers for all health knowledge domains (such as health maintenance, disease management, evidence-based medicine, and population health management). Doing so will enable AHCs to evolve from their traditional roots into organizations that are able to respond to contemporary forces and anticipated needs of individual patients, regions, the nation, and beyond.

Pursuing this path will require that AHCs allocate resources to knowledge management. Actual investments in the technological infrastructure will depend on the current status of an individual AHC infrastructure, but in virtually all cases, additional attention and investment will be needed to strengthen knowledge management and electronic commerce capabilities. Equally important and perhaps more difficult will be the preparation of staff, not only by building skills to use knowledge management systems, but also for a potentially dramatic transformation of their roles as clinicians, educators, and researchers. Health professionals will increasingly serve as coaches to more of their patients. Instructors may function more as collaborators in the learning process. Researchers may find that some traditional research methodologies are too limited given the new questions they will be seeking to answer and the new capabilities of computers to process increasingly complex problems. From discovery to application dissemination and all possible combinations of these three activities, networking will become normative behavior.

Today, all AHC personnel need to be knowledge workers (*Drucker, 1988*). Faculty and staff need to think in terms of what the organization needs and to define the resources (other than financial) they need from the institution to be effective in their work in a post-Gutenberg world. AHCs can use knowledge management activities to promote desired behavior. Moreover, well-designed knowledge management programs can facilitate work processes, enrich work experience, and promote career development of the workforce and thereby increasing satisfaction of staff.

A variety of factors may impede knowledge management within AHCs. AHC leaders and staff may underestimate the need to strengthen their knowledge management capabilities and incorporate knowledge management practices into their work processes in light of the myriad demands on their time, attention, and financial resources. Revenue streams for patient care services that depend on externally determined reimbursement mechanisms do not create incentives for health organizations and professionals to pursue nonreimbursable activities like knowledge management, despite the potential positive impact on patient outcome, organizational efficiency, and ultimately the bottom line. Further, AHCs may not recognize the crucial distinction between explicitly managing their organizational knowledge and developing information systems (see next section). Or, they may possess a false sense of security

created by the fact that AHCs have been in the knowledge business since their inception and already have numerous, albeit disjointed, knowledge management activities underway.

AHC leaders face substantial challenges in creating an environment in which knowledge and information of all kinds are shared with ease. Such an effort requires decisions and behaviors that will likely conflict with some traditional AHC habits. Previous organizational structures and practices, as well as reimbursement mechanisms, reinforced a tendency to think in terms of departmental needs rather than the whole enterprise and to hold onto information and knowledge rather than to share it. And even if faculty wanted to share information with colleagues, there typically were limited means to do so easily. As a result, sharing information beyond a work unit was not standard practice. There are also knowledge issues that arise because the various business units of the AHC – the medical school, nursing school, hospital, public health school, primary care network, basic science departments, medical libraries, e-health databases, etc. – have different professional and administrative knowledge glossaries, grammars, and standards.

Several knowledge issues of particular concern to AHCs have become more complex as technology and business models have evolved. Libraries face growing challenges in keeping up with the growth in electronic media and the technological infrastructure needed to serve patrons on top of rising subscription costs. Biomedical researchers require increasingly sophisticated capabilities (i.e., access to and expertise in biomedical computer applications) to analyze complex molecular structures and link them to relevant clinical information. Current laws and policies aimed at protecting intellectual property are outmoded in the digital environment and a new policy framework has not yet begun to take shape (*National Research Council, 2000a*). Managing intellectual property in the AHC environment requires a fine balance between the education of professionals and dissemination of research results to advance health and the protection of intellectual property to maximize potential revenue associated with new discoveries. Moreover, the relationships that AHCs establish to leverage their intellectual capital – through funding or collaboration or for dissemination – require new organizational models and behaviors and raise new conflict of interest issues that need to be managed (*Angell, 2000; COR Health LLC, 2000; Intelihealth, 1999*).

Universities are a collection of brilliant people, but not examples of collective brilliance. Because there is little information flow, the university is not intelligent as a whole.

— Betty Zucker, as quoted in Intellectual Capital: The Wealth of New Organizations by Thomas A. Stewart, 1997

IT in Support of AHC Knowledge Management

AHC leaders and staff may view the presence of an information technology (IT) infrastructure as equivalent to knowledge management. Certainly, mature knowledge management initiatives cannot succeed without a robust IT infrastructure, but knowledge management encompasses much more than technology because knowledge management is ultimately about behaviors and actions. Moreover, not all IT is capable of supporting knowledge management efforts. Ultimately, an organization's knowledge management should inform and drive the IT infrastructure development. To accomplish this objective, some organizations name a chief knowledge officer to oversee knowledge management efforts and to work with the chief information officer (see Exhibit 3 for comparison of chief information officer and chief knowledge officer roles within an AHC).

Much like their organizational structure, the IT infrastructure of AHCs — including electronic mail, office support software, clinical information systems, online access to health knowledge sources, and a variety of administrative systems – is typically large, complex, fragmented, dominated by the clinical operation, and gradually becoming more integrated. AHCs have advanced their technological platform considerably during the past decade and are continuing to do so by implementing more comprehensive and integrated systems, building institutional Web sites and resources, and confronting issues surrounding the control and management of information systems. For example, many AHCs are making strides toward achieving the objective of having all relevant patient data available to health professionals during a patient encounter. This represents a threshold improvement for the practice of sound medicine and is not easily achieved in the complex AHC practice environment, as it requires overcoming historical differences in how inpatient and outpatient records were maintained.

Despite the considerable progress achieved, however, significant work remains for information systems to meet the needs of contemporary health care and for individual organizations to implement truly robust systems throughout their organizations. In addition to widely known issues surrounding health care IT (e.g., confidentiality protection, ease of use, standards for data), outstanding needs generate additional requirements for information systems in AHCs (*Goldsmith, 2000*). For example, one as yet unmet requirement for information systems is the ability to generate three distinct kinds of clinical data sets. In addition to the patient records traditionally maintained by health care organizations to support institutional needs, increasingly patients seek to maintain their own records to aid in the long-term management of their health. The growing emphasis on managing population health requires databases that incorporate health information for the residents of entire regions. Each of these kinds of health records — personal, organizational, and population — impacts research and education, as well as patient care, and is an important element of the health information infrastructure for the country, but to date organizational health records have received the most attention and development (*National Committee on Vital and Health Statistics, 1998*).

Organizations seeking to manage their knowledge effectively require an even higher level of capabilities from their IT infrastruc-

ture. Current information systems within AHCs facilitate communication; collect, organize, and provide access to data; streamline certain work processes (e.g., ordering tests and reporting results); and, in some cases, guide clinical decision-making through alerts or links to knowledge sources. In addition to these functions, a knowledge management infrastructure facilitates connections within communities or practice or work units; provides access to all the kinds of knowledge needed for staff to perform their work; increases organizational knowledge; and promotes the use of knowledge in routine tasks, innovation, and interactions with customers.

Thus, an information system that is part of a knowledge management infrastructure includes standard terminology, directories of available contents, robust search engines, templates for easy collection of knowledge, both global and unit-specific databases and knowledge sources, and prompts or alerts of available knowledge embedded within processes supported by the information system (*McCune, 1999*). Moreover, the system is supported by staff who focus on the knowledge needs of users. Ideally, such systems provide the knowledge needed by users without them having to think about what they need and how to get it.

