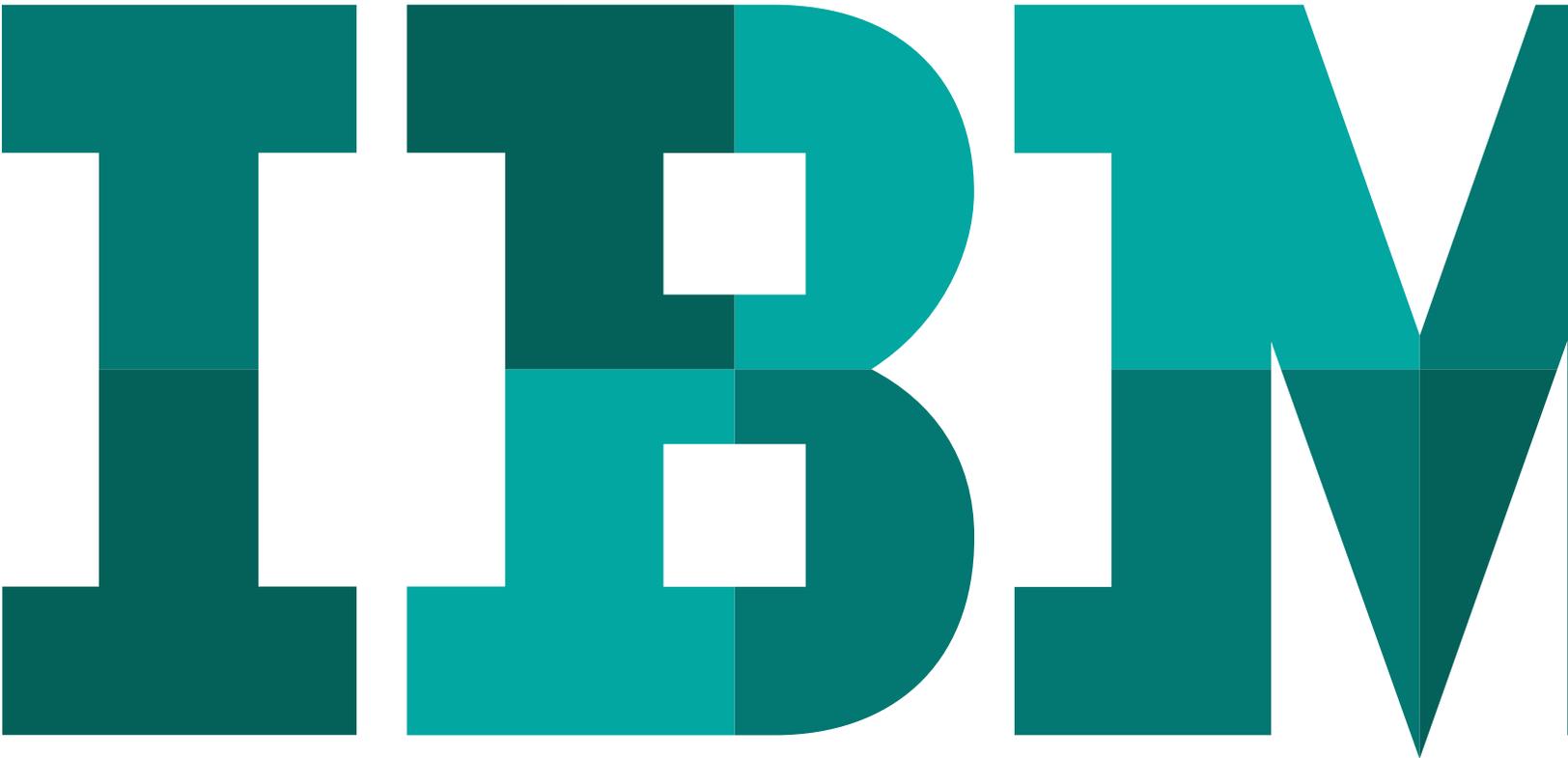# The digital hospital evolution

*Creating a framework for the healthcare system
of the future*

IBM

Globally, the challenges of healthcare delivery vary widely, yet health systems around the world have similar objectives: to deliver the highest quality care to the most people possible at the lowest possible cost. Healthcare spending around the globe continues to rise at unsustainable rates, consuming an ever-increasing slice of the world's economy. As measured by the percent of GDP healthcare, costs rose from 8.2 to 9.4 percent from 2000 to 2009.[1] The burden of chronic diseases is rising in both developed and developing nations, fastest among lower-income countries, populations and communities, where they impose large costs in human, social and economic terms.[2]

In response, the worldwide healthcare industry is undergoing radical transformation, driven by a fundamental shift in the expectations of all stakeholders: patients, governments, insurers, employers and providers. Increasingly, healthcare delivery organizations worldwide are rethinking the services they offer as funding and payment models evolve, focusing on wellness and outcomes rather than volumes of services consumed. For transformation to succeed, organizations will need to adopt both technology and process improvement strategies to enable secure access, exchange and analysis of patient information and to create greater efficiencies in both business and clinical processes. These strategies will give rise to a more patient-centric care model through better monitoring and management of wellness and chronic disease and enable cost containment while improving overall delivery system health.

Managing towards a sustainable healthcare system

The industry's challenges and priorities are driving healthcare systems to forge innovative solutions to manage the increasing expense and complex social burdens that aging populations and increasing chronic disease rates bring. In both developed and emerging economies, the healthcare infrastructure is transforming to address the steady rise in both healthcare demand and costs. In emerging economies such as those in China, India, the Middle East and Latin America, state-of-the-art hospitals and medical centers are being built or retrofitted to meet these challenges.

Efficiency drives down cost

