Connect to care
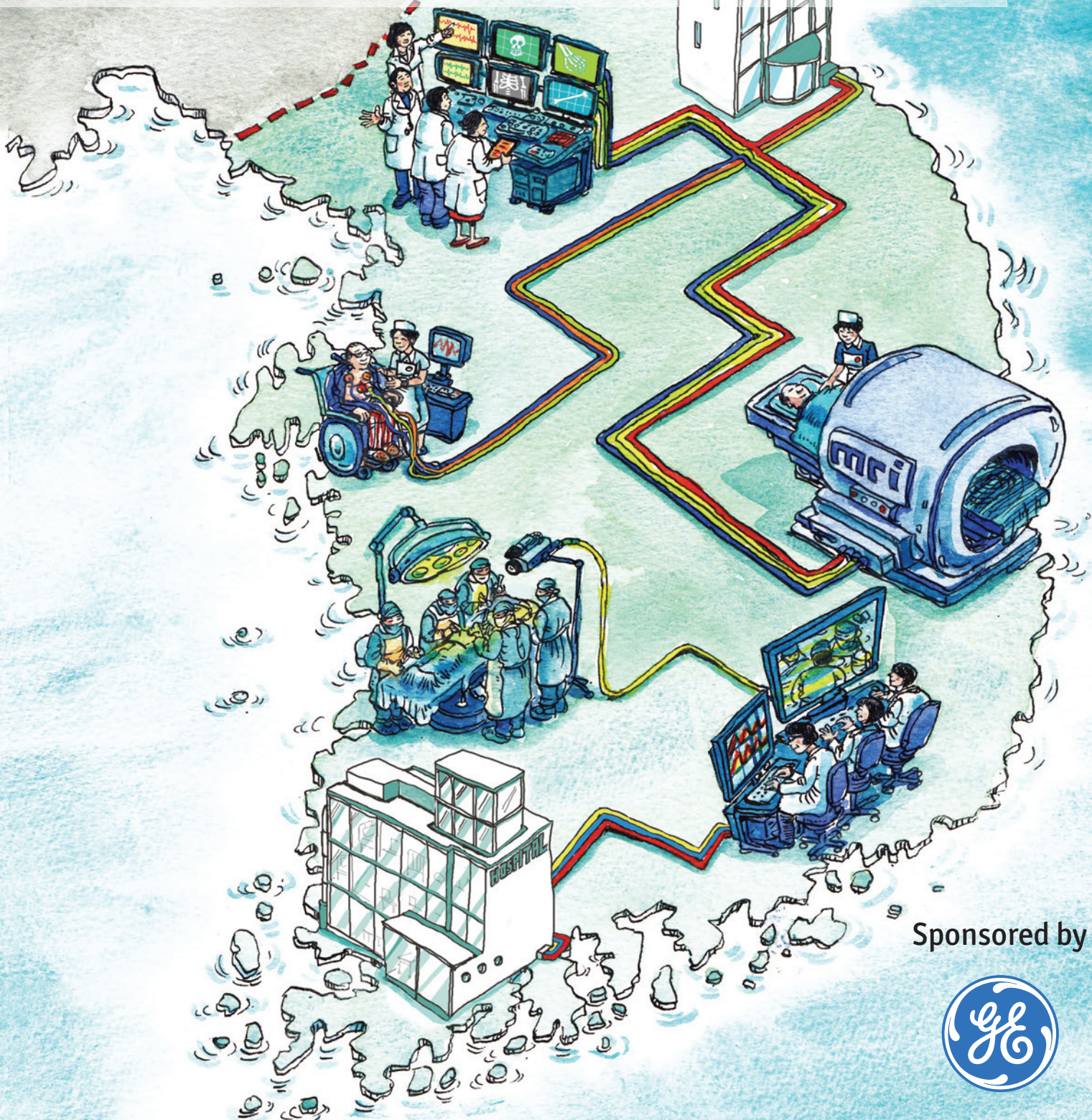## The future of healthcare IT in South Korea

An Economist Intelligence Unit report
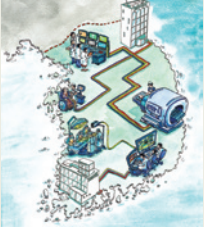
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Preface

Connect to care: The future of healthcare IT in South Korea is an Economist Intelligence Unit report, sponsored by GE. The EIU conducted interviews independently and wrote the report in English; it was then translated into Korean. The English version should be regarded as definitive. The findings and views expressed here are those of the EIU alone and do not necessarily reflect the views of the sponsor.

We would like to thank all interviewees for their time and insights.

November 2011

Interviewees, in alphabetical order

- **Hune Cho**, professor, Kyungpook National University and chair, Korea Society of Medical Informatics
- **Hyoung-sun Jeong**, professor, Yonsei University
- **Suk-wha Kim**, chairman, Department of Plastic Surgery, Seoul National University Hospital and president, U-Health Industry Promotion Forum
- **Yoon Kim**, associate professor, Department of Health Policy and Management, Seoul National University College of Medicine
- **Yoon-nyun Kim**, professor, Dongsan Medical Center, Keimyung University
- **Chul Lee**, president and CEO, Yonsei University Health System
- **Shin-ho Lee**, director of health service, Korea Health Industry Development Institute
- **Lee Yong-kyoon**, senior researcher, Korea Hospital Association
- **Lim In-taek**, former director, Bureau of Health Industry, Health Industry Policy Division, Ministry of Health and Welfare, Government of South Korea
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- **Sarah Muttitt**, CIO, Ministry of Health Holdings, Singapore
- **Dennis Protti**, professor emeritus and founding director, University of Victoria School of Health Information Science, Canada
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- **Kun-ho Yoon**, director, Institute of U-Healthcare, Seoul St. Mary's Hospital, Catholic University of Korea

Executive summary

By many comparative measures South Korea has an enviable healthcare system: one that covers the entire population, is relatively cheap to run (healthcare spending is around 7% of GDP, far lower than in many comparably wealthy economies) and gives patients access to a broad range of specialist advice and state-of-the-art treatments. Yet the sustainability of the system, funded in part by mandatory national insurance contributions and in part through patient co-payments, is far from assured.

In some respects it will become a victim of its own success. With the population's rising longevity, healthcare spending by those aged over 65—an increasingly large part of the population—is forecast to surge in the next decade, putting significant strain on funding. Ageing is also driving change in the country's disease profile, with the incidence of longer-term, costly-to-treat diseases like cancer and diabetes rising rapidly. For such treatments, out-of-pocket payments are as much as 50%, making them unaffordable for many. Such diseases will also require constant, long-term monitoring, greatly affecting patients' quality of life. There is also much inefficiency in a system that allows patients to go anywhere they like whenever they like and which, though low fee-for-service charges, encourages unnecessary duplication of basic procedures.

This paper, *Connect to care: The future of healthcare IT in South Korea*, examines whether the country is set to use healthcare IT—particularly systems that enable data sharing across providers, and remote monitoring and diagnosis—to alleviate these problems. This is not a foregone conclusion. Despite the fact that South Korea leads the world in terms of mobile broadband Internet connections and is a world-leading exporter of consumer technology, many of its healthcare connectivity projects have not yet achieved broad success.

To be sure, the government has acknowledged the cost, quality and access benefits of connected healthcare, with the drive for standardised health informatics starting in earnest in 2004. And some technologies—such as electronic medical records (EMRs) and order communication systems—have been widely adopted, while pilot schemes for others (for instance under the "U-health", or ubiquitous health, telemedicine banner) have been successful. Yet many health informatics programmes remained at the pilot stage, failing to get broader medical or private-sector buy-in.[1]

Why is this the case, and what needs to be done to remedy the situation? To answer these questions, the Economist Intelligence Unit interviewed a series of healthcare experts and practitioners from key

[1] A note on definitions: Electronic medical records (EMRs) typically refer to computerised medical record created within an organisation that delivers care, such as a hospital or physician's office. Electronic health records (EHRs) typically refer to computerised records that aggregate information on individuals from data exchanged between multiple providers. "E-health" is a catch-all term referring to any application of information technology in the provision of healthcare. "U-health", short for "ubiquitous health", is a term used in South Korea to refer to various applications of IT in providing healthcare services, particularly telemedicine.

government, medical and academic bodies in South Korea. Their opinions, together with our own research and analysis, inform the paper's key findings.

Regarding the first question, a number of barriers prevent the wider adoption of healthcare informatics in South Korea. These include:

- **Slow regulatory reform.** Many practitioners and experts—including at the Ministry of Health and Welfare (MoHW)—recognise that delays in regulatory reform are retarding the broader adoption of some healthcare IT. For instance, the national Medical Law recognises only face-to-face consultations between doctors and patients and does not permit doctors to issue medical advice or diagnoses via telemedicine. It also restricts the storage of medical information to providers' physical premises. In addition, systems that enable the sharing of patient information run the risk of breaching South Korea's strict personal data protection regime (although the new Personal Information Protection Act, which came into force as this report went to press, resolves some of these concerns). Legislation to address these issues is pending, but many doubt that it will be passed quickly.