A knowledge infrastructure makes needed information and knowledge available automatically as part of the work process, or upon demand to meet specific requests, or via periodic updates that provide a synthesis of developments with easy access to greater detail. Clinicians need immediate focused access to current and relevant knowledge when making decisions in the course of regular patient care. Clinical alerts (e.g., to prevent adverse reactions) have been shown to be very effective in achieving positive outcomes and are used by many AHCs, but just-in-time knowledge access is not a standard part of each health professional's interaction with their organization's information system (*Chueh and Barnett, 1997*). Similar opportunities exist to support research and education through just-in-time knowledge strategies, as well. For example, AHCs face the ongoing challenges of sharing knowledge among researchers in real time, increasing the efficiency of research, and quickly moving the knowledge created through research into practice and teaching.

A knowledge management system can enable AHCs to optimize resources spent on obtaining access to external knowledge sources as well as the time spent by faculty and staff on keeping up with the knowledge in their field. Individual departments or service centers may provide staff with summaries of seminal journals for their field. Urgent findings can be highlighted in regular bulletins and linked to the records of patients with relevant diagnoses. Costs of subscriptions can then be consolidated and staff can be freed from reviewing every journal to focus on those of particular interest. Summaries of developments across multiple fields can be combined to offer interdisciplinary perspectives on advances in clinical care and research.

An AHC knowledge management system should intersect the clinical arena with the research and education enterprise. If it does not, there is a great likelihood that the information systems for each mission will be designed and implemented so that most of the potential synergy across the missions will be lost. Specific knowledge resources and processes for capturing and formatting organizational knowledge are required to meet the needs of education and research communities of practice. Particular consideration of how to facilitate knowledge trans-

fer across mission domains, organizational units, or specialties is needed. Although a single information system within an AHC is unlikely, consistency among various systems used by staff is desirable and knowledge management practices would be aided by a global index (accessible from each system in use) that identifies how to access various organizational knowledge resources.

AHC information systems need to be evaluated in light of the new requirements posed by knowledge management. Does the system reinforce a knowledge management and learning culture? Does the system provide a means of implementing knowledge strategies for patients, referring physicians, students, and staff? Does the system capture the various kinds of information that will form the basis of new organizational knowledge? Does the system offer the potential to create advantage in the market by allowing the institution to provide services or provide them in a way other organizations cannot offer?

Managing for knowledge means creating a thriving work and learning environment that fosters the continuous creation, aggregation, use and re-use of both organizational and personal knowledge in the pursuit of new business value.

— Paul Allaire, Chairman, Xerox Corporation

Managing an AHC Asset

Recommendation 1. AHCs should explicitly manage their knowledge as an organizational asset to improve their performance and strengthen their ability to meet both the market and social needs of their immediate community or region and the broader health care community.

The emergence of the knowledge age is opening a wide range of possibilities for the future of health care. The emergence of the knowledge economy is creating a new set of demands for organizations to meet for success in the market. Meanwhile, the need for a health system that focuses on improving the health of the population and managing costs presents its own set of challenges to AHCs. The combination of these factors led the Blue Ridge Group to conclude that knowledge management is a critical success factor for AHCs in the 21st century. Fortunately, the set of characteristics that define AHCs – multimission, large size, complex organizational structure, sophisticated work, highly educated professionals, and a strong tradition of seeking, discovering, and disseminating knowledge — provide the foundation for large gains to be earned through well conceived knowledge management initiatives.

Such initiatives must be based on clearly defined organizational strategies and support organizational mission. Thus, a first step for AHCs seeking to expand their knowledge management capacity is to assess their current mission and strategies in the context of the anticipated environment. Among the multitude of factors to be considered:

- The impact of the interconnected economy, but not yet fully connected public
- Which parts of the evolving health market (including e-health) it makes sense for an AHC to compete in
- The extent to and means by which AHCs can advance health of populations
- The changing educational environment, as well as the changing base of learners (including health professional students, patients, faculty, and staff)
- The kind of research that will likely be in demand
- How to build an infrastructure that fosters collaboration across disciplines and across domains
- How to generate value in each AHC program

Once an AHC has developed focused organizational strategies for the emerging environment, it can develop corresponding knowledge strategies. An AHC may choose to foster productivity of a particular unit or community of practice, capture existing knowledge for reuse elsewhere in the organization, encourage collaboration among researchers, or embed knowledge in routine encounters with patients and other customers as a means of solidifying market position. Exhibit 4 presents a scenario of

how an AHC might focus its knowledge assets on strengthening its clinical enterprise, and Appendix 3 describes approaches AHCs can use to strengthen their position as knowledge managers in the clinical arena.

If AHCs follow a path similar to that of organizations with robust knowledge management programs, knowledge management practices and infrastructure will become a visible and integral part of daily operations. AHCs can improve their ability to share and act on knowledge within and external to the organization by building facile enterprise-wide knowledge webs to support the various communities of practice that exist within AHCs or in which AHCs participate (including patients, localities, and surrounding regions). Knowledge management initiatives, however, need not and probably should not begin with organization-wide implementation. A phased implementation is more likely to yield desired results and complement availability of organizational resources. For example, an AHC can initiate limited scope, high impact knowledge projects or build upon existing knowledge activity in the near term to strengthen their knowledge management skills, while concurrently developing a comprehensive knowledge management infrastructure.

A variety of activities are appropriate for the first phase of an AHC knowledge management program. AHCs can begin by identifying their existing knowledge management activities and assessing their value in serving their defined needs and potential to serve as organizational models. Units displaying clear evidence of explicit knowledge management or early adopters of IT are strong candidates for participation in larger pilot projects. Pilot projects should be designed to provide specific knowledge management capabilities to a defined community of practice. Both pilot projects and ongoing programs should have a clear strategy and be evaluated to determine if objectives are met and to identify those factors that contributed to or hindered successful knowledge management within that organization. Highlighting early projects can introduce other staff to the concepts and benefits of knowledge management, as well as reinforce the organization's commitment to the endeavor.

Once pilot projects are underway, an AHC can attend to the design of its knowledge web (i.e., goals, policies, content, processes, staff, and technological infrastructure). This design process should incorporate lessons learned from the pilot or previous knowledge management experiences, build on work accomplished or underway within information technology units and the library (including information technology and resources already in place), and focus on meeting the current and projected needs of the communities of practice. In addition, AHCs should assign responsibility for leading knowledge management efforts within the organization to "knowledge officers" and introduce performance expectations that address knowledge management behaviors by staff. Subsequent phases will likely involve expansion of pilot programs and development of the knowledge web with sustainable budgets so that the AHC as a learning organization can continue its progression.

By already serving as a steward of some AHC knowledge, providing integrated services to multiple audiences, and adapting to an increasingly technology-intensive environment, the health sciences library is well positioned to play an active role in AHC knowledge management development. Library staff can contribute to the development of the technological infrastructure and

consideration of how to manage organizational knowledge that resides outside standard knowledge bases. Aided by IAIMS funding from the National Library of Medicine, some health sciences libraries have already sought such a role (*IAIMS Consortium, 2000*).

In the knowledge-creating company, inventing new knowledge is not a specialized activity — the province of the R&D department or marketing or strategic planning. It is a way of behaving, indeed a way of being, in which everyone is a knowledge worker — that is to say, an entrepreneur.

