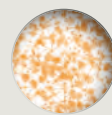
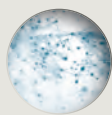


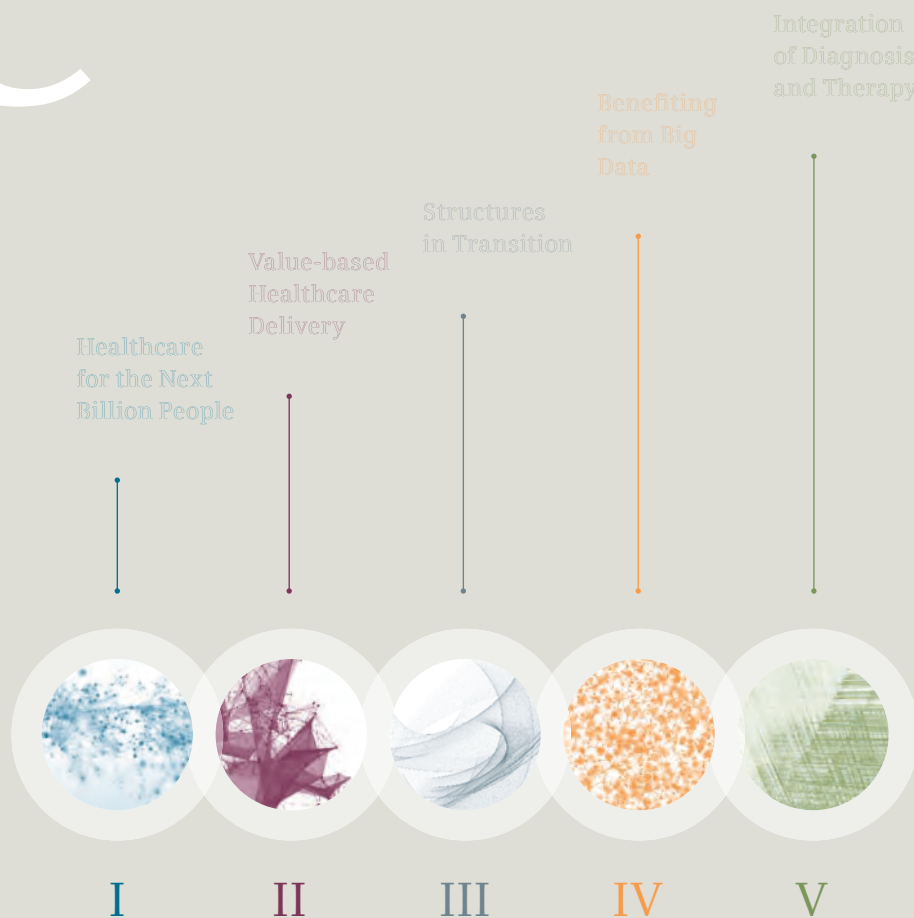
Thinking Healthcare Ahead



A Medical Solutions Publication | 2015

Thinking
Healthcare
Ahead

ng care





A man who
does not know
the way to the
sea ought to
seek a river to
accompany him.

Poenulus, Titus Maccius Plautus,
Roman playwright, c. 254 – 184 BC





This book focuses on five major trends that will influence the way healthcare will be delivered around the world in the coming years. Whether in academia, in the healthcare business, or in industry – in emerging or developing markets – we are all aware of the challenges currently facing healthcare. And we are all driven by the same aim: Thinking healthcare ahead.

Hermann Requardt
Member of the Managing Board of Siemens AG
CEO of Siemens Healthcare

US\$50

will have to come from emerging economies for every US\$100 spent on health in 2022.

US\$21 billion

is the amount the global operating-room market is expected to reach in 2019.

80%

of health data is unstructured and stored in hundreds of forms such as lab results, images, and medical transcripts.

Thinking Healthcare Ahead

I



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Chapter One

Healthcare for the Next Billion People

The disproportionately growing and aging population in emerging economies calls for new healthcare delivery models.

Infographic

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Emerging Economies – Challenges & Opportunities

All infographics are available for download:

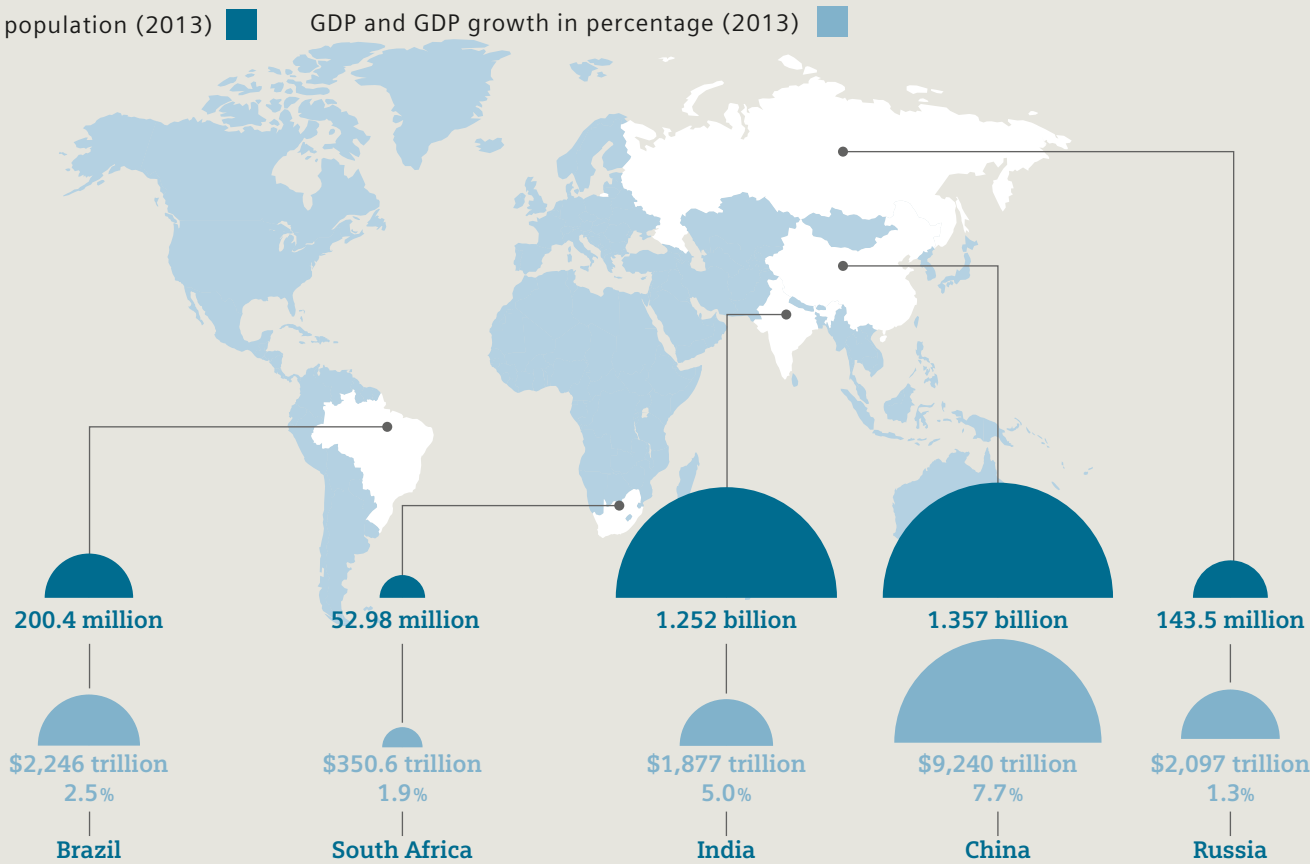


www.siemens.com/annual-infographics

Emerging countries are considered as hot destinations for private investments due to their history of rapid growth. The healthcare systems in those countries are facing many challenges such as the burden of rising and aging populations, the delivery of adequate healthcare to the masses, and the adaption to as well as the utilization of the tech explosion.

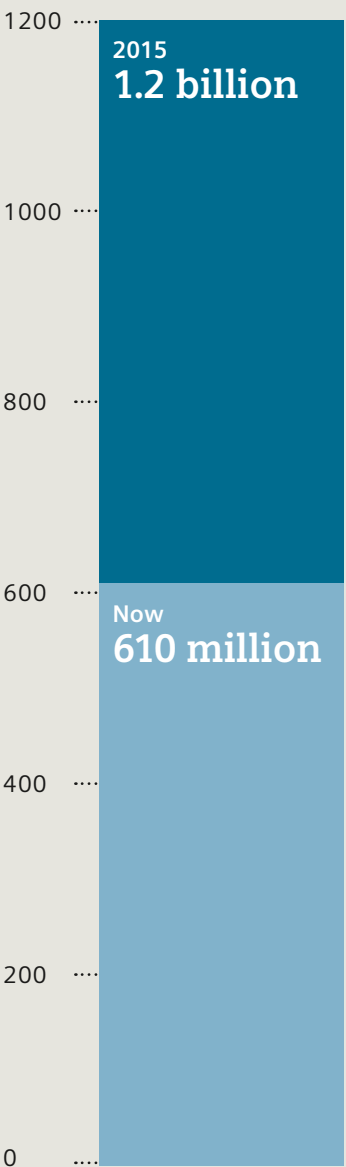
The big five ¹⁾

Brazil, Russia, India, China, and South Africa, so-called BRICS, still rank among the fastest-growing economies in the world. Even if growth has slowed down, individually, their global influence continues to rise.



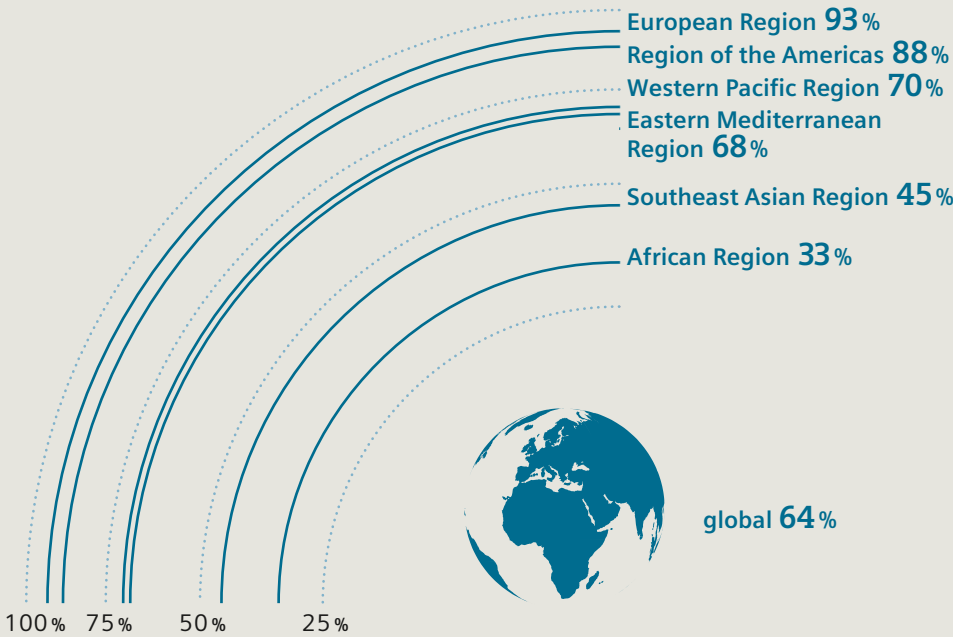
Tech explosion meets population explosion ²⁾

Forecasts predict that **Brazil, Russia, India, China, and Indonesia** will be the sources of the most dynamic growth in digital consumption. Already more than 610 million residents in these countries are regular Internet users and are expected to grow to 1.2 billion by 2015.



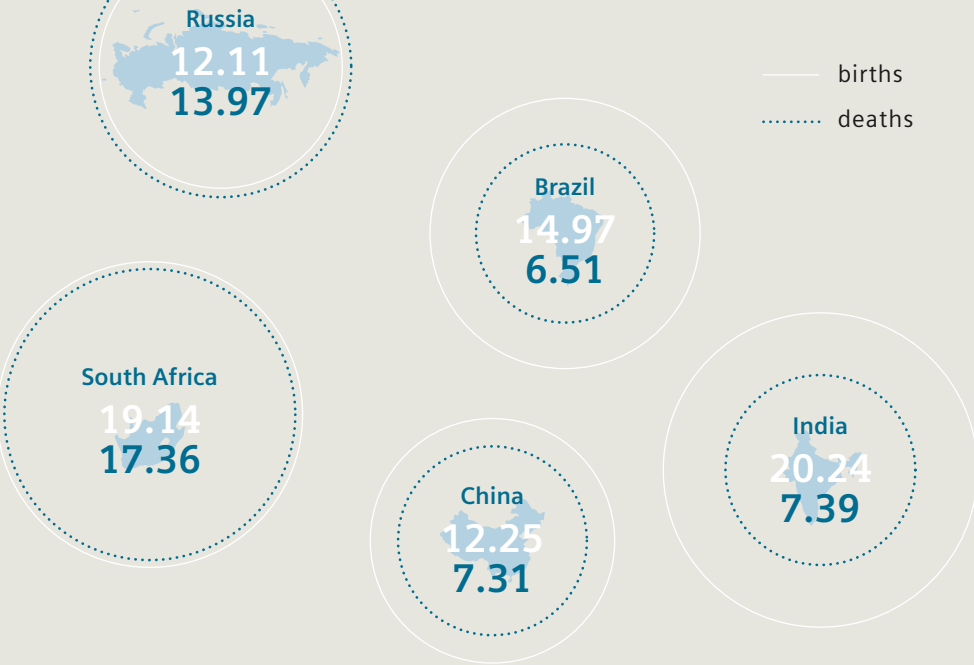
Access to improved sanitation ³⁾

Proportion of population with access to improved sanitation in 2012.

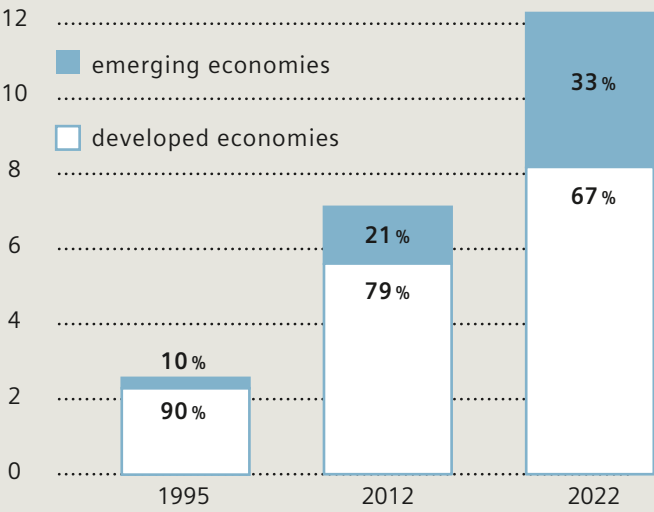


Living and dying ⁴⁾

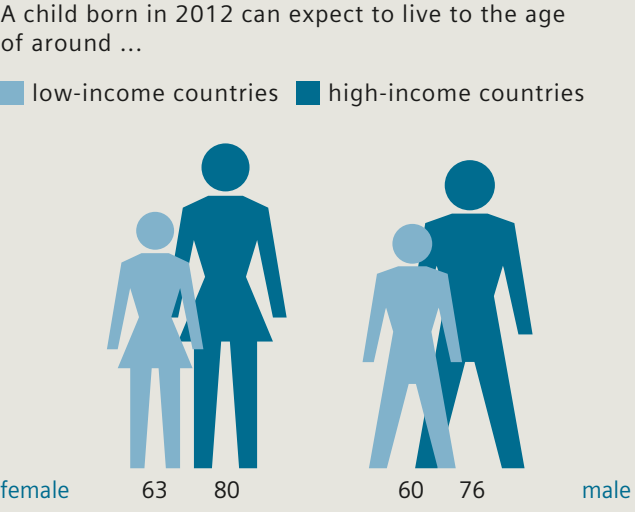
per 1,000 population



Global health expenditure (in trillion US\$) ⁵⁾



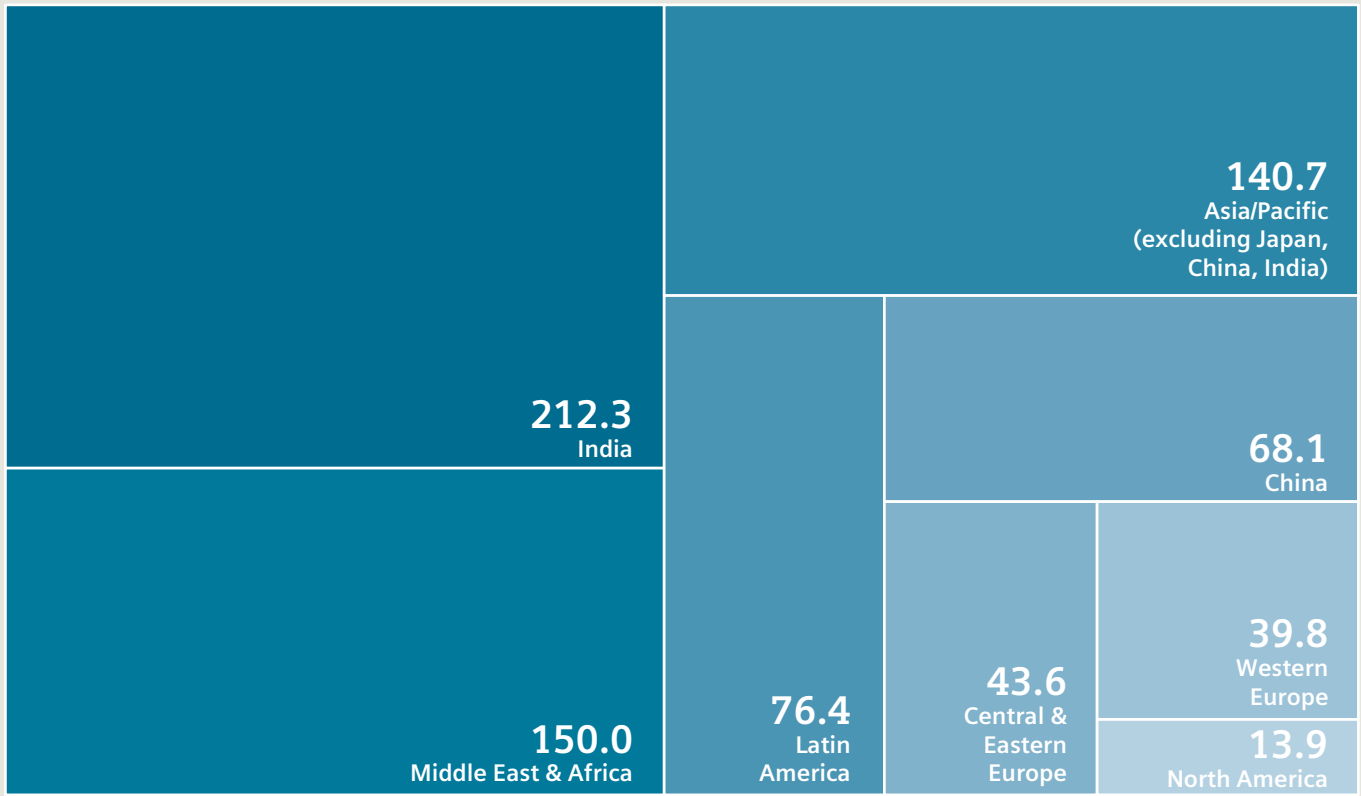
Gaps between rich and poor countries ³⁾



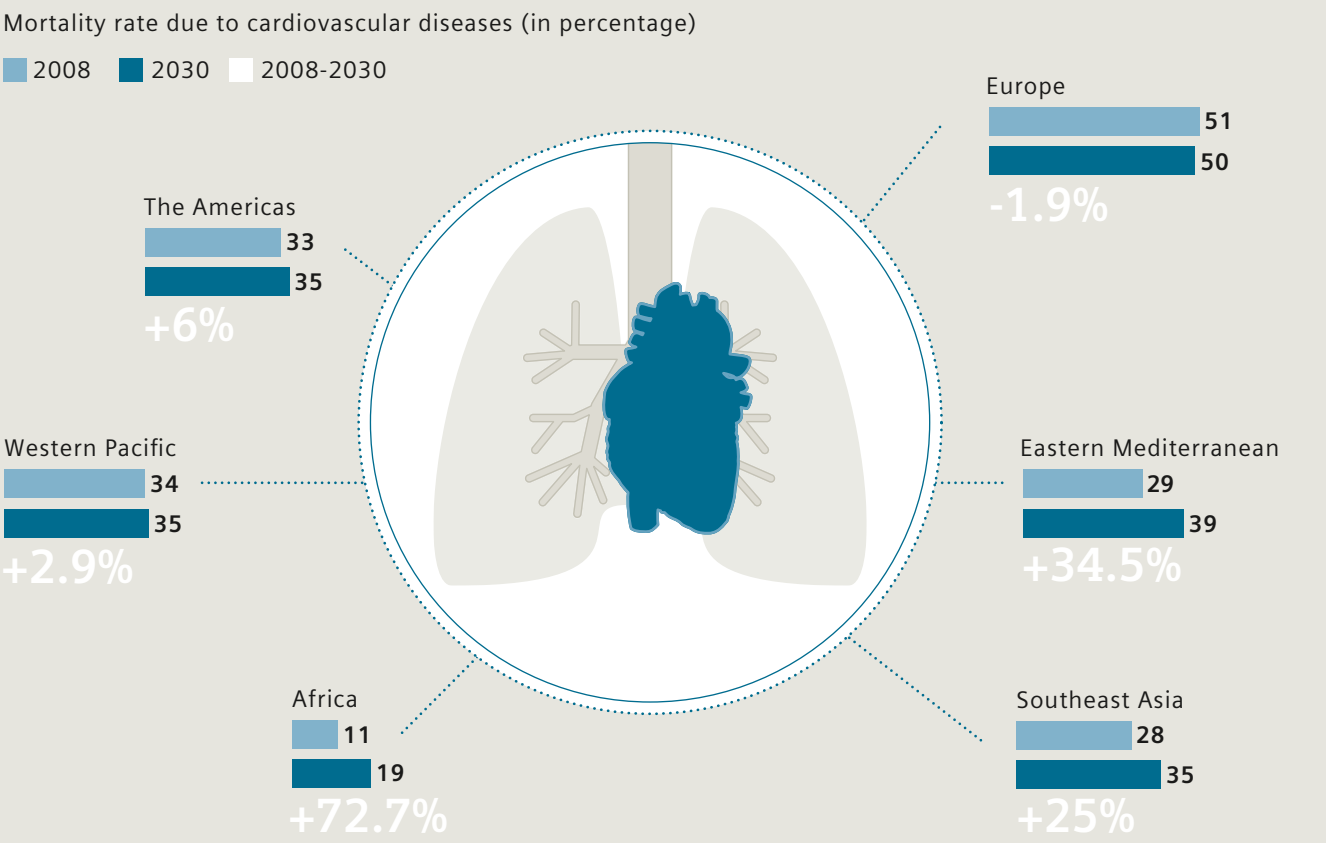
More reachable via cell phone ⁷⁾

The rise of mobile phones enables communication with healthcare providers and advances healthcare in developing countries. Worldwide shipments of advanced mobile phones costing under US\$100, by region in 2013.