- **Divisions within the medical establishment.** On the one side are large private hospitals, comparatively rich and popular, which are broadly supportive of introducing more technological innovation in healthcare and have already taken steps in that direction themselves. On the other are much more numerous smaller clinics and neighbourhood doctors, many of whom are suspicious of technology that may reduce the need for their services among the outpatients on whom their livelihood depends. This is far from a clear division, however: even representative bodies such as the Korea Hospital Association and Korea Medical Association struggle to find consensus among their members.

- **Lack of incentives for practitioners and private-sector investors.** Many think that the initial investment required for health informatics and telemedicine is too high and the short-term gains are too low to justify it—with the added concern that only large, already overburdened hospitals will be able to afford such technology, worsening inequalities in access. Smaller-scale medical organisations complain that the government is not subsidising investments sufficiently. Furthermore, the fact that the national insurance scheme does not yet provide reimbursements for much e-health reduces the likelihood that practitioners will adopt it. Meanwhile, although the government is keen to develop healthcare as a growth industry, regulatory concerns and the lack of widespread adoption have made the private sector reluctant to invest.

- **Lack of widespread patient demand.** Despite the quality-of-life benefits that much innovative healthcare IT can offer, particularly for sufferers of chronic disease, the vast majority of patients in South Korea have yet to witness them. Where trials have been conducted, the MoHW reports broad patient satisfaction, while some physicians interviewed for this report claim patients that have experienced such treatment are prepared to pay extra for its maintenance. But without widespread demand there is little public support for action to resolve legal and other barriers to the broader adoption of healthcare IT, and little incentive for private-sector investment.
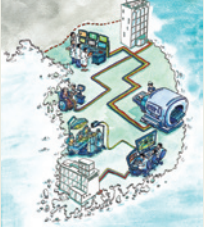
Regarding the second question, stakeholders in South Korea suggest a number of solutions to overcome the challenges outlined above. These include:

- **Establish dedicated government organisations to oversee healthcare IT.** Many interviewees say that the creation of a dedicated government organisation focusing exclusively on healthcare information technology—with sufficient clout—is necessary to drive progress. Some cite the Office of the National Coordinator for Health Information Technology, under the Department of Health and Human Services in the US, the National eHealth Transition Authority in Australia, or similar bodies elsewhere as examples. Others concur with the need for a dedicated organisation that promotes IT in the healthcare and medical services areas and mediates conflicts of interest among different groups, such as Canada's Health Infoway. Such bodies may help reduce conflicts arising from differing priorities at various government agencies.

- **Establish clinical buy-in through demonstrations and incentives.** Part of the problem with promoting new technology is that many practitioners have yet to experience its benefits first-hand. Advocates suggest the government needs to secure buy-in through more numerous targeted trials and demonstrations. Smaller clinics should be enticed to participate in trials through referrals and financial incentives, while some physicians recommend making new IT training a mandatory aspect of doctors' qualifications. Moreover, rather than allow competing private-sector interests to lead the way in national projects, some advocate committed government investment in the necessary infrastructure and systems to establish universal standards.

- **Get patients involved.** Top-down attestations of efficacy are rarely as successful in promoting a technology as personal experience. Promotions should therefore emphasise the communication and quality-of-life benefits of such technology more widely, some practitioners say. Increased demand would help promote the viability of the business to private-sector investors and generate support for legislative change to enable its broader adoption.

South Korea is certain to face more challenges in rolling out healthcare IT infrastructure—as even those countries at the forefront of this drive have experienced. For one thing, getting the most from new technology is not just a matter of putting the hardware in place: organisations and systems must be optimised to maximise potential efficiency gains. Then there is the matter of ensuring inter-operability: by following established standards from the outset South Korea could save itself future costs.

Resolving such issues assumes the barriers and challenges outlined in this paper can be effectively overcome. The government is certainly aware of the challenges it faces and appears to be committed to resolving them. The MoHW has committed to creating an "ongoing platform for discussion" of issues related to health records and data that will include civic groups, industry members and academics, with the aim of agreeing on standards for the management of electronic health records throughout their lifecycle. It is also promising closer co-operation with other ministries in various programmes to promote R&D and collaboration between interested parties. The future sustainability of the country's healthcare system may depend on the success of such efforts.

I.   Progress and problems

South Korea has notched up no shortage of remarkable achievements in the decades since the devastating 1950-53 Korean war. It has managed to transform itself from one of the world's poorest countries into a prosperous, export-driven powerhouse. No less impressive, if not as frequently touted, is the development of the country's healthcare system. South Korea boasts a large and diverse pool of healthcare providers, with patients free to seek treatment at any they wish. The majority of doctors are specialists, and there is a higher penetration of state-of-the-art diagnostic equipment relative to the population than in the UK or Canada, according to the Organisation for Economic Co-operation and Development (OECD).

Health insurance, provided by the National Health Insurance Corporation (NHIC), and funded by the government and contributions from households and businesses, is mandatory and covers virtually the entire population. The NHIC also caps prices for most medical services, keeping out-of-pocket payments for minor treatments low by international standards. Best of all, at a time when governments worldwide

Figure 1: Increasingly costly
Healthcare spending
% of GDP

US	Canada	Australia	New Zealand
South Korea	Denmark	Japan	UK
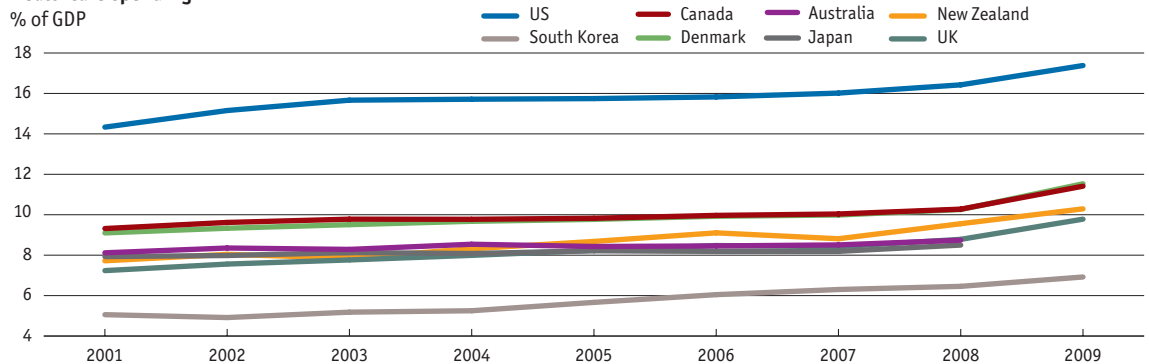
Source: OECD

grapple with the need to cut spending, the system is relatively cost-efficient—South Korea's healthcare spending as a percentage of GDP is around 7%, around half the rate of some of its developed-country peers (Figure 1).

Not surprisingly, the generally high quality and consistent availability of medical care has produced significant advances in the general health of the population. South Koreans' average life expectancy has jumped from 72 to 80 over the past two decades, while the infant mortality rate has fallen from 8 per 1,000 births to 5—again on par with Canada and the UK, and lower than the rate in the US (Figures 2 and 3).