— The Knowledge Creating Company, Ikujiro Nonaka, 1998

Preparing AHC Professionals

Recommendation 2. AHCs should help current and future health professionals acquire the skills needed to use existing organizational knowledge, prepare for the new demands associated with their professions in the digital era, and contribute to the new disciplines of knowledge management as they emerge.

AHCs face substantial education and training challenges as they increase their knowledge focus and as health professionals grapple with their evolving roles. These issues impact both the educational and operational domains of AHCs, require both immediate and longer-term responses, affect current and future health professionals alike, and can be addressed through a combination of traditional and innovative approaches. The content and methodologies used in the education of health professionals will shift perceptibly (*AAMC, 2000a*). A primary objective is to lessen the distance and discomfort between human (carbon-based) and computer (silicon-based) knowledge so that accessing, processing, and applying the growing knowledge base becomes second-nature for all professionals, whether or not they are already accustomed to information technology and inclined toward ongoing knowledge synthesis.

From the perspective of transitioning an AHC into a knowledge-managed organization, the most pressing need is to ensure that staff and students alike understand that application of relevant knowledge resources is an integral part of health care processes. This requires proficiency in the use of both information systems, in general, and the AHC's information systems specifically. It also requires that health professionals and students develop, expand, or reinforce a consistent habit of incorporating available knowledge into their work processes.

Subsequently, AHCs can focus attention on developing more subtle but equally important skills. Data management, identifying gaps in knowledge, developing strategies to fill gaps, and capturing new knowledge that emerges from organizational experience are capabilities that all health professionals need to master. Traditional classroom and training experiences, collaboratories (see below), online tutorials, new curriculum content, updated incentives, individual and work unit role models, information systems, processes, and policies can all be used to promote knowledge management learning.

Defining professionalism in and preparing students and professionals for a changing environment presents a complex set of questions for AHCs. What are proper roles and professional values? What proficiencies are required? And how does one demonstrate accountability in the knowledge-based, consumer-focused health economy? These questions are particularly germane as the care system shifts from one designed for and oriented to the deliverer to one designed for and oriented to the user. A critical challenge facing AHCs is to mobilize human adaptability to achieve better performance while remaining connected to and guided by the set of essential values and virtues that have traditionally shaped health professionals. Faculty and staff need to be supported during these anticipated transitions since all are at varying starting points.

The substantial shift in the balance of power is particularly important as a cultural change. AHCs need to create an environment where models of new behavior can be developed and assessed in the midst of change so that health professionals can determine which approaches are most appropriate. This will likely result in new roles being created and new kinds of interactions emerging. Explicit boundary-spanning roles, such as clinician-executives, clinician-educators, and clinician-researchers, need to become more prevalent as a means of maintaining balance among the AHC missions of research, service, and teaching (*Levinson and Rubenstein, 1999*). Such individuals equipped with computer-based data repositories and support programs can assure that knowledge flows across boundaries and that the databases used by learners contain sufficient common language across domains to carry messages clearly. In time, new models of professional development may be appropriate, including knowledge managers as a specific discipline within library science or as part of the role of the clinician-educator or clinician-manager.

Learning and practice will be more interdisciplinary and will engage people working in *teams* (*Detmer, 1997; Duderstadt, 2000*). One term suggested for such environments is *collaboratories*, where all stakeholders are involved through some representatives capable of both contributing and learning so that smoother, more effective approaches to care, education, or research emerge. The goal is more effective knowledge transfer, better management, safer care, and better outcomes for the resources used. For example, teams of students and faculty can be established to pursue relevant and timely problems or issues. The goal of such a model is not simply mastery of knowledge bases through memory and study but also development of new skills and talents on planning and management of change in real-time learning so that others available can discuss just what was learned. As an added benefit, the organization, as well as those directly involved, can capture and apply the output. It is likely that a number of new models for care, education, and research will emerge from these various communities of practice within such stimulating environments.

The flows of knowledge are what precipitate innovation and innovation is the most prevalent means of competition.

— Wellsprings of Knowledge: Building and Sustaining the Source of Innovation, Dorothy Leonard-Barton, 1998

A National Health Information Infrastructure

Recommendation 3. AHCs should actively participate in the effort to develop and manage a sound national health information infrastructure.

As health care becomes more knowledge-intensive and its dependence on connectivity increases, the existence of a robust national health information infrastructure (NHII) specifically designed to meet the needs of contemporary patient care, health professional education, and medical research will grow in importance to individual health organizations, particularly AHCs. Such an infrastructure will ultimately impact how well the nation's health professionals are able to access the ever-growing tangle of knowledge on maintaining health and managing disease, the ability for health care organizations to extend their use of telemedicine technology, the adoption of new education modules for professionals, and the ability of researchers to collaborate over distances. In essence, a series of electronic health information resources combined with the technologies that support the Internet and the workstations of individuals and organizations constitute what now serves as the NHII in the U.S. These resources (e.g., shared research databases, clinical repositories, and electronic journals) are aimed at health professionals and the public, are maintained by a variety of public and private organizations, and are growing on a daily basis.

Just as with the development of an organizational information technology infrastructure, there is a range of issues associated with a national infrastructure that must be confronted. These relate to technology adopted, content made available, processes for capturing new knowledge and information, policies for protecting privacy and rights of authors, issues of ownership of data, both human and financial resources needed to develop and manage the infrastructure, and the level of services provided. As the scale of an NHII far exceeds that of organizational systems, the complexity of issues is magnified. Despite the fact that health care telecommunications issues are more complex than those associated with many industries and that the potential impact on health is substantial, there is no individual or agency responsible for oversight of this valuable public resource nor has there been much interest among health professionals in it. As a result, the infrastructure is not developing to meet the full range of health needs (*National Committee on Vital and Health Statistics, 1998*).

The NHII can impact the health of both individual and populations of patients. For example, the Internet as currently designed may impede telehealth opportunities. The bandwidth allowed in the design of the Internet is disproportionately sized so that a central source can send far more information to people's homes than it is capable of receiving from them. Meanwhile, telehealth applications require a lot of bandwidth sending pictures from homes to help guide care in real time (*National Research Council, 2000b*). Other technological limitations arise for researchers seeking to access the National Library of Medicine's Visible Human image datasets or to use the computational tools that accompany the Genbank database of molecular sequences

(*Lindberg, 2000*). Moreover, recent federal legislative developments could impede rather than stimulate the development and use of the NHII, as in the case of pending legislation on health data privacy threatening use of cancer registries and similar research databases (*Detmer, 2000*).

Several professional societies and government agencies are already addressing some of the issues surrounding an NHII. For example, NLM has a long history of using the Internet to make its resources available, continues to expand its offerings for broader audiences, has sponsored research on applications of the next-generation Internet underway, and commissioned a recently released report on the use of the Internet to support health (*National Research Council, 2000b*). A coalition of organizations has joined forces to provide public health professionals with timely, convenient access to information resources to aid them in improving the health of the public (*Partners in Information Access for Public Health Professionals, 2000*). Despite these and other efforts, substantial work remains to be done.