744.9 total (in Mio. units)



Development of disease patterns ⁸⁾



Hospital bed density ⁹⁾

Beds per 1,000 population. The numbers include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers.



Advancing computerization ¹⁰⁾

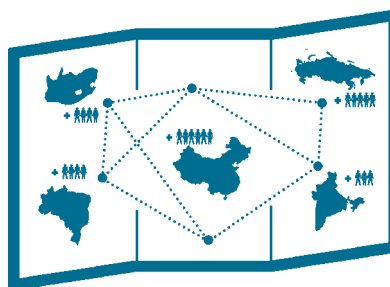
The global healthcare business intelligence (BI = transformation of raw data into useful information for business analysis purposes) market was valued at an estimated

\$2,376.6 million in 2013 and is expected to reach **\$4.7 billion**, growing at a compound annual growth rate (CAGR) of **14.8%** in the next five years. This rapid growth is mainly attributed to federal health reforms, a rise in healthcare data, the need to manage rising healthcare costs, improve medical outcomes & patient satisfaction and meet increasing regulatory compliance requirements.

Sources: 1) worldbank.com, <http://bit.ly/1mkFKTJ> 2) GrowGlobally.org, MCI Group, <http://bit.ly/1sMT5Xk> 3) World Health Statistics, <http://bit.ly/1otsccd> 4) indexmundi.com, <http://bit.ly/1ljRSZ4> 5) World Economic Forum: Health Systems Leapfrogging in Emerging Economies – Project Paper, P. 5, <http://bit.ly/1qMVwag> 6) World Health Statistics 2014, Part III: Global health indicators, P. 5-13, <http://bit.ly/1qmeozq> 7) IDC Worldwide Mobile Phone Tracker, <http://bit.ly/1hJymTx> 8) Strategy&: Pharma emerging markets 2.0 & How emerging markets are driving the transformation of the pharmaceutical industry, P. 19 9) CIA World Factbook, <http://bit.ly/VUPnv5> 10) MarketsandMarkets, <http://bit.ly/1rDtfJD> (all references last accessed on 08/29/14)

Healthcare in the Emerging World

Text: Kathleen Raven



Rising populations in emerging economies will lead to increased demand for medical devices, diagnostic equipment, and pharmaceuticals in the near future. At the same time, this demand will leverage technological advances.

Between 2006 and 2011, pharmaceutical sales doubled in emerging markets such as Brazil, India, China, and South Africa, according to the U.S. consulting firm Strategy& (formerly Booz & Company). While providers, producers, and payers in these four countries scramble to satisfy demand, national and state governments debate jurisdictions and responsibilities. A 2014 report by the World Economic Forum estimates that one-third of all global health expenditure will occur in emerging economies by 2022. Above all, emerging markets must focus on cost-effectiveness and scalability to meet high patient volumes. Some regions have integrated telemedicine and novel organizational structures in an attempt to meet

demand. While mature markets naturally provide medical equipment and supplies to emerging nations, they also have much to learn from these regions, many of which have taken a “leapfrog approach” to innovative health delivery.

Brazil

Since 1988, Brazil has guaranteed free public healthcare to all citizens through Sistema Único de Saúde (SUS). With its strong and steady growth, Brazil’s economy is considered a growth market, one step above the emerging countries. Generally, the people in the southern part of the country are healthier than their northern counterparts. The country created an economic evaluation agency called CONITEC (formerly CITEC), and some research hints that it has become a stumbling block to market access. Brazil has, however, been successful in setting up manufacturing partnerships with major pharmaceutical firms, including Bristol-Myers Squibb for the distribution of its HIV drug, Reyataz, and GlaxoSmithKline (GSK). In exchange for technology and knowledge

transfers, the state provides GSK a set price and volumes for its pneumococcus vaccine for children. In 1955, Sanofi was one of the first companies with a presence in Brazil, which became the company's fifth-largest market by sales in 2011. Johnson and Johnson also runs research and development hubs in Brazil.

India

India's healthcare system can be a conundrum. Most of its 1.2 billion people go without proper healthcare. Only the very wealthy can afford to visit private hospitals, stocked with the latest imaging and medical devices. To address this problem, a handful of hospital systems use a "hub-and-spoke" model. Top hospital systems located in the country's urban centers recruit and consolidate highly specialized physicians who work in well-equipped facilities. These hubs are connected to "spoke" clinics in rural areas. These individual clinics provide cheap basic care and diagnoses, but refer patients to larger hubs for surgery and other complicated care needs. Physicians in the hubs use telemedicine to advise rural patients. Patients who receive care close to homes save money on transportation and may miss fewer days at work. India's doctors, accustomed to a heavy and constant patient load, continuously sharpen their skills to improve precision and find ways to reduce costs. India's collection of best hospitals regularly tie or perform better than average U.S. hospitals. Another core aspect of efficiency in India's healthcare system is the rigid separation of health worker roles. For example, a doctor would not record a patient's basic

intake information. The opposite occurs in the United States, where low-skilled jobs are often cut first. Indian doctors rely heavily on established protocol for many procedures, which lessens waste and helps prevent mistakes. Hospital systems monitor how doctors use medical supplies, and then ask suppliers to modify them accordingly, usually saving money in the process. These changes can be done without waiting for governments to intervene.

China

Like India, China's healthcare system has long maintained a mix of public and private health providers. The countries face similar challenges in providing care to billions over a vast geographical area. The Chinese government wants to increase its investment in the country's healthcare delivery stream and boost its public healthcare program. China had planned to spend US\$137 billion between 2009 and 2011 on universal health coverage for its 1.35 billion residents, but the actual costs were much higher, according to an article of July 8, 2014 in the *China Daily*, an English-language newspaper. The government plans to make health expenditure as much as 7 percent of overall gross domestic product (GDP) by the year 2020, compared with 5.5 percent, or US\$350 billion, in 2010 (Source: McKinsey). Chinese people are mostly concerned with rising medical costs and unequal access to health services. Part of these growing costs can be attributed to rising cancer rates in China, a 2014 report from The Lancet Oncology Commission found. The financial burden from cancer care in China is US\$2,202 >

per patient compared with US\$641 per patient in India. Among other things, the healthcare infrastructure is going through a large-scale expansion. At the same time, however, medical specialists are in short supply. Hermann Requardt, Member of the Managing Board of Siemens AG and CEO of Siemens Healthcare, explains: "We need more intelligent systems that are either simpler to operate or can be easily integrated into a network infrastructure, so that the expertise which is not available in the country can be called up from elsewhere." Requardt anticipates that China, especially in the rural areas, may see the greatest growth in the market for ultrasound systems, since these have relatively low infrastructure requirements.

South Africa

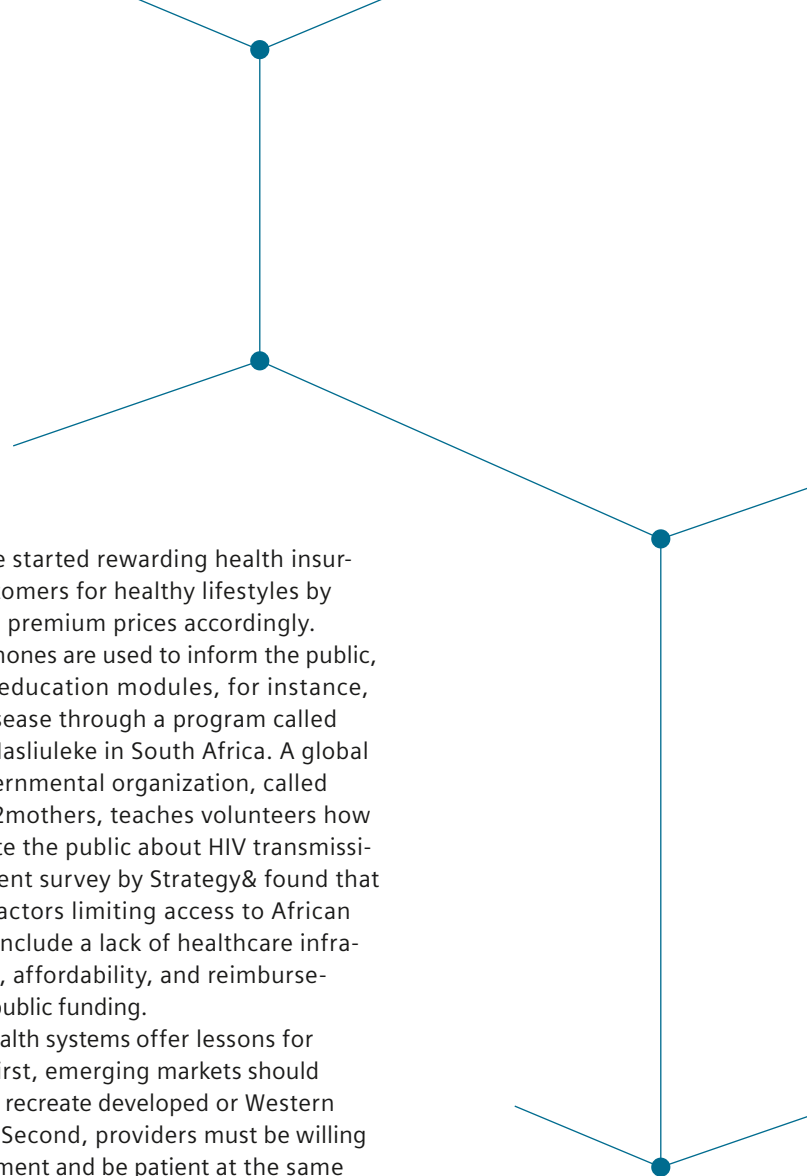
With a per-capita GDP of US\$12,504 in 2013, South Africa is the wealthiest nation in Africa. African countries are trying to catch up, but few have sufficient capital to invest in brand-new healthcare infrastructure. As such, pharmaceutical leaders consider South Africa and Northern African countries to be important second-tier emerging markets, and the greatest growth in these pharmaceutical markets is expected to be in anti-infective and antiviral medications. In an attempt to provide healthcare, some African countries have child health programs by Pesinet, a French NGO, in which community health workers check in on families and thus serve as gateway access to qualified nurses and doctors. In another innovative way to encourage health, a large South African private insurer named Discovery

Insurance started rewarding health insurance customers for healthy lifestyles by adjusting premium prices accordingly. Mobile phones are used to inform the public, through education modules, for instance, about disease through a program called Project Masliuleke in South Africa. A global non-governmental organization, called mothers2mothers, teaches volunteers how to educate the public about HIV transmission. A recent survey by Strategy& found that the top factors limiting access to African markets include a lack of healthcare infrastructure, affordability, and reimbursement or public funding. Global health systems offer lessons for others. First, emerging markets should not try to recreate developed or Western systems. Second, providers must be willing to experiment and be patient at the same time. ■

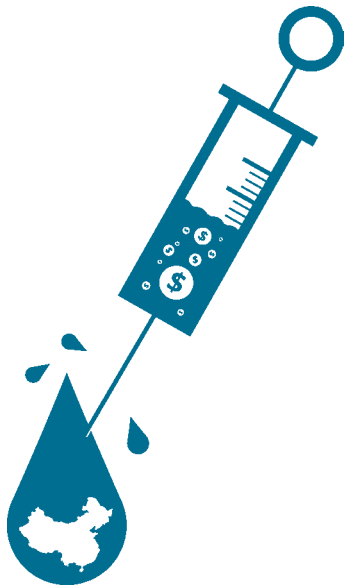


We need more intelligent systems that are either simpler to operate or can be easily integrated into a network infrastructure.

Hermann Requardt, Member of the Managing Board of Siemens AG and CEO of Siemens Healthcare



Fast Facts



Innovation and Demand Soar in Emerging Economies

Spending on healthcare in countries such as China and India will continue to rise in line with their economic growth, and they will become big markets for healthcare companies. Serving them will require innovations in technologies, delivery, and business models — some of which will be adopted by developed countries. Demand for vaccines and treatments for traditionally “Western” diseases will soar in these countries.

Source: Harvard Business Review (hbr.org), <http://bit.ly/1vKUNdY> (last accessed 8/26/14)



Policymakers now stand at a fork in the road, and face two alternative paths: the familiar but long, expensive, and ultimately unsustainable path of developed economies – or a shortcut that leapfrogs over the problems experienced by developed economies and results in a system that provides better health outcomes, financial stability, and individual satisfaction.

Robert Greenhill

Managing Director, Chief Business Officer and Member of the Managing Board, World Economic Forum



Source: World Economic Forum, <http://bit.ly/1IbNMSy> (last accessed 8/26/14)

59

... percent of patients in emerging markets already use mobile health applications or services (vs. 35 percent in developed markets).

Source: SAP Business Trends, <http://bit.ly/1reQlk3> (last accessed 8/26/14)



Business Model on Four Pillars

Text: A. Mohan
Photos: Atul Loke

From its centralized laboratory in suburban Mumbai, India, Thyrocare Technologies processes 100,000 diagnostic tests each night – more than in any other comparable lab worldwide.

made Thyrocare the leader in the Indian diagnostic industry, commanding 60 percent market share. There are four pillars to his business model – large volumes, speed, low costs, and accuracy.

Airborne

During the day, close to 25,000 vials are flown in from every corner of India. By the time dawn breaks over the Mumbai coastline, the automation solutions at Thyrocare Technologies have processed nearly 100,000 tests and posted the reports online, almost all without any human intervention.

“We are a single laboratory for a billion people. We are faster than any local laboratory that serves its local population. We are the fastest on earth.” After all, Thyrocare >

The size of a football field, the laboratory is situated in the basement of a three-storied building in a suburb of Mumbai. The man behind Thyrocare is Dr. A. Velumani. “Thyrocare is the world’s largest single-floor, centralized, fully automated, IT-enabled laboratory,” says the 54-year old CEO and founder.

Velumani’s entrepreneurial vision of providing tests at an affordable cost has

Top: “We are a single laboratory for a billion people,” says Thyrocare’s CEO Dr. A. Velumani. Bottom: Each patient sample is collected in Thyrocare prebar-coded empty vials.





In 1995, Dr. A. Velumani set up his first laboratory in a small garage. Today, his laboratory automation system has two customized tracks, each one more than 246 feet long with 32 immunoassay analyzers attached to it.

boasts of a turnaround time of less than 20 hours from the time the sample was collected somewhere in India.

Advantage Automation

Thyrocare was the first in India to use barcodes and bidirectional interfacing in diagnostics to eliminate errors. "Today, error in my laboratory can be one in a hundred thousand or less. Theoretically what is achievable has been practically achieved," says Velumani.

In addition, the advantage of automation reduced the turnaround time by three hours and decreased costs. It made the workforce more productive while reducing the overall need for manpower as well as the quantity of consumables like vials and reagents.

Ambitious

Velumani's aim is to have 12 single-floor fully automated laboratories across the world, each servicing areas within a three-hour flying time. Asked if that weren't a rather ambitious dream, he replies, "I don't dream. I never dreamed I would be an entrepreneur one day." ■

Learn more



www.siemens.com/thyrocare

The outcomes achieved by the Siemens customers described herein were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that others will achieve the same results.

Where Innovations Meet Economies of Scale

Text: Reinaldo José Lopes
Photos: André Vieira



DASA, Brazil's largest diagnostics company, is meeting the country's healthcare challenges. The merger of several laboratories and imaging providers employs over 20,000 staff and performs tens of millions of exams annually.

Learn more



[www.siemens.com/
dasa-brazil](http://www.siemens.com/dasa-brazil)

DASA chairman Romeu Domingues aims to create a unified corporate culture within the company's 26 brands: an innovation-based, high-quality, and high-productivity corporation. He explains how his company achieves those goals and fulfills its social



commitment in a country with a growing need for high quality and high productivity in medical services.

Please tell us something about your 26 brands and the various kinds of clients they entail.

Romeu Domingues: DASA deals with four different market segments. 74 percent of our revenue comes from private patients, 10 percent from "lab to lab." Furthermore, DASA performs exams for private hospitals. And seven percent comes from the public health system, and it's a pity it's just seven percent. The profit margins are smaller. On the other hand, there's our sense of social

responsibility, and it helps us generate an economy of scale. After all, we're now the largest diagnostic lab in Latin America.

DASA has a strong interest in innovation. What are the benefits of that approach?

Romeu Domingues: We can't afford not to invest in innovation, in new technologies, in being a pioneer. So, how does our business stay afloat in the long run? Only with innovation, with a focus on being a pioneer. If you save ten seconds here, ten seconds there, at the end of the day that's a lot of time and money. So we discovered that, besides technical quality, we could be a lot more productive. ■

DASA was the first Brazilian company in the health sector to open its capital to investors, starting in 2004, when it was listed on Bovespa, São Paulo's stock exchange. Dr. Romeu Domingues heads DASA's administrative council.



A Revolution in Diagnostics

Text: Moritz Gathmann
Photos: Fabian Weiß



Left: Dr. Arkady Stolpner is especially proud of his training center in St. Petersburg, where the younger doctors learn how to use the equipment. Right: The first center in the north of St. Petersburg is still at the core of his activities.

Ten years ago, Dr. Arkady Stolpner opened the first privately owned magnetic resonance imaging (MRI) center in Russia. "To get an MRI diagnosis in one of the state-owned clinics of St. Petersburg, you had to wait four months," he says.

In 2003, an old friend proposed that Dr. Arkady Stolpner open private MRI diagnostic centers. "Everybody told us that because of the costs, it would never work out," he remembers. Stolpner, however, founded the Diagnostic Treatment Centre of the International Institute of Biological Systems (DTC IIBS) in St. Petersburg. In August 2003, they welcomed their first patient. In December 2004, he opened a second center in the nearby town of Tver

and, in 2005, another in the Siberian city of Krasnoyarsk. Today, Stolpner's doctors scan 3,600 patients a day, and with 1.2 million MRI exams per year, his 77 centers account for 20 percent of all such exams in Russia.

"We understood from the very beginning that equipment alone is not enough," says Stolpner. Quick troubleshooting is an issue when you have large distances. Stolpner copes with it by training his own service engineers.

Another issue is maintaining the quality of diagnostics. "All MRI centers are merged into a single telemedical network," explains Stolpner. His most experienced doctors supervise their colleagues in the other cities from the consulting center in St. Petersburg. Stolpner is also proud of his training center there, where the younger doctors learn how to use the equipment. ■

Learn more



www.siemens.com/mri-russia

A Community Effort

Text: Hanan Solayman
Photos: Uwe Mühlhäuser

In Egypt, cancer is spreading with an annual average of 155,000 new patients who receive state-covered treatment. Unfortunately, due to lack of facilities, less wealthy Egyptians have to wait for months before treatment can begin.

Egyptian cancer specialist Dr. Assem Rostom returned to his birthplace to treat the poor for free after 35 years of work in the United Kingdom. "It's been my life dream to build an advanced charity oncology center in Egypt. And after two previous failed attempts, we finally made it," Dr. Rostom says, welcoming us into his office in Alexandria. After 35 years in the UK as Senior Consultant Clinical Oncologist at the Royal Marsden Hospital of London, he has returned to his birthplace to give back to his community.

Fundraising

Several local businessmen formed the board of a non-profit organization called "Ayadi Al-Mostakbal" (Future Hands) and raised a threshold amount of two million U.S. dollars to start the Ayadi Al-Mostakbal Oncology Center (AAOC) in 2006. The hospital's philosophy is to offer chemotherapy and >



It's been
my life
dream to
build an
advanced
charity
oncology
center
in Egypt.

Dr. Assem Rostom,
AAOC, Alexandria, Egypt





AAOC provides advanced chemotherapy and radiotherapy treatments.



Left: Dr. Rostom is seen as the “human doctor” who isn’t there only for treatment but as a companion for the journey itself. Every AAOC patient wants him to follow their treatment himself.

Bottom: AAOC doctors closely follow international treatment guidelines, such as those of the National Comprehensive Cancer Network.

Right: Walking into AAOC with Dr. Rostom and Alaa Orfy, an Alexandrian businessman, they recall how it all started: “A board of ten businessmen, who had their own share of contributions, actively worked within their communities to raise EGP 5,000 (about US\$1,000 at that time) from 50 donors each, and other donations from the private sector.”



radiotherapy free of charge to those who cannot usually afford it.

Continuous Expansion

Since its inauguration, the AAOC has continued to expand its facilities, upgrading and updating the deployed technologies. There are plans to add a 44-bed facility, including the first purpose-built palliative care unit in Egypt.

During the seven years since the opening, more than 14,500 new cancer patients have been treated at the AAOC, without a single patient being turned away, even at later stages, reflecting its slogan: "We share, we care." Most patients come from Alexandria and surrounding cities, but a sizable

number of patients come from faraway cities as well, particularly Beheira and Matruh. As part of the extension plans, non-Alexandria residents will be able to reside temporarily in the new building while undergoing their daily treatment.

Combined Costing

To keep the hospital expenses sustainable, the board agreed to provide treatment for fees to those who can afford treatment expenses based on social service assessment. Today, these fees represent a fifth of the AAOC annual budget. All other costs are covered by the board's fundraising and direct donations from the public. ■

Learn more



www.siemens.com/aaoc



II

Chapter Two

Value-based Healthcare Delivery

Cost pressure requires a shift to new incentive models beyond budget cuts and efficiency gains.

Infographic

Balancing Quality and Cost

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“What matters most is the patient’s outcome.”

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“The data does not lie.”