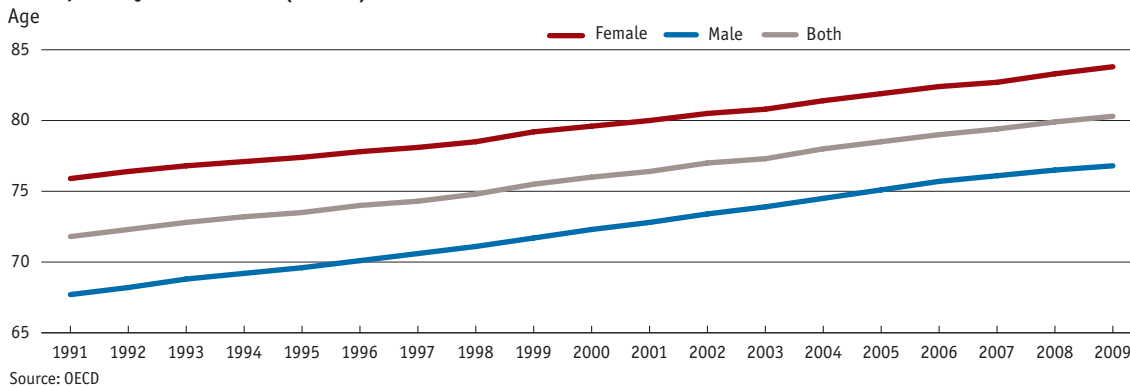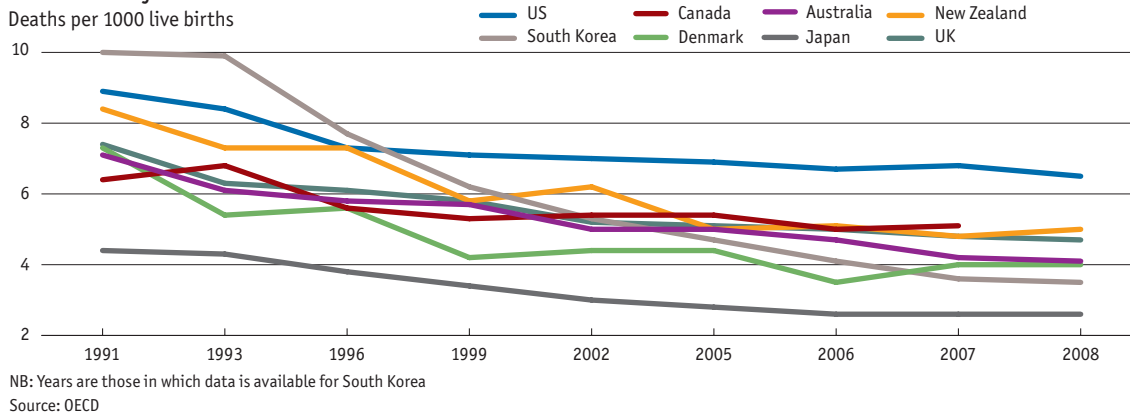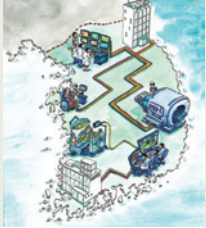**Figure 2: Living long...**
Life expectancy in South Korea (at birth)
Age

Female   Male   Both

Source: OECD

Figure 3: ...and prospering
Infant mortality
Deaths per 1000 live births

US   Canada   Australia   New Zealand
South Korea   Denmark   Japan   UK

NB: Years are those in which data is available for South Korea
Source: OECD

Future burdens

While these successes deserve to be celebrated, in some sense they contain the seeds of the problems South Korea's healthcare system now faces. With its people living longer and one of the world's lowest birth rates—approximately 1.2 children per woman in 2010—the country's population is ageing at an unprecedented pace (Figure 4), pointing to a massive future burden on healthcare resources. The Ministry of Health and Welfare (MoHW), which oversees health-related spending and policy, recently projected that national healthcare expenditure could triple to W256trn (US$236bn) annually by 2020,

Figure 4: A greying society
Proportion of population by age group

%

Legend: 2010 · 2015 · 2020 · 2025 · 2030

Age groups: 0-4, 5-14, 15-64, 65 or over

Y-axis: 0, 10, 20, 30, 40, 50, 60, 70, 80
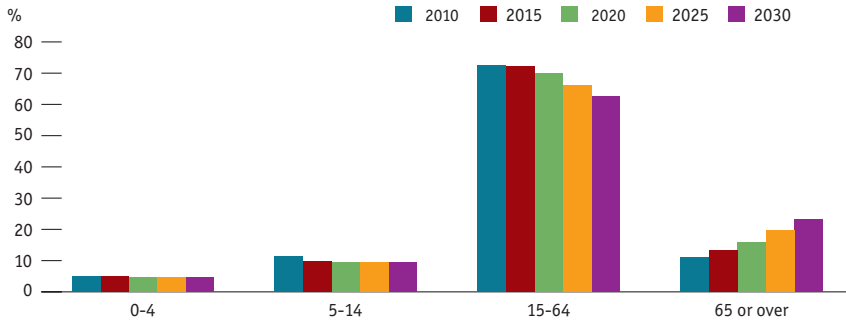
Source: UN, *World Population Prospects: The 2010 Revision*, medium variant

potentially putting the country in the same league as relatively profligate countries like France in terms of the ratio of healthcare costs to economic output.
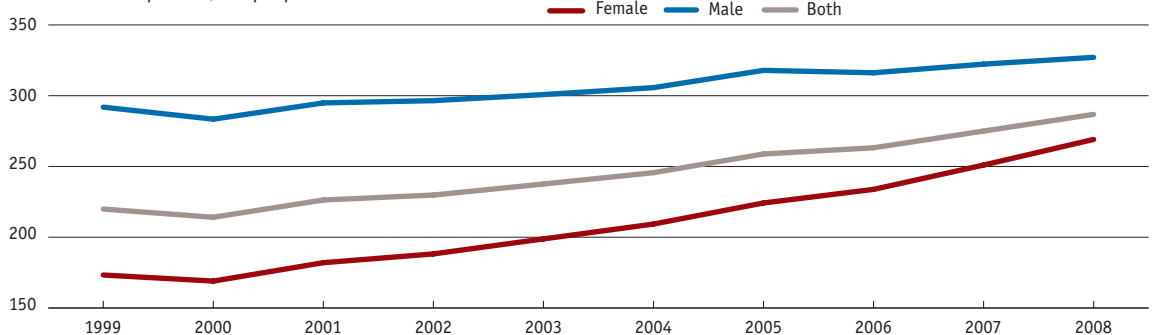
The NHIC has flirted with deficit but remained largely in the black in recent years, despite its expenditure growing at a compound annual rate of 13% from 2003-10, while revenue has grown at 11%. But the NHIC-affiliated Institute for National Health Insurance has warned the agency is on increasingly shaky financial footing, forecasting it will post a W16trn shortfall in 2020 and a W48trn deficit by 2030, as spending on those 65 and over surges five-fold.

Compounding the strain on the healthcare system is the country's changing disease profile. While in the past the emphasis was on fighting communicable diseases, the vast majority of current hospital visits are connected to chronic conditions like diabetes, heart conditions and particularly cancer, responsible for around one-third of all deaths and with a growing incidence rate (Figure 5). Aside from the unquantifiable impact on quality of life that comes with the monitoring and treatment of chronic disease, managing ailments that can persist for a lifetime requires significant investments of time and money by the NHIC, providers and, not least, patients, who under South Korea's co-payment system may be responsible for up to half of their treatment costs (Figure 6).

Figure 5: On the increase
South Korea cancer rates
Crude incidence per 100,000 people

Legend: Female · Male · Both

Y-axis: 150, 200, 250, 300, 350

X-axis: 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008

Source: www.cancer.go.kr

The relative expense of dealing with chronic diseases is one reason South Korean patients are burdened with some of the highest out-of-pocket medical payments per capita among OECD members. Many households feel they have little choice but to supplement the national insurance scheme with private coverage for cancer and other serious illnesses.

These costs are exacerbated because South Koreans are more prone to seek out medical treatment than their counterparts in other developed countries, with the possible exception of Japan. In 2009 they were

second only to Japan among OECD countries in terms of doctor consultations per capita, with 13 visits per year, compared to five in the UK and even fewer than that in the US (Figure 7).

An unbalanced system

But the issue is not only one of expense: South Korea's healthcare system has some imbalances that affect the quality—and equality—of care across the country. The freedom patients enjoy to choose their healthcare providers has resulted in the robust demand for medical services falling disproportionately on certain segments of the medical system—chiefly top-tier hospitals.

Not surprisingly, when their health is at stake, many South Koreans seek out the institutions they perceive as the best, and the top hospitals in Seoul dominate the NHIC's spending. The trend has persisted despite the insurer's efforts to correct it by introducing a tiered co-payment system under which patients pay a higher percentage of their medical costs at tertiary care institutions.

"Many Korean patients, if they get a cough or have a problem with digestion, would rather go right to first-level hospitals than clinics," says Chul Lee, president and CEO of Yonsei University Health System, which runs the leading Severance Hospital. The phenomenon not only pressures the resources of these institutions, but as their services tend to be more sophisticated and their charges higher, it raises costs, sometimes unnecessarily, for patients and the NHIC.

The rush to high-end hospitals—by those who can afford it—has also challenged perceptions about the equality of the healthcare system, and has stoked fears among doctors at smaller hospitals and clinics about an exodus of patients.