AHCs not only have a vested interest in seeing the NHII evolve in a timely and coherent manner, they also have much to contribute to its evolution. First, AHCs and their professional organizations have considerable influence locally, regionally, and nationally that can be used to bring attention to the need for the NHII as a means of enabling knowledge management and improving health. Second, AHCs can actively participate in the development of processes used to evaluate the quality of content included in the NHII. Third, AHCs can develop training programs that will prepare health professionals who can use the NHII, as well as help to develop the NHII. Fourth, AHCs can participate in research and development surrounding the NHII, through collaborative projects in their regions, by serving as institutional testbeds, and by assessing the effectiveness of NHII projects and technologies. AHCs can explore how the NHII can be made most useful for health care organizations, professionals, and individual patients through its use in their own institutions. Finally, AHCs can serve as role models on how to use the resources available through a knowledge management infrastructure to improve organizational performance within health care organizations.

Looking even more broadly, AHCs can also contribute to and benefit from the evolution of a global health information infrastructure. By partnering with international organizations, AHCs can help to make existing knowledge more readily available to health professionals elsewhere and identify new teaching and research opportunities for their faculty. Shared knowledge may provide the foundation for collaborative relationships and structures that extend the influence of an AHC in its efforts to advance health (*Michigan State University, 1999*).

Partners in Knowledge

Recommendation 4. Federal agencies, philanthropic organizations, and professional organizations should advance understanding of the role of knowledge in the future health system and support activities that will further diffuse successful knowledge management practices in health care.

For knowledge management to become an integral part of the future health system in the U.S., a variety of public and private organizations must continue, expand, or initiate programs that promote both the cultural and technological requirements needed for effective knowledge management within health care organizations. Such programs should include both direct (i.e., funding) and indirect (i.e., policy) efforts to increase understanding, build capabilities, and promote use of knowledge management by organizations, professionals, and patients. Health care organizations will benefit from funding that supports research, investment in technology, development of content, creation of new curriculum, and training. Federal agencies, accreditation organizations, third-party payers, and the business community can also advance knowledge management by creating incentives that reward knowledge management by organizations and individuals, as well as identifying and removing barriers to knowledge management.

For example, in addition to a continuing role in the development of health knowledge sources (e.g., NLM's Medline Plus and Pubmed, GenBank), federal agencies can ensure that sufficient funding is available to train new and retrain existing health professionals in knowledge management skills. A National Institutes of Health (NIH) working group on biomedical computing recently called for NIH to develop a new training program to prepare individuals in biomedical computing applications and to fund research infrastructure needs such as database development, coordination, and management (*NIH, 1999*). Perhaps less obvious, as a major influence for health care organizations, the Health Care Financing Administration can ensure that its requirements support rather than thwart knowledge management and make its knowledge resources available to health care organizations.

Just as guidelines on the use of computers in clinical data management were developed in the 1970s, attributes of computer-based patient records were developed in the 1980s, and criteria for evaluation of computer-based patient record system implementation were developed in the 1990s, basic components of and guidelines for knowledge management systems for health care organizations are needed (*Barnett, 1979; Institute of Medicine, 1997; Computer-Based Patient Record Institute, 1995*). Other knowledge management research issues include, but are not limited to:

- Identifying incentives such as reimbursement mechanisms that encourage investment in knowledge management resources by health care organizations
- Identifying effective means of meeting knowledge needs for health care

professionals who are not part of health care organizations

- Identifying effective methods of cultivating knowledge management in health care organizations other than AHCs
- Facilitating knowledge across mission areas within AHCs

AHC professional associations (i.e., AAMC, AHC, and UHC) already support knowledge management by pooling and making available AHC information to their constituents, as well as by bringing AHCs together to share knowledge and collaborate on specific initiatives. For example, AAMC has launched a Web site on research compliance with links to institutions with model policies, guidelines, and training materials (*AAMC, 2000b*). Currently, through a project called *better_health@here.now*, the AAMC is exploring how medical schools and teaching hospitals can best use information technology in biomedical research, education, and health care to improve the health of people and communities (*AAMC, 1999*). Part of this project includes a review of the IAIMS grant program and development of recommendations on how NLM and other agencies can continue to shape the scope and context of information technology applications. These organizations, along with AMIA and specialty societies, can fulfill the important role of educating members on knowledge management skills as well as on the need to support development of an NHII.

The competitiveness of a firm is more than anything a function of what it knows, how it uses what it knows, and how fast it can know something new.

— Blur: The Speed of Change in the Connected Economy, Stan Davis and Christopher Meyer, 1998

Conclusion

Increasing connectivity resulting from advances in computing and communications technology, accompanied by an increasingly consumer-driven market, are changing the speed and nature of economic interactions, as well as creating a new source of value for individuals and organizations. Organizations are changing what they do, how they do it, and how quickly they do it. At the same time, the health care sector continues to face a set of challenges that impact the nation's health, such as lack of universal coverage, the need to create safer care systems, and a gap between available and applied medical knowledge (*Blue Ridge Academic Health Group 1999; Institute of Medicine, 1999; Haynes et al., 1995*). Information systems and knowledge management are linked to the resolution of many of the issues facing health care organizations and will likely account for dramatic changes in health care in the next decade.

The Blue Ridge Academic Health Group is convinced that AHCs must confront the forthcoming changes directly and deliberately define their role within a health care industry that is experiencing constant change, amidst an economy that is simultaneously undergoing transformation. Despite an already full agenda and, in some cases, serious financial concerns, AHCs need to anticipate and manage their forthcoming organizational metamorphosis. To do so, AHCs will need to acquire the organizational capabilities to function effectively in an environment that is increasingly knowledge-driven, connected, fluid, dependent on more players, and much more responsive to consumers.

The Blue Ridge Group believes that AHCs can and should expand their knowledge management capacity to convert a potential threat into an unprecedented opportunity and solidly advance their organizations. Incorporating knowledge management practices into work processes and routinely acting on insights gained from organizational knowledge will benefit each mission area, each organizational unit, and potentially each patient and staff member. Sound knowledge management is essential to AHCs as they strive to become value-driven organizations where:

- Patients feel connected and view the institution as a resource not just when they are sick, but as they manage their health on a daily basis
- The surrounding community can visibly see how the AHC is contributing to monitoring and improving the population's health
- The faculty and residents are supported in their clinical care decisions through comprehensive, validated, targeted information and knowledge — including clinical, financial, and administrative data
- The education process is streamlined, interactive, customized, multidisciplinary, reflective of the current practice environment, and flexible to meet the needs of students
- Researchers rely on institutional knowledge systems to develop proposals, manage research grants, and disseminate findings, as well as to build communities of collaborators where data are shared, combined in new ways, analyzed, and used to create new knowledge

- The influence and revenue generating opportunities extend beyond its immediate area
- Collaboration and innovation are evident throughout the organization
- Staff share a common understanding of the institution's goals and each individual decision is understood as an opportunity to support those goals

AHCs (individually and as a group) possess phenomenal energy and intellectual assets with which to transform their organizations in response to changing societal needs and expectations and emerging technology. AHCs can use all their various kinds of knowledge to innovate their roles in the health system and can use the organizational processes to fulfill those roles. They can also identify new resources and form new collaborative relationships that will enable them to increase the visibility of knowledge management as a standard practice for effective health care, education, and research. Moreover, they can promote the development and use of a national information infrastructure as a means of advancing health. AHCs are well positioned to be leaders of the health community throughout the knowledge age. They must, however, take full advantage of their organizational knowledge to do so.

Appendix 1.
Previous Blue Ridge Group Recommendations

From Report 1. Academic Health Centers: Getting Down To Business

1. AHCs must base their management structures on the "enterprise." Individual components of AHCs that currently perceive themselves as independent and isolated must view themselves as integral to a common enterprise and must commit to accomplishing common goals and objectives.