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Balancing Quality and Cost

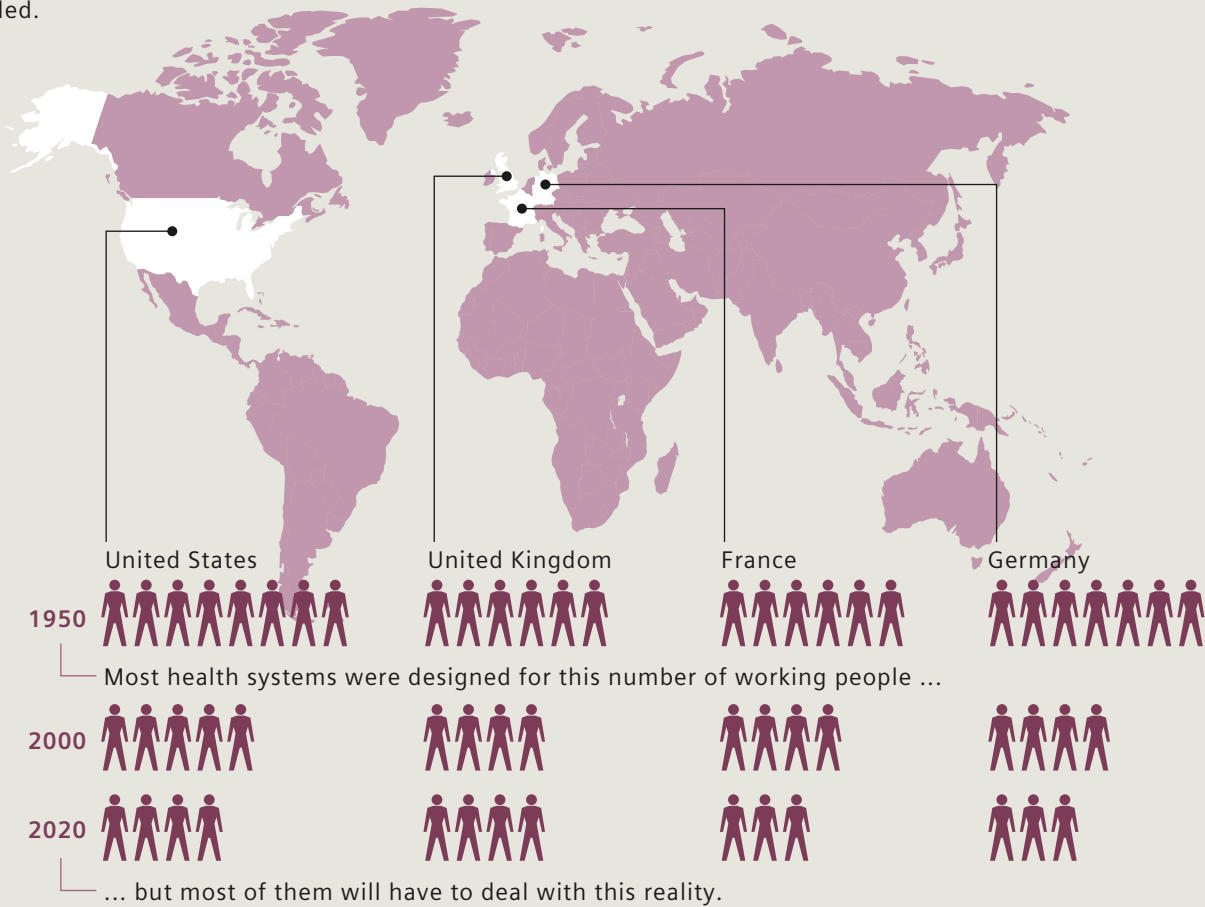
All infographics are available for download:

www.siemens.com/annual-infographics

Global forces will reshape the way every country delivers healthcare in the future. However, most governments and providers end up trying the same things. The former are required to provide the right incentives and increase competition, the latter need to improve efficiency and quality, and stand their ground successfully.

The impact of demographic shifts on healthcare ¹⁾

Due to declining birth rates and longer-living populations, the developed world is aging at an alarming rate. Providing for their care will put a severe strain on medical resources, all the more so for the way the systems are funded.



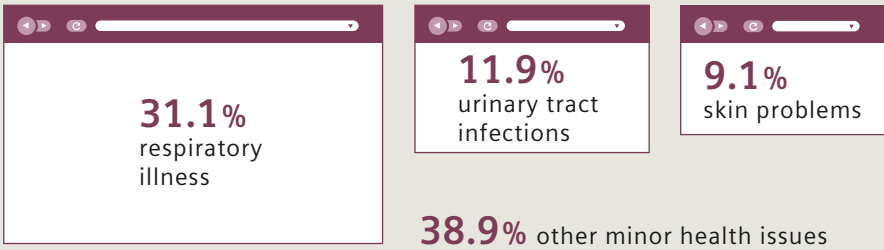
Five basic types of healthcare systems ²⁾

- 1 Free market**
Unique to the United States
 - Maintains safety net through public payment of premiums
 - Offers services and insurance through private sector
- 2 Bismarck**
Germany and France
 - Provides insurance through competing social funds
 - Offers multiple sources of provision
- 3 Hybrid**
Netherlands and Japan
 - Requires private insurance for high earners and social insurance for all others
 - Provides services through public or private sector
- 4 Beveridge**
United Kingdom, Spain, Italy, Scandinavia, and Portugal
 - Funds system through general taxation
 - Provides services through public sector; treatment is free at point of care
- 5 Ex-Semashko**
Russia and former Eastern Bloc countries
 - Is decentralizing from communist model and restructuring either to Beveridge or Bismarck system

Top reasons for e-health visits ³⁾

Since healthcare systems are facing a shortage of physicians, millions of additional patients, and cost pressure, technology-enabled alternatives to traditional healthcare are required. Telemedicine may be a solution and an opportunity to save costs.

Over **80%** of telemedicine visits are for such maladies as



Mobile lifestyle and health manager ⁴⁾

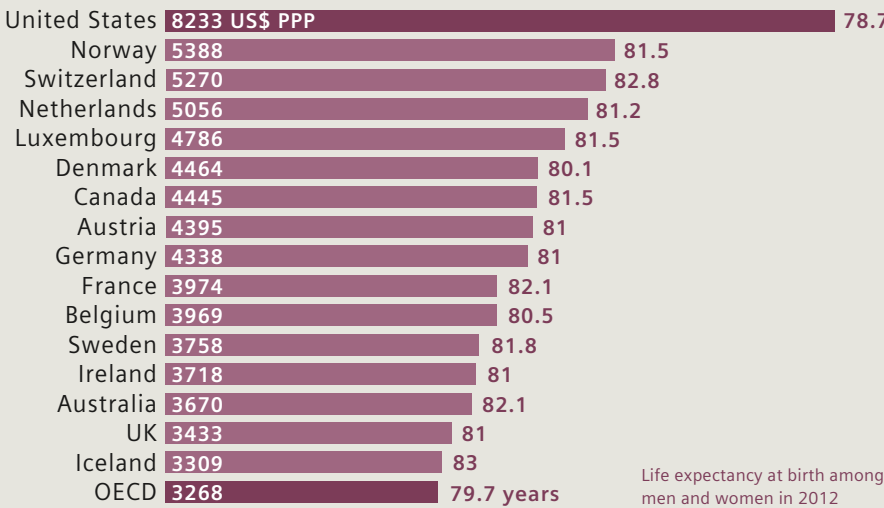
500 million

smartphone users worldwide will be using a healthcare app by **2015**, and **50%** of the more than **3.4 billion** smartphone and tablet users will have downloaded mobile health apps by **2018**. With the aid of these apps, consumers are starting to actively manage their health to stay well and keep away from the doctor's office.

30% of total smartphone users will have used m-health applications by **2015**

Total health expenditure per capita, public and private related to life expectancy ⁵⁾

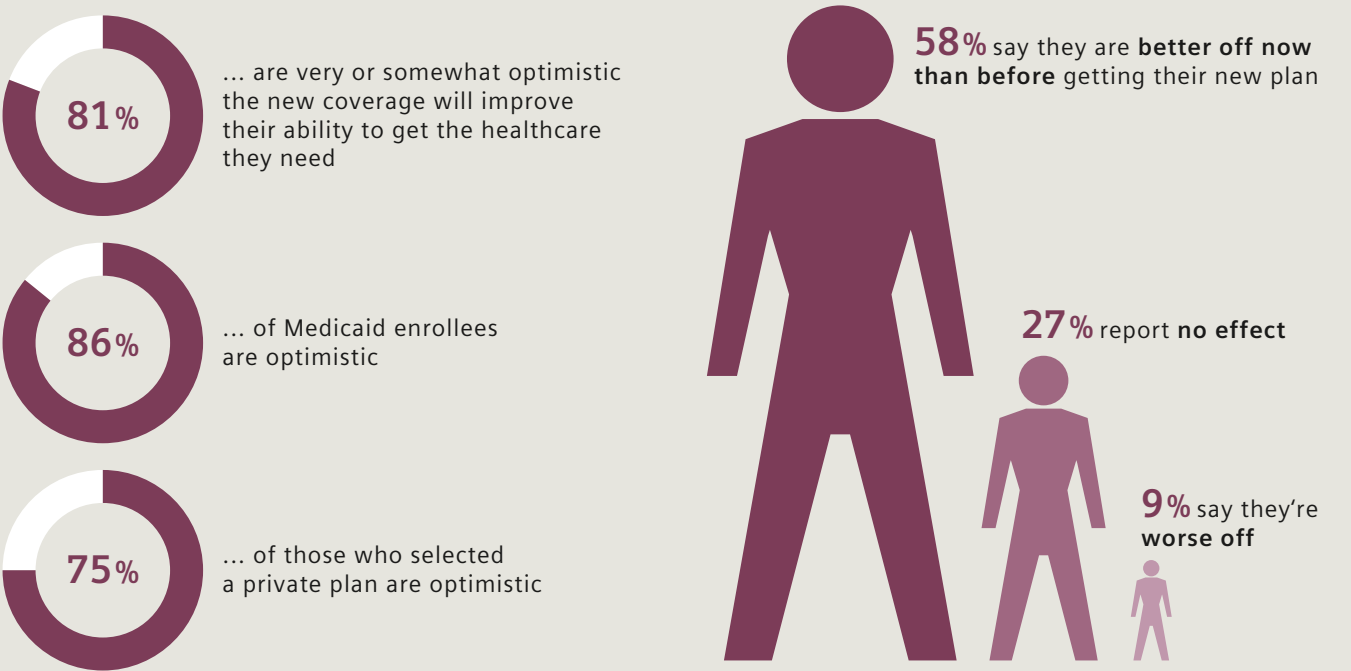
High health expenditures do not necessarily result in a higher life expectancy.



Life expectancy at birth among men and women in 2012

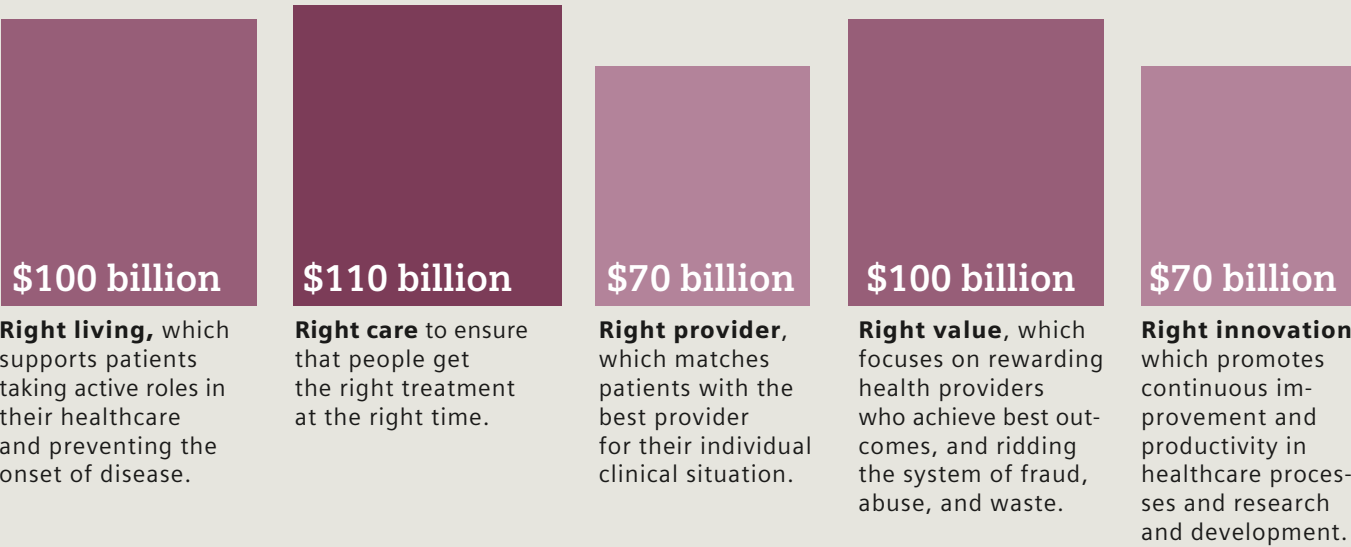
What do Americans think about their Obamacare coverage ⁶⁾

Because of the Affordable Care Act, millions of Americans have enrolled in new private health plans through the marketplaces or signed up for Medicaid.

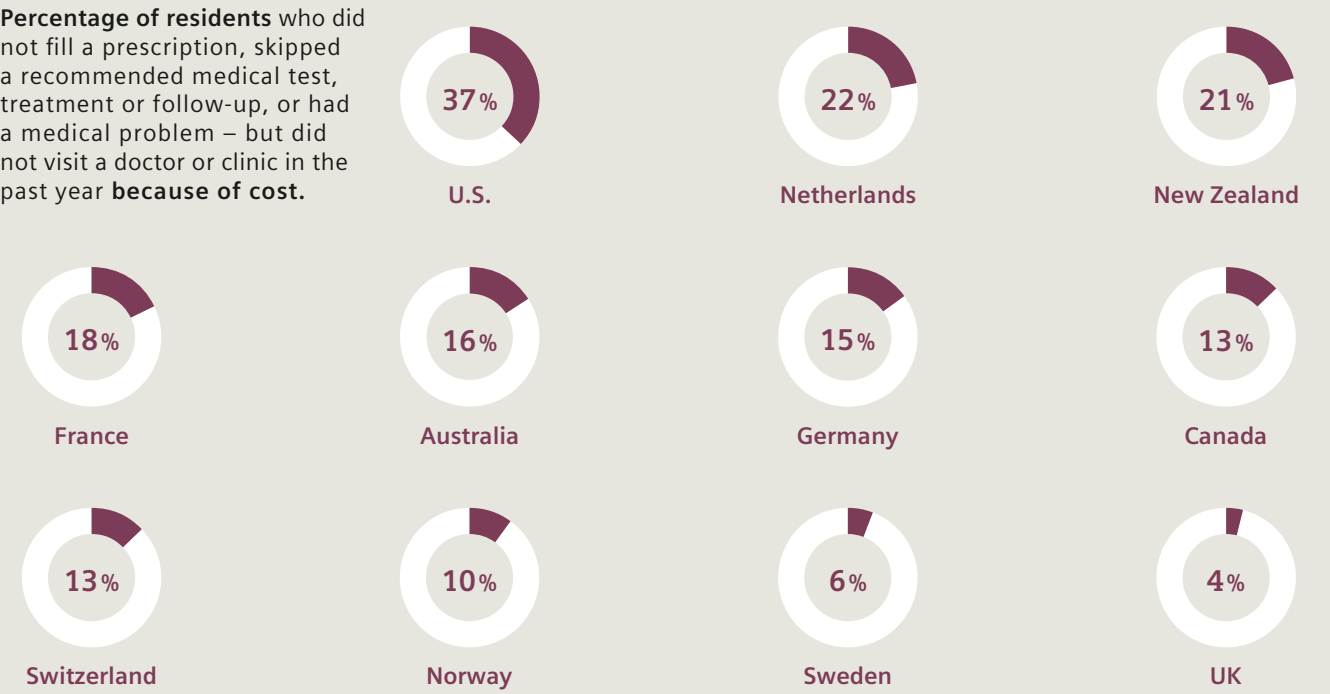


How to reduce healthcare costs ⁷⁾

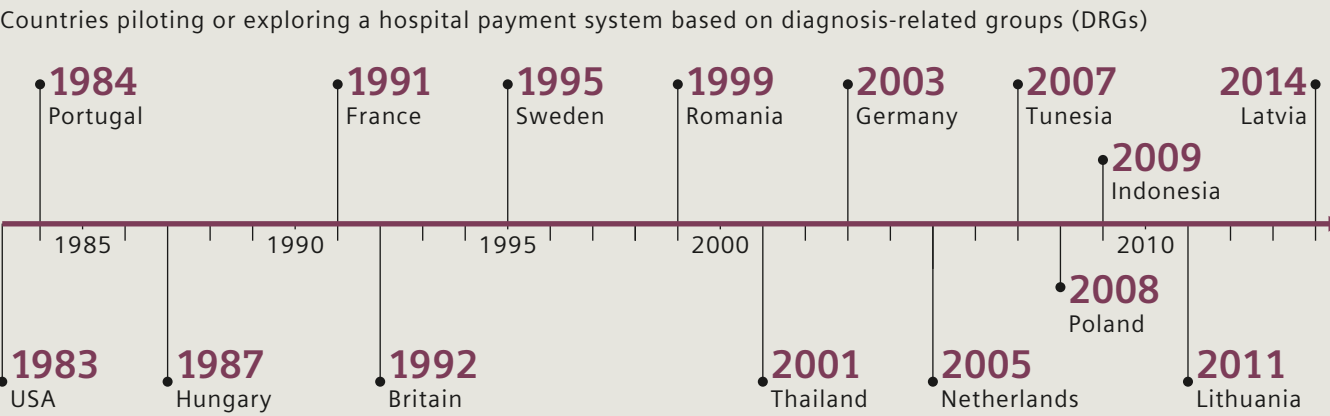
McKinsey & Company estimates that harnessing Big Data across five dimensions of healthcare could yield nearly **half a trillion dollars' worth** of value:



The UK and Sweden rank best on cost-related problems ⁸⁾



Hospital payment systems on diagnosis-related groups ⁹⁾



Payment systems based on diagnosis-related groups (DRGs) are one type of hospital payment mechanism, along with capitation payments, global budgets, or a combination thereof. Although DRG-based payment systems are now mainly understood as a **reimbursement mechanism**, their original purpose was to enable **performance comparisons across hospitals**.

Sources: 1) A.T. Kearney: Healthcare Out of Balance, P. 6, <http://bit.ly/1nJFqNB> 2) John Lister, Health Policy Reform: Driving the Wrong Way? (London, Middlesex University Press, 2005), A.T. Kearney: Healthcare Out of Balance, P. 4, <http://bit.ly/1nJFqNB> 3) Health Affairs, Wall Street Journal; Bob O'Meara, Todd Huseby & Jason Dombi, AT Kearney, <http://bit.ly/1qaeMN> 4) research2guidance, <http://bit.ly/1nJFrBI> 5) OECD Health Data 2012, <http://to.pbs.org/Pe9nLI>, <http://bit.ly/1qtVKpJ> 6) The Commonwealth Fund Affordable Care Act Tracking Survey, <http://bit.ly/1AZFOzG> 7) McKinsey Global Institute, <http://bit.ly/1ponUUE> 8) The Commonwealth Fund, <http://bit.ly/1q4zYlr> 9) Bull World Health Organ 2013, <http://bit.ly/VUqbdd>, US National Library of Medicine, <http://1.usa.gov/1qi-J5Xw> (all references last accessed on 08/29/14)

Building Healthcare Business Models

Text: Kathleen Raven



Healthcare systems mired in disagreement over reimbursement models may become global artifacts sooner than expected. Value-based metrics must support current models to achieve lasting change. Case studies in the United States, Sweden, and Germany provide insight into possible solutions.

United States

The fee-for-service, quantity-over-quality model still dominates the U.S. healthcare reimbursement system. However, in the next five years, more than two thirds of payments will be value-based purchasing (VBP), according to a 2014 report by McKesson Health Solutions in the United States.

VBP is defined by the Deloitte Center for Health Solutions as “a payment methodology that rewards quality of care through payment incentives and transparency.” The California-based hospital system and insurer Kaiser Permanente saves about US\$3 million annually through better transparency by

monitoring its electronic health record (EHR) for patients’ disease management. The U.S. has lagged in lowering costs and improving patient outcomes, but it has been a forerunner in the idea of accountable care and meaningful use. However, 23 percent of physicians reported that they were unfamiliar with these guidelines included in the Affordable Care Act (ACA), according to a 2012 survey by U.S.-based Deloitte. In a step forward, the U.S. insurance provider BlueCross/BlueShield of North Carolina has publicly committed to ACA’s stringent payment rules.

For example, hospitals receive no reimbursement through Medicaid (the public health program for low-income families and individuals) if a medical condition is acquired while a patient is in the hospital. The insurance provider also committed to payments tied to performance for acute-care hospitals for Medicare (the public health program for aging adults).

One of the largest problems in U.S. healthcare is widespread confusion among all players on costs. Cost, as defined by

health researcher Michael Porter of Harvard Business School, is the actual expense of patient care, not the charges billed or collected. As VBP gains popularity in the U.S., today's "cash cows" such as diagnostic tests or imaging, which are often optional services, may slowly fade from fashion. The U.S. earned high marks on preventive care and low wait time, but ranked last in health equity, according to the 2014 Commonwealth Fund survey. The U.S. spent US\$8,508 per capita on health expenses in 2011, while Germany spent US\$4,495 and Sweden averaged US\$3,925 per capita.

Sweden

By contrast, Sweden ranked highest on the Commonwealth's report for healthy lives. Sweden's healthcare is among the best in the world – it's no secret. Nearly all Swedish doctors are paid with a salary, thus reducing any tendencies to over-treat, a common problem of the fee-per-service model. Nevertheless, the country could benefit from better coordination of services. In 2009, the Stockholm County Council tried exactly that by introducing a value-based reimbursement system for total hip-and-knee replacements. Rather than send patients to different departments with separate billing, the council suggested putting a capped price on 11 main points of care, including pre-op evaluation and additional surgery to the joint within two years if needed. For the entire package, Sweden charged €8,500 (US\$11,400), and departments must work together to keep costs within that figure. Since 2010, Swedes have been able to

choose between a private or public provider for primary care. This arrangement has resulted in productivity gains and a "more socially just distribution of resources," writes Karin Svanborg-Sjövall, a project manager with the Swedish think tank Timbro. But wait times remain long. A specialized service like a hip replacement, for example, might have to be scheduled three months in advance.

Germany

Healthcare providers in Germany work within clearly defined organizational structures of the public health system. This model makes it easier for health officials to regulate costs across all hospital systems and clinics. One disadvantage is a silo-like arrangement of physicians, specialists, and providers.