Figure 6a: Deep pockets required
Out-of-pocket expenses (latest year)
US$ per capita, PPP
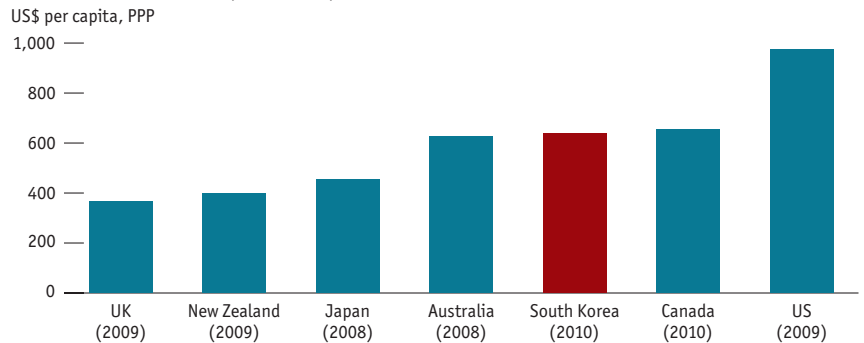
Source: OECD

Figure 6b
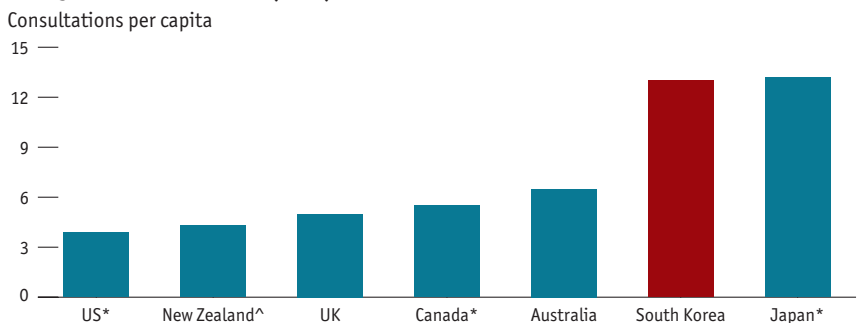**Private health expenditure as a % of total expenditure on health (2009)**
%
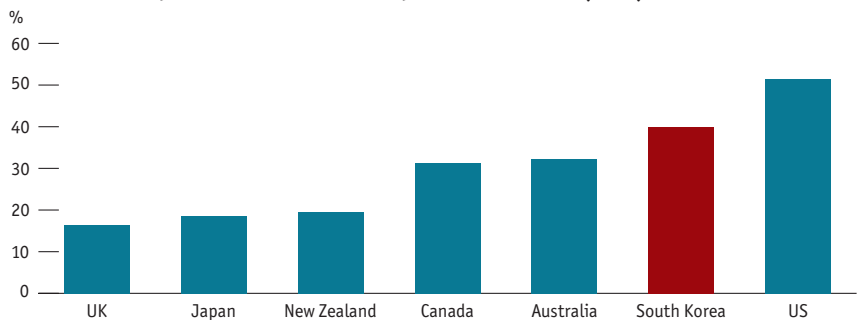
NB: Private health expenditure includes the outlays of private health insurance schemes, companies and NGOs as well as direct out-of-pocket costs.
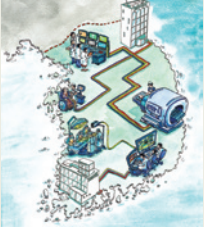Source: World Health Organisation

Figure 7: Overused
Average doctor consultations (2009)
Consultations per capita

^ 2007 * 2008
Source: OECD

II. A technological panacea?

Far from playing down these pressing issues, South Korea's policymakers have moved with characteristic speed and determination to acknowledge and address them—indeed, many of the most sobering forecasts and strident calls for change come from within the government. Much of the dialogue on how to tackle the problems affecting South Korea's healthcare landscape centres on the belief that information technology will play a primary role in any resolutions.

Healthcare IT "is the definitive way to aggressively and effectively address growing medical expenses and stronger interest in improved health and welfare services," the Ministry of Knowledge Economy (MoKE) says. "It can help increase operations efficiency in healthcare institutions while reducing inefficiencies and extra baggage that weighs down on the entire medical system."

Healthcare IT initiatives in a number of countries support the ministry's claims. Denmark, Singapore, Canada and the UK, for example, are moving beyond the simple digitalisation of records towards systems that allow the sharing of information between providers. The efficiency benefits stand to be substantial: Health Infoway, a non-profit body created by the Canadian government to assist in the development and management of Canada's healthcare IT systems, predicts C$1bn in savings from the use of centralised diagnostic imaging systems. Telemedicine is also a boon in a country where large distances and remote communities mean access is a significant concern: such systems cut 47m km of patient travel in 2010 alone.[2]

But the use of healthcare IT systems is about more than reducing dollars spent: in many cases they have led to improved healthcare service delivery and better outcomes for patients. While healthcare quality improvements are less easy to quantify than savings, they are part of the return on investment that governments and providers must consider.

Often such systems serve as enablers, allowing patients to make effective, results-based decisions about their health and lifestyle and facilitating more timely delivery of services through improved access to information. Danish patients, for example, are able to access their own health records using the Danish

2 "Telehealth Benefits & Adoption - Connecting People & Providers Across Canada", Praxia & Gartner, May 30, 2011

National Heath Portal, which provides a variety of e-health services—everything from managing and booking appointments, to renewing and purchasing prescriptions, to reviewing wait times and quality ratings of hospitals are available online, encouraging patients to actively participate in their own care.

Canada Health Infoway, to take another example, predicts that use of electronic health records (EHRs) will lead to reduced wait times through more effective management of cancelled appointments and other scheduling changes. Improved communications between facilities can lead to more timely delivery of service, allowing patients to be notified as soon as an appointment becomes available.[3]

Health Infoway also predicts that centralising patient information will improve health outcomes by ensuring that providers have access to the latest patient data. This reduces the likelihood of misdiagnosis and duplicate testing, ensures that patients receive the most effective treatment and limits the possibility of errors resulting from incomplete information. Infoway also cites expected quality-of-life benefits to sufferers of chronic disease, such as diabetes, in remote monitoring of day-to-day risk factors, cutting back on the need for visits to healthcare providers.[4]

There are strong indications that EHRs can lead to significant improvements to patient safety as well. An early study published in the *Journal of the American Medical Informatics Association* found that physicians using Clinical Decision Support components of EHRs reduced drug errors by up to 81%.[5] In another case, the Veterans Health Authority in the US used EHRs to create a diabetes registry that was then used to identify high-risk populations and facilitate targeted patient interventions.[6]

For South Korea—a country that has built its fortune as one of the world's foremost technology exporters, tops global charts in terms of broadband and smartphone penetration, and has a clear track record in successfully applying IT to improve administration—these results should come as no surprise. South Korea's own experiences in other sectors, and examples from other countries in the healthcare field, provide ample evidence that IT adoption can cut costs and accelerate the provision of medical services by automating simple processes, eliminating duplication, and enabling practitioners to draw on wider and more accurate pools of information.

A promising start

On the government side, the push for IT adoption in the medical sector has been spearheaded by the MoHW and the MoKE, with the two-pronged goal of improving healthcare delivery and fostering the local healthcare industry.

According to Lim In-taek, until recently director of the Bureau of Health Industry under the MoHW's Health Industry Policy Division, the drive for health informatics started in earnest in 2004, when the ministry formulated a five-year plan aimed at standardising the terminology and components used in hospital information systems. This was supported by the establishment of a research body, the Center for Interoperable Electronic Health Records (CiEHR), that saw experts from private hospitals join forces to develop a common information architecture and clinical content models tailored to the South Korean healthcare environment.

Yoon Kim, the former director of the CiEHR and currently an associate professor in the Seoul National University College of Medicine's Department of Health Policy and Management, says a demonstration EHR

[3] Canada Health Infoway, *Knowing the Benefits*. http://www.knowingisbetter.ca/#benefits

[4] Ibid.

[5] Bates et al. "The impact of computerized physician order entry on medication error prevention", *Journal of the American Medical Informatics Association*, 1999 6(4).

[6] Kupersmith et al, "Advancing Evidence-Based Care for Diabetes", *Health Affairs*, April 2007
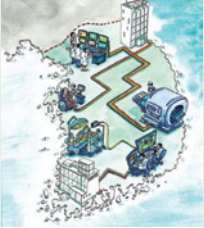
system run by the university's Bundang Hospital and nearby clinics resulted in average healthcare cost reductions of 5-12%.

These efforts laid the groundwork for the development of EHR and clinical information systems that were rolled out to public hospitals and health agencies nationwide and that the ministry envisions will become a nationwide health information exchange. The initiative has already produced clear results: according to the MoKE, as of the end of 2010 some 66% of hospitals had adopted electronic medical records (EMRs) and nearly 100% were running picture archiving and communication systems (PACS), which allow medical images such as x-rays to be stored and transmitted digitally.

The medical sector has also seen rapid uptake of order communication systems for prescriptions and medical expenses, not least, say practitioners, because they speed up the payment of reimbursements from the NHIC to medical institutions.

These larger accomplishments have been supplemented by a series of pilot projects under the government's "U-Health," or ubiquitous health, umbrella. These include the development and deployment of devices that can monitor important indicators such as blood glucose remotely, and the use of telemedicine in treating chronic disease such as diabetes and asthma. When these were implemented on a trial basis in islands and remote areas, where people sometimes struggle to access medical services, some 90% of patients found the services satisfactory, the MoHW's Mr Lim says.