The Cleveland Clinic Abu Dhabi (CCAD), a new 2.2 million-square-foot multi-specialty digital hospital modeled after the world-renowned U.S. medical center, will offer a range of tertiary/quaternary medical services that will bring the highest international standards of healthcare to the region. One of the United Arab Emirate's flagship healthcare projects — owned jointly by the government of Abu Dhabi and Mubadala Development Company, and operated by Cleveland Clinic — it will be a physician-led medical facility served by western-trained and board certified physicians.[3] The hospital is being built from the ground up to host the latest technologies in surgery, imaging, telemedicine and electronic medical records, integrating systems in a manner that will be the first of its kind in the country and the Middle East region.[4]

"It's a building that blends cutting-edge technology, evidence-based design, world-class care, and Arabic culture with elegant architecture," says Mohammed Ayoub, lead designer with Henningson, Durham and Richardson International, the project's architect.[5]

Like other state-of-the-art facilities in emerging markets, CCAD is attracting world-class medical talent. Designed to provide an outstanding patient experience with the highest quality, it is expected to attract patients from around the region and the world. The facility will spur UAE's medical tourism market, which generated revenue of about US$1.7 billion (Dh6.24bn) in 2010, and is expected to grow by roughly 15 percent annually, according to research firm Business Monitor International.[6]

According to the Organisation for Economic Co-operation and Development (OECD),[7] hospitals worldwide absorb 30 to 40 percent of all healthcare spending; for example, about one-third of U.S. healthcare is provided by hospitals, 35 percent in France, 42 percent in Australia and Korea, 44 percent in Turkey and the Czech Republic and 45 percent in Denmark, while nearly half of healthcare in Japan is provided by hospitals. At the same time, healthcare delivery is moving beyond the hospital walls to focus on the patient in less expensive environments that facilitate care management – from clinics and ambulatory centers to the home. In response, more efficient digital hospitals are emerging as critical hubs in these integrated healthcare networks that hold the potential to drive greater efficiency, improve quality of care and provide access for more people than ever before. To deliver the highest quality care to meet the needs of their communities, integrated health systems are leading in the transformation of healthcare, migrating from its traditional focus on acute care episodes toward providing more coordinated, patient-centered care.