A group of German healthcare executives chose to react disruptively to cost pressure rather than make small changes. The West German Headache Center solved the issue of separation using a value-based approach to organization called an Integrated Practice Unit (IPU), which organizes care around specific patient medical conditions or population segments, such as aging adults. By moving neurologists, psychologists, and physical therapists into one day hospital, the new German IPU lowered costs by 20 percent and improved patient symptoms by 54 percent, according to a study by the Institute for Strategy & Competitiveness at Harvard Business School. IPU's represent a present and future answer to the need for all health systems to provide continuous patient care monitored, ideally, by a single physician or case worker. They reduce variability >

across procedures and/or diagnosis-related groups (DRGs), and thereby standardize structures and processes across hospitals, write analysts Julie Coffman and Jim Rehtin of Bain & Company.

Yet, Germany faces impending challenges. Traditionally, German states have paid for new hospital construction and other infrastructure costs. This meant the DRG system did not account for infrastructure expenses in bills to patients. Now, as German states struggle to fund rising infrastructure costs, the DRG system needs to be adjusted, writes Christopher Chapman, of Imperial College London Business School.

Further trends include a shift towards privatization and increased specialization of individual hospitals. With around 26 percent of all hospitals being private, Germany is

still to be found at the lower end of the scale when compared with other European countries. In the Netherlands, for example, more than 80 percent of hospitals are by now private. In Belgium the number is 65 percent. The potential for privatized hospitals in Germany will however remain high in the coming years, according to professor Hans Maarse of Maastricht University.

With regards to specialization, hospitals can firstly benefit from optimized use of expensive equipment. For medical experts, growing experience from an increased number of special cases will unlock advantages, too. This will in turn improve the overall quality of the services offered, and thereby also the attractiveness of the hospital for its patients. ■

Conclusion

These examples help demonstrate how value-based motives can improve patient outcomes and lead to new business models. These models will be built upon greater pricing transparency and interdisciplinary approaches to patient care. Healthcare providers that are nimble and adaptive will pull ahead.

Fast Facts

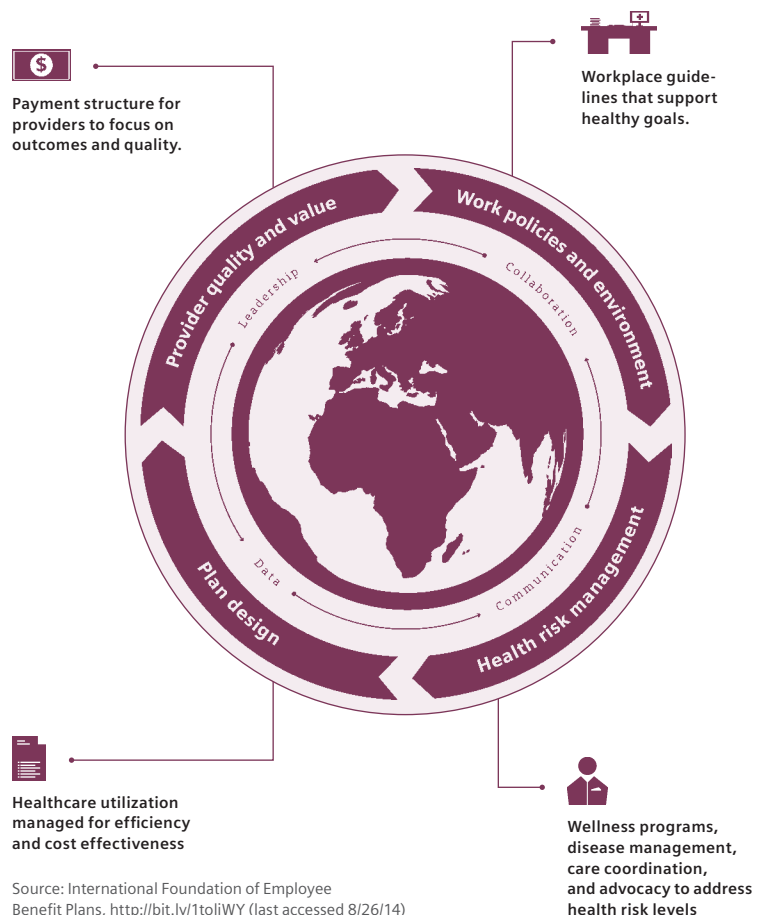
90
percent of payers and
81
percent of providers

... are already using some mix of value-based reimbursement (VBR) combined with fee-for-service (FFS). Stakeholders using mixed models are anticipating significant expansion in value-based care, projecting that payment with some form of value measurement will make up two thirds of the market by 2020, up from one third today. Providers using mixed models expect FFS to decrease from about 56% today to 34% five years from now.

Source: McKesson Health Solutions, p. 5, MHSvbrstudy.com (last accessed 8/26/14)

What is Value-Based Healthcare?

Value-based healthcare (VBHC) is a healthcare management strategy focusing on costs, quality, and, most importantly, outcomes. Its goal is to create a culture of health within an organization by removing barriers and encouraging participants to pursue healthy lifestyles that ultimately lead to a healthy workforce. VBHC involves collaboration among plan sponsors, participants, and providers to pursue high-quality and high-value care while reducing the need for high-cost medical services.





A Living Laboratory

Text: Patrícia Fonseca
Photos: Walther Appelt

How to improve the quality of care for the community at affordable prices? Salvato Trigo created a new healthcare delivery system: He founded the first private teaching hospital in Portugal.

Has the healthcare revolution started with the opening of the teaching hospital Fernando Pessoa?

Salvato Trigo: When we organize a healthcare system, we have to decide whether to invest in health or to spend on disease. In our hospital, we created a health environ-

ment for our patients – this was the beginning of our healthcare revolution. We aren't primarily interested in the so-called "disease market," but more in the "health market." This means that we want people to come here and consult with our doctors while healthy, and not just when they're suffering.

What is your economic assessment so far?

Salvato Trigo: The balance is positive. Possibly, it could have been better if we weren't going through a serious financial crisis. In the health sector, we feel that a lot. We decided not to invest in just another



private hospital – replicating existing models would have been a waste.

What more do you hope to accomplish in the near future?

Salvato Trigo: Our main goal for the future is to do differently, to make it better. I believe that this model of teaching hospital has the potential to be replicated and exported. ■

The statements by Siemens' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

Salvato Trigo, 65, a well-known Professor of Literature, is founder, owner, and rector of the University Fernando Pessoa in Oporto, Portugal. His latest visionary project: to create the first private teaching hospital in Portugal.

Learn more



www.siemens.com/fernando-pessoa





Jens Deerberg-Wittram is President of the International Consortium for Health Outcomes Measurement and faculty member and senior lecturer of the Harvard Business School.

“What matters most is the patient’s outcome.”

Text: Peter Jaret
Photos: Ye Rin Mok

Dr. Jens Deerberg-Wittram, President of the International Consortium for Outcome Measurements (ICHOM), is convinced that healthcare systems can raise their value by constantly measuring clinical outcomes that matter to patients.

What are the key considerations when measuring outcomes?

Dr. Deerberg-Wittram: The most important things are defining how to measure, who is measuring, and when we should measure

outcomes. And we believe this needs to be standardized in order to compare results from across the globe.

What are the benefits?

Dr. Deerberg-Wittram: There are three main effects. The first one: As a patient, you can make informed choices. So, if you know that the outcomes at a certain hospital are particularly great, you might prefer to go there. The second effect is for the physicians and the care teams: If they get feedback regularly on how well they are doing or where there are areas for improvement, they will improve. And there is a third effect for health plans that have the ability to shape contracts around quality rather than volume and numbers of procedures.

What is your personal motivation for working on outcome measurements every day?

Dr. Deerberg-Wittram: I have learned over the years that there are great people who are really motivated to do their best for their patients. So, it’s our obligation to provide them with data on how to improve, how to learn from each other. I had the feeling that we had to bring that to a higher level. And ICHOM is the sounding board for that. ■

Learn more



www.siemens.com/ichom



“The data does not lie.”

Text: Peter Jaret
Photos: Ye Rin Mok

Experts in value-based care believe that business models in other industries can enable healthcare to manage costs and improve care. Hoag Orthopedic Institute (HOI) is one example of how to measure health outcomes and implement results.

As an integrated care unit, HOI specializes in orthopedics and is able to control the clinical quality along the care processes. Dereesa Reid, chief executive officer of HOI, explains their approach.

How does measuring outcomes work and in what ways does this affect your business?

Dereesa Reid: The process of measuring outcomes is collecting the data and being able to compare that data. We not only make it available to the public, we also use it internally and make it actionable. We set ➤



Left: Located in Orange County, California, Hoag Orthopedic Institute combines a 70-bed hospital with two freestanding surgery centers.
Right: Dereesa Reid is CEO of Hoag Orthopedic Institute.

organizational targets in financial performance and quality. And those targets are not only at the top of the organization, but they are driven throughout the organization. And it's important for us to share best practices.

HOI is an integrated care unit – a facility dedicated to treating orthopedic problems. How does this concept fit into value-based healthcare?

Dereesa Reid: We embody the idea that if you focus on a limited number of things, you can do them very well and very efficiently. We also embody the idea of a cycle of care.

We treat patients through the entire cycle of care for their condition, which means preparing them if they need surgery, following them through rehabilitation, and then measuring how well they are doing three, six, nine months later, and beyond. That's when we know if we really provided value. Too often, outcome measures only follow patients from hospital admission to discharge.

What is the advantage for the patients?

Dereesa Reid: The big advantage is patient satisfaction. I've never worked in a place where I receive so many happy patient

Learn more



www.siemens.com/hoag



letters. That's because we have created an integrated care unit that surrounds patients with the best care possible and gets them back to what they enjoy doing.

What is the direct effect for the staff working here?

Dereesa Reid: The direct effect on employees working here has also been another amazing outcome. We measured employee satisfaction last year for the first time and the scores were exceptionally high. What you find is when you recruit teams of people that are committed to one speciality, they're able to go to work every day and use the skills that they want to use to provide the best care.

Where do you see the institution in ten years?

Dereesa Reid: I hope that we will become part of a global community where we are collaborating with other orthopedic hospitals and surgeons across the world. We're providing better care for more people at lower cost and we're touching more lives throughout the world. ■

Left: Dereesa Reid of HOI and Jens Deerberg-Wittram of ICHOM discuss value-based outcome measurements as a way to fix the healthcare system.
Right: Hoag Orthopedic Institute exemplifies the integrated practice unit, a facility dedicated to excellence in one speciality.



III

Chapter Three

Structures in Transition

Stakeholders must think beyond their own organization to develop more efficient, effective ways to deliver care.

Infographic

Facing the Challenge of Change

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Trend Stories

Shaping Tomorrow's Healthcare Today

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Culture Change in Healthcare

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Best Practice Stories

A New Era in the Public Healthcare Sector

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A Hospital for Everyone

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Facing the Challenge of Change

All infographics are available for download:

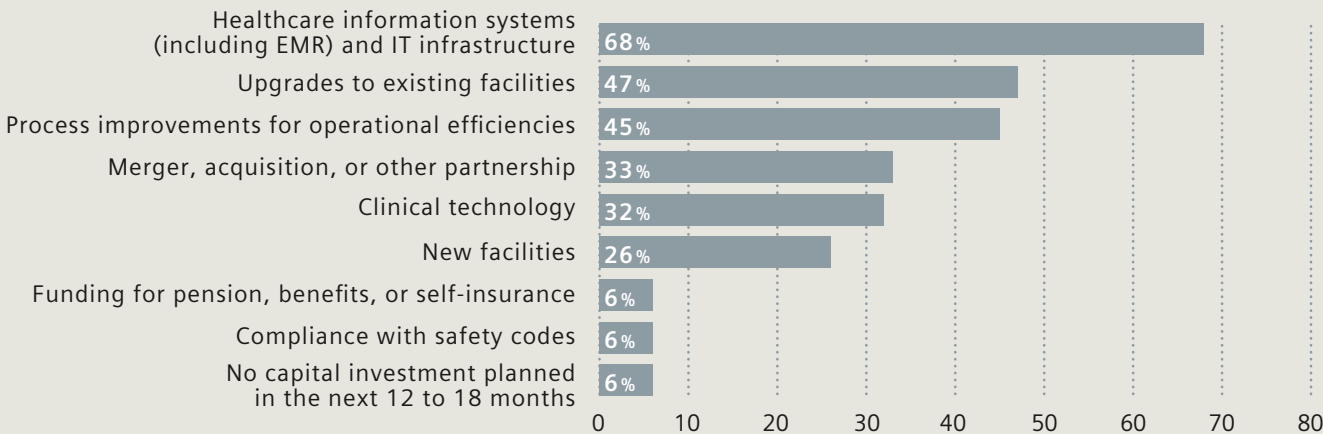


www.siemens.com/annual-infographics

The world of healthcare delivery is changing rapidly, and organizations need to radically transform their business strategies to keep up with the new environment. They face big challenges – whether they choose to focus on specific services, merge with other organizations, or automate their processes.

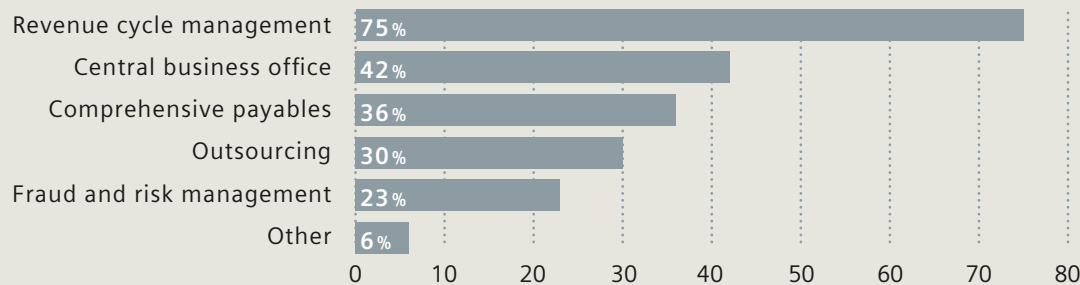
Priorities for capital investment ¹⁾

Top priority of U.S. healthcare industry executives is health information technology to generate the data they need to improve performance.



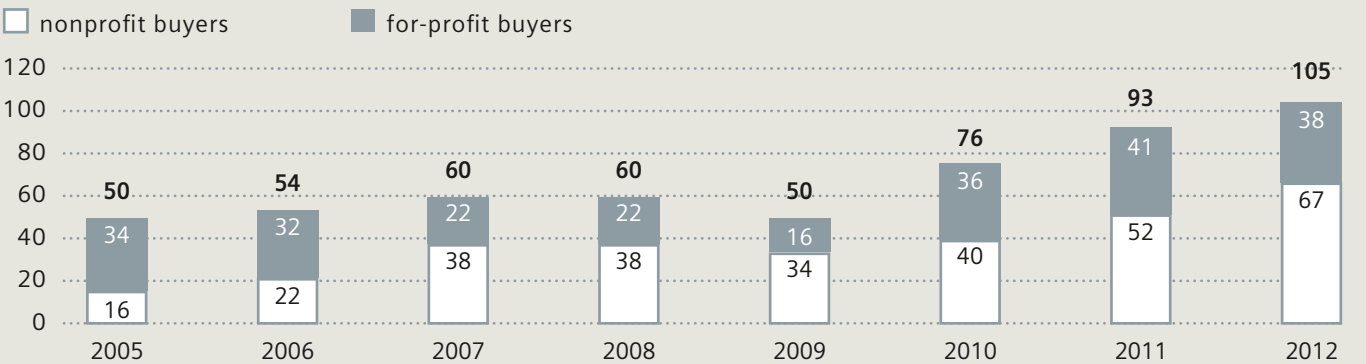
Areas of opportunities for financial efficiencies ¹⁾

In which of the following areas do U.S. healthcare executives see opportunities for financial efficiencies in their organization?



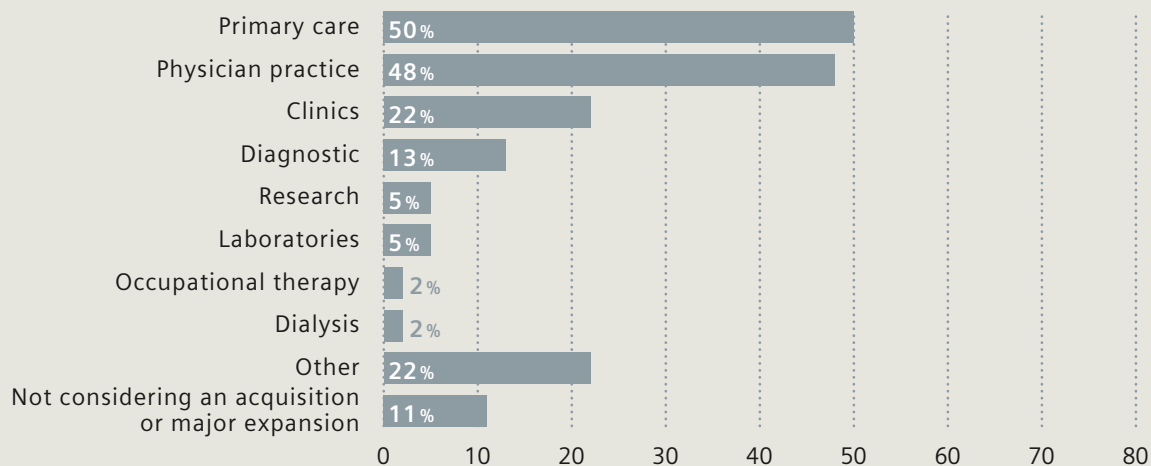
A wave of hospital mergers (in numbers) ²⁾

Hospitals across the U.S. are being swept up in the biggest wave of mergers since the 1990s, a development that is creating giant hospital systems that could one day dominate American healthcare and drive up costs.

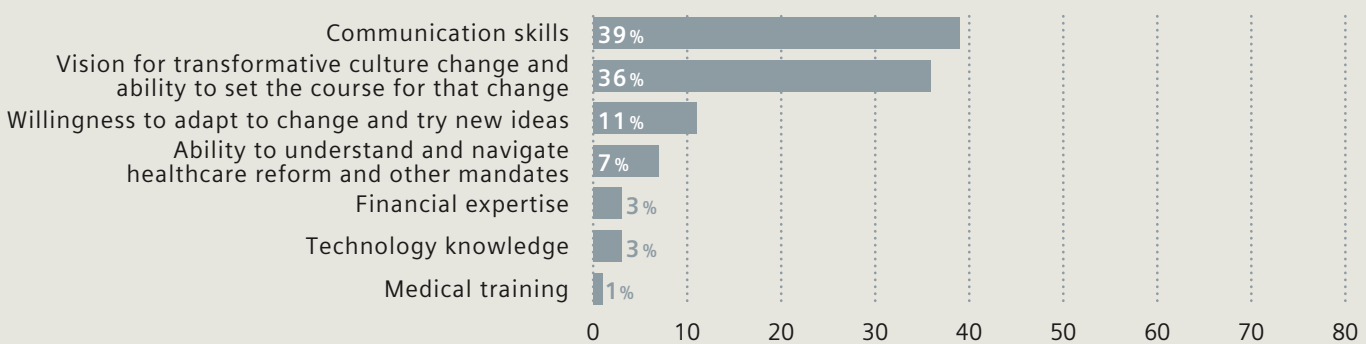


Focus of acquisition or major expansion ¹⁾

U.S. healthcare executives were asked: If you are considering an acquisition or major expansion, which of the following areas will this be focused on?



Most important skills according to executives in the U.S. healthcare industry ¹⁾



Cutting wait times ^{3, 4)}

A new electronic system based on radio-frequency identification (RFID) cuts the wait time for chemotherapy treatment at the National Cancer Centre Singapore. **2011:** Implementation of the new electronic system



Connecting the divide between inpatient and outpatient care ⁵⁾

If providers hope to close the gap between inpatient and outpatient care, they should adopt an infrastructure that supports continuity of care. Among the most essential steps are:

- 1 Provide teams with interprofessional, evidence-based tools**
Care coordination and integration of inpatient/outpatient care depend on an interprofessional plan of care. Therefore healthcare organizations should provide teams with interprofessional evidence-based tools to build individualized care plans for patients.
- 2 Implement integrated clinical documentation (IICD)**
The IICD captures a patient's story, needs, problems, plan, interventions, and progress. Also providing Clinical Decision Support (CDS) tools such as clinical practice guidelines and evidence-based screens, scales, and content.
- 3 Engage patients and family members**
Providers are called to move from a provider-centered model to an authentic patient-centered approach by adhering to the steps of inform me, engage me, empower me, partner with me, and support my community.

The Canadian province of Ontario has about **13.5 million residents** and covers about **415,000 square miles**.

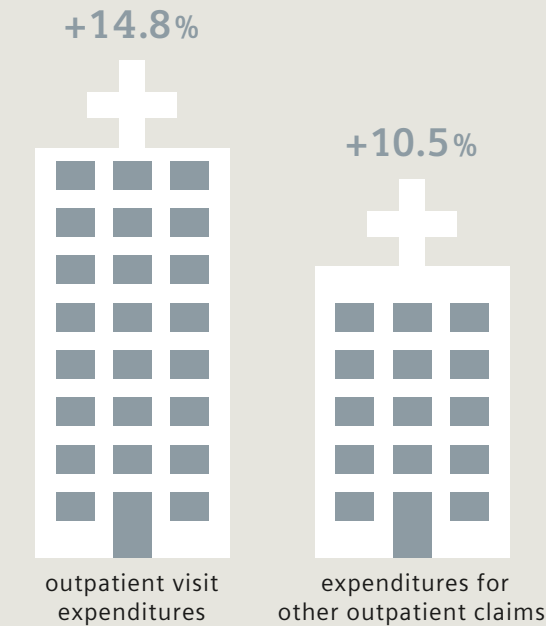
In a region this vast, it might take **12 months** for an initial face-to-face consultation with a dermatologist. The Ontario Telemedicine Network is cutting that wait time to **five days**.



More dollars for outpatient care ⁶⁾

Outpatient care is one of the most rapidly growing sources of healthcare expenditures for the privately insured in the United States.

Between 2010 and 2012, outpatient visit expenditures rose 14.8 percent. During the three-year period, expenditures on other outpatient claims, including facility claims for imaging and radiology, increased by 10.5 percent.