Some private hospitals have also proven themselves trailblazers in the application of technology to the healthcare setting. Dr Lee of Yonsei University Health System says the organisation's PACS is among the world's largest, and that its information and storage network allows doctors to retrieve data at unprecedented speed—the kind of speed that allows them to manage "100 patient visits in one morning". It also operates a smartphone booking system that enables patients to register for appointments on their handsets. Dr Lee says it has enjoyed rapid uptake and that major institutions in the US have expressed their intention to use it as a model.

The Seoul St. Mary's Hospital at the Catholic University of Korea operates a dedicated Institute of U-Healthcare that is researching several cutting-edge treatments for chronic conditions, including software that uses algorithms to filter data on the blood glucose levels of diabetes patients, a task previously shouldered largely by doctors. "When we use something like this we can minimise the physician's effort by about 50%, and also significantly decrease payments for a physician to take care of the disease," says Kun-ho Yoon, the institute's director and a professor at the university's Department of Endocrinology & Metabolism.

Immediate improvements

Suk-wha Kim, a paediatric plastic surgeon at the Seoul National University Hospital and president of the U-Health Industry Promotion Forum, which groups government, medical and industry representatives to promote the use and standardisation of healthcare technology, stresses that the goal of the U-Health drive has to extend beyond cost savings or efficacy. "The primary purpose … is to maintain people's health status," he says.

Pilot schemes have demonstrated this principle in action. Dr Yoon emphasises the benefits for sufferers of chronic disease, many of whom only visit the hospital at three- or six-month intervals and would

otherwise struggle to communicate with healthcare providers the remainder of the time. He points out that telemedicine can also link patients with specialist institutes or experts like dieticians or social workers, who may not be readily available at the nearest hospital or clinic, providing access to a wider range of expertise and the much-needed reassurance of "sustained help" from caregivers.[7]

Dr Kim agrees that an important benefit lies in minimising the time chronic disease patients spend "outside the scope of the health system," while keeping them consistently informed of their vital conditions and treatment regimens. These are things remote monitoring allows providers to do relatively easily and in many cases empowers patients to do themselves.

U-health schemes have also helped resolve inequalities in access. The MoHW's Mr Lim points out that innovations developed since the government mapped out the development of the U-health industry in 2008 have been used to expand access to medical services for patients in islands and remote rural areas, which are too often underserved in terms of the quality and availability of care. "In addition, six lower-level local governments have joined remote healthcare service projects to extend services to their communities," he adds. "This is in line with the objective of the telemedicine service project—to provide healthy lives and preventive care to all Koreans."

Collectively these innovations have the potential to have a broader impact on the South Korean healthcare system—to help drive the shift from cycle of diagnosis-treatment to one of consistent preventative care. Such a shift should bring considerable efficiency benefits in its own right.

A new growth engine?

The potential benefits of these initiatives extend well beyond doctors and patients. They have opened the door on a high value-added new industry at a time when the country's status as a consumer electronics and technology exporter is increasingly being challenged by competitors like China and Taiwan.
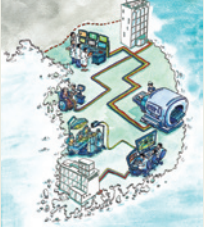
The MoKE has named healthcare as one of South Korea's most promising new growth engines, and together with the MoHW has made millions of dollars of funding available for U-health, biotechnology and medical tourism-related projects. These include a "U-health city" in the eastern town of Wonju that aims to become a major hub for the medical technology sector. South Korea's corporate powerhouses are also leaping on the U-health bandwagon; Samsung Electronics has unveiled plans to invest around US$3bn by 2020 in the development of electronic healthcare equipment, focusing on diagnostic tools and biopharmaceuticals.

The public and private sector also have high hopes that some of the healthcare systems developed in South Korea will prove equally appealing to other markets.

"The government strives to export the 'IT-integrated hospital' model, which modularises the required elements for hospital administration … combining Korea's advanced clinical technology with IT to boost global competitiveness," says Shin-ho Lee, director of health service at the government-affiliated Korea Health Industry Development Institute (KHIDI). "We expect that [this] … will play an important role in promoting Korea's medical tourism industry and in improving medical services in developing countries."

While it may be too early to judge how these ambitious efforts will pan out, the country's medical tourism industry has already demonstrated significant potential. According to the government, around 82,000 tourists travelled to South Korea for medical reasons in 2010, a 36% increase from the previous

[7] Clinical benefits have also been noted. See Cho et al, "Long-term effect of the Internet-based glucose monitoring system on HbA1c reduction and glucose stability: a 30-month follow-up study for diabetes management with a ubiquitous medical care system", *Diabetes Care*, December 2006.

year, with cosmetic treatments and checkups among the biggest draws. The authorities hope to nearly double this figure by 2012. Practitioners say the intelligent use of IT can contribute to South Korea's allure as a medical-tourism destination by lifting standards of service.

"I have patients from China, Mongolia and even Australia," says Dr Kim of the U-Health Forum. "They would often like to get my opinion before they visit. I think that telemedicine will support the incoming patient and is very important for post-operative management when they return home—what we would call 'after service.' That will add value to the kind of medical tourism we offer."

III. Barriers to change

With the government, providers and businesses seemingly united in championing the healthcare technology cause, it is surprising that in many respects IT adoption in South Korea's medical sector remains limited, and that a great deal of healthcare IT projects have not proceeded beyond the pilot stage.

Medical practitioners, institutions and even the authorities admit that a host of barriers prevent the country from fully capitalising on its solid infrastructure, wealth of expertise and medical industry know-how. "We have seen robust patient information sharing between some large hospitals and primary [and] secondary medical institutions ... yet the practice [has so far] failed to go nationwide," says Mr Lim of the MoHW. "We believe the delay in regulatory [and] institutional reform supported by social consensus is holding back medical-care providers."

Perhaps the foremost obstacles are embedded in the legal system. In the words of Dr Yoon of Seoul St. Mary's Hospital: "Technology innovations have happened quickly in South Korea, but the regulations are far behind." Or, as Lee Yong-kyoon, senior researcher at the Korea Hospital Association (KHA), puts it: "We don't have a technology problem, we have a legal barrier problem."

The national Medical Law recognises only face-to-face consultations between doctors and patients as legitimate and does not permit doctors to issue medical advice or diagnoses via telemedicine, although clinicians can use telemedicine to communicate with each other in some cases. This means telemedicine-based dialogue between doctor and patients—bar the few exceptions opened for U-health pilot programs in remote areas—runs the risk of violating regulations, a significant disincentive to telemedicine use.

The law also restricts the storage of medical information to providers' physical premises, meaning data cannot be easily shared or stored in third-party systems. (Japan, which had a similar law, modified it in 2010 to allow for the transmission and storage of such data outside hospital premises.) Moreover, the law fails to provide solid legal footing for other technology-based activities, such as doctors issuing electronic prescriptions to pharmacies—workflows that are already widely practiced in many other developed countries.
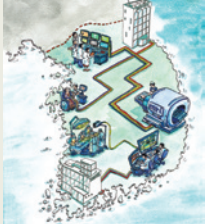
Aware the law is out of date, the government has tabled amended legislation with the National Assembly that would pave the way for telemedicine to be used in a normal clinical setting. But this seemingly innocuous reform has provoked a firestorm of opposition, mainly from politicians concerned that it could raise medical costs or exacerbate the rush to big hospitals, which will presumably be in the best position to invest in state-of-the-art telemedicine systems.

With seemingly more pressing issues like North Korea and global economic turmoil dominating the political agenda, the amendments have languished in the legislature, and there seems little hope in the medical community that they will be enacted anytime soon.

"I'm not confident the [new] law will be passed in the next two or three years," says Dr Lee of the KHA, whose members broadly support the updated legislation.

Even if reforms survive the fraught political process, others say they are unlikely to usher in a telemedicine revolution. Professor Kim of Seoul National University's College of Medicine points out the revamped legislation may be ill-equipped to address some of the other legal issues telemedical practice will inevitably throw up, such as the sharing of information on patients potentially breaching South Korea's strict personal-data protection regime.

"You need to have privacy and security protection in place, including laws, technology and public awareness," he says. "If you look at the level of detail of the US law [related to telemedicine], it's almost 2,000 pages long. I don't think the current law in the National Assembly will provide enough detail in terms of security and privacy."

The Personal Information Protection Act, which consolidates all existing privacy laws into one comprehensive "mother of all privacy laws" became effective in October 2011, as this report was going to press. This will address some of these concerns by, for instance, mandating encryption of personal data. But it is far from a panacea.

