Digital Health South Korea

Market Intelligence Report

June, 2019

PATIENT PROFILE

PROGRAM DETAILS

NOTES

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TECHNOLOGY IS GREAT
BRITAIN & NORTHERN IRELAND

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This report has been prepared by Intralink, an international business development consultancy specialising in East Asia.

The company enables western companies to expand in Korea, Japan, China and Taiwan, and Asian companies to collaborate with innovators in the west.

Intralink has 80 multilingual employees, a 29-year track record and offices in Oxford, London, Seoul, Shanghai, Tokyo, Taipei, Silicon Valley and Boston.

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1. Introduction

South Korea (Korea) offers strong opportunities for UK digital health companies with the government, major hospitals, large conglomerates and a growing number of tech start-ups all investing heavily in the field. The country is grappling with rapidly-increasing medical costs due to its ageing population and an increased rate of chronic disease and this, coupled with its highly-developed ICT infrastructure and its people's willingness to embrace new technologies, makes Korea an attractive market for UK digital healthcare technology and solution providers.

With a market valued at GBP 2.4bn in 2015 and expected to reach GBP 4.4bn by 2020, the digital healthcare market in Korea is growing rapidly. The government is actively supporting the sector and the next few years will see an increase in the commercialisation of smart healthcare products and services in both the domestic marketplace and in consumer goods developed in Korea for international markets. Despite this activity, the Korean digital health market lags the world's leading nations due to regulatory barriers around data sharing and telemedicine which have held back investments in the development and application of new technologies.

Since President Moon Jae-In came to power in May 2017, his administration has identified digital healthcare as a key growth sector and pledged to increase investment and drive deregulation where appropriate to spur innovation. Digital health is one of the four pillars of the Moon administration's plan for the fourth industrial revolution, with particular emphasis placed on areas such as healthcare related Big Data, Health IT (HIT) and artificial intelligence (AI). The new government has identified the country's strict data regulations as a key stumbling block for innovation within digital healthcare and announced it will invest up to GBP 678mn towards the expansion and deregulation of the local data market – a prerequisite for the digital healthcare industry to flourish.

Major Korean conglomerates are investing in digital healthcare research and collaborating internationally. Samsung Electronics announced that it is looking at digital healthcare as a way of moving beyond its electronics hardware. Its investment will focus on preventable medicine and on developing the health functionality of the group's existing smart watches and other wearables. SK Telecom, Korea's largest mobile network operator, also sees opportunities presented by digital health and recently announced a partnership with local biotechnology firm Macrogen to develop an AI solution for genome analysis to help cancer patients get the right chemotherapy treatment.

Korea's digital healthcare capability gap has created opportunities for overseas digital health companies to enter the market. Promising areas for UK companies include big data, HIT, AI-based healthcare products and services, telemedicine and consumer health electronics. While big data and HIT already boast a relatively large market size (GBP 242mn and GBP 273mn respectively), the AI-based medical equipment, telemedicine and consumer health markets represent good opportunities in the future due to a lack of domestic expertise combined with attractive government development plans and anticipated deregulation.

2. Korea - An Overview

KEY POINTS

• Korea has climbed out of poverty to become a technology powerhouse over the last 60 years

• The country is the world's 11th largest economy with a GDP of just over GBP 1 trillion

• It has maintained an annual GDP growth rate of around 3% in recent years

In the space of just 60 years, Korea has transitioned from an agricultural economy to one driven by highvalue industries such as automotive, shipbuilding and advanced manufacturing. Perhaps most remarkable of all is the country's success in the areas of electronics and information communications. As well as dominating the global semiconductor industry, Korea has leap-frogged its peers in terms of ICT infrastructure (smartphone penetration rate, broadband speed, etc.) and this fact, coupled with a demanding and technology-embracing population, means Korea is becoming an economy driven by creativity and innovation.