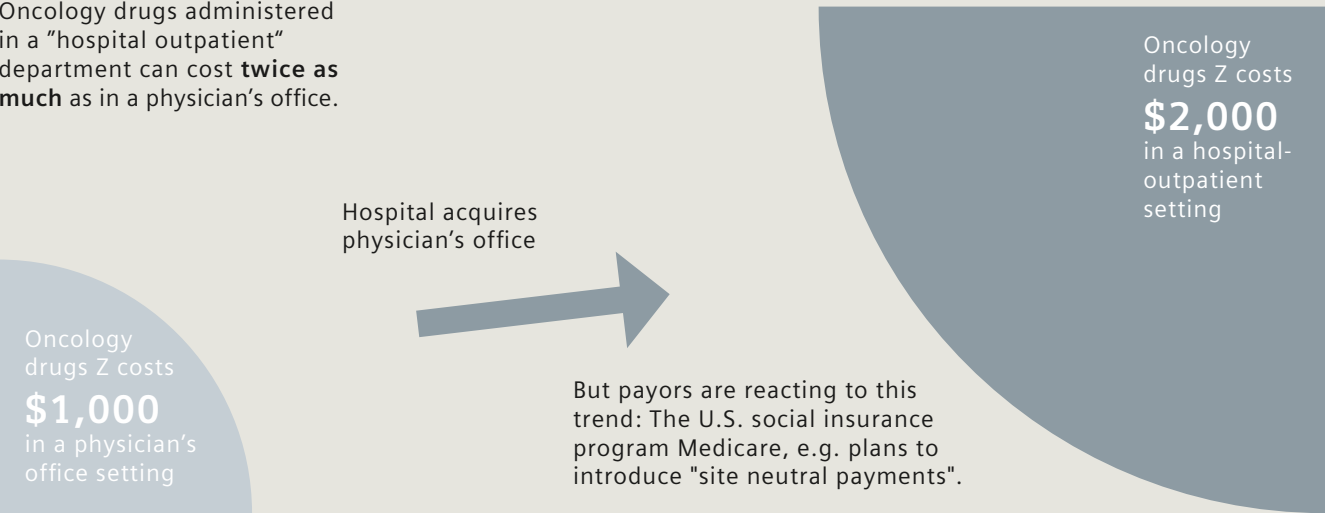


»We found that the quality of what goes on in the operating room doesn't closely correlate with the patient's perception of the quality of his or her medical care«

Martin A. Makary, M.D., M.P.H., an associate professor of surgery at the Johns Hopkins University School of Medicine, and leader of the study described online in JAMA Surgery. He also states: "It is important for patient satisfaction to be tracked and transparent, but the quality of the actual care may be independent of that. It's misleading to say a patient satisfaction score says it all." ⁷⁾

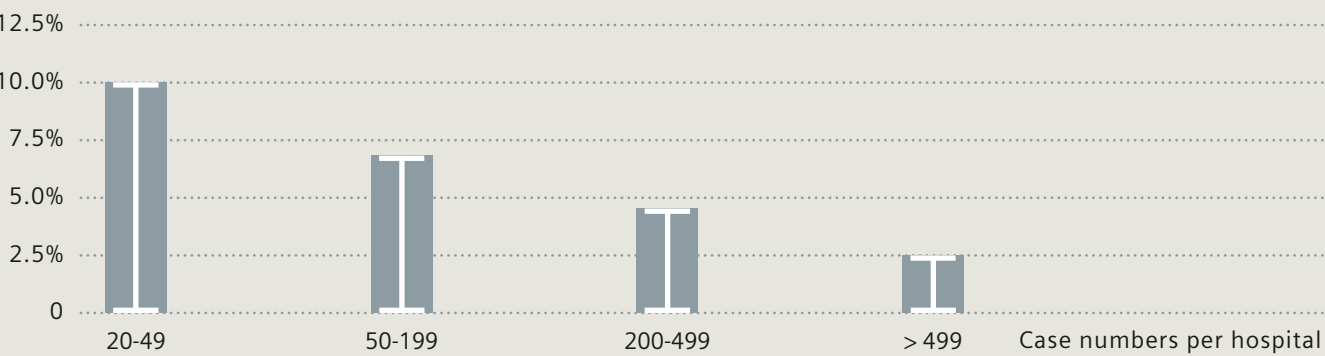
When providers merge, consumers pay ⁸⁾

Oncology drugs administered in a "hospital outpatient" department can cost **twice as much** as in a physician's office.



Higher case numbers lead to increased quality ⁹⁾

Range of re-operation rates following initial hip replacement for all German hospitals in 2010 (in %)



Sources: 1) Health Finance (a survey of the US HealthLeadersMedia Council), sponsored by Bank of America Merrill Lynch, P. 9 2) Irving Levin Associates, <http://nyti.ms/1nJFxJ2> 3) straitstimes.com, <http://bit.ly/1vsnbUY> 4) Ontario Telemedicine Network, <http://bit.ly/1sxryds> 5) Michelle R. Troseth, <http://bit.ly/1vTREbZ> 6) Health Care Cost and Utilization Report, Health Care Cost Institute Inc., P. 21 7) Johns Hopkins Medicine, <http://bit.ly/1v9cJih> 8) PwC Health Research Institute, <http://pwc.to/WeEjiq> 9) The Boston Consulting Group, Qualitätswettbewerb. Chancen für Deutschlands Gesundheitssystem (German only), <http://bit.ly/1ru88He> (all references last accessed on 08/29/14)



Today

Centrally regulated markets dominate global healthcare systems. They target standardization and efficiency, but the mostly fragmented systems usually incentivize delivered services, not patient-centered outcomes.

In many countries, diagnosis-related group (DRG) systems dictate the payment for healthcare goods and services. DRGs were intended to allow standardization and transparency across entire health systems. However, DRG-based systems have developed pricing guidelines from a top-down approach. As the medical community continually adapts to new conditions and treatments, practitioners worry that DRG systems limit innovation, according to health accounting researcher Christopher Chapman, PhD, of Imperial College London Business School. Another concern with most health system models is that patient care is fragmented by specialty and discrete services, such as primary care, hospital, and rehabilitation.

A typical everyday example is the discharge of a patient from a hospital following an intervention. Information flow to the patient's primary care physician, the specialist performing the follow-up, and even his or her family supporting the recovery at home is scarce and sometimes anecdotal. In the United States, payers have started addressing the problem by introducing readmission penalties that limit payments to hospitals in cases of excessive rates of readmission within a certain period of time after discharge.

Neither patients nor health workers feel that payments reflect the value of care, but everyone agrees value-based care should be the common goal. The introduction of electronic health records (EHR), once held up as a panacea, is also constrained by the fragmentation of healthcare services. According to August Watanabe, MD, a retired executive vice president of Eli Lilly and Company, the problem seems to be that there is little in the healthcare system that encourages or rewards effective and efficient use of technology.

Shaping Tomorrow's Healthcare Today

Text: Kathleen Raven

The Day After Tomorrow

In future health systems and business models, collaboration between providers from different healthcare sectors and among payers, providers, and industry will be an integral part of a solution based on patient needs. A value-based approach can provide a framework for decision-making and constant adaptation.

Lasting change can occur if healthcare leaders focus on actionable steps and measure progress. The tools that help physician buy-in are shared purpose, self-interest, respect, and tradition, say authors Thomas H. Lee, MD, CMO of Press Ganey, and Toby Cosgrove, MD, CEO of Cleveland Clinic. This is essential to shift physician engagement from a short-term fee-per-service perspective to sustainable patient health outcomes.

Value-based outcome measurements can be implemented to move beyond a binary result of the patient's improved health: yes or no. For example, hospitals may share the same five-year survival rate for prostate cancer patients, but metrics that incorporate a patient's quality of life, like incontinence or severe erectile dysfunction rates, demonstrate big differences between hospitals and can be used to provide better care for individual patients earlier. Healthcare providers can improve patient-centered care through specialization on certain diseases, integration across healthcare sectors, and collaboration between local providers and centers of excellence. The Children's Hospital of Philadelphia has acquired facilities in Pennsylvania and New Jersey that allow for integrated care across all units and a better overall scope of services.

Meanwhile, EHR systems collect and share not only patient notes, images, test results, and prescriptions, but also feedback on the quality of care. Dashboards can allow doctors to compare their performance against their peers' on metrics such as patient outcomes and satisfaction. Healthcare executives and leaders need to be willing to spend more time evaluating potential partnerships to ensure an ideal balance of skills and resources. Entrepreneurs, academics, practitioners, and engineers need to brainstorm what a health system might look like beyond fee-for-service or DRGs. ■

Culture Change in Healthcare

Text: Kathleen Raven

Consolidation, integration, and specialization are typical industry buzzwords. They've also become international healthcare buzzwords and key concepts for driving and shaping changes in health systems.

Consolidation

Consolidation allows all players in healthcare systems, providers in particular, to benefit from integration, specialization, big(ger) data, and increased patient attraction. Providers consolidate through mergers and acquisitions, collaborations, as well as franchising and certification models.

Fragmented healthcare services can erode efforts to maintain a level of value-based care. An answer to this challenge is vertical consolidation across healthcare sectors (primary care, specialist, hospital, and rehabilitation) along the patient value chain. Horizontal consolidation among providers in the same sector, such as hospitals, enables economies of scale (for example, in purchasing and process optimization), and sharing the workload between local providers and centers of excellence. The fact that a consolidated institution is, at the same time, close to their patients' homes and able to provide the appropriate level of care even for the most challenging cases makes them more attractive to their

customers. If they solve the challenge of aligning their IT systems and addressing data privacy issues, consolidated institutions have access to a larger patient data pool that they can use to drive clinical studies and generate medical and organizational evidence.

Integration

Multidisciplinary healthcare teams must collaborate to achieve desired patient outcomes and share the burden of risk and costs. IT can facilitate this process by enabling consultations with physicians and nurses, and improving communication and information flow.

Integration helps avoid redundant tests or administrative tasks and reduces the risk of errors due to information gaps, about incompatible drugs and allergies, for example.

On a larger scale, the evolution steps of healthcare integration can be illustrated by the concepts of service provider, episode integrator, and population manager. The service provider offers treatment within a narrow range of highly specialized services, typically tied to fee-for-service reimbursement. An episode integrator, such as an oncologist, integrates acute care across separate specialties within a hospital as well as outpatient care and follow-up. A population manager optimizes the health of a certain population, usually a defined number of enrollees within a certain territory, e.g. in the United States. These new models can be contracted by commer-

cial payers, government-funded payers, and employers to optimize the result-versus-cost ratio of care delivery across an entire population – from nutrition education of school children to elder care. Such an approach could even facilitate structured changes across an entire healthcare system.

Specialization

Patient care can be managed by specific medical conditions, while at the same time, taking into account different specializations, services, and common comorbidities. As healthcare systems adopt a more evidence-based approach to care, specialized provider networks can lead the way in achieving higher case numbers, building up better dedicated expertise, implementing guidelines, and offering state-of-the-art services and tools.

Healthcare executives have found that specialization can help improve workflows and cut back on errors or oversights. Care paths and workflows can be optimized for a specific disease condition, such as stroke or acute myocardial infarction. And of course, this works best with a specialized team. By specializing on patients with a certain medical condition, clinicians and non-clinicians are more aware of costs per services and how they affect the total fee of the care cycle. They can optimize patient outcomes and still contain costs by providing the right level of care for the individual patient in the appropriate higher or lower cost setting. ■



The case for change is that no change is not an option. The current system of health and social care is both unsustainable and suboptimal.

Source: "All together now. Making integration happen", NHS Confederation





CEMA is an example of consolidation unifying the first and third level of public healthcare.

A New Era in the Public Healthcare Sector

Text: Andreas Fink
Photos: Javier Pierini



Dr. Alejandro Cristaldi, General Manager of the CEMA outpatient center in Mar del Plata, Argentina.

At the new Centro de Especialidades Médicas Ambulatorias (CEMA), the Argentine city of Mar del Plata is linking its outpatient facilities and medical centers. General Manager Dr. Alejandro Cristaldi explains why CEMA is a benchmark for public health.

For you, what does CEMA stand for?

Dr. Alejandro Cristaldi: CEMA started as an idea when Mayor Gustavo Pulti and Health Secretary Dr. Alejandro Ferro recognized the need to unify the first level of public healthcare with the third level. That means integrating the 33 ambulatory centers located around the whole municipality of General Pueyrredón with our two public hospitals. As an ambulatory, CEMA serves patients who cannot be treated in our ambulatory centers but do not need to be hospitalized. And CEMA works as an analytical hub – here we make the lab analysis for the whole network and here we have a

radiology “bunker” where we can evaluate the X-ray images made in seven ambulatory centers.

So is CEMA completely digitalized?

Dr. Alejandro Cristaldi: Yes, and this is a big step in the public health sector. Before, we had everything on paper. Now – outgoing from CEMA – we are in the process of digitalizing and integrating the whole network of our 33 health centers. Our goal is to offer medical excellence and save on costs at the same time. ■

The outcomes achieved by the Siemens customers described herein were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that others will achieve the same results.

Learn more



www.siemens.com/cema

A Hospital for Everyone

Text: Christine Wollowski
Photos: Walther Appelt

Hospital do Subúrbio, on the outskirts of Salvador da Bahia, Brazil, shows how an underdeveloped and financially weak region can improve its medical care through a public-private partnership.

Brazil ranks 72nd in healthcare standards worldwide. Salvador, a major city, falls significantly below Brazil's average and its suburbs rate even worse. For 20 years, no new public hospital had been opened in the city.

Then the government built Hospital do Subúrbio in the city's northern suburbs, which are populated primarily by young residents with a low socio-economic status. Hospital do Subúrbio is there for them – free of charge, even for those who have no health insurance.

government's criteria, the government will contribute to operating costs: 82 percent of the doctors must be specialists, beds may not be placed in the corridors, and morbidity and mortality rates must meet international standards. The result is a hospital that compares favorably with the state's best private hospitals. The annual cost to the state is 142 million reais (about US\$61 million); it saves a million in administrative costs alone.

"We are 30 percent more cost effective than Hospital Geral, a comparable facility, and technically speaking, we are the best-equipped hospital in the city," explains Jorge Oliveira, Director of Prodal, which owns two private hospitals and runs Hospital do Subúrbio. "We are also significantly more flexible in terms of management."

The Government Saves Money, the Public Benefits

The hospital was built by the state and equipped by the private company Prodal, which also manages it. If it meets the

Emergency Care Without Hours of Waiting

The hospital – with its polished granite floors, upholstered waiting-room chairs, and wide, spacious halls – looks like a UFO in these surroundings. New patients are examined

Learn more



www.siemens.com/hospital-do-suburbio



Hospital do Subúrbio meets the same standards as an expensive private hospital – but this is a public hospital. It was made possible by the first partnership between the government and private enterprises in Brazil's medical sector.

immediately and given priority according to the severity of their illness. "Here, we have excellent technological facilities for diagnosis and therapy that provide security and agility in the process of patient care," says Jorge Motta, the hospital's technical manager.

More Public-private Partnerships Planned

The most important factor is the patients' 97-percent satisfaction rate, as recorded by a survey. "Now everybody wants to come to Subúrbio," says Jucicleide Oliveira, who brought her son in. "Here, there are no long wait times, doctors and medication are always available, and the diagnostic equipment works!"

The hospital's great success has led to overcrowding, so it will be expanded within the next year. Secretary of Health for Bahia state Jorge Solla is so pleased that he is already planning more medical public-private partnerships in Salvador. "The private partner is much more flexible. It can adapt the staff as needed and approve repairs immediately, which spares us the government's long bureaucratic processes." ■



IV

 Chapter Four

Benefiting from Big Data

Big Data and data-analytics projects aim to reduce costs and improve diagnosis, therapy, and care.

 Infographic

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 Trend Stories

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the Key to the Future P. 68 — 69

Growing Need for Computerized
Decision Support P. 70

Big Changes for Future
Patient Care P. 71

Healthcare Dives
into Big Data P. 72 — 73

 Best Practice Stories

Salvaging a Treasure Trove P. 74 — 75

Semantic Technologies in Health
Information Retrieval P. 76 — 79

What Big Data Looks Like

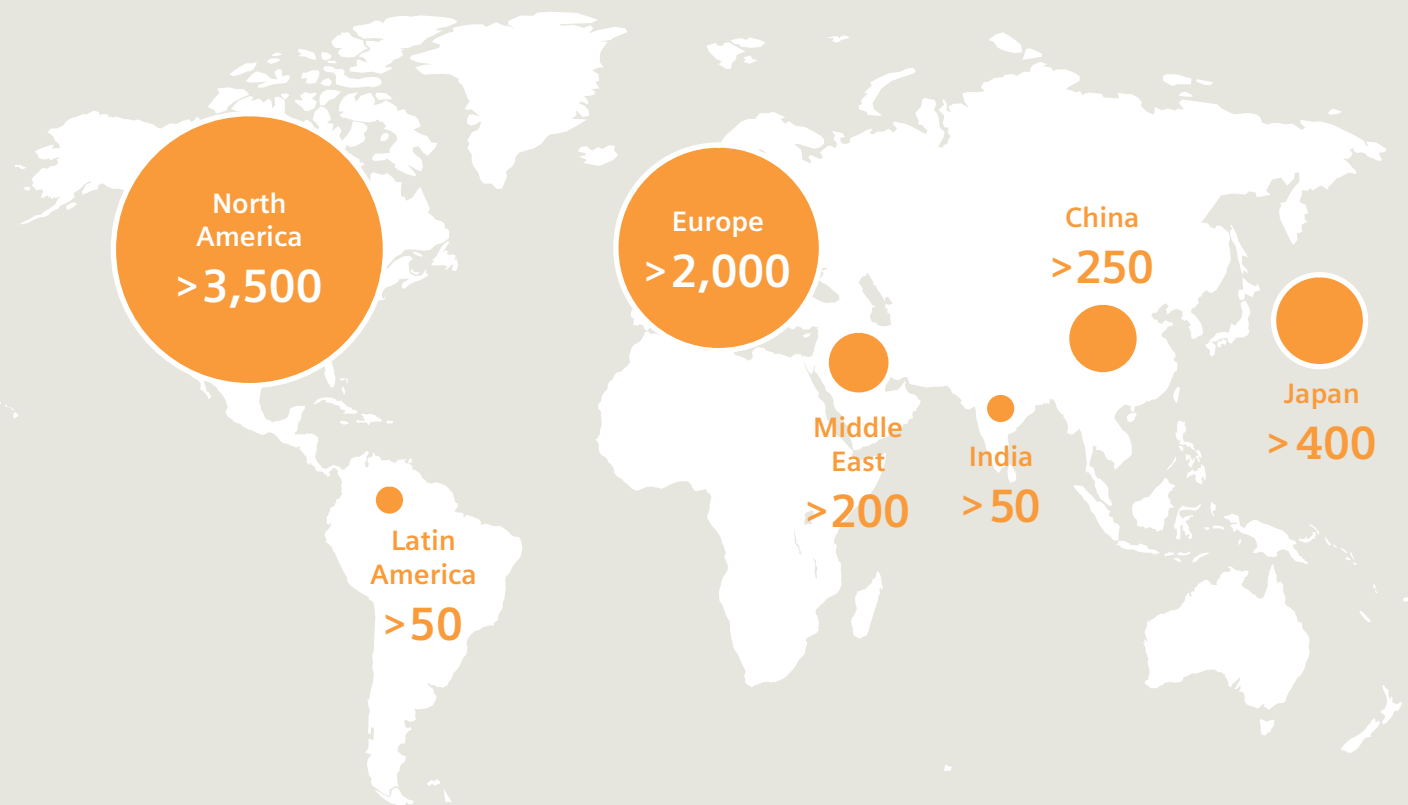
All infographics are available for download:



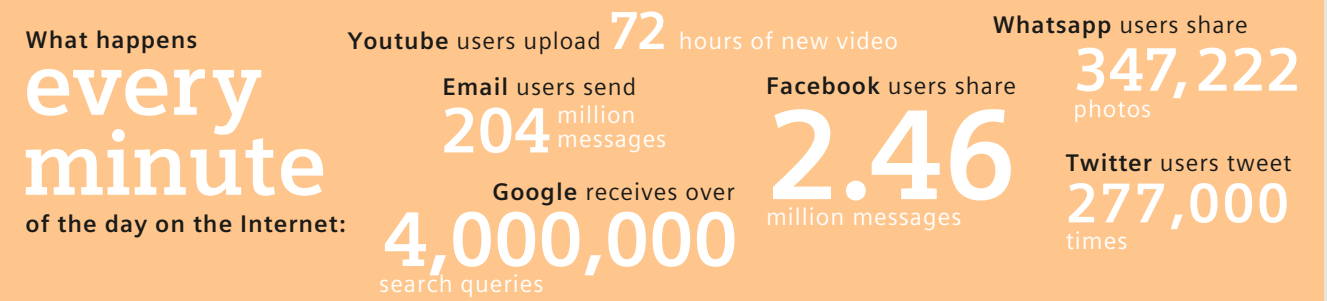
www.siemens.com/annual-infographics

Healthcare is probably one of the most data-intensive industries out there. Basically there are four main sources generating all this healthcare data: medical care providers, public and private payers, ancillary service providers – from pharmacies to laboratories –, and healthcare consumers. The challenge is not just in storage and access, but in making this data usable.