Strictness of personal data protection has not proved an insurmountable barrier elsewhere. Some countries, such as Germany, have even more stringent regulations than the US regarding patient privacy and consent, while others, such as France and Australia, have focused heavily on ensuring that such issues are addressed early and comprehensively in their national healthcare IT programmes.

Divided opinions

The legal struggle over U-health is partially a result of, and contributes to, the divisions at the heart of South Korea's medical system. On the one side are large private hospitals, comparatively flush with cash and crowded with patients, which are broadly supportive of introducing more technological innovation in healthcare and have already taken steps in that direction themselves. On the other are smaller clinics and neighbourhood doctors, many of whom are struggling and whose livelihood may depend on just a handful of patients, and who are suspicious of anything that may disrupt an already unfavourable status quo. The latter are broadly represented by the Korean Medical Association (KMA), which declined to be interviewed for this study. And, of course, caught in the middle are many institutions and practitioners who understand the views of both sides—members of the KMA itself are said to be split on the telemedicine legislation issue.

"The conflict between doctors and top-tier hospitals is the biggest problem in the industry," says

the KHA's Dr Lee. "For doctors in small clinics, outpatients represent almost 80% of their total patient numbers, and if telemedicine is introduced they really worry about a decrease in the number outpatients to their clinics."

Many primary care physicians even see the MoHW's efforts to introduce remote treatment in isolated areas as "the small hole that will bring down the dam," says Dr Yoon of St. Mary's Hospital.

"All the officials say they want to launch U-health in clinical practice, and might show doctors some nice charts about how it will work in the future … but [the doctors] have said, 'we don't have the resources to establish these kinds of systems, and if the law is passed the big hospitals will establish them and suck away all our patients. How can we compete with that?'"

Financial barriers

As in so many transformations, then, the core issues holding back U-health are financial. While there is little doubt that technology investments of this nature can produce sufficient clinical and financial benefits in the long run, most healthcare IT systems require high initial investments with little prospect of short-term reward.

The complaints about regulatory shortfalls "are just nice excuses, in my personal opinion," says Hune Cho, chair of the Korea Society of Medical Informatics. "The major reason for not adopting [healthcare technology] is the cost-benefit ratio.

"Nobody disagrees with [the benefits of having] IT in their hospitals if they can use it for free. But the amount of investment is beyond their means, so they're reluctant. They know it's good to have—when they go outside the hospitals they can see everyone using smartphones to communicate face to face and so on, but the required investment is too great. They want some assistance from the government. The government might be anxious to implement [technology] in hospitals, but it doesn't provide any money to do that."

The situation is complicated further by the fact that U-health treatments fall outside the national insurance system, meaning they are generally not eligible for reimbursement and thus represent even more of a cost risk for institutions and patients. Authorities, anticipating changes in legislation and more widespread healthcare technology adoption, are preparing to bring things like telemedicine and remote monitoring under the national insurance umbrella, but the process is likely to be slow and dogged by budgetary concerns. Coverage was only extended recently to magnetic resonance imaging (MRI), for example, despite the fact that it has been in relatively common use at hospitals for years.

"New technologies like home monitoring, teleconsultation and telecare should be incorporated in HIRA's system in the future," says Byong-ho Tchoe, director of the Healthcare Research Center at the Health Insurance Review & Assessment Service (HIRA), which reviews insurance claims on behalf of the NHIC. "We will face many challenges like how to set price mechanisms, how the providers will claim for remote treatments, which kind of payment method will be desirable to protect against moral hazards or fraud, and who and how much should be reimbursed—I think many kinds of providers will engage in the care process."

"Basically it's a matter of money," says Hyoung-sun Jeong, a professor at Yonsei University and member of the government Health Insurance Policy Deliberation Committee, which plays an integral role
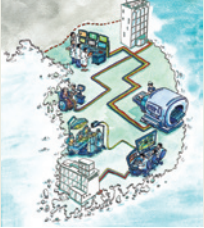
in setting reimbursement and contribution rates for the national insurance system. "Once a technology is submitted, and its safety and efficacy admitted, whether it's covered by health insurance or not should again be judged by our committee … because it should be supported by the inflow of money."

Even staunch supporters of healthcare IT are aware that rolling out insurance coverage to a range of expensive, state-of-the-art treatments could take a toll on an overburdened insurance system. "If the NHIC covered telemedicine it could be very popular … [but] we cannot sacrifice the financial sustainability of the NHIC," says Professor Kim of the Seoul National University College of Medicine.

Private-sector interest in U-health initiatives has also been limited, observers say, by the lack of a clear profit model for healthcare IT services. As the MoKE says: "In order to prove itself as a successful newfound business model in the market, health information technology-based businesses must show, fundamentally, strong cost structures and guarantee profits." But an uncertain legal environment, price controls on medical services and significant initial investment requirements make meeting those thresholds difficult.

Dr Kim of the U-Health Forum believes a few "brave businesses" will have to kick-start U-health services outside the national insurance system, and establish its requirements and price caps, to point the way for the industry.

Many practitioners also express the view that authorities' supportive rhetoric about U-health has yet to be sufficiently backed by action (unlike in Singapore, one of the comparative case studies below). As the stalled reform of the Medical Law shows, legal and political tangles can trip up the introduction of technological innovation, and sustained, unified efforts are needed by the government to overcome them. Yet too often even different branches within the administration are pursing separate agendas. Despite the backing of the MoHW, Seoul National University's Professor Kim, for example, saw the CiEHR initiative halted by the Ministry of Finance, which wasn't convinced by the cost-benefit analyses conducted for the project.

A lack of co-ordination also undermines national initiatives, Professor Kim says. "The government is always talking about U-Health, telemedicine, but I don't think that they really understand how to implement it and simultaneously pursue their own agenda…The MoKE wants to develop industry; the MoHW looks at health services—it's difficult to co-ordinate agencies from different industries."

IV. Delivering on the promise

The stumbling blocks to greater healthcare IT adoption in South Korea may be numerous, but so too are the potential solutions. One possible starting point, industry insiders say, would be the creation of a dedicated government organisation—with a healthy amount of clout—focusing exclusively on healthcare technology and acting as a neutral arbiter in addressing the issues and debates thrown up by technology dissemination. In this area, other countries may provide a clear model.

In the US, the Office of the National Coordinator for Health Information Technology under the Department of Health and Human Services is responsible for systematically applying IT to support healthcare and medical services, according to Professor Lee of the KHIDI. Others highlight bodies in Australia (the National eHealth Transition Authority) and elsewhere as potential bellwethers. "We also need a dedicated organisation that promotes IT in the healthcare and medical services areas and mediates conflicts of interest among different groups," Professor Lee says.

The MoHW's Mr Lim agrees. "Korea is short of a permanent authority in full charge of overseeing the consistency of health informatics initiatives and of mediating conflicts of interest," he says. "An authoritative body with full responsibility is essential to give more momentum to U-Healthcare campaigns within the government system."

Demonstrating the benefits

If U-health is truly to live up to its "ubiquitous" title, technological solutions will have to penetrate all levels of the health system, including those where they are currently encountering the most resistance. Practitioners believe despite the strident opposition of some doctors to telemedicine, most could be brought on board with just a few well-placed—but widely disseminated—trial programmes.

Dr Yoon of St. Mary's Hospital draws a parallel with the drugs industry: "If pharmaceutical companies develop a new drug, what do they do? Phase 1 and 2 trials, then huge phase 3 and phase 4 trials that go all over the world. Is that really [necessary] in developing the new drug? I feel the main purpose is

education for the physician, allowing them to look at the drug, the effects, and the result in patients. Afterwards, physicians are convinced it can be launched successfully."

"Every policymaker says U-health is nice and can improve patient care," Dr Yoon continues. "But which doctors really have experience with it? Only a few in research institutes or some big institutions." He suggests that the government might instead start out with a "very simple" scheme to communicate with physicians and allow them to experience the clinical benefits and efficiencies of the technology. Then, he says, they will see it as a win-win. "But [authorities] want to make the policy first without establishing the infrastructure—that's what made this conflict."

A demonstration-based approach would likely require the government to make significant initial investments, though future uptake will be driven by the private sector, says Yoon-nyun Kim, a professor at Keimyung University's Dongsan Medical Center.

Any new healthcare systems should be "promoted and established through voluntary participation by private players," he explains. "Intense competition, however, has fuelled redundant investment and the industry does not have established standards, which are barriers to further progress. Therefore, the government should lead the establishment of these new systems, designate a pilot district for testing such a project, and make a long-term investment to create the necessary infrastructure. Then, we can determine the right direction of investment over the long term and find ways to deal with problems that will be identified in the process at the national level."

Those with experience note that as in introducing any change to a well-established industry, carrots— and sticks—can also help break down resistance to a healthcare IT rollout (as the case study on Denmark, below, demonstrates).