With a population of 51 million people, Korea boasts the 11th largest economy in the world, a GDP of

GBP 1.2 trillion in 2018 and a per capita GDP of GBP 22,980 in the same year. Whilst not experiencing the growth witnessed in China, the country has maintained strong annual growth for a developed economy of close to 3% in recent years, outpacing its regional rival, Japan. Korea's trade dependency ratio is extremely high at over 80% and its economic performance is heavily affected by the economies of China, the US and Japan. Trade and investment flows between Korea and the EU are growing as a result of the FTA that came into effect in 2011. Trade between Korea and the UK specifically has grown rapidly over that period and both countries have expressed a strong desire to conclude a trade deal once the UK leaves the EU.

Figure 1: Korean GDP (2013 - 2018)

Unit %

	2013	2014	2015	2016	2017	2018E
Growth (%)	2.9	3.3	2.8	2.9	3.1	2.7

Unit: USD 1M

■ Real GDP (current USD)   ●— Growth (%)
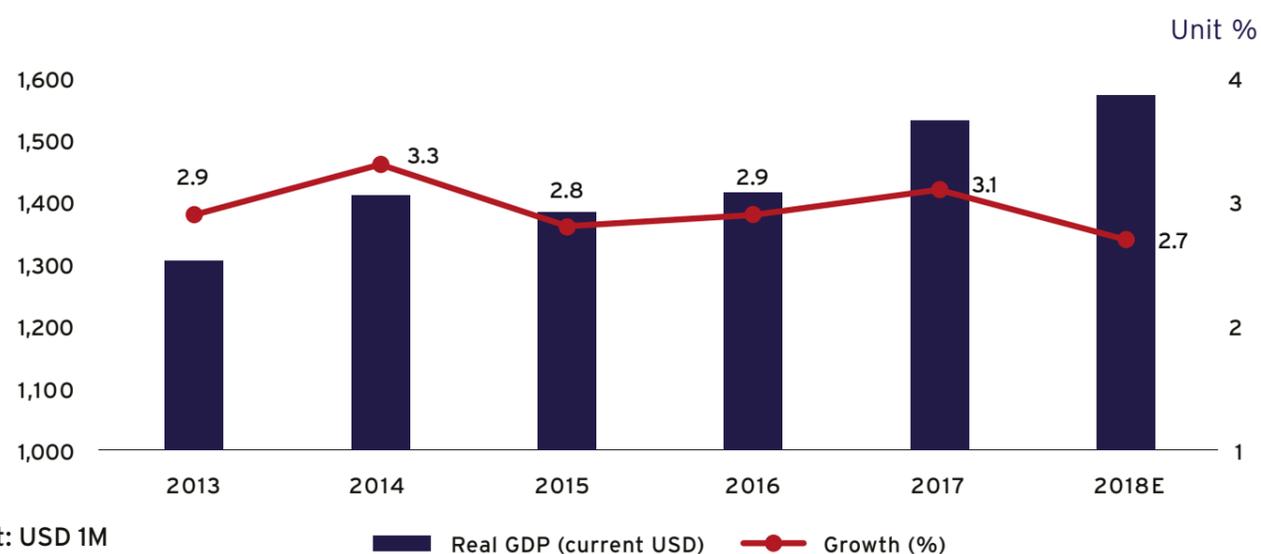
Source: World Bank

2.1 Korea's Healthcare System

The Korean healthcare system is run by the Ministry of Health and Welfare (MoHW) and is funded by a compulsory National Health Insurance Scheme (NHIS) that covers 97% of the population. As of 2017, Korea boasts approximately 70,000 medical institutions including advanced and general hospitals, clinics, nursing homes, and traditional Korean medical institutions. Nearly half of the institutions (32,000) are located in Seoul and the province that surrounds Seoul, Gyeonggido. Together this 'greater Seoul' area is home to approximately half of the nation's population, making the Korean healthcare industry heavily Seoul-centric.

Korean hospitals, though categorised as non-profit organisations, operate essentially as businesses. Hospitals compete to attract patients and are highly receptive to new technologies. The healthcare industry is dominated by a handful of advanced, large players that operate networks of branch hospitals. Around 5% of outpatients visit the top five mega-hospitals: Asan Medical

Center, Samsung Medical Center, Seoul National University Hospital, Severance Hospital and St Mary's Hospital. These hospitals, all of which are located in Seoul, are known as 'the Big 5' and each has around 2,000 beds and approximately 1,000 doctors.