Amount of Big Data stored across the world, in petabytes (1PB = 10⁶ gigabytes)¹⁾



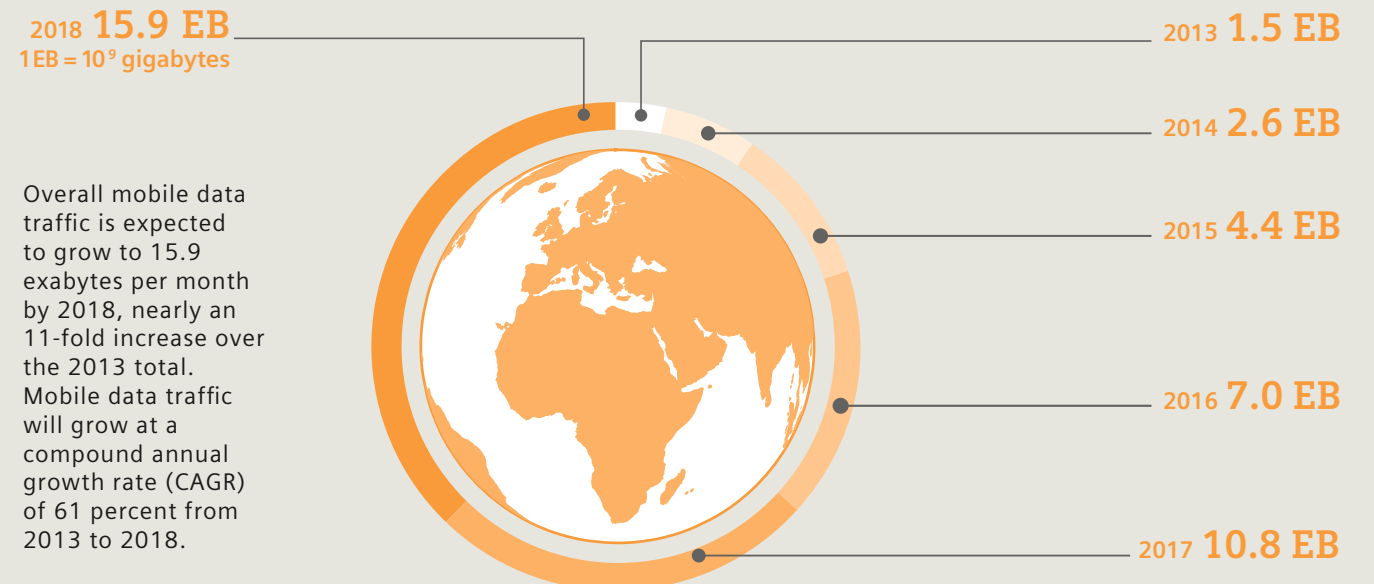
Data never sleeps²⁾



Data explosion by 2020³⁾

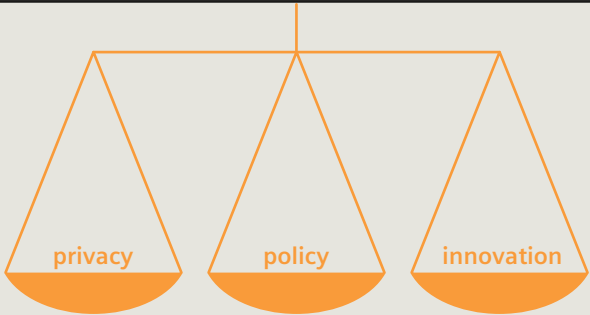


Global mobile data traffic⁴⁾

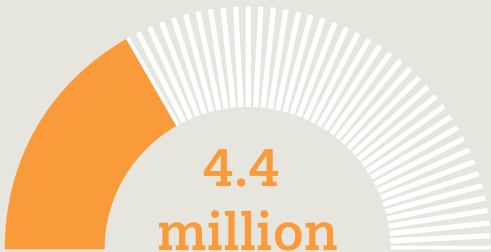


The challenge of balancing privacy, policy, and innovation ⁵⁾

The healthcare industry will need to walk the line between protecting patient privacy and security, complying with the increasing number of regulations, and innovating through new technologies. Sensitive, personally identifiable information includes patient names, diagnoses, medications, hospital records, insurance IDs, social security numbers, billing information, genetic history – and it is at risk.

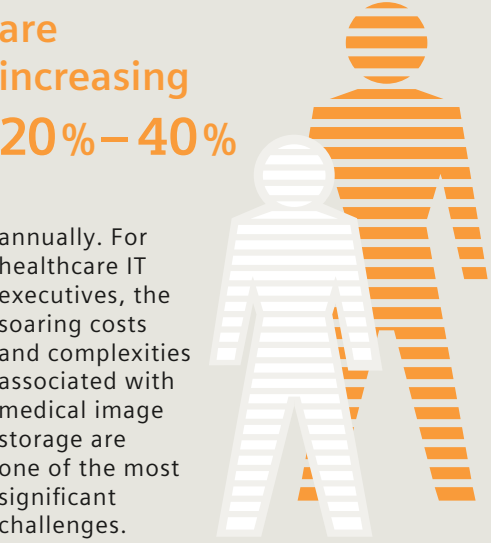


Wanted: data scientists ⁶⁾



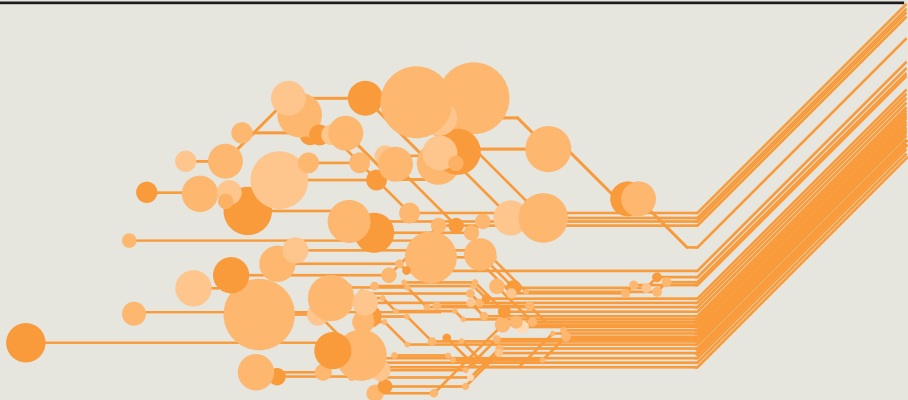
By 2020, 4.4 million IT jobs globally will be created to support Big Data. “But there is a challenge. There is not enough talent in the industry. Our public and private education systems are failing us. Therefore, **only one-third of the IT jobs will be filled.** Data experts will be a scarce, valuable commodity,” said Peter Sondergaard, Senior Vice President at Gartner and Global Head of Research.

Medical image archives ⁷⁾



The need for connectivity ⁸⁾

The ability to collect information from anywhere at anytime has created a complex world; information comes from many different sources, increasing the potential for “dirty data” such as useless information in the form of inaccurate reports. The healthcare industry will face the challenge of weeding through the many new technologies to invest in those with the greatest ROI.



6 ways that Big Data can transform healthcare ⁹⁾

- 1 Support research**

Data-driven solutions could lead to better diagnostic tools and treatment methods, improving outcomes and cutting costs in the process.
- 2 Transform data in information**

Improve data communications and quality, and enhanced, efficient care will follow.
- 3 Support self-care**

Several companies are exploring Big Data and how to use it to “help us help ourselves.” Better health data insight at the community level is achievable.
- 4 Support providers**

Despite facing provider resistance, companies develop new user-friendly support systems to alleviate pressures by saving time and money and improving outcomes.
- 5 Increase awareness**

New technologies and their companies are taking on these tasks as specified by the previous serially numbered points in the name of prevention and the prioritization of global, public health issues.
- 6 Pool data**

Big Data may not cure cancer today, but its promise lies in what it can uncover to enhance treatment methods tomorrow.

Medical data volume ¹⁰⁾

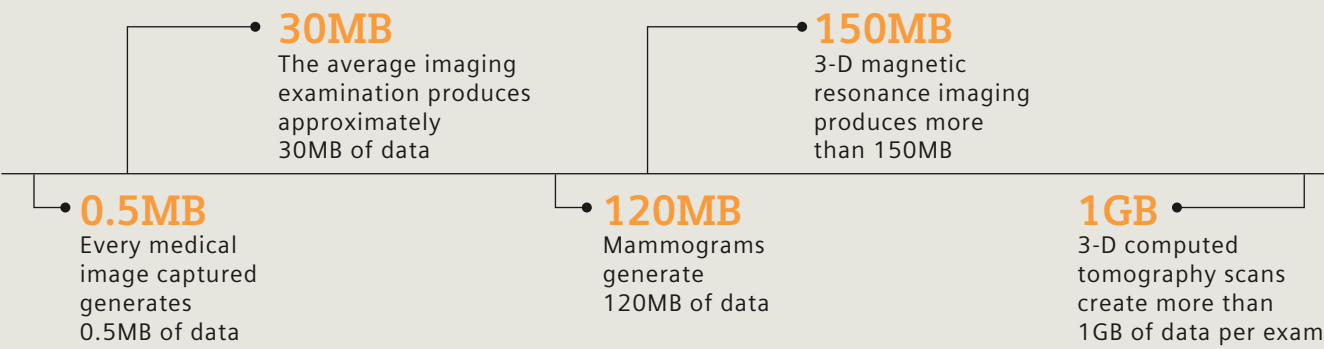
80 %
of health data is unstructured and stored in hundreds of forms such as lab results, images, and medical transcripts.

4.9 million
patients worldwide will use remote monitoring devices by 2016.

16,000
hospitals worldwide collect data on patients.

If Big Data was used effectively, the U.S. healthcare sector could save every year **\$300 billion to \$450 billion**

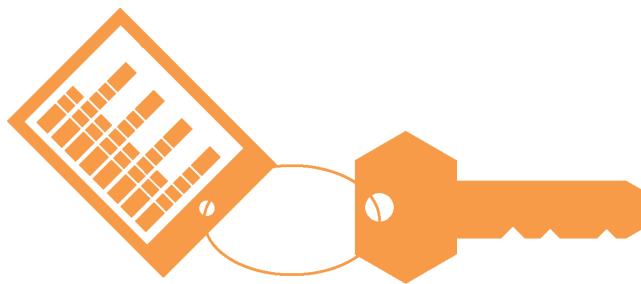
Growing file sizes ¹¹⁾



Sources: 1) McKinsey Global Institute, Big data: The next frontier for innovation, competition, and productivity, 2011, P. 103 2) Domo (Bits.blogs.nytimes.com, intel.com, apple.com, time.com, dailymail.co.uk, skype.com, statisticbrain.com), <http://bit.ly/1f9DUGb> 3) IDC, IDC IVIEW, The Digital Universe in 2020, December 2012 4) Cisco VNI Mobile, <http://bit.ly/Msevdw> 5) Deloitte Development LLC, <http://bit.ly/1rDtDYp> 6) Gartner, <http://gtmr.it/SQ9IFS> 7) IDC Global Health Insights, EMC2: Managing healthcare data within the ecosystem while reducing IT costs and complexities, P. 2 8) Deloitte Development LLC, <http://bit.ly/1rDtDYp> 9) Healthcare IT Connect, <http://bit.ly/1zP0QPd> 10) IBM, McKinsey Global Institute, <http://bit.ly/1qaeJ9t> 11) NetApp, Delivering Excellence in Patient Care with Ready Access to Clinical Data, September 2012, P. 4 (all references last accessed on 08/29/14)

Smart Use of Big Data is the Key to the Future

Text: Meredith Knight



Healthcare providers that harness the large quantities of data they already collect and combine them with new patient-generated information will accelerate their adaptability to the major challenges facing the industry.

Healthcare providers commonly ignore 90 percent of the data they generate, according to McKinsey Global Institute, but they are now moving to capitalize on this information to face the challenges of operating in a changing world—one of increasing costs, growing chronic disease, and a payment shift incentivizing health outcomes rather than volume of care.

How to Help Reduce Costs

Consulting group McKinsey & Company estimates that using Big Data will save between 12 percent and 17 percent of U.S. healthcare costs. Providers that implement best practices can immediately streamline a number of their processes, including coding,

billing, and supply-management practices. Most importantly, Big Data will let healthcare providers, both large and small, access and analyze their patient outcomes to pinpoint where dollars are best spent and where they can be saved.

How to Maximize Outcomes

Big Data allows healthcare providers to meaningfully evaluate their practices and compare them within and across organizations. Physicians often rely on their intuition and past experience to treat patients, creating variation in patient care and subsequent costs. Big Data pools thousands of patient experiences, indicating what treatments work best for customers.

Establishing evidence-based practices at the organizational level creates opportunities to place the right patient with the right provider, eliminating some of the burden and cost of unnecessary specialization. Of course, the personal physician-patient connection will always be crucial, but analysis of Big Data makes clear where organizations can foster that connection most effectively.

Big Data offers providers and payers the chance to monitor patients outside of the clinic. By linking to information from third-party data vendors, healthcare providers can gain a window into their customers' daily health behaviors.

How to Support Patients with Multiple Comorbidities

Patients battling several health problems access healthcare most frequently and cause the highest costs, but they also stand to benefit the most from the power of Big Data. Providers who utilize Big Data for their sickest patients will see the most significant results. Information about diabetic blood sugar, hypertensive blood pressure, and asthma inhaler use can now be transmitted (along with location data) directly into a patient's EHR. Data systems can notify providers of problematic trends or a lack of data. It's an opportunity to intervene early, perhaps just with a phone call, rather than waiting for an emergent and costly episode.

Beyond the EHR, Big Data offers providers and payers the chance to monitor a patient outside of the clinic environment. By linking to shopping histories, social media, and location information through third-party data vendors, healthcare providers can gain a window into their customers' daily health behaviors, thought to determine up to 50 percent of overall health status.

Challenges to Healthcare Providers

Big Data is deemed "big" for three reasons: volume (now expressed in exabytes, or 10^{18} bytes), velocity (the rate of access to and from the system), and variety (how those bytes are formatted). The volume of stored healthcare data has quadrupled since 2010, and much of that data is stored in imaging and video format.

Challenge – cost:

Leveraging Big Data solutions requires industrial-level management and analysis

infrastructure and a large-scale investment.

Solutions: Although the setup costs of Big Data implementation run to the millions of dollars, the U.S. government, for example, has incentivized adoption of Big Data technologies through the Affordable Care Act, tax subsidies, and other legislation.

Challenge – expertise:

Expert knowledge is required for implementation and continued use. Large IT projects fail or have much longer installation times because of the complexity of the systems.

Solutions: Big Data systems require people with specialized experience for design, implementation, and continued use. To find these data scientists, healthcare providers must look to the same pool that IT companies recruit from. Through the development of their own internal "informatics departments" that nurture employee capabilities in clinical and information technologies simultaneously, providers will ensure the analytical expertise is in place to keep leveraging datasets.

Challenge – security:

No data is more personal than health data. Patients expect extra privacy protection if they are going to fully participate in Big Data projects in the healthcare space.

Solutions: Internally, data management programs authorize users at different levels and time periods so that unauthorized access to medical records is impossible. Another approach is to anonymize all data beyond a handful of providers with direct patient contact. Even for internal reporting and research, providers would not be able to gain access to identity information, which is reassuring to patients. ■

Growing Need for Computerized Decision Support

Researcher: MarketsandMarkets (M&M) is a full service market research company and consulting firm that produces 400 high-level, strategically analyzed, full-length reports a year, tracking more than 10 industries.

The global clinical decision support system market is estimated to rise rapidly in the coming years and with good reason – the systems help to reduce costs and improve quality and clinical outcomes.

According to a report by MarketsandMarkets, the Global Clinical Decision Support System (CDSS) market is estimated to surpass US\$550 million by 2018, at a compound annual growth rate (CAGR) of close to 10 percent between 2013 and 2018.

Factors That Influence Growth

The main drivers of growth in this market include rising budgetary pressure to reduce healthcare expenditures, growth in the aging population, rising incidences of various diseases resulting from medication errors, a growing need to integrate healthcare IT solutions, improved quality of care and clinical outcomes, and some favorable government initiatives. Concretely, this

means that CDSS, for example, helps to reduce readmission rates by as much as 50 percent. Furthermore CDSS can lead to improvements in the quality of care, with a confidence interval of 0.67-0.99 and greater patient satisfaction. Factors that are hindering growth, however, include rising incidences of data breach and loss of confidentiality, the high costs of maintenance and service, a shortage of qualified IT professionals, and the expense of CDSS solutions.

A High Rate of Growth Worldwide

Geographic analysis reveals North America is the largest contributor to the global market and can expect the highest rate of growth. Europe is in second place, which is attributed, among others, to improving economic conditions and to initiatives by the European Commission, such as the eGovernment Action Plan 2011-2015 to support and complement information and communication technologies (ICT), including e-health. Asia (China, India, and South Korea), and Latin America (Brazil) are also poised to grow at high double-digit CAGRs. ■

Learn more



<http://bit.ly/1oAyTdm>

Big Changes for Future Patient Care

Text: Meredith Knight

Big Data will create a convenient, real-time healthcare experience for patients. Insights gleaned from that data will improve the quality and accessibility of care, and help foster a spirit of cooperation and research between patients and providers.

A patient's electronic health record (EHR) will form the hub of patient care. Instead of manually entering data, medical devices will automatically upload the generated data to the EHR, adding convenience and reliability. Data can also be combined with lifestyle devices that monitor exercise, sleep cycles, and heart rate. This gives physicians a more cohesive picture of a patient's overall health status.

Beyond the EHR

In our digital society, every person generates hundreds of data points through the use of credit cards, loyalty cards, social media, and geo location. This information, which is widely available through third-party vendors, offers a unique view of customers' health choices. It could tell a provider, for example, if a former smoker has bought cigarettes recently. Harnessing this data will unlock opportunities for intervention and lasting behavioral change.

Personalized Medicine

Long a buzzword in the field, Big Data will make personalized medicine a reality. Future patients will have their complete medical data, including their sequenced genomes, stored within their EHR. This will increase the effectiveness of matching treatments to individual patients, improve patient safety, and eliminate duplicate care.

Limitless Research Opportunity

The ultimate goal of harnessing data is not just to streamline healthcare, but also drive innovation. Some centers' analyses can spot local and regional trends. The University of Pittsburgh Medical Center, for example, uses its homegrown data system to track flu outbreaks. It then alerts doctors who are likely to see patients affected by these patterns.

Challenge: All-in Participation

Patients are wary of releasing their health information without knowing how it will be used. A reported 72 percent of U.S. adult social media users think that the information could be used against them when they try to take out insurance. The best way to encourage patient participation is transparency. Healthcare companies should prepare clear, concise and informative consent materials to help patients understand how their data will be collected and why it will be useful. ■

Healthcare Dives into Big Data

Text: Meredith Knight

Big Data will transform perspectives in healthcare that have long defined the industry. No longer will we pool data from individuals to predict what happens on the population level. Instead, population data will be so comprehensive, it will accurately predict what happens to an individual patient.

Healthcare has long focused on the individual. Only in the last 200 years have researchers begun to pool patients into groups to investigate the health of populations. Big Data offers healthcare the opportunity for a paradigm shift: Instead of thinking from the patient level up, there will now be enough good data to look at whole populations to extrapolate what will happen to an individual.

Genomics: from the Lab to the Clinic

Perhaps no single factor will transform healthcare as much as personal genomics. In the coming decades, nearly every patient will have their genomes analyzed, whether to aid cancer diagnosis or know their risk factor for disease. Through the expanding use of prenatal genetic screening, many patients are already partially sequenced before birth.

Harnessing genetic data is an opportunity that healthcare providers should not miss, because of its potential for future research. While some enterprises outsource, hospital system Providence Health & Services recently partnered with health information company NantHealth to provide sequencing to each of its 22,000 patients diagnosed with cancer each year.

Analysis of genetic data is becoming so sophisticated, scientists can get nearly instantaneous results of which markers are increasing and decreasing in expression, providing a real-time profile of a patient's physiological changes based on external factors like infection or stress. The standard 20-variable blood chemistry panel could realistically be replaced with one that tests for tens of thousands of known markers. This data will tell physicians if a person with genetic risk factors for disease development is starting to manifest illness.

How to Turn Promising Data into Something Useful?

One physician or healthcare team would not be equipped to look at the results of a thousand markers and make insightful inferences. That level of analysis can only be done with a computer program that flags and alerts providers to surprising or significant results.

Implementation of these systems is expensive because of software and staffing costs. Hadoop, which many healthcare companies rely on to support their Big Data efforts, is an open-source software platform created to handle large datasets. The software interfaces with other open-source and proprietary analysis programs. Critical for information security and access, the software is housed across a global computing framework and is designed to work with many collaborative users.

Getting Big Data Analysis to the Bedside

Universal access to data is crucial for a healthcare delivery system that increasingly implements data-driven care protocols at the bedside and telemedicine. In a pilot study of patients postcolorectal surgery, the Mayo Clinic cut complications by half, decreased patient stay, and saved US\$10 million by using a program that identified best care practices, then measured and monitored those metrics in real time.

Big Data is also being captured and analyzed at the bedside. These analytic strategies can identify a patient's risk of hospital readmission and divert staffing and resources to help prevent it. At SickKids Hospital in Toronto, Canada, infants in the neonatal intensive care unit wear biosensors that collect data thousands of times per second. These bio-signals are uploaded and processed in real time for fastest possible identification of hospital-acquired infections. The hospital can begin treatment 24 hours sooner than if physicians waited until traditional biometrics indicated an infection.

Free Data, Endless Research

With access to a data supply that is growing so rapidly it seems infinite, the real power of Big Data lies in the insights that can be pulled from data sources, ranging from gene expression profiles to prescription rates and census data, many of which are free.

These analyses have already proved useful both in measuring the safety of drugs and finding new uses for established ones. Healthcare system Kaiser Permanente's informatics department was instrumental in identifying the link between the arthritis drug Vioxx and cardiac complications, simply through analysis of their own patients' outcomes.

Atul Butte's lab at Stanford School of Medicine looks more like a cubical-lined office building than a traditional biological laboratory. But the data mining that takes place there produces a publication nearly every two weeks based on insights pulled from open-source datasets. Their lab discovered that the anti-seizure drug topiramate could be effective in treating the inflammatory bowel disorder Crohn's disease and found genes that contribute to diabetes through control of immune cell receptors located in fat.

These ideas were not generated through the formulation of a hypothesis, followed by systematic testing. They were anomalies that fell out of previously generated data. The next step for these discoveries will be to take the potential treatments, which have been generated by millions of data points collected from thousands of people, and start testing them to see if they become useful to individual patients. ■

Universal access to data is crucial for a healthcare delivery system that increasingly implements data-driven care protocols.

Salvaging a Treasure Trove

Text: Thomas Meissner, MD
Photos: Sebastian Forkarth



According to estimates, 400 million tissue samples lie dormant in databases around the world. Researchers consider these samples to be a treasure trove of data that would greatly enrich molecular pathology and personalized cancer therapy.

Until now, however, these samples could only be analyzed by the manual extraction of genetic material¹. But manual extraction of the nucleic acids is time-consuming, provides varying quality, and requires a lot of human resources. This

is an enormous challenge for molecular pathology, because the analysis of a patient's genome sequence in cancer cells should become part of routine diagnostics.

Automated Solution for Extracting DNA and RNA

Therefore, Ronald van Eijk, PhD, a molecular biologist at the Department of Pathology at Leiden University Medical Center (LUMC) in the Netherlands, and his colleagues have evaluated a fully automated and standardized tool which can extract both DNA and RNA molecules from a tissue sample. The researchers found out that manual working hours in the lab can be decreased by 50



There are significant differences in the genetic patterns of tumors, even between patients who have the same type of tumor. "The number of tests per patient is increasing dramatically," says Ronald van Eijk, PhD, from Leiden University Medical Center.

percent. The hospital received the test results approximately 24 hours faster than when performing classic DNA isolation².

In the resulting DNA probe, genetic changes in tumor tissue can then be analyzed simultaneously with next-generation sequencing (NGS) to determine the effective treatment. The tissue preparation tool contributes significantly to the quality and purity of extracted nucleic acids and enables molecular labs to transition to this new era in molecular pathology. Molecular tumor diagnostics is already clinical routine at the LUMC. ■

Learn more



www.siemens.com/leiden

¹ Genetic Engineering and Biotechnology News 2008; 28 (10)

² Experimental and Molecular Pathology 2013; 94: 121-125





Semantic Technologies in Health Information Retrieval

Text: Philipp Grätzel von Grätz, MD
Photos: Detlef Schneider

Imagine patient data from various sources accessible to physicians with hyperlinks and intelligent indexing. Imagine patients receiving an integrated dataset that allows them to understand their illness.