Fundamental to this transformation is the digital infrastructure – known as information and communications technology (ICT) – that enables information sharing among healthcare providers, payers and patients. However, deployment of such technologies within the industry has been slow, and uneven across various areas of hospital operations. Automation of hospital administrative processes, such as patient registration, admission, and discharge is relatively widespread. Yet fully digital hospitals – that run the gamut of clinical applications and advanced hospital information systems interconnected by a robust and reliable infrastructure – are exceptions rather than the rule.

Digital hospitals, whether newly-built or existing operations retrofitted with the latest digital information technology, promise to boost efficiency and quality through better integration with all sources of care. They are enabling deployment of eHealth systems that provide online information, disease management, remote monitoring and telemedicine services that can extend the reach of scarce medical resources and expertise. Digital hospitals provide faster and safer throughput of patients, creating more capacity through process efficiencies, while containing costs. Examples of benefits include:

- Improved patient outcomes, as measured by reduced length of hospital stay, readmission rates and other key metrics
- Safer, healthier, green environments and medical workplaces that help attract world-class medical talent
- Improved consumer service and patient satisfaction
- Decreased documentation and administration effort, while increasing staff satisfaction
- Broad improvements in healthcare access, quality, safety and sustainability
- Improved operational efficiencies and decreased capital expenditures

"More efficient, digital hospitals are emerging as critical hubs to drive greater efficiency, improve quality of care and provide access for more people than ever before."

Standardization drives down cost while improving quality

Narayana Hrudayalaya (NH) hospital group in Bangalore, India, performs high volumes of open heart surgical procedures at a fraction of the cost of other countries, while achieving equal and sometimes better outcomes. The system was founded in 2001 by Dr. Devi Shetty, a world-renowned cardiologist, who was the personal physician to Mother Teresa.[8]

NH started as a large scale cardiac center with a modern digital infrastructure built on the outskirts of Bangalore. It has since expanded into a series of larger-than-usual interconnected centers specializing in eye care, trauma and cancer treatment on a sprawling 35-acre campus. In addition, NH manages or owns hospitals in 14 other Indian cities and maintains a telemedicine practice — where surgeons use a Skype-equipped laptop — extending its reach to 100 facilities throughout India and more than 50 in Africa. An initiative distributing 5,000 dialysis machines recently made the company the country's largest kidney-care provider.[9]

The system's interconnected information infrastructure and Dr. Shetty's relentless drive to improve processes allow NH to maintain economies of scale by leveraging intense specialization to maximize productivity. The cardiac hospital is known as the world's largest and most prolific, performing more than 4,000 surgeries a year — roughly half on pediatric patients — more than the combined total of The Cleveland Clinic and the Mayo Clinic, the number 1 and number 2 ranked cardiac centers in the U.S.[10] In 2004, the typical cost of an open heart surgery at NH was 90,000 rupees, or about US $2,000. Since then, NH has driven down the cost to $1,700, in part due to the high volume of procedures it performs.[11]

NH achieves unprecedented efficiency by standardizing procedures and breaking down processes into their component parts, not unlike an automotive assembly line. Highly paid senior surgeons perform only the most demanding parts of an operation; leaving the more routine procedures to more junior physicians. Dr. Shetty's ultimate goal is to drive the cost of heart surgery down to $800 per operation. To do that, NH plans to grow the cardiac network to 30,000 beds by 2017, through a national network of 55 low-cost, 300-bed heart hospitals.[12]

Managing complexity: the Digital Hospital Framework

Digital hospitals are complex ecosystems with hundreds of clinical and business processes made up of thousands of sub-processes. When properly integrated, these processes should seamlessly unite patients, clinicians, staff, assets and information throughout the hospital, delivering the right information and resources at the right time to the point of care.

Essential to this integration are the ICT that interconnects all aspects of care delivery and administration. New hospitals take an average of three to five years to build, while existing hospitals that are retrofitted with the prerequisite pervasive, medical-grade networks and multi-modal digital communications can take as long as five to ten years to completely modernize.