There is a total of 701,744 hospital beds in Korea for a population of just over 51mn. This equates to 13.5 hospital beds for every 1,000 citizens, placing it second in the world after Japan's in terms of bed ratio. Korea is home to many hospitals of significant scale, as just 40 large public hospitals account for approximately 46,200 of its hospital beds.

The concentration of a small number of very large hospitals in and around Seoul, coupled with Korea's advanced ICT infrastructure and a population that is receptive to new technologies, facilitates the rapid integration of new healthcare solutions, making the country an excellent test bed for new digital healthcare applications and offering ample opportunities for innovative UK digital healthcare businesses.

3. Digital Healthcare Market Overview

KEY POINTS

- Digital healthcare market in Korea is expected to double in size to GBP 4.4bn by 2020
- Investment in digital health is seen a way to combat Korea's quickly growing medical expenses (growing at 6.8% annually versus the 2.1% average in OECD countries)
- Key Digital Healthcare players include Samsung Electronics, LG Electronics, KT, SK Telecom, LG U+, SK C&C, LG CNS, H3 Systems, Insung Information, Vuno, Lunit and the 'Big 5' hospitals

According to the Ministry of Food and Drug Safety (MFDS) 'Smart Healthcare Medical Devices: Technology and Standards Report 2018', the digital healthcare market in Korea was estimated at GBP 2.4bn in 2015 and is expected to reach GBP 4.4bn by 2020. Korea faces quickly growing medical expenses (6.8% versus an OECD average of 2.1%) due to an increase in the rate of chronic illness and a rapidly ageing population – over 40% of whom are expected to be over 65 by 2060. To combat rising costs the government has implemented various measures aimed at expanding its digital health industry. These include increasing investment in new technology development and improving regulations around digital healthcare products and services.

The digital healthcare market in Korea can be divided into five main areas: health IT, healthcare big data, blockchain-based healthcare technologies, telemedicine and consumer health electronics. Significant developments have been made in health IT and healthcare big data sectors with the intention of enhancing medical data exchange, improving nationwide healthcare delivery and establishing an initial precision medicine foundation. Blockchain-based healthcare technologies and consumer health electronics have become focus areas of new policy initiatives for main drivers of smart healthcare technology. Although currently limited to pilot projects, with anticipated deregulation, the implementation of telemedicine programmes is also expected, opening up a new digital healthcare industry for Korea.

Figure 2: Digital Healthcare Ecosystem

3.1 Key Players

The digital healthcare ecosystem consists of government institutions, regulatory bodies, industry associations, medical centres, large corporations, blockchain-based healthcare service providers and a number of notable start-ups and scale-ups. Key players in digital healthcare include the leading local hospitals such as Seoul National University Hospital and Asan Medical Centre, large Korean conglomerates like Samsung Electronics and LG Electronics, telecommunications providers, such as SK Telecom and KT, systems integrators, such as LG CNS and SK CNC, as well as start-up and scale-ups, such as H3Systems, Lunit, and Insung Information.

Hospitals have been exceptionally active through internal efforts in digitising information, building internal Big Data systems, and introducing AI solutions through their own initiatives. The 'Big 5' have become leaders in the digitisation of Korea's healthcare system, largely driven by the need to meet better care standards as a responsibility for servicing around 5% of all patients in the country. These hospitals are recognised as the essential cornerstones of Korea's healthcare system and benefit from government funding and designations as government research hospitals.

Korea's major conglomerates are also driving Korea's digital health market. Samsung Electronics' wearables have advanced features including S-health to monitor activity levels. Samsung's healthcare equipment affiliate, Samsung Medison, specialises in digital X-ray systems, diagnostic ultrasound systems and hospital information systems. KT Corporation has developed several health management systems including bloodsugar management services in collaboration with hospitals and has been active in providing infrastructure for tele-healthcare systems across the world. LG Corporation's subsidiary, LG CNS, is providing hospital information systems, various healthcare solutions such as electronic health records (EHR), Home Health EHR and mobile healthcare solutions in Korea and around the world.