2. AHCs must use performance measures with evidence-based value to make informed decisions and to demonstrate public accountability.

3. AHCs should implement business practices based on performance metrics to improve return on investment.

4. AHCs need to develop and implement performance measures that assess AHC impact on the community and region.

From Report 2. Promoting Value and Expanded Coverage: Good Health Is Good Business

1. By 2001, Congress should pass legislation that mandates health insurance coverage, whether privately or publicly funded, for all residents as a national objective. By 2005, Congress should pass legislation that creates the framework and authorizes funding for insurance to be extended to all residents. This insurance should provide access to a minimum set of effective health services, including preventive, health maintenance, and acute and chronic illness care.

2. The Department of Health and Human Services, state and local health departments, health care provider organizations, schools of public health, private foundations, and other public and private health-related organizations should make population health management the primary objective of public health.

3. Each community or region should assume responsibility for improving the health of its residents. Each health care delivery organization (public or private) within the community or region should help to initiate (if necessary), actively participate in, and support through their clinical and service programs these efforts to advance the health of residents of the community or region. Federal and state legislators and agencies should support community and regional efforts by developing policies (including distribution of resources) that create incentives for individuals, local agencies, health care organizations and professionals, and employers to adopt strategies that measurably advance health.

4. In addition to participating in community or regional efforts to advance the population's health, each academic health center (AHC) should provide leadership – through research and education of current and future health professionals – on population health management and a value-driven health system as fundamental strategies for health care delivery in the 21st century.

Appendix 2.
External Forces Shaping Health Care

In addition to a multitude of developments within health care that are changing its shape, the health care milieu is also being shaped by a series of interwoven external forces, including demographic trends, increasing consumerism, advances in telecommunications and computers, and changes in the nature of economic transactions. As the U.S. population has aged, become more diverse, and developed new family structures, its needs and desires have changed. The past decade of continued economic growth and the accompanying increase in purchasing power of many citizens has made them more demanding consumers. Their overall experience, not just the quality or price of a product or service, is now one of the factors weighed in their consumption decisions (*Neuborne, 1999*). Whereas in the past health care was able to force the public to deal with its disjointed service patterns, today more care systems are moving aggressively to smooth the patient experience through well-organized disease management models. Whether through evening and weekend hours for pediatric clinics, physician practices located in grocery stores, drive-up windows for filling prescriptions, or at-home monitoring of chronic conditions, health care organizations are striving to meet these new needs and demands of patients (*Ernst & Young LLP, 1998a*). There is a reasonable likelihood that such "user friendly" redesign for services will become a central health industry driver in the coming decade (*Institute for the Future, 2000*) and that health care will increasingly incorporate business practices that are standard in other industries as part of its routine operation.

Advances in information technology and communications have changed the nature of work and what is most highly valued in the market (*Davis and Meyer, 1998*). Telecommunication capabilities make it possible to invest less in physical capital and focus more on intellectual capital. Relationships with many employees are shifting, as they are more likely to be loyal to their work team or profession than to one company. AHCs have already experienced this phenomenon with subspecialists in medicine and nursing. In the future, more and more of the workforce will qualify as crucial knowledge workers so that their leaving the organization will add both substantial training and recruiting costs. There are few examples in AHCs today that are more reflective of this trend than are IT support personnel. Thus, there is a greater need to build connections with employees through mentoring, professional development opportunities, or flexible employment models and to maintain contact after staff leave the organization. Moreover, formal relationships are giving way to evolving roles within economic webs, where competitors may now collaborate and businesses increasingly depend on other businesses for their well-being (*Davis and Meyer, 1998*). Mergers between organizations present challenges in preserving valuable organizational knowledge, as well as aligning and leveraging the combined knowledge base. Global transactions are now commonplace across most industries and offer new potential markets even for typically local products, but require knowledge of and sensitivity to local cultural and infrastructure concerns.

Not only are businesses responding to consumer demands for higher levels of service, they have begun to customize their services and products. This customization is possible in part because interactions between producers and consumers are increasingly supported by "pervasive connectivity" (*Davis and Meyer, 1998*). Such connectivity allows greater communication

between the customer and producer, and producers use this as an opportunity to learn about customer preferences so that they can anticipate future needs, customize to meet unique needs, and upgrade their offerings through incremental enhancements. For businesses, the ideal interaction with customers involves an exchange of information and emotion (e.g., loyalty, esteem, or engagement), as well as compensation for the good or service received.

Appendix 3. Possible Approaches to Knowledge Management in the Clinical Arena

The pace of scientific discovery and the accompanying growth in knowledge about maintaining health and managing diseases, along with the proliferation of users of this knowledge and possible speed of diffusion, presents an opportunity for AHCs to reshape their role as educators or disseminators of knowledge. For example, Iowa's Virtual Hospital has been very helpful to Iowans and thousands of others (*University of Iowa, 2000*). By recognizing that not all information is equal and not all users are equal, AHCs and their staff can apply their expertise to helping shape a knowledge base that relies upon valid information (*Cochrane Collaboration, 1999; Medem, 2000*). Achieving such an outcome will require consideration of what constitutes reliability and development of guidelines to ensure accuracy. Further, AHCs can assist nonmedical consumers of this knowledge in understanding specific considerations for its application.

Some AHCs may choose to pursue their role as knowledge managers quite aggressively from the perspective of preparing their patients and citizens to become proficient in using available health knowledge to manage their personal health. Building upon existing community and patient education programs (e.g., mini-med schools) and using existing technological resources (e.g., computer classrooms), these AHCs may develop and offer classes for the general public, selected employers, or targeted patients on how to access health resources on the Internet and assess the quality of those resources. By interacting with patients and potential patients in new ways, AHCs may help to solidify local relationships and encourage the emergence of a new kind of community of practice that may benefit the AHC.

AHCs can seek to harvest knowledge – both explicit and tacit – not necessarily captured through traditional means or in traditional places. For example, in addition to the knowledge from the scientific bases, there is knowledge about how the culture of particular groups influences whether or not they will follow treatment protocols, whether an insurer will reimburse for a given treatment, or how to gain authorization for a certain drug expeditiously. These aspects of providing clinical services are not resolved through literature searches, yet can impact the efficiency and effectiveness of services provided as well as patient satisfaction with care.

Patients themselves represent an untapped well of information at the sametime as they may be the most important students that AHCs educate. Clinicians may find that information shared by patients is nonlinear when juxtaposed against their structured data gathering and evaluation. Those data that are difficult to codify may, however, contain valuable insights for care of that patient or family member, or may point to the need to investigate a broader problem within the population. AHCs could explore alternative ways to capturing patient experiences so that patients feel heard, encounters with clinicians are efficient, and potentially useful information is identified and acted upon (possibly by someone other than the primary clinician.) Patients are unlikely to know what information is most useful to clinicians nor know what has been captured from previous visits and would likely benefit from education on how to have effective interactions with clinicians. Patient encounters can shed light not only on immediate health needs, but also on broader health needs and service preferences if such information is captured and shared within the organization.

About the Blue Ridge Academic Health Group

The Blue Ridge Academic Health Group seeks to take a societal view of health and health care needs and to make recommendations to academic health centers to help them create greater value for society. The Blue Ridge Group also intends to recommend public policies to enable AHCs to accomplish these ends.