In addition to digital medical devices and continuously available high-speed networking infrastructure, hospitals must reengineer business processes to create paperless automated workflows. Electronic medical records, including computerized physician order entry (CPOE) and access to medical imaging, must be integrated seamlessly, while the decomposition, redesign and planning of clinical and business processes must start early in the cycle, even before the specification and selection of technology.

Whether planning the development of new acute care and ambulatory facilities or modernizing aging technology infrastructure of existing hospitals, healthcare executives and their boards must endorse the big picture, understanding how departments interact within an enterprise and how different facilities across diverse care settings must work in a coordinated health system.

Understanding the dependencies and relationships between various IT programs and initiatives can help healthcare decision makers cope with the complexity of the numerous solutions and choices available to them. For example, implementing an electronic health record system that allows laboratory results and diagnostic images to be viewed at the bedside may require upgrades to the wired and wireless network infrastructure and changes to enterprise storage capacity.

Real-time location tracking technologies, including infrared and radio frequency identification (RFID), might have a dual use; improving clinical care–by reducing time to locate equipment or implementing a closed-loop medication management system–while supporting the tracking of assets in order to optimize asset capital requirements.

A framework representing the various categories and components of IT–networks and storage and electronic health records and care orchestration systems and the like–can help executives understand how the IT elements in the framework relate to their larger strategic objectives (see Figure 1).
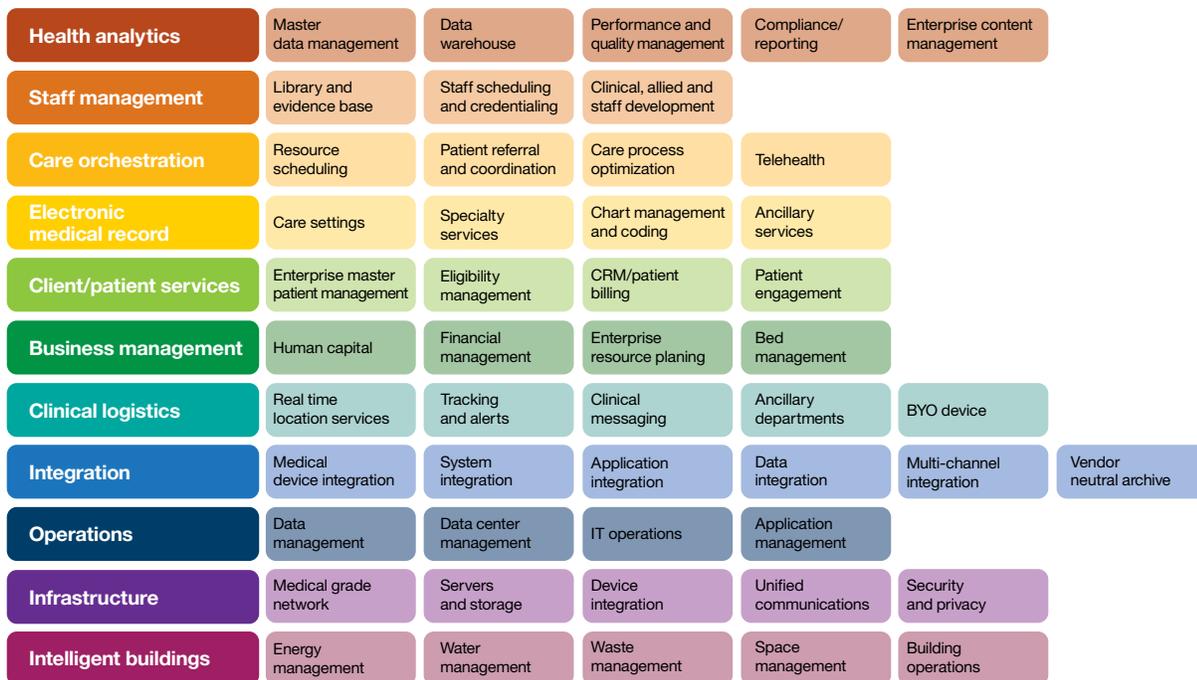
Category					
Health analytics	Master data management	Data warehouse	Performance and quality management	Compliance/ reporting	Enterprise content management
Staff management	Library and evidence base	Staff scheduling and credentialing	Clinical, allied and staff development		
Care orchestration	Resource scheduling	Patient referral and coordination	Care process optimization	Telehealth	
Electronic medical record	Care settings	Specialty services	Chart management and coding	Ancillary services	
Client/patient services	Enterprise master patient management	Eligibility management	CRM/patient billing	Patient engagement	
Business management	Human capital	Financial management	Enterprise resource planing	Bed management	
Clinical logistics	Real time location services	Tracking and alerts	Clinical messaging	Ancillary departments	BYO device
Integration	Medical device integration	System integration	Application integration	Data integration	Multi-channel integration
Operations	Data management	Data center management	IT operations	Application management	
Infrastructure	Medical grade network	Servers and storage	Device integration	Unified communications	Security and privacy
Intelligent buildings	Energy management	Water management	Waste management	Space management	Building operations