Yonsei University Health System's Dr Lee says doctors were "reluctant" to adopt the organisation's healthcare information system when it was first implemented in the mid-2000s, but quickly changed their tune when it was made part of the entry and evaluation process for new residents. "Doctors are really keen to pass tests for everything," he jokes. Yonsei also maintains an IT training room with hundreds of computers and simulations that doctors can visit "24 hours a day, seven days a week to develop their skills".

Professor Kim of Seoul National University also found local clinics less than willing initially to join the EHR network launched by the university's Bundang Hospital in the CiEHR initiative, but were persuaded when offered incentives, such as the hospital referring patients back to clinics involved in the project.

"We observed a change in the attitude of physicians," he says. "Initially they felt threatened, and worried about losing patients to the Bundang Hospital, but later they felt assured."

Physicians are also the more likely to be persuaded the more healthcare IT can be linked to benefits in outcomes. Indeed, incentives for deployment can be tied to specific benefits—an approach adopted in the US to encourage reluctant organisations to make the switch to digitisation. Here, part of the US$787bn in federal stimulus funding deployed to combat the 2008-09 recession was earmarked for the healthcare industry to help offset the cost of digitising its records systems (the HITECH Act). However, funds are only released should the investment meet regulators' definition of "meaningful use", to maximise impact. (The precise definition of "meaningful use" has, however, caused some controversy among healthcare practitioners in the US.)

Convincing the patients

Others point out that among all the talk of policy, financing, and conflicting views within the medical community, in the race to promote healthcare technology it is vital not to forget about the most important stakeholders of all: the patients, who will be the ultimate beneficiaries of any improvements to medical care. The government and institutions may attest that telemedicine or remote monitoring devices can revolutionise chronic disease treatment. But the vast majority of patients have yet to witness, or comprehend, the benefits, which means there is currently little widespread demand for U-health.

Dr Lee of the KHA believes this is one reason for politicians' apparent lack of urgency in creating a legal environment conducive to U-health solutions. "We're concerned about public sentiment on this issue; the image is still that the hospitals are haves and the people are have-nots. So when the KHA and related organisations argue [for legal reform] to the National Assembly, legislators are really worried about how it will be viewed by the public," he says.

"Patients are very passive because they don't know what the technology is or how they can benefit from it," says Dr Yoon of Seoul St. Mary's Hospital. Even when U-health is adopted, he says, "I believe it won't influence clinical visits a lot, because patients still want to make some personal contact with their physician. The human touch is essential in the patient-physician relationship."

U-health has to be marketed to the public, Dr Yoon says, by emphasising its communication benefits— "that it can substitute when patients cannot come to the hospital but can communicate over the Internet or a mobile phone ... [It will show] that human care still exists, and that communication systems can improve the quality of care and monitoring."

Like doctors, says Dr Kim of the U-Health Forum, many patients are quick to transform into healthcare IT advocates when they experience IT-driven treatments themselves.
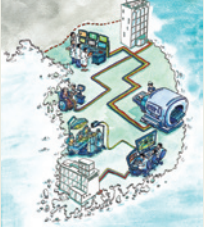
"Based on my personal experiences over the past few years, patients really appreciate U-healthcare, and they are willing to pay W10,000 or 20,000 [extra] every month for it," he says. "They even have willingness to buy the gateway devices, that probably cost W500,000 won, on their own.

Dr Kim also stresses the benefits to sufferers of chronic disease from more constant contact with healthcare professionals. "Ubiquitous health care is the kind of healthcare management that lets the patient follow treatment protocol every day," he explains. "Chronic disease management is essentially dependent on the control of the patient's own will, and patients need help."

Dr Kim's own experience with a small-scale trial of remote monitoring covering 150 chronic obstructive lung disease patients found there was a significant decrease in the number of patients being readmitted to hospital for the condition. "We need to make that kind of evidence; that is the real project for ubiquitous health care in Korea," he says.

Taking action

South Korean authorities are moving aggressively to address the public perception and other gaps in the country's healthcare IT framework. The government, for example, is closely watching Canada, where Canada Health Infoway, a non-profit organisation founded by the government to research and promote EHRs, has striven to gather public feedback on controversial issues such as patient information sharing

(although this has not worked entirely as planned, as the case study below suggests). The MoKE believes that by benchmarking such initiatives South Korea too can "find reasonable solutions to controversies".

The MoHW and MoKE have also launched initiatives aimed at encouraging the private sector to take up the gauntlet, and proving the commercial viability of new healthcare technologies. The "Smart Care" and "Global U-Health" projects, due to run into 2012, have seen several major hospitals boost the provision of remote treatments and diagnoses with the backing of the government and businesses such as LG Electronics.

The MoKE says the industry will receive further encouragement from the recent passage of the Industrial Convergence Promotion Act, which is aimed at increasing government support for IT-enabled services and simplifying the approval process for new technology products. The Act "is expected to help the market test the commercial viability of new technologies and services," the ministry notes.

Mr Lim of the MoHW also says the government plans to create an "ongoing platform for discussion" of issues related to EHRs that will include civic groups, industry members and academics to agree on standards for the management of electronic patient records throughout their lifecycle. The ministry is also promising closer co-operation with the MoKE and the Ministry of Education, Science and Technology "to increase R&D investment in infrastructure technology development and its diffusion." More U-healthcare pilot projects and increased funding for research in health informatics are also planned.

These are lofty goals. Even if they are met, South Korea is certain to face more challenges in rolling out healthcare IT infrastructure—as even those countries at the forefront of this drive are discovering. For one thing, getting the most from new technology is not just a matter of putting the hardware in place: organisations and systems must be optimised to maximise efficiency (for example, to reduce reliance on the major hospitals). IT in a sub-optimal system will just tend to make it more consistently sub-optimised. Then there is the matter of ensuring inter-operability. Many countries that have developed proprietary systems are now faced with the task of modifying them to ensure international inter-operability. By following established standards from the outset, South Korea could save itself future costs.

It is with an eye on future costs that many policymakers, practitioners and institutions in South Korea remain dedicated to reforming medical IT. Rapid population ageing, coupled with a variety of systemic inefficiencies, put the sustainability of the healthcare system at risk. Removing the barriers to wider adoption of cutting-edge IT will help address some of these issues and will cement South Korea's reputation as a global forerunner in IT innovation.

V. Comparative case studies

Singapore: Moving into the e-health elite

Thanks to a major e-health initiative, Singapore, already a healthcare leader in Asia, may soon join the short list of countries with nationwide electronic health records. In April 2011, Singapore launched the first phase of its National Electronic Health Record (NEHR) system, which by June 2012 will link all of the country's public healthcare institutions, as well as a number of community hospitals, general practitioners and long-term care facilities, to a central repository of electronic patient information at a cost of S$176m (US$146m). Doctors and nurses at these institutions will be able to access a wealth of data, including clinical diagnoses, medication histories and lab results for about 70% of Singaporeans, no matter where a patient was last treated.

Although many of Singapore's public hospitals have been sharing patient data since 2004, the introduction of the NEHR represents a major step towards the goal of improving health outcomes and the efficiency of Singapore's health sector, which faces many of the public health challenges common to developed countries: a rapidly ageing population, increase in chronic disease and rising demand for healthcare services. As successful e-health initiatives in places like New Zealand and Denmark (see box below) have shown, the widespread digitisation of Singapore's health sector promises to help healthcare providers and policymakers make better decisions about care, streamline the delivery of services and manage demand.

Singapore has already achieved much in the way of electronic patient information exchange, an important goal of national e-health strategies, but its existing platform, the EMR eXchange (EMRX), has critical limitations. In addition to connecting only public institutions, the EMRX exchanges unstructured documents. This means that x-rays, for example, cannot be shared between facilities that use different imaging systems and patient data, which follow no particular format, cannot be analysed to support clinical decisions, research or disease management.

EMRX has played an important role in improving the continuity of care for many patients, but the NEHR will be a considerable step up, ultimately allowing sharing of detailed, integrated data across all of Singapore's healthcare institutions, says Sarah Muttitt, chief information officer at MOH Holdings, the holding company that manages Singapore's public healthcare institutions and a main architect of the NEHR.

"Regardless of whether you're a public-sector provider or private-sector provider, there will be access to relevant patient information so that in any setting there would be sufficient information for [patients] to receive good care," says Dr Muttitt.

The NEHR will also make national health planning, disease management and resource allocation easier. In its second phase, the NEHR will incorporate technology to analyse clinical, financial and usage data in order to measure the impact of care, the cost effectiveness of medications and procedures, and overall performance—information that should allow policymakers a strategic view of the strengths and weaknesses of the sector.