Three basic premises underlie this mission. First, health care in the United States is experiencing a series of transformations that ultimately will require new approaches in health care delivery systems, education, research and knowledge management. Second, the recent upheavals in health care have been largely driven by financial objectives. Yet, the potential exists for fundamental changes in health care to improve health and manage costs. Analysis and evaluation of the ongoing evolution in health care delivery must address the impact on the health of individuals and the population, as well as on cost. Third, AHCs play a unique role in the U.S. health care system as they develop, apply, and disseminate knowledge to improve health. In so doing, they have assumed responsibilities and face greater challenges that other health care provider institutions do not bear. As a result, AHCs face greater risks and greater opportunities as the U.S. health care system continues to evolve.

The Blue Ridge Group was founded in March 1997, by the Virginia Health Policy Center (VHPC) at the University of Virginia and the Health Market Unit leadership at Ernst & Young LLP (now Cap Gemini Ernst & Young U.S. LLC). Group members were selected to bring together seasoned, active leaders with a broad range of experience in and knowledge of academic health centers and health care in the United States. Other participants are invited to Blue Ridge Group meetings to bring additional expertise or perspectives on a specific topic.

Blue Ridge Group members collectively select the topics to be addressed at annual meetings. Criteria for selection of report topics include relevance to the operation of academic health centers and to the ability of AHCs to provide value to society, the likelihood of being able to make specific recommendations that will lead to productive action by AHCs or other organizations, and the ability to frame useful recommendations during two-day meetings.

Before each meeting, an extensive literature review is conducted. During the meeting, participants reflect on emerging trends, share experiences from AHCs, and hear presentations on specific issues. Most of the working session is dedicated to a discussion of what AHCs can and should be doing in a particular area to achieve visible progress, or a discussion of what public and private policy and philanthropic organizations can do to facilitate the efforts of AHCs to fulfill their societal mission. The results of the group's deliberations are presented in brief reports that are disseminated to targeted audiences.

About the Core Members

Enriqueta C. Bond, Ph.D.

President
Burroughs Wellcome Fund

Dr. Bond is the president of the Burroughs Wellcome Fund. She formerly held a number of research and administrative positions at the Institute of Medicine, National Academy of Sciences; Department of Medical Sciences, Southern Illinois University School of Medicine; and the Biology Department at Chatham College. Dr. Bond also serves on several advisory committees and boards, some of which include the Council of the Institute of Medicine and the National Center for Infectious Diseases, Centers for Disease Control and Prevention. She has authored and coauthored more than 50 publications and reports on science policy.

Robert W. Cantrell, M.D.

Vice President and Provost
University of Virginia Health System

Dr. Cantrell is vice president and provost for the University of Virginia Health System. Also a surgeon-educator and medical administrator, he is the former president of the American Academy of Otolaryngology-Head and Neck Surgery. As a captain in the U.S. Navy, he served as chair of Otolaryngology-Head and Neck Surgery at the Naval Regional Medical Center in San Diego, California. Dr. Cantrell was also the Fitz Hugh professor and chair of the Department of Otolaryngology-Head and Neck Surgery at the University of Virginia School of Medicine. He also has been a consultant to the surgeon general of the U.S. Navy and to the National Institutes of Health (NIH). Dr. Cantrell is a member or fellow of 33 otolaryngological societies and has taken an active leadership role in many, including the American College of Surgeons, the American Society for Head and Neck Surgery, and the American Broncho-Esophagological Association. Dr. Cantrell has received the Mosher Award for clinical research, published numerous articles, and lectured nationally and internationally.

Don E. Detmer, M.D.

Dennis Gillings Professor of Health Management
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Dr. Detmer heads the Health Policy and Management Center within the Judge Institute of Management Studies at Cambridge University's Business School. He chairs the Board on Health Care Services of the Institute of Medicine and is a board member of several organizations, including the China Medical Board of New York, the Nuffield Trust in London, and the *American Journal of Surgery Editorial Board.* He has authored more than 140 articles and book chapters. Dr. Detmer earned his medical degree at the University of Kansas after undergraduate studies there and at Durham University of England. He conducts his work with the Blue Ridge Group through a professorship at the University of Virginia, where in the past he served as vice president and provost for health sciences and as university professor.

Michael A. Geheb, M.D.

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Dr. Geheb is professor of medicine and senior vice president for clinical programs at Oregon Health Sciences University. Dr. Geheb has also served as professor of medicine, and was the first director and chief executive officer of the University of Alabama at Birmingham Health System. Prior to that, Dr. Geheb was associate dean for clinical affairs and director of clinical services at the State University of New York at Stony Brook University Medical Center. Dr. Geheb's professional associations include the American Federation for Clinical Research, the Board of Directors of the University Hospital Consortium, and the American Board of Internal Medicine's Board of Directors. Dr. Geheb is coeditor of the textbook *Principles and Practice of Medical Intensive Care* and coeditor of the *Critical Care Clinics* series. He also speaks frequently to national audiences on health care policy issues related to academic productivity and financial models for academic clinical enterprises.

Jeff C. Goldsmith, Ph.D.

President
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Dr. Goldsmith's consulting firm assists a wide range of health care organizations with environmental analysis and strategy development. He is a member of the board of directors of Cerner Corporation and of Essent Corporation. He is currently an associate professor of medical education at the University of Virginia. He is a former lecturer in the Department of Medicine of the Pritzker School of Medicine at the University of Chicago and in the Graduate School of Business at the University of Chicago. He has also lectured on health services management and policy at the Harvard Business School, the Wharton School of Finance, Johns Hopkins, Washington University, and the University of California at Berkeley. Dr. Goldsmith has served as national advisor for health care for Cap Gemini Ernst & Young LLP, was director of planning and government affairs at the University of Chicago Medical Center, and special assistant to the dean of the Pritzker School of Medicine. Dr. Goldsmith has written for the *Harvard Business Review* and has been a source for articles on medical technology and health services for the *Wall Street Journal*, the *New York Times*, *Business Week*, *Time*, and other publications.

Michael M.E. Johns, M.D.

Executive Vice President for Health Affairs
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Dr. Johns heads Emory's academic and clinical institutions and programs in the health sciences and is a professor in the Department of Surgery. A former dean of the Johns Hopkins School of Medicine, he was professor and chair of the Department of Otolaryngology-Head and Neck Surgery at Johns Hopkins. Before that he was assistant chief of the Otolaryngology Service at Walter Reed Army Medical Center. Dr. Johns is a member of the Institute of Medicine and a fellow of the American Association for the Advancement of Science. He serves on the governing boards of the National Research Council and the Clinical Center of the NIH and on the Advisory Committee of the Director of the Centers

for Disease Control and Prevention. He is president of the American Board of Otolaryngology and editor of the *Archives of Otolaryngology-Head and Neck Surgery.* Dr. Johns received his bachelor's degree and continued with graduate studies in biology at Wayne State University. He earned his M.D. at the University of Michigan School of Medicine.

Peter O. Kohler, M.D.

President
Oregon Health Sciences University

Dr. Kohler is president of Oregon Health Sciences University. After holding positions at the NIH, he became professor of medicine and chief of the Endocrinology Division at the Baylor College of Medicine. He later served as chairman of the Department of Medicine at the University of Arkansas, then as dean of the Medical School at the University of Texas Health Science Center in San Antonio. Dr. Kohler has served on several boards. He has been chairman of the NIH Endocrinology Study Section and chairman of the Board of Scientific Counselors for the National Institute of Child Health and Human Development. Currently, he is chairman of the Institute of Medicine Task Force on Quality in Long-Term Care. He is past chair of the Board of Directors of the Association of Academic Health Centers. Dr. Kohler received his B.A. from the University of Virginia and earned his M.D. at Duke Medical School.