Figure 1: The IBM Digital Hospital Framework.

Data-assisted bedside manner

Formed in 1998 through the merger of five different health institutions, The Ottawa Hospital (TOH) is one of the largest academic teaching hospitals in Ottawa, Ontario, Canada. With four campuses throughout the city, the hospital has approximately 1,200 beds, 12,000 employees and 1,500 physicians. With the goal of becoming a top-10-percent performer in both quality of care and patient safety in North America, the hospital created a comprehensive clinical process management approach, designed to improve workflow, patient safety and quality of care.

The approach automates a wide range of clinical and business processes and business rules, while making its electronic medical records (EMR) available through a wireless network, to a patient's "circle of care," which can include physicians, pharmacists, liaison nurses and medical students. A simple, easy-to-use visual interface identifies the providers involved in a patient's care and facilitates communication and collaboration between them.

A multi-disciplinary activity plan enables providers to assign tasks, monitor activities and gain visibility into the entire chain of activities, helping the care team communicate and collaborate while reducing the amount of time spent searching for patient statuses.

The approach has been extended to hand-held tablets through a custom mobile application that helps caregivers share X-ray images and other results directly with the patient or family members at the bedside. This results in clearer communications, greater patient understanding and an enhanced sense of control for the patient. Physicians and nurses now have bedside access to information that is critical to their patients' care and can perform important tasks from the bedside, increasing time spent with patients and improving relationships.

"The hospital's mobility strategy has transformed the way we do our work," said Dr. Glen Geiger, Chief Medical Information Officer at TOH, in a press release announcing the hospital's receipt of a 2012 Mobilizer Award from Mobile Enterprise Magazine. "Our clinicians are finding it to be more efficient to review results and orders at the bedside and our patients are more engaged."[13]

Meeting the challenge

The benefits of fully digital hospitals are clear, yet the path to hospital modernization is not without obstacles, both technical and cultural. It requires bold leadership as well as careful planning and execution. In particular, establishing early and clear program management that interlocks the vision, business architecture, technical architecture and roadmap for future growth is critical. It is also incumbent upon the new generation of healthcare professionals – who have adopted technology and "bring their own devices" to collaborate, bring the pieces together and provide leadership within the 21st-century digital hospital.

Vision and strategy are vital. Hospitals without a substantial foundation in clinical and business process management must invest in design and planning from the outset. Whether retrofitting an existing hospital or building new facilities from the ground up – it takes time, focus and coordination to re-engineer and establish the right business-process management and the proper technology to support true process integration.

Execution is equally important. The 21st-century digital hospital requires the right execution from both a talent and a technology perspective. The digital hospital goes beyond advanced clinical systems and must include seamless integration among applications, medical, communication and physical infrastructure technologies to create a real-time, standards-based digital information and collaboration environment.