Successful digital healthcare start-ups and scale-ups have also received global attention. Lunit has developed data-driven imaging biomarker (DIB) technology that is derived from large-scale medical image data. The company's deep learning technology defines important diagnostic features without guidance from previously established medical criteria, expanding diagnostics beyond what has been possible to date. Another company, Vuno, has designed an AI-based image diagnostics device called VUNOmed BoneAge. Using deep learning to interpret X-rays of a patient's left hand, the device can identify a person's skeletal age. Lunit and Vuno were two of Korea's first companies to secure approval from the MFDS for AI-based advanced medical devices, representing a breakthrough for Korea's digital health sector.

Table 1:   Korea's 'Big 5' Hospitals

	Hospital	No. of beds	Daily no. of outpatients	Daily no. of inpatients
1	Asan Medical Centre	2,704	11,862	2,557
2	Severance Hospital	2,048	4,400	2,000
3	Samsung Medical Centre	1,989	5,823	253
4	Seoul National University Hospital	1,778	6,181	1,670
5	Seoul St. Mary's Hospital	1,355	4,663	1,205

Source: Intralink Research

Table 2:   Major Conglomerates in Digital Health

Corporations	Revenue '17	Products	Remarks
Samsung Electronics	GBP 161bn	S-Health, S-detect	Smartwatch with advanced functionalities including S-health
LG Electronics	GBP 41.3bn	27HJ710S-W, 17HK700G-W	Medical imaging displays, digital X-ray detectors
KT Corp.	GBP 15.7bn		Blood sugar management systems; also, infrastructure for tele-healthcare systems in other countries in collaboration with Seoul National University Bundang Hospital
SK Telecom	GBP 11.8bn		Mobile EMR, medical self-diagnosis applications; AI-based genome analytics technology in partnership with Macrogen
SK C&C	GBP 1.7bn	AIBRIL	Enterprise system platform to digitise hospitals' administration and to enable doctors to access EMR data through mobile phones; health and wellness platform in collaboration with AIA Korea; AI-based new drug development platform
LG CNS	GBP 2.1bn	Touch Dr.	Enables the management of chronic diseases such as high blood pressure and diabetes at home (in collaboration with Intel)
Samsung Medison	GBP 0.3bn	HERA W10, GC, GM,	Ultrasound imaging systems; general imaging and radiology systems; breast cancer diagnosis system

Source: Intralink Research

Table 3:   Notable Digital Healthcare Start-ups/Scale-ups

Corporations	Revenue '17	Products	Remarks
Insung Information	GBP 59.9mn	Hicare	First Korean medical device with active and interactive communication between automatic electronic blood pressure meters and wireless medical devices through an external interface
H3 Systems	GBP 2.1mn	GlucoAutoCheck	Telemedicine system that receives health data from diagnostic/measuring devices and transmits the data to healthcare centers via a mobile network; international partners - AMC Health (US), Honeywell (US) and Telit (UK)
BioSpace	GBP 1.7mn	InBody	Provides a non-invasive full body measurement with in-depth results in less than one minute
Healcerion	GBP 1.7mn	SONON 300L	First-FDA approved handheld ultrasound device
JLK Inspection	GBP 0.5mn	JBS-01K	AI-based medical image diagnosis system
Vuno	GBP 0.1mn	ASR, BoneAge, Fundus AI, Deep AWS	Automatic speech recognition for medical records input; G.P. Altas-based bone age assessment system; AI-based screening solution for various abnormalities in the fundus of the eye; deep learning based early warning system

Source: Intralink Research

4. Key Areas in Digital Health

Korea's strong ICT infrastructure serves as a foundation for digital healthcare to blossom, but the legacy of regulatory barriers around data sharing and telemedicine have slowed investments in the development and application of new technologies. Fortunately, the overall digital healthcare market in Korea is growing rapidly as recent government movements have catalysed investment and expansion in these sectors, bringing Korea's digital healthcare market closer to its full potential.