Edward D. Miller, Jr., M.D.

Dean and Chief Executive Officer
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Dr. Miller is chief executive officer of Johns Hopkins Medicine. His former posts include chairman of the Department of Anesthesiology and Critical Care Medicine, interim dean of the School of Medicine; professor of anesthesiology and surgery and medical director of the Surgical Intensive Care Unit at the University of Virginia; E.M. Papper Professor and chairman of the Department of Anesthesiology in the College of Physicians and Surgeons at Columbia University. Dr. Miller has authored and coauthored more than 150 scientific abstracts and book chapters. He received his B.A. from Ohio Wesleyan University and his M.D. from the University of Rochester School of Medicine and Dentistry.

John G. Nackel, Ph.D.

Managing Director, New Ventures
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Dr. Nackel is the managing director, New Ventures, with Cap Gemini Ernst & Young U.S. LLC. Prior to this position, he served as national director, Health Care Consulting. While with Cap Gemini Ernst & Young, he has worked in various positions and directed numerous projects in the U.S. and internationally. He has served the pharmaceutical and life sciences, managed care, and provider segments of the health care industry. In his New Ventures position, he oversees the firm's spinoff companies and strategic investments. Dr. Nackel has presented papers and keynote addresses at more than 200 professional society and health care trade association meetings. He has published more than 30 articles on applications of cost and quality improvement, information systems and health systems engineering; and is the co-author of the award-winning book *Cost Management for Hospitals*. He was co-editor of the Society for Health Systems' special issue focused on patient care. Dr. Nackel received a B.S. from Tufts University and master's degrees

in public health and industrial engineering from the University of Missouri-Columbia. Also from the University of Missouri, he was awarded a Ph.D. in health care systems design from the Department of Industrial Engineering.

George F. Sheldon, M.D.

Chairman and Professor
Department of Surgery
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Dr. Sheldon's background in graduate medical education spans four institutions: Kansas University, the Mayo Clinic, the University of California at San Francisco, and Harvard University. He is currently chairman and professor of the Department of Surgery at the University of North Carolina at Chapel Hill. He was formerly professor of surgery in the Department of Surgery at the University of California at San Francisco. He has held several national appointments, including president of the American Surgical Association, chairman of the American Board of Surgery, and member of the Council on Graduate Medical Education. He is currently president-elect of the American College of Surgeons and chair-elect of the Council of Academic Societies of the Association of American Medical Colleges. He has published 195 articles and book chapters and coauthored eight books.

About the Invited Participants

Gerard N. Burrow, M.D.
Special Advisor to the President of Yale for Health Affairs
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Dr. Burrow is a special advisor to the president of Yale for health affairs. He is also a senior advisor to the WHO program on safe motherhood. Dr. Burrow has 44 years of medical experience and specializes in endocrinology and thyroid disease. He has held several appointments as assistant professor, associate professor, and professor of medicine at Yale University and the University of Toronto and served as dean of the School of Medicine and vice chancellor for health sciences at the University of California at San Diego. He has served as president of the American Thyroid Association, and is a member of the Institute of Medicine of the National Academy of Sciences. He is a fellow of the American Association for the Advancement of Science, and a member of the Society for Clinical Investigation and the Association of American Physicians. He serves on the Board of Directors of Gaylord Hospital, the Sea Research Foundation, and the National Medical Fellowships, Inc. He is past chairman of the medical schools' section of the American Medical Association. Dr. Burrow earned his B.A. from Brown University and his M.D. from Yale University. He has served on the editorial boards of several scientific journals, including the *Journal of Clinical Endocrinology, Metabolism, and Annals of Internal Medicine*. He is also coeditor of a major textbook, *Medical Complications During Pregnancy*. He has written more than 150 scientific articles.

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Dr. Frisse is vice president of Clinical Information Services at Express Scripts, a pharmacy benefits management concern. His responsibilities there include the development of Internet-enabled consumer health information and clinical data analysis systems. Previously, Dr. Frisse was associate dean and director of the Bernard Becker Medical Library in the School of Medicine, professor of medicine, and associate professor of medical informatics at Columbia University. He also served as a faculty and academic director of the Health Science Management Executive M.B.A. program at the John M. Olin School of Business. Dr. Frisse received his B.S. from the University of Notre Dame and his M.D. and M.B.A. from Washington University in St. Louis. He earned his master's degree in Medical Computer Science from Stanford University. He has written frequently for the journal *Academic Medicine*.

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Ms. McLaughlin is the subject matter expert for knowledge management at Xerox. She is a principal in the industry consulting and systems integration organization. She is also a corporate knowledge management champion, and participates in the development of the corporate business strategy for the development of knowledge management methods and practices. She is currently involved in projects focusing on strategic linkages for knowledge management and intellectual capital management systems. Ms.

McLaughlin holds a Diploma of English Studies from the University of Cambridge, England; an undergraduate degree in Business Economics from the Academy on the Rhine, in Cologne, Germany; and an M.S. for Information Management from the American University, in Washington, D.C.

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Mrs. Reel has more than 15 years of experience in information systems, working with health care providers and payors. Mrs. Reel is a member of the Information Technology Board for the State of Maryland, the Health Care Information Systems Executive Association, the College of Health Care Information Systems Executives, and the Health Care Information Management Systems Society. She has served as chairperson for the Maryland State Health and Medical Systems Committee and sits on the Advisory Board for Villa Julie College, in Baltimore. She is also a member of the Customer Advisory Board for Bell Atlantic and the Client Advisory Board for Compuware. Mrs. Reel received a B.S. in Information Systems Management from the University of Maryland and an M.B.A. from Loyola College of Baltimore.

Jay Toole

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Mr. Toole serves as a national director for the CGE&Y's Health e-Commerce practice. In this role, he is responsible for overseeing e-Commerce strategy and implementation engagements and developing the firm's knowledge resources for providers, life sciences, and managed care organizations. He has more than 25 years experience in health care and information systems. He has served as president of a major health care information systems vendor, director of a worldwide information systems health care practice for a "Big Six" accounting firm, and directed numerous strategic information systems planning engagements for hospitals, multi-hospital groups, and integrated health care providers. Mr. Toole received his B.A. from Franklin and Marshall College and certification from the Executive Graduate Program in Health Care Financial Management from the University of South Carolina. He serves on the editorial boards of *ADVANCE for Health Information Executives* and *Health Informatics* magazines. He is a past board and executive committee member for the Computer-Based Patient Record Institute (CPRI); past chairman of the Center for Health Care Information Management (CHIM); past board member for the College of Health Care Information Management Executives (CHIME), and a current member of the American Hospital Association (AHA) and Health Care Financial Management Association (HFMA).