Process automation is key. Deployment of an EMR is only the tip of the iceberg. Automation of both clinical and administrative processes requires rethinking interactions and systems to be more collaborative. Processes should seamlessly unite patients, clinicians, staff, assets and information throughout the hospital. Hundreds of processes and thousands of sub-processes, including all patient and staff communication, must be integrated to enable efficient resource utilization, effective clinical workflows and paperless, regulatory compliant operations. These technology enablers are just one piece of a patient-centered business strategy that is focused on efficiency, quality of care and patient safety.

ICT must be robust. As a critical component, the technology infrastructure is the foundational building block. It starts with robust plans and strategies to store, manage, secure and analyze data of all types; complimented by a medical-grade network, built on standards and best practices that deliberately address the unique requirements of a healthcare organization. The requirements of interoperability, security, availability, productivity, and flexibility are universal, and the underlying mission of providing safe, high quality patient care must be factored into network design. Intuitive user interfaces are also needed to help overcome traditional barriers to technology adoption by medical professionals.

Complexity must be managed. Digital hospitals are complex environments with diverse and disparate applications, devices and technologies, all of which are highly interdependent. Standards adoption and interoperability is critical, and a component view depicting these interdependencies and future growth is key. As noted above, digital hospital program management that coordinates all stakeholders (hospital, community, and vendors), processes, technology, architectures and the integration design and planning efforts is critical. A technology architecture blueprint is as important as a building blueprint, while architecture and integration need to be designed up front, using a standards-based approach.

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A model of digital efficiency

In Spain, the largest hospital network in the region of Catalonia deployed advanced video-imaging technologies, broadband networks and electronic health records to help professionals all around the region to share patient data, provide time-sensitive care and improve patient experience in the delivery of care. The ability to connect primary care physicians to hospital professionals has significantly reduced the waiting times for patients to see certain specialists. Letting all hospitals in the network share the same patient data has placed the patient as the focal point of healthcare processes, eliminated duplicate testing, reduced unnecessary hospital displacements and allows for faster response in emergency situations.

A 2012 study analyzing the strategic alliances that Catalan hospitals form with other healthcare entities and institutions to foster technological and organizational innovation found that such alliances "may help improve performance, competitiveness, and services provided to users."[14] Its findings suggest that healthcare system managers should "promote strategic alliances as a means of optimizing system efficiency without reducing user satisfaction — a key challenge within the context of the current economic situation," the study concludes.

How IBM can help hospitals transform

Enabling processes with technology requires a deep understanding of how all the "moving parts" work together. IBM can provide process, technology, architecture, integration and program management services to new digital hospitals, or hospitals looking to digitally transform their infrastructure.

Digital hospitals succeed when their planning starts early and complexity is managed from the outset. IBM has developed comprehensive frameworks, based on digital hospital design and implementation experience. We have expertise and frameworks to help design and manage the digital hospital process complexity and ICT interrelationships. IBM is uniquely qualified to help manage complexity by providing a comprehensive view to facilitate application scope, definition, specification and selection for incremental and long term value.

IBM brings together two essential bodies of knowledge and resources to help your organization answer these questions and continue the transformation of the healthcare industry: deep expertise in managing and integrating complex systems that has helped transform the world's retail, financial, and energy industries; and broad expertise in life sciences, bioinformatics and the full spectrum of healthcare disciplines.

With more than 8,000 employees dedicated to healthcare, including more than 60 medical doctors and 350 healthcare professionals, IBM has completed more than 3,000 successful healthcare transformation initiatives, ranging from small hospitals to national healthcare projects. IBM holds more than 600 patents in the life sciences, healthcare and medical device fields. We have been an active participant with governments working to lay the foundations of a 21st century healthcare system. Together with our healthcare clients and partners, IBM is redefining value and success in healthcare to help build a smarter healthcare industry

For more information

To learn more about smarter healthcare, please contact your IBM marketing representative or IBM Business Partner, or visit **ibm.com**/healthcare.

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