Prof. Alexander Cavallaro envisions a future where patients would open their radiological reports on a tablet-PC to find a document with relevant hyperlinks – much like an Internet page.

Prof. Alexander Cavallaro, Senior Radiologist at the Imaging Science Institute (ISI) at Erlangen University Hospital, Germany, sees today's educated lymphoma patient, who carries the computed tomography images home on a DVD. In Cavallaro's vision of the future, the patient would open the radiological report on a tablet-PC to find a document with relevant hyperlinks for further reading.

THESEUS MEDICO Research Project

Physicians are also interested in Cavallaro's vision. They do not necessarily need >



THESEUS MEDICO brought together experts from the University of Erlangen (photo), the German Research Center on Artificial Intelligence, Siemens, the Fraunhofer Society, and Munich University.



Semantic searches are suitable for a highly specialized field like medicine.

Prof. Alexander Cavallaro, MD, Imaging Science Institute, Erlangen



hyperlinks to patient websites, but links to previous images to compare and assess the effectiveness of the treatment. They also need to integrate imaging and laboratory data, as well as information on clinical signs and symptoms, to make a diagnosis or modify a treatment plan.

Equipping a medical report with this kind of contextual and target-group-specific information is not easy and requires semantic technologies that have been developed in artificial intelligence research. How semantic technologies can be applied to medicine was illustrated by the THESEUS MEDICO research project, which was funded by the German Federal Ministry of Economics and Technology.



By learning, adjusting, and trying to understand medical data via semantic technologies, THESEUS MEDICO can greatly aid clinicians like Cavallaro.

An Anatomical Algorithm

"We soon realized that we really needed software solutions that could search and – to a certain degree – interpret images," Cavallaro recalls. The case chosen for this project was that of a lymphoma patient. One of the first steps was to develop an algorithm that could identify various abdominal and thoracic organs on CT scans. The image information allows the automatic creation of hyperlinks between words in text documents.

One Problem, but More Benefits

Cavallaro sees many benefits of a more semantic approach to radiology. One of them had to do with the automatic analy-

ses of organs and their locations. Once, for example, a pathological lymph node is described semantically, the system is able to "jump" to exactly that location in a follow-up examination. The radiologist no longer has to go through all the CT slices.

A Step into the Future

"THESEUS MEDICO certainly paved the way for the further development of the many IT solutions we use today – especially in the fields of radiologic reporting and data integration," says Cavallaro. He is convinced that semantic technologies are the way to move from the age of complex data collection toward the age of knowledge and interpretation of data. ■

Learn more



[www.siemens.com/
imaging-data-analysis](http://www.siemens.com/imaging-data-analysis)

The displayed solution is a prototype and under development. Not available for sale. Its future availability cannot be ensured.



Chapter Five

Integration of Diagnosis and Therapy

Improved imaging and laboratory tests support more accurate diagnosis and more appropriate, less invasive treatments.

Infographic

Integrating Diagnosis:
Why Is It So Important? P. 81 — 84

Trend Stories

Virtual Models for
Better Decisions P. 86

Fast Facts P. 87

Bringing Value to the
Decision-making Process P. 88 — 91

Best Practice Stories

Surgery 2.0 P. 92 — 93

A Race Against Time P. 94 — 97

“Yes, we scan!” P. 98 — 101

Integrating Diagnosis: Why Is It So Important?

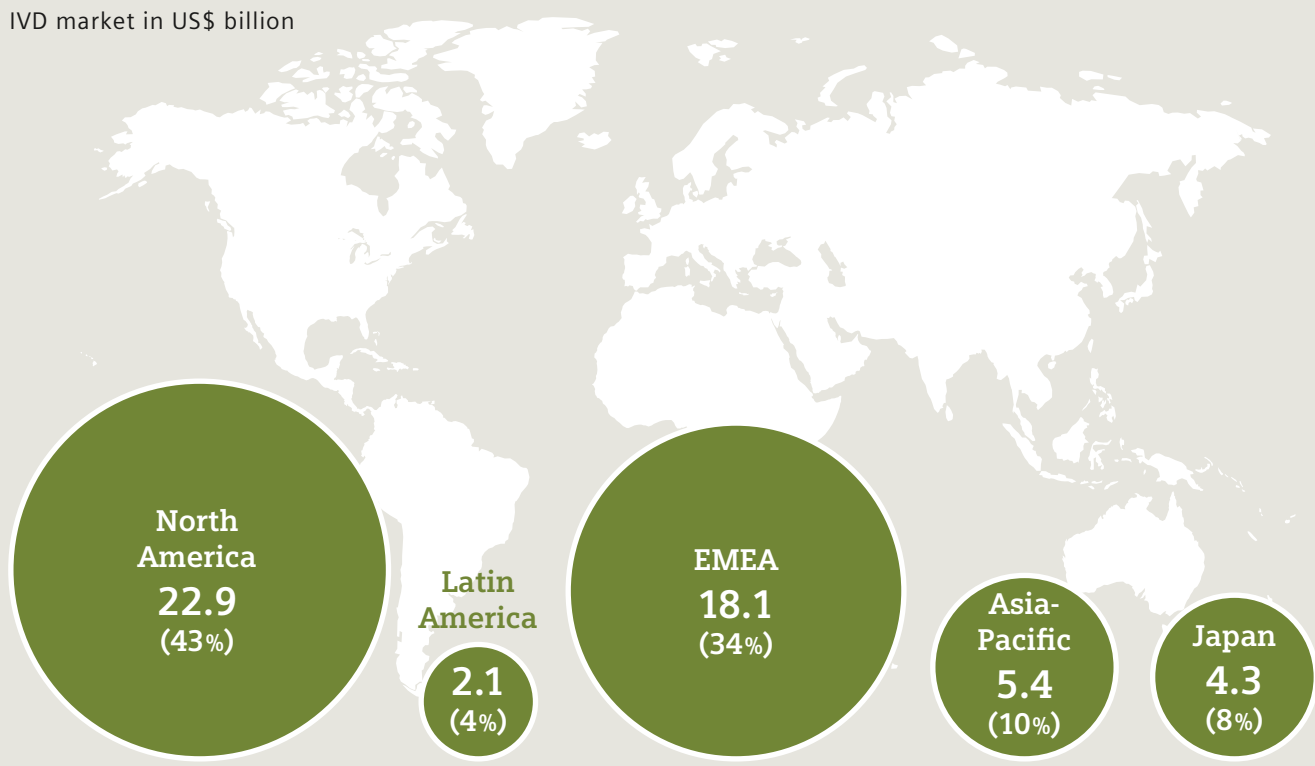
All infographics are available for download:

www.siemens.com/annual-infographics

In spite of all the advances made in medicine, people still get sick. But diagnosis is continually getting better thanks to new developments in molecular diagnostics, medical imaging, or even 3-D virtual modeling of organs. At the same time, diagnosis plays a continuously growing role in planning, guiding, monitoring, and managing minimally invasive and other therapies.

In vitro diagnostics sales by region ¹⁾

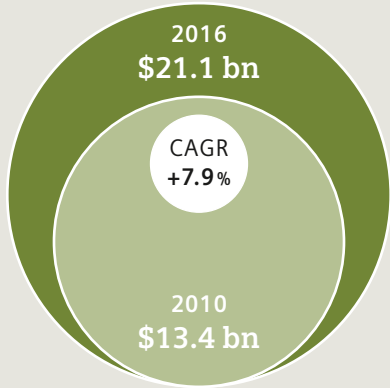
IVD market in US\$ billion



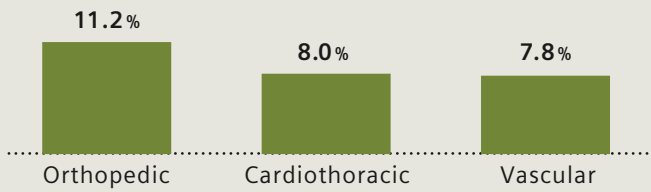
Looking at the **in vitro diagnostics market by region**, North America remains the largest market at \$22.9 billion (43%), followed by EMEA (Europe/Middle East/Africa) at US\$18.1 billion (34%), Asia-Pacific at US\$5.4 billion (10%), Japan at US\$4.3 billion (8%) and Latin America at US\$2.1 billion (4%).

The market for minimally invasive medical devices ⁴⁾

The **global market** for minimally invasive medical devices and instruments was worth an estimated **\$13.4 billion in 2010**. The market is expected to reach **\$21.1 billion by 2016**, a compound annual growth rate (CAGR) of 7.9%.



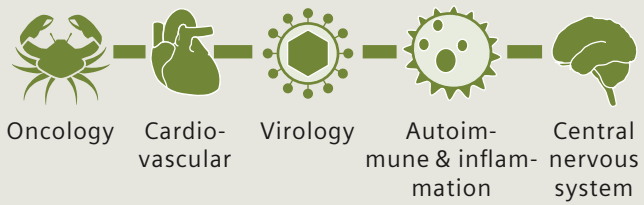
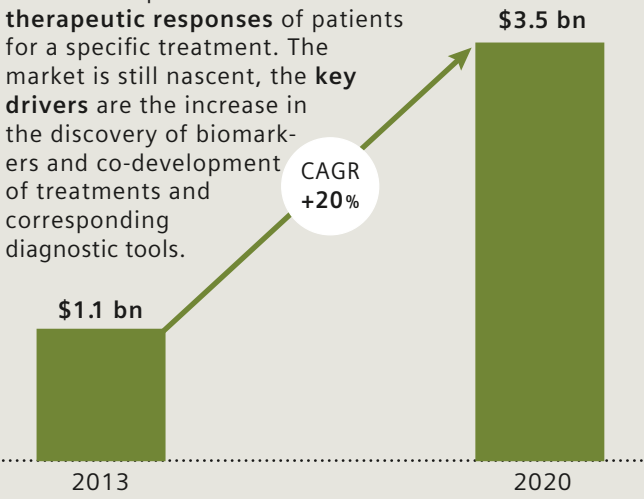
CAGR rate by surgery segment 2011-2016



Orthopedic surgery is the **fastest-growing application segment**, with a CAGR of 11.2% between 2011 and 2016, followed by cardiothoracic surgery (8%) and vascular surgery (7.8%).

Global companion diagnostic technologies market ⁷⁾

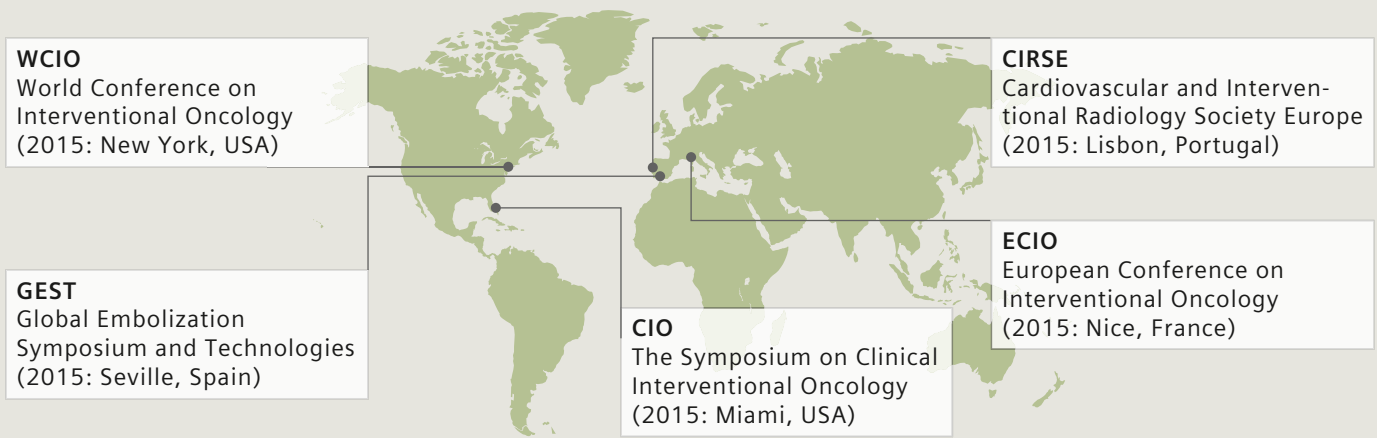
Companion diagnostics are in vitro diagnostics that provide **information about therapeutic responses** of patients for a specific treatment. The market is still nascent, the **key drivers** are the increase in the discovery of biomarkers and co-development of treatments and corresponding diagnostic tools.



Companion diagnostics is **segmented on the basis of its use** for indications such as oncology, cardiovascular conditions, central nervous system indications, inflammation and virology.

Interventional oncology – the growing field in interventional radiology ³⁾

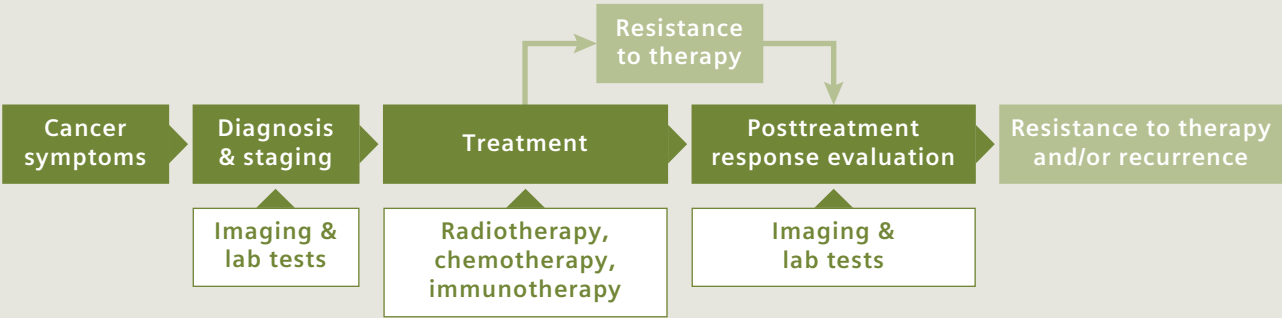
More and more dedicated meetings focus on interventional oncology.



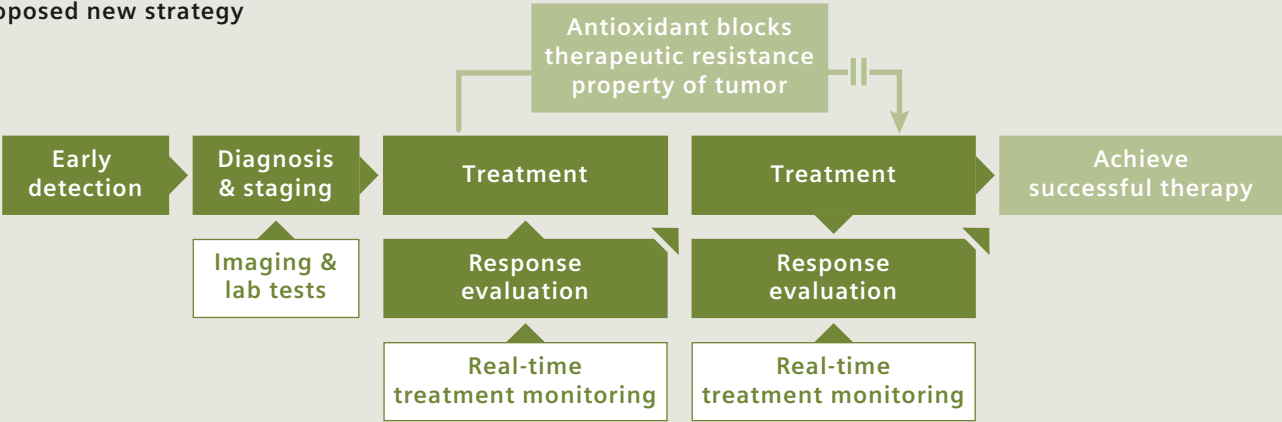
Real-time dynamic therapy management ²⁾

The **current therapeutic strategy** used in the clinic compared to the **proposed hypothetical model** which can potentially **improve the clinical outcome** of various therapies for treating tumors of different sub-types.

Current strategy

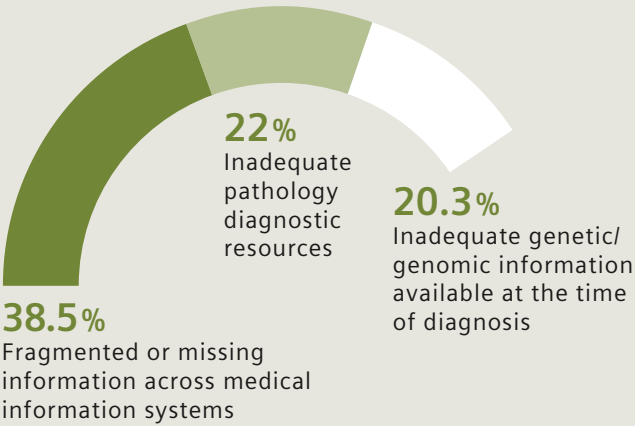


Proposed new strategy

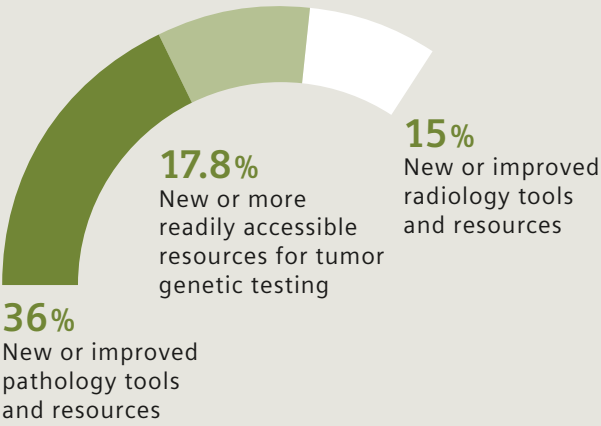


In the U.S., 28% of cancer is misdiagnosed ⁶⁾

The top reasons are:



Possible ways to avoid misdiagnosis:

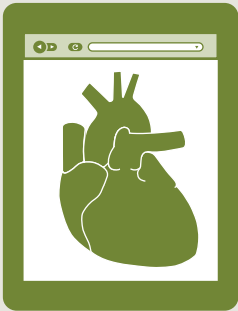


The five main barriers to improving access to diagnostics in the UK ⁵⁾

- 1 Organizational:**
poor communication between primary and secondary care, variable referral management practices, delays in reconfiguring pathology services and confusion over responsibility for technology assessment
- 2 Financial:**
perverse payment incentives and the lack of an effective activity-based payment system, the short-term nature of National Health Service (NHS) budgeting, and poor understanding of the cost benefits of diagnostic testing
- 3 Operational:**
capacity constraints, including variations in opening times, variable progress in automation, lack of trained staff, and uncertainty over future demand
- 4 Cultural:**
failure to engage frontline staff, risk aversion at board level, and inadequate collaboration with industry and other providers
- 5 Regulatory:**
new more exacting [sic!], European Union regulatory requirements for medical diagnostics

Prediction due to personalized models ⁹⁾

Researchers can take a mass of data from imaging examinations and extract mathematical models of organs. Currently, **models of the heart are particularly illustrative**. This "virtual heart" can be merged with the individual data of a patient, thus adapting the model to specific characteristics of the patient. This enables the simulation of the effects of various therapeutic options.

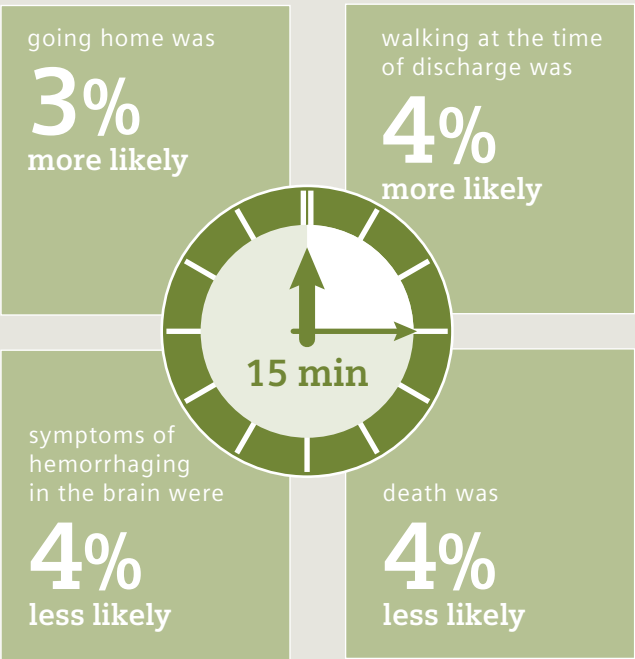


Sources: 1) Enterprise Analysis Corporation, 2012 In Vitro Diagnostics Industry Review, 2013 2) Siemens Healthcare (Basis: Theranostics 2013; 3(6):437-447. doi:10.7150/thno.5658) 3) Siemens Healthcare 4) BCC Research, <http://bit.ly/1wLGScc> 5) Deloitte Centre for Health Solutions, Working differently to provide early diagnosis – Improving access to diagnostics, 2013, P. 6 6) Boston Group, BMJ Quality and Safety, <http://bit.ly/1vTRO31> 7) Alisha Menezes, Allied Market Research, <http://bit.ly/1C8w3RI> 8) University of California, Los Angeles, (UCLA), <http://bit.ly/1pOQNj4> 9) Siemens Healthcare 10) Deloitte Centre for Health Solutions, Working differently to provide early diagnosis – Improving access to diagnostics, 2013, P. 4 (at all: last accessed 08/29/14)

Timely treatment after stroke is crucial ⁸⁾

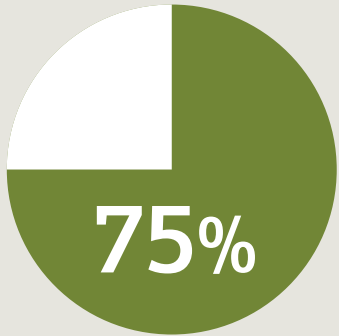
A study by University of California, Los Angeles (UCLA), analyzed how critical the time between the onset of stroke and the administering of treatment is.

For every 15 minutes of time saved before treatment ...



The influence of diagnostic tests on clinical decisions ¹⁰⁾

75% of clinical decisions are **based on a diagnostic test**. Demand for access to quicker, more accurate diagnosis is **rising at a rate of 10% per year** (in the UK).



Virtual Models for Better Decisions

Text: Jürgen Schönstein



There have been a number of innovations in the history of imaging that drastically changed diagnostics. Virtual body models for the evaluation of therapies might just be the next milestone.