The Korean government has encouraged a wide adoption of HIT, such as universal EHR/EMR, to help improve nationwide delivery of healthcare and promote the development of the domestic healthcare industry. Korean healthcare organisations and the government have been strong supporters of the emerging concept of u-Health (or ubiquitous health), involving the use of HIT as well as patient and environmental sensors to help monitor and improve a patients' conditions. To stay competitive Korean healthcare organisations spent an estimated GBP 272.6mn on HIT in 2015, a number that is expected to almost triple to GBP 706mn by 2022.

4.1　Health Information Technologies (HIT)

The Health Insurance Review and Assessment Service (HIRA) indicated that adoption rates of EMR systems in Korea were 93.6% in hospitals and 91.6% in clinics in 2017. This wide EMR coverage is associated with Korea's near-universal digitisation of patient data, digital storage of clinical images, electronic hospital administration databases and the expanding use of remote sensor technology.

EMR systems in Korea have sophisticated functionalities such as clinical-decision support and warnings for drug-drug contradictions and age restrictions. Rather than relying on international EHR/EMR providers, the vast majority of Korean hospitals operate either domestic healthcare information management systems such as BESTCare (www.ezcaretech.com) or have created their own information management systems inhouse. Korea's leading local providers of healthcare information management systems include ezCaretech, Hyundai IT, Samsung SDS, and LG CNS.

Efforts are also being made to improve health Information exchange (HIE) rates between external organisations. As part of the government policy to encourage hospitals to share information across healthcare providers, the Korean government announced a three-year project in 2018 called FEEDER-NET. The Ministry of Trade Industry and Energy (MOTIE) allotted GBP 7.8mn to convert participating hospitals' EHR data into a common data module (CDM) and develop a cloud-based open research platform that works on the CDM network. As of December 2018, 41 hospitals had joined the initiative.

Opportunities

In Korea 93.6% of hospitals have already implemented electronic medical records in an effort to digitise operations from patient acceptance to discharge/transfer. Following Seoul National University Bundang Hospital – the first hospital in the Asia-Pacific region to go fully digital and paperless in partnership with SAP SE – another local hospital, St. Mary's Hospital in Seoul, is building a Smart Medical Center where everything is fully digitised. This trend is expected to continue as more hospitals are willing to go digital in order to cut costs, reduce treatment errors and improve patient experience.

While most of the hospitals and clinics have high rates of HIE internally, there are relatively low HIE rates between external organisations (58.1% as of 2015, the latest information available). Current regulations do not allow for the transfer of patient information to third parties without explicit consent. However, the current government has committed to loosening regulations around data sharing and accelerating the standardisation of health records to help improve public health.

The expected government deregulatory measures coupled with Korea's highly developed ICT industry and high ranking overall digital technology levels make the country an excellent market for UK digital health solution providers. With the total market size of health IT predicted to reach to GBP 705.9mn by 2022, this segment will provide ample opportunities for UK companies, especially those that are strong in clinical IT Systems, medical imaging information systems as well as multiparameter patient monitoring systems as these three areas are expected to account for 93% of the total health IT market over the coming years.

4.2 Healthcare Big Data

Korea has been late to recognise the importance of data but, with the healthcare data market expected to be worth GBP 170mn by 2023, the current administration is making strong efforts to exploit big data and related applications such as precision medicine and AI solutions. In 2018, the government revealed plans to build a bio database for medical big data by collecting the genetic and biometric data of ten million patients in collaboration with six major hospitals enabling digital healthcare companies to use hospital data for developing new solutions and products. Additionally, in August 2018 President Moon announced the investment of GBP 678mn towards developing better data technology and revising data regulations to encourage further innovation and investment in big data solutions.

R&D and large-scale investments in the healthcare data field are underway in the private sector, but the most prominent efforts at developing this field are being led by Korea's medical institutions. Asan Medical Center supports big data research that uses its data, established the Health Innovation Big Data Center, and created the annual Microsoft and Medical Big Data Analysis Competition in 2017. Seoul National University Hospital started its healthcare big data programme through a joint venture called H2Square with its subsidiary, ezCaretech, and Plane Partners, a company specialised in bioinformatics. Korea University Hospital won one of the core national big data projects in 2017, known as the Precision Hospital Information System Project, and is implementing precision-based medical services at the hospital level.