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Exhibit 2. Knowledge Management Goals, Strategies, and Actions

GOALS	STRATEGIES	ACTIONS
• Enable knowledge sharing	**Create knowledge management culture** • Make knowledge visible and show role of information within an organization • Instill responsibility for knowledge sharing **Build technical and staffing infrastructure** • Build connections among people as part of the knowledge-management infrastructure (both technically and socially) • Assign explicit knowledge roles **Harvest organizational knowledge** • Share expertise and best practices • Capture past experiences and organizational learning • Access valuable knowledge from external sources • Build and mine customer knowledge bases	• Demonstrate leadership commitment through vision statement, time on meeting agenda, and investment in knowledge management resources • Establish organization-wide knowledge goals • Align performance incentives with sharing behaviors • Establish ways to recognize outstanding knowledge management practices by staff • Appoint a chief knowledge officer • Designate knowledge stewards to maintain organizational knowledge bases and provide assistance to staff seeking information or knowledge • Rotate staff into and out of specific knowledge management roles • Establish networks with common hardware and software platforms • Provide electronic access to knowledge bases wherever staff are working • Establish electronic connections with customers, suppliers, and other potential partners • Develop databases that contain internal and external knowledge (e.g., enter project summary reports into database, document lessons learned, purchase online subscriptions or databases) • Distribute knowledge on demand and push knowledge to staff • Promote learning opportunities (e.g., mentors, multifunctional project teams, communities of practice, training, technology or best practices fair) • Seek to uncover organizational knowledge through knowledge mapping, prototyping, learning history, after-action reviews, and internal benchmarking
• Act on organizational knowledge and insights	• Apply organizational knowledge in decisions, processes, and transactions • Embed knowledge in products and services • Create new knowledge through innovation • Use knowledge to strengthen organizational relationships	• Try new approaches to stimulate innovation • Provide open access to company information • Identify or create internal knowledge brokers
• Assess value	• Measure knowledge assets and impact of knowledge management	

Exhibit 3. Chief Information Officer Role Versus Chief Knowledge Officer Role

Chief Information Officer

Overall responsibility

Setting strategy for the technical infrastructure design of information systems (IS) to support knowledge management strategy.

Key relationship is with the Chief Knowledge Officer

Specific responsibilities

- Fiduciary and management responsibility for the development and ongoing operation of the IS technology network including vendor relationships
- Managing IS professionals with technical expertise
- Developing and maintaining IS policies and standards to ensure ease of use and access, regulatory compliance, and data integrity
- Identifying the IS technical needs and maintenance of relationships with key stakeholders
- Evaluating new IS technology to support the evolution of knowledge management
- Developing and implementing business processes supported by IS technology, including financial and administrative systems, to support the AHC and its knowledge management domains

Clinical Domain

Stakeholders: groups of patients (populations), individual patients, insurers, referring physicians, AHC physicians, nurses and other care-givers, other employees

Sample Activities:

- Modifying the patient business cycle, including billing and registration, for ease of use
- Developing Web-based strategies to deliver knowledge to patients and referring physicians
- Providing technical support for laboratory information systems and filmless clinical imaging systems

Research Domain

Stakeholders: researchers, trainees, and administrators

Sample Activities:

- Developing databases and sites for dissemination of results
- Developing and supporting IS tools for grant management

Education Domain

Stakeholders: undergraduate and graduate students, including residents, community physicians, nurses, and other practicing health professionals

Sample Activities:

- Developing and maintaining Web-based application processes for undergraduates, graduates, and postgraduate education
- Developing and applying computerized testing technology
- Maintaining online tracking of registration, course billing, and continuing medical education credits

Chief Knowledge Officer

Overall responsibility

Identifying knowledge domains and setting strategy for their development. These domains are in clinical, research, and educational knowledge areas.

Key relationship is with the Chief Information Officer

Specific responsibilities

- Identification, evaluation, and development of key information databases to be created, acquired, and integrated to establish each domain of knowledge management
- Managing knowledge management professionals who can organize and assemble content to be deployed using information systems technology
- Identifying program needs in knowledge domains and maintenance of relationships with key stakeholders
- Identifying and monitoring new knowledge management approaches
- Providing advice on directions and goals of the business processes in each knowledge management domain, including the business processes to support the AHC

Clinical Domain

Stakeholders: groups of patients (populations), individual patients, insurers, referring physicians, AHC physicians, nurses and other care-givers, other employees

Sample Activities:

- Standardizing content for medical records, including information to referring physicians and to patients, potentially online
- Developing, monitoring, and updating clinical protocols

Research Domain

Stakeholders: researchers, trainees, and administrators

Sample Activities:

- Establishing standards for scientific databases
- Developing knowledge domains for technology transfer
- Developing standard institutional forms and protocols for submitting grants (both federal and commercial)

Education Domain

Stakeholders: undergraduate and graduate students, including residents, community physicians, nurses, and other practicing health professionals

Sample Activities:

- Developing content for distance and online learning for students, residents, and practicing physicians
- Developing content for secure online testing

Exhibit 4. Patient-Focused, Knowledge-Driven Health Care Services

Imagine a patient-focused, knowledge-driven AHC health system where high quality care is provided efficiently and patients experience convenience, greater control in their interactions with AHC, continuity across AHC encounters, integration of all health-related information, and assistance with their ultimate objectives – staying healthy and achieving good results when treated for illness. In turn, patients develop stronger affiliation with the AHC insofar as they feel confidence in and connected to the AHC even when they are healthy and view the AHC as a partner in their efforts to manage the health of all family members.

Such a system might offer the following features to its patients:

- Access to credible health information via a portal established and managed by the AHC
- Access to information about the services offered by the health system (e.g., by visiting their employer's employee health office, public library, or searching the Internet from home) presented in a format that represents the viewpoint of the public rather than the organizational structure of the AHC and integrated with insurance coverage information (e.g., will services be covered and how much will patient pay out of pocket)
- Portfolios of services developed for patient convenience (e.g., babysitting services available for families with young children or counselors available to families of terminally-ill patients following visits with physicians)
- Access to a designated health coach (either on-line or in person) who assists in navigating health system services and in developing a comprehensive health plan
- Reminders of needed health maintenance (e.g., well-child visits, periodic examinations for adults, flu or tetanus shots) perhaps as part of quarterly health statements that document how well patients are doing in meeting recommended health objectives for their demographic group
- The option of scheduling appointments via the Internet (just as airline travelers are now doing) and receiving e-mail reminders of scheduled appointments
- Acknowledgement of their status (e.g., new, returning, frequent, out of town patient) and specific consideration of their needs (e.g., since you lasted visited the following has changed at our clinic)
- A single request for demographic, history, insurance, and clinical information upon initial contact with the health system and subsequent confirmation that information is up-to-date
- Confidence that all relevant previous health history is available to health professionals
- For return visits, the option of pre-registering 24 hours prior to a scheduled appointment via the Internet from their home or work site or upon arrival at a clinic terminal
- Relevant medical literature and institution or physician specific patient education during visits
- Information about health services that would benefit the patient or his or her family (e.g., stress reduction classes, how to access credible medical literature in various media, how to access support groups for caregivers of parents) in addition to those typically associated with the reason for a given visit
- Ability to use electronic mail to contact physicians directly for non-urgent questions related to ongoing care or contact triage nurses and receive rapid response for questions about whether a patient needs to schedule an appointment
- Invitations to education sessions that might be of interest to them (e.g., visiting lectures, community presentations) and notices or bulletins from the AHC to inform the patients about new information on topics of concern to the patient or family members
- Access to designated parts of their medical records to download into their personal health managers (that were provided to the patients at their initial visit to the institution) and upload information (via the Internet or during visits) for key elements of information that his or her physician is interested in tracking
- Access to billing information to reconcile health system bills and insurance statements.

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