For decades after Wilhelm Roentgen's discovery of X-rays, medical imaging was a major tool in diagnostics. And since the late 1970's, scanning devices have been used as tools to guide minimally invasive procedures. But for Dorin Comaniciu, Head of Imaging and Computer Vision at Siemens Corporate Technology, this is just a prelude: "Today we do image-guided therapies," he explains. "Tomorrow, this will be about recommending and supporting therapy decisions, guiding therapy through very detailed models of the patient." Comaniciu, together with a team of 150 researchers, is working on using imaging and lab data to create computational models of a specific patient's body; for example, they build "virtual hearts," which will

enable surgeons to better plan and manage their procedures.

With such models, they will also be able to predict if a therapy will work, thus reducing cost and patient suffering by avoiding ineffective treatments, and at the same time, improving patient outcomes. Greg Sorensen, CEO of Siemens Healthcare North America, sees these tools for optimizing the use of therapies: "Even more than a good diagnosis, in terms of frequency, monitoring how a therapy is working is what our technologies are used for – and if you do that well, you can save your healthcare system huge costs, by terminating ineffective therapies, and shifting people to effective therapies."

But this decision will always be the clinicians' to make, assures Sorensen: Predictive tools can help reduce the risk of error and support therapy choices, but not replace the clinical expertise. "A lot of our activities are about bringing more intelligence to the data," explains Comaniciu. "Our job is to bring value to the decision-making process." ■

Fast Facts



The global operating room market is expected to grow from nearly US\$13.1 billion in 2014 to reach nearly

\$21

billion in 2019.

Source: www.bccresearch.com,
<http://bit.ly/1p6ZHMt> (last accessed 8/26/14)



Diagnostics is the missing link for a sustainable healthcare system, providing immediate opportunities to reduce costs and to deliver higher quality of care.

Value Based Healthcare Center Europe



Source: Value Based Healthcare Center Europe,
<http://bit.ly/1qoV5Gz> (last accessed 8/26/14)

Personalized medicine and technological advances

With the cost of decoding an individual's genome expected to fall in the next two to three years to US\$1,000 from its current price range of US\$10,000 to US\$25,000, the market for genome decoding in developed countries will explode. This will lead to a greater understanding of disease and the development of new therapies but will raise complex privacy and cost-benefit issues.

Source: Harvard Business Review (hbr.org),
<http://bit.ly/1q1G2mn> (last accessed 8/26/14)

Bringing Value to the Decision-making Process

Text: Jürgen Schönstein
Photos: Steffen Thalemann

Innovation in healthcare is more than just improving technology – it is about re-thinking how healthcare is delivered, to improve outcomes and, at the same time, make it available to more people. **Greg Sorensen and Dorin Comaniciu** discuss how improving diagnosis will change healthcare for the future.

Too many people, in the U.S. as well as globally, have no access to healthcare at all. Will the healthcare of the future be healthcare for all?

Greg Sorensen: Expanding access is certainly a key part of what we are doing. The goal of less expensive medicine is shared by all. Our point-of-care diagnostics business, for example, aims to bring devices directly to any patient care environment. Much of this equipment is sold to doctors' offices and nursing locations.

But the equipment is becoming more and more complex. Take imaging, for example: A few decades ago, all you could do was take diagnostic pictures. Then, with improvements in quality, imaging became part of the treatment, using

image-guided procedures. Where will this trend lead us next?

Dorin Comaniciu: We are currently working with imaging to develop virtual models – of the heart functions of an individual patient, for example. That involves understanding the anatomy, the movements, the electrophysiology and all specifically for the respective patient.

Greg Sorensen: When we think about wearable devices such as fitness bands, the reason they count steps so accurately despite many sorts of body movements is because built into their software is a model that interprets the signals that come from the device bouncing around. In the same way, a small data point like a blood test result can be used inside a model to inform larger questions about disease changes. This enables relatively simple measurements to become very powerful.

Something as simple as an app that could remotely model a person's health metrics, even if they don't have direct access to healthcare facilities?

Dorin Comaniciu: This will certainly be a very important direction for us. But here is what we can do already, for example, for patients whose hearts are not beating



synchronously. If this symptom is not treated, it can lead to heart failure. But cardiac re-synchronization therapy does not work in 30 percent of the patients. We want to find procedures through which we collect information about a patient, and based on a physiological model of the patient's heart, say in advance if this therapy will work or not. This is a very important new trend in medical science.

Greg Sorensen: And these tools can help prevent readmission, which saves a lot of money. About half of all patients, for example, do not respond to the therapy that they receive. Even more than a good diagnosis, in terms of frequency, monitoring how a therapy is working is what our technologies are used for – and if you do that well, you can save your healthcare system huge costs, by terminating ineffective therapies, and shifting people to effective therapies.

How do you decide where to focus your research efforts?

Dorin Comaniciu: Our researchers are passionate to make a difference in the real world. With our clinical partners – interventional radiologists, cardiologists, as well as surgeons – we are trying to improve the quality of care while helping to reduce the

cost. One example is minimally invasive surgery, where building 3-D models of the interior human body will help with motion compensation: How do we compensate for breathing? Or take tumor operations: We build virtual models of the vessels inside the liver, and this modeling supports the minimally invasive procedures.

Is the purpose of the model to help the surgeon prepare his strategy through simulation, or is it used as a real-time tool during the procedure?

Dorin Comaniciu: Primarily, it is to prepare for the surgery – to understand what therapy will do. The second step is guiding the actual surgery with 3-D models, by showing, for example, on the model what kind of vessels you might touch during the excision of a tumor.

In other words, imaging is not just a guide, but more like an assistant. Could you imagine this being used in hospitals or health systems where such highly skilled medical experts are not available, bringing high-quality procedures into underserved areas globally?

Greg Sorensen: Absolutely. That is the most exciting part of the job for me: We have >

Dorin Comaniciu (left) is Head of Imaging and Computer Vision for Siemens Corporate Technology in Princeton, New Jersey, USA

Greg Sorensen (right), a Harvard-trained medical practitioner and researcher, is President and Chief Executive Officer of Siemens Healthcare North America



Exploring new ways in integrating diagnosis and therapy: Greg Sorensen and Dorin Comaniciu.

an opportunity to massively impact how healthcare is delivered. Software that allows a surgeon in a remote part of the world to plan and deploy a surgical approach they otherwise could not do, that will help people all around the world.

So a lot of your research focuses on software?

Dorin Comaniciu: We do work with a lot of software that is tied in with the hardware – scanners, for example, are becoming more and more intelligent. Lab tests are becoming more intelligent. So a lot of our activities are about bringing more intelligence to the equipment. A good example is intelligent software for MRI. This future technology will allow MR scanners to do acquisitions many times faster – and it's strictly a software technology.

The USA is probably your biggest single market – but which market is most interesting in the longer term? China, India, or maybe Brazil?

Greg Sorensen: The growth lies not in any one country. It is definitely global, but we know that many trends that are set in the

United States percolate throughout the world. The same ideas of paying for value, of quality and safety, are what everyone wants. Percentage-wise there is faster growth in other parts of the world, but innovations in the USA spread far and wide.

So from an American businessman's perspective, who has to deal with cost-cutting healthcare reform: Do you sometimes envy other healthcare markets?

Greg Sorensen (laughs): That's a good question. But you know something interesting? When patients in different countries are surveyed, they always love their own healthcare system. I am in the United States, and I love the U.S. market. It is the most dynamic, with lots of innovative things going on.

Dorin Comaniciu: I am always looking at this through the lens of technology. And I am quite optimistic that we can increase the efficiency of any system, while increasing the effectiveness for the patients.

Can you give us an example?

Dorin Comaniciu: When you look at fractures or lesions in ribs, which are curved, reading the images is quite cumbersome in 3-D. So

150

Global researchers

about eight years ago, we had the idea to “unfold” the rib cage, and then to provide the clinicians with a plane image, where they can immediately see if there is a problem. It took us quite some time to perfect this technology to unfold the rib cage reliably – but once we did this, it quickly became a product. You can imagine how much this has increased productivity, and also the confidence in reading these images.

Where do you see the next “killer app” in healthcare?

Greg Sorensen: One of the reasons that we work so hard to stay close to our customers is that we frequently see them taking a device we have designed for one use and start using it in a completely different way – which might open a whole new market for us. X-ray machines initially designed to look at bones were used to look at vessel wall calcifications. Blood tests thought to measure one disease state turn out to be valuable in many others. We have some ideas about where our technology is going, but we are fascinated by the directions our customers take our offerings.

Dorin Comaniciu: Reproducibility of results is one of the most important topics. We try to develop analytics to ensure that reproducibility increases, but the decisions still need to be made by the clinicians. We can present data in a way that the probability of errors is decreasing and ultimately the results are improving. Our job is to bring value to the decision-making process.

Greg Sorensen: And that is why there is no replacement for human skills. A finding or test result might be normal pre-op yet be abnormal post-op. Human knowledge will always be required to place findings in clinical and human context. ■

Improving the outcomes for individual patients through better diagnoses and adapted therapies is one big challenge for the healthcare of the future – the other is to bring healthcare to the billions of people around the globe who currently have no access, by making healthcare more affordable. The solution to both challenges lies in making better decisions, which will improve results while reducing costs – and this is where Dorin Comaniciu, Head of Imaging and Computer Vision at Siemens Corporate Technology, and his 150 global researchers focus their attention. They are using imaging and lab data to create computational models of a patient’s heart, for example – and with this “virtual heart,” surgeons will not only be able to better plan and manage their procedures, they will also be able to predict if a therapy will work; this helps reduce cost by avoiding or adjusting ineffective treatments, and improves patient outcomes. “Smart scanning and testing” will not only guide procedures with high-quality images and lab data, but by using models, it will be more like a “virtual assistant.”

In this context, Greg Sorensen, CEO of Siemens Healthcare North America, sees the current challenges for the health system in the United States as an opportunity to innovate for the global market: The United States has the highest standards in medical technology, but is under great pressure to optimize the cost of healthcare delivery. He knows that “people who want low-cost healthcare in the developing world actually share the same goal as everybody in the United States – affordable healthcare.”



Thanks to the University Clinic Ulm's (above) hybrid room, Prof. Florian Gebard, MD, can perform complex surgeries - such as removing an osteosarcoma from a patient's pelvis (above right).

Surgery 2.0

Text: Eric Johnson
Photos: Anna Schroll

A combination of novel navigation and positioning, using infrared light instead of X-radiation, is revolutionizing the operating room.

Lose a limb or lose a life – this was the worst-case dilemma confronting Georg M. from Germany. His pelvis had become riddled with a rare, malignant tumour, osteosarcoma, which threatened to kill him. Conventional surgery would require removal of nearly half his pelvis, which would likely ward off certain death, but possibly render the bone incapable of proper function.

Everything changed when he came under the care of Prof. Florian Gebhard,



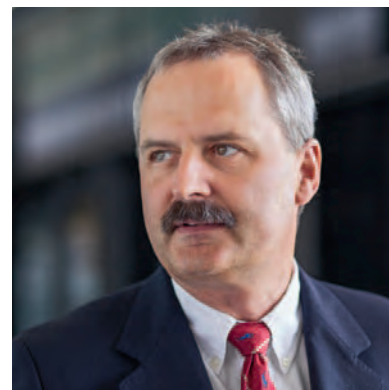
Head of the Department of Orthopaedic Traumatology, Hand, Plastic, and Reconstructive Surgery of the University Clinic Ulm. He proposed a radically different approach to treating the patient's disease.

Prof. Gebhard's speciality is the hybrid operating room. It has some features standard to a conventional OR, such as surgical and instrument tables, an anaesthesia workstation, and ventilation equipment. But it also hybridizes into an imaging center that is used for positioning and monitoring during actual surgeries. Even more high-tech is the addition of a navigator – a machine that maps out body internals and surgical kit in three-dimensional detail. For Georg M., the hybrid OR means much more. It allowed him to beat bone cancer, while keeping intact both life and limbs. ■

Learn more



[www.siemens.com/
OR-of-the-future](http://www.siemens.com/OR-of-the-future)



A hybrid OR can be a strong draw in an increasingly competitive market.

Prof. Florian Gebhard, MD,
University Clinic Ulm







A Race Against Time

Text: Philipp Grätzel von Grätz, MD
Photos: Matti Immonen

Finland is the world's leading nation in acute stroke care. Nowhere else is intravenous thrombolysis administered more efficiently. Professor Markku Kaste of Helsinki University Central Hospital is the maestro behind this story.

The improvement in stroke care at Helsinki University is absolutely cost effective and raises the interest of healthcare providers across the globe: Kaste's colleague, Dr. Atte Meretoja, is now spreading the knowledge about optimum stroke care to Melbourne, Australia.

Which benefits are offered by the Finnish model of stroke care?

Kaste: In Finland, the investment we have made in stroke care has really paid off. The mortality of patients has decreased, the life expectancy has increased, and furthermore, the quality of life has improved.

Meretoja: This Finnish model represents a great opportunity for improving stroke care. We urge centers around the world to take this opportunity. >



Left: Stroke patients are transported directly into the CT room, where a brief neurological examination and some point of care lab tests are done. The CT examination is performed immediately afterwards. Right: Another very important aspect is a better involvement of the emergency medical services. The hospital is pre-notified that a stroke patient will arrive.



What is the reason for the quick treatment of stroke patients at Helsinki University Central Hospital?

Kaste: The key element in optimal stroke care is to have a CT inside the emergency room. So the faster you get the imaging, the better are the treatment results, especially if thrombolysis is a possibility. When modern imaging technology is taken inside the emergency room, it will shorten door-to-needle time and improve the outcome of patients.

Meretoja: In Helsinki, we managed to reduce the average door-to-needle time to 18 minutes. This means that we are more than one hour quicker than, for example, our colleagues in the U.S. or in many parts

of Europe. Another important aspect is that we have stroke specialists available at the emergency department all the time. We have 40 neurologists in total in our department. This makes it possible to offer a 24/7 service.

Can the Finnish success story be transplanted to other territories?

Meretoja: Our experience of transferring knowledge between Helsinki and Melbourne shows that this is truly feasible. Within a year, the Helsinki result could be duplicated. Measures of process improvement similar to the ones mentioned above drove door-to-needle time down from 45 to 21 minutes. ■

The outcomes achieved by the Siemens customers described herein were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that others will achieve the same results.

Learn more



www.siemens.com/stroke-helsinki



“Yes, we scan!”

Text: Kerstin Schweighöfer

Photos: Walther Appelt

Jelle Barentsz is a Professor of Radiology at Radboud University Medical Center in Nijmegen, Netherlands. As Director of the Prostate MR-Reference Center, he focuses on the advantages of MRI in diagnosing and treating prostate cancer.

Professor Barentsz, in your clinic's reception area, there are brochures in all languages. Where are your patients from?

Jelle Barentsz: Many of the 3,000 prostate patients we treat every year come from abroad, including high-level industrial managers and politicians. Thanks to the latest MRI technology, we can clarify in just over an hour for them whether they have simply an enlarged or chronically inflamed prostate, or a serious case of prostate cancer.

Patients diagnosed with prostate cancer often face years of uncertainty. Why is that?

Jelle Barentsz: The distress begins as a man's blood test has shown elevated Prostate Specific Antigen (PSA) levels. Out of ten men with elevated PSA, only two have cancer – and of these two, only one has a carcinoma that will influence life expectancy. Still, both cancer patients would usually have surgery – with incontinence and impotence as frequent side effects. All ten men would have to endure an uncomfortable digital rectal examination, and then 12 needles are inserted into the tumor to take tissue samples, which is even more painful and can lead to complications. In 40 percent of all cases, the needles miss the suspected tissue, and in 40 percent of cases they fail to reach the most aggressive part. 70 percent of all carcinomas are not palpable. ➤

Thanks to multi-parametric MRI technology, Prof. Jelle Barentsz, MD, can spare patients with suspected prostate cancer unpleasant exams and uncertainty.



This page: Radboud University Medical Center in Nijmegen, Netherlands
Right page: Barentsz explains the several steps of the MRI exam in detail.

And you can spare your patients all that?

Jelle Barentsz: Yes, thanks to the multiparametric MRI technology, with an error rate of far less than ten percent.

Why aren't these new methods used to treat prostate patients everywhere?

Jelle Barentsz: There are several barriers: First, skepticism. Second, not every radiologist can simply switch over to this method. He must first be trained and gain experience. Third, politics has to be motivated, and fourth, insurance companies consider it too expensive, which is not a good argument! A quick, clear diagnosis spares the patient the current long, expensive, and often unnecessary treatments. There are fewer side effects and costs are lower.

What are the next steps in conquering prostate tumors?

Jelle Barentsz: Continue our persuasive efforts at conferences and symposia. Furthermore we are providing training in the new technology for radiologists and medical technicians at our reference center in Nijmegen, and online support when they return home. I wouldn't rule out the possibility that we could stamp out cancer with early detection. That's my dream. ■

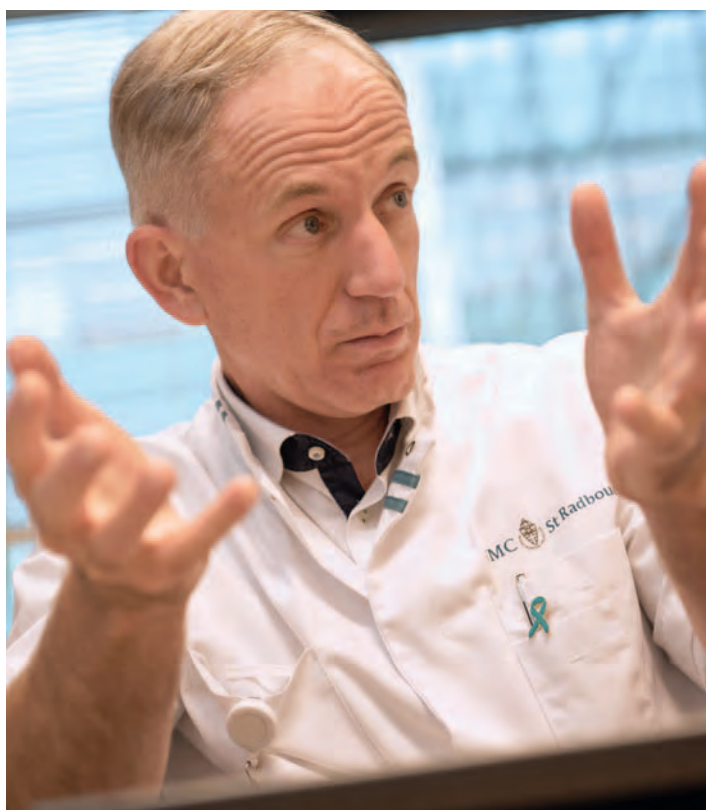
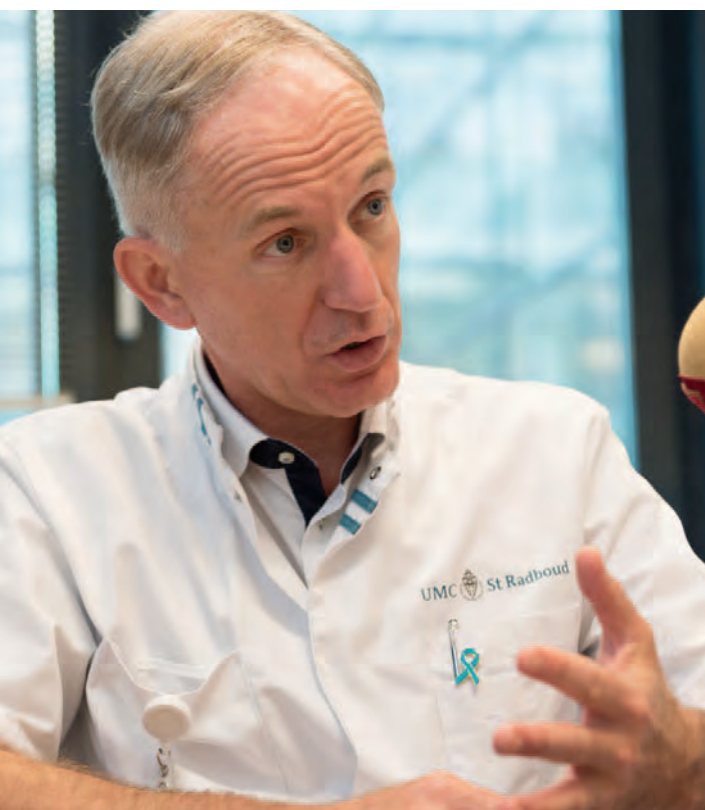
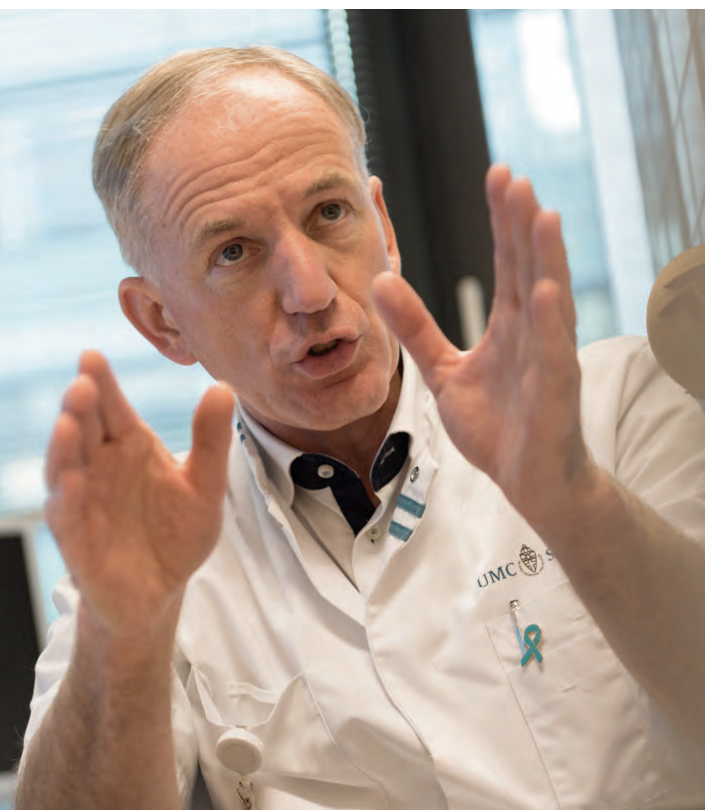
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¹⁾ Not available in the U.S.

Learn more



www.siemens.com/prostate-cancer-nijmegen¹⁾



“Thinking Healthcare Ahead” on Your Tablet

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also available
within the
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Thinking Healthcare Ahead