The NEHR project is expected to take five to ten years to complete, a process the Ministry of Health is reluctant to rush. Each phase of the project will incorporate lessons learned, IT training for healthcare providers and clinician feedback—an incremental, multi-stakeholder approach that was critical to the success of the Danish model.

The viability of Singapore's e-heath endeavour will probably owe much to other important similarities with Denmark, such as the role of a single organisation in guiding the development of the national healthcare IT architecture. In Singapore's case this is MOHH, which provides leadership on overall IT strategy. And then there is Singapore's small size, a distinct advantage when it comes to implementing a nationwide project.

"Size and scale in Singapore have allowed us to accelerate the pace [of the project]," says Dr Muttitt, who also cites the government's strong political vision and backing for e-health, and the city-state's existing e-health infrastructure. "All of those things are very important to setting an environment that is conducive to this kind of project."

Canada: A learning process

Ten years after embarking on an ambitious plan to develop a nationwide e-health network, Canada remains a way from achieving its goal. In 2001 Canada Health Infoway was created to foster a pan-Canadian electronic health record (EHR) system, which promises to enable a safer and more efficient healthcare environment and to save taxpayer dollars along the way. Once the national system is fully functional, says Infoway, which works with Canada's provinces and territories to build their EHR capacities, it will lower the country's annual healthcare costs by more than C$6bn (US$6.3bn).

However, the system is not yet fully operational despite a decade of work and federal funding of more than C$2.1bn. Canada still falls behind other developed countries in overall healthcare IT adoption: only 37% of Canadian physicians use electronic medical records (EMRs)—necessary building blocks for exchangeable EHRs—compared with almost universal adoption in Australia, Denmark, the Netherlands, New Zealand and the UK.

Behind physicians' low takeup of healthcare IT, say critics, is a misalignment of technology investments with the actual needs of the healthcare system. For example, provinces have often prioritised national EHR inter-operability over the adoption and exchange of electronic medical records at the local level. But because most healthcare is provided locally, clinicians consider the ability to exchange patient information between local facilities more important than to do so across provincial lines. Another criticism is that physicians have not been given sufficient incentives to adopt healthcare IT.

However, there have been significant local successes. Ontario, for example, has established province-wide sharing of medical images, with early evidence pointing to significant reductions in cost and increasing care quality. Another example is Alberta, which leads the country with almost 60% of its physicians using EMRs, thanks to financial incentive programmes it established early on. E-Chart Manitoba, Canada's first province-wide EHR platform, launched in March 2011 and is expected to provide clinicians with access to 30m patient records with a single logon. Canada has also put in place a number of successful telehealth projects, a boon for those living in remote locations far from specialised care.

Canada has also made important progress on a national level, even if that progress has been more modest than expected. Infoway's pan-Canadian technology blueprint and its work creating e-health standards and patient registries has laid the foundation for national information exchange, which will arguably happen quickly once local IT takeup happens in significant numbers.

Policymakers have also shifted their focus away from national EHR inter-operability to building healthcare IT capacity at a local level. British Columbia, Alberta, Saskatchewan, Ontario and Nova Scotia all have comprehensive programmes to support physicians' adoption of EMRs, and the 2010 federal budget included C$500m in support of the same goal.

"Right now our goals are just to try to get technology moving effectively within jurisdictions," says Denis Protti, professor emeritus and founding director of the University of Victoria's School of Health Information Science in British Columbia. "Someday we'll have the ability to link data across the country, but it's not seen as a major priority [currently]. There's so much more that needs to be done."

Denmark: Early adopter

In Denmark, healthcare IT is so developed that ambulance technicians can access a patient's electronic medical record (EMR), and even update it, while en route to the emergency room. Virtually all Danish primary care physicians use EMRs, while 98% percent of all lab orders, 89% of prescriptions and 90% of clinical communications between primary and secondary healthcare providers take place electronically. For Denmark, which is widely regarded as a world leader in e-health, the benefits are clear: digitisation saves time and money, and has enhanced communication across the Danish healthcare landscape, from physicians to specialists to patients.

An early adopter of healthcare IT, Denmark's success story is one of incremental change, innovative policy and doctor buy-in, all of which have allowed it to overcome some of the challenges inherent to all e-health initiatives, the most fundamental of which can be healthcare providers' opposition to adopting new technology in the first place. "For most physicians, time is money," says Denis Protti, an expert on global healthcare IT and founding director of the University of Victoria's School of Health Information Science in British Columbia. And the benefits of spending time to learn new technology may not be immediately apparent.
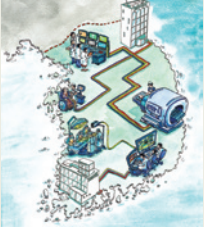
To overcome this resistance, the Danish government in the late 1990s temporarily dispatched "data consultants" to encourage general practitioners (GPs) to use computers and to communicate electronically. Now a permanent fixture, data consultants meet with doctors a couple of times a year to help them make best use of their technology and to reassure them that IT support is always available to them. The government also engages "practice coordinators", specialists who communicate with their fellow doctors and hospitals on their technical needs and transmit their feedback to policymakers, where it has an impact on how policy develops.

Recently Denmark has also been successful in encouraging doctors to communicate with patients via email, something they have been traditionally reluctant to do. Professor Protti attributes this to uncertainty about the legal status of email consultations, how they fit into patients' records and, again, fear of extra work. But by doubling the payment doctors get for an email consultation versus a phone consultation, along with mandating email use in 2009, physician email use has been on the rise. "Studies around the world are increasingly showing that many patients would like to be able to communicate electronically with their physicians," says Professor Protti. "Denmark is one of the few that has made some progress in that arena. A lot of countries around the world are still struggling with that particular facet of healthcare delivery."

Innovative policy has also helped drive the adoption of healthcare IT standards in Denmark, which are critical in ensuring the inter-operability of IT solutions, their utility to practitioners and privacy for patients. To develop broad consensus around new standards, the Danish government will send all of its healthcare IT vendors along with a few specialists and GPs on an overseas trip, tasking them only to return home with an agreed standard, for example, on the electronic exchange of microbiology lab results. "They say, okay, folks we're going to send you to southern France in January for an extended weekend, and we want you to come back with a standard," says Professor Protti. "So this group of people, funded by the government in effect, goes down and they arrive on a Friday afternoon, and before Friday evening is over they've agreed to a standard."

Increasingly such efforts are international in scope. Denmark's initial healthcare IT infrastructure was based on proprietary technology, which does not lend itself well to future enhancements or expansion. However, increased attention is being paid to global standards—for instance those recommended by Integrating the Healthcare Enterprise, a non-profit organisation that promotes unified standards that enable flexible, scalable sharing of healthcare information. Denmark's next goal is to reinvest in healthcare IT to ensure international inter-operability, allowing greater flexibility and cost-effectiveness in future.

UK: eDischarge delivering benefits

From limiting the traditional confusion caused by doctors' handwriting, to ensuring that general practitioners (GPs) are kept up to date with the treatment received by their patients in hospital, electronic discharge systems are increasingly popular in UK hospitals.

Replacing handwritten notes that had to be posted to the GP and could easily be mislaid, eDischarge systems, as they are known, allow doctors to write up discharge notes directly into an electronic program.

At the Royal Cornwall Hospitals NHS Trust, which manages three sites and serves a population of 450,000 people, eDischarge was initially introduced in paediatrics in July 2010. The population of the largely rural county doubles over the summer months thanks to an influx of tourists, and paediatric departments regularly find themselves under particular pressure owing to accidents to children on holiday.

Under the pilot programme, paediatric staff found that the administration of discharging patients was significantly sped up and the turnover of beds was accelerated.

"What's great about the eDischarge system is that it cuts administration and improves bed management," says Yadlapalli Kumar, consultant paediatrician at the Royal Cornwall Hospital, Truro. "The time it takes for case notes to be fully dealt with has been cut by days—and now they are ready before the patient leaves."

The system has since been rolled out to other departments and has become an integral part of hospital management. Hospital notes are automatically sent to the pharmacy, and any subsequent corrections or changes of medication dose are updated on a central system, reducing the possibility of error. Electronic copies are also emailed to the GP, and a paper copy is given to the patient.

"It means there is now immediate communication with GPs, who in the past haven't always had the information they need about why a patient has been admitted, or what treatment they've received," says Dr Kumar. "The feedback we've had has indicated that discharge notes are reaching them far quicker than they used to, and nursing staff have reported that drug errors are significantly reduced."

A further advantage is that the eDischarge system has a secondary function as a database. As it retains diagnostic and treatment information, patterns and trends can be discerned across groups of patients, in a way that would be impossible with paper records.

From the perspective of patients, greater communication between hospitals, GPs and pharmacies reduces the need to repeat their symptoms and history, and provides increased confidence that their treatment is understood by all practitioners concerned.

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