Precision Medicine

Most hospitals in Korea are still at the early stages of building precision medicine programmes. According to Korea Institute of Science and Technology Information data (KISTI, 2017), Korea's approximate market size for genetic diagnostic testing, a pre-requisite for precision medicine programmes, is around GBP 173mn, and is expected to increase to GBP 618mn by 2025.

The Korean government established a fund of GBP 68.8mn to drive the development of the pharmaceutical industry through genomics analysis under the Ministry of Health and Welfare, and in 2013 a multi-ministry genome project, the 'Genome Technology to Business Translation Program' was started with the funding of GBP 387mn over an eight-

year period. This programme was established to carry out human, agricultural, and medical genomics projects with the goal of achieving the implementation of genomic medicine and exploration of genomic-based biological resources.

Genome Korea is the country's largest personal genome project and is intended to complement the Korean government's ongoing multi-ministry genomics initiative. Ulsan National Institute of Science and Technology (UNIST) is working in collaboration with Ulsan Metropolitan City, Ulsan University Hospital and the University of Ulsan to sequence approximately 10,000 individuals by the end of 2019. The Korea Center for Disease Control has established large biobanks, such as the National Bio Bank which consisted of data from 670,000 people as of 2016 and is headquartered in Gyeonggi-do, as well as 17 regional biobanks in other provinces. Since then a major cohort was conducted in 2018 covering a study of 250,000 people and the genetic information of 100,000 individuals for the purpose of establishing a preliminary precision medicine initiative.

To spur healthcare digitisation, the Korean government announced in September 2017 the launch of two national projects: The Precision Medicine Hospital Information System (P-HIS) Project and the Precision Medicine-Based Cancer Diagnosis (K-Master) Project. Both projects are led by Korea University under the supervision of the Ministry of Science and ICT and the MoHW. These initiatives are expected to help in developing new cancer treatments and establishing a cloud-based hospital information system.

Most NGS tests are for research and are outsourced to local service providers. The genetic diagnostic tests available are NIPT, NBS, cancer screening TOT (NGS Cancer panel test), Exome and Metagenome. The major test providers are Macrogen (www.macrogen.com), DNA Link (www.dnalink.com), Chunlab (www.chunlab.com), LabGenomics (www.labgenomics.co.kr) and Theragen Etex (www.theragenetex.com).

Precision medicine is also a well-known application of AI-based healthcare products and services in Korea. Gachon Gil Hospital adopted IBM Watson for Oncology in December 2016 and in 2017, six other hospitals including Pusan National University Hospital, Konyang University Hospital and Chosun University Hospital introduced Watson for Oncology as a strategy to differentiate their treatment programmes from the 'Big 5' and attract patients. Both regional and smaller hospitals see new and cutting-edge technologies as

a way to be more competitive and raise their profile by branding themselves as an 'AI-based' treatment hospital.

AI-based Healthcare Products and Services

The Ministry of Science and ICT has projected that Korea's AI healthcare market will grow by approximately 70.4% annually, from just GBP 1.23mn in 2015 to GBP 17.65mn by 2020. In May 2018, the Korean government announced plans to invest GBP 24.6mn over the next three years to build a Korean medical AI system dubbed "Dr. Answer" that analyses patients' medical data to offer personalised diagnostics and treatment plans. The state-run medical AI project will be led by Seoul's Asan Medical Center and is to involve 25 local hospitals and medical institutions as well as 19 AI software developers, including Vuno, JLK Inspection and Kakao Brain.

Industry Insider's Thoughts

"After-care service for patients is weak in Korea, and AI has a high potential to reduce the significant cost required for tracking patient health. Currently it is too expensive to properly monitor patients after medical treatment and manage records of diagnosis and treatment."

CEO – Healthcare Chatbot Inc.

According to the Ministry of Science and ICT the market for AI-driven new drug development is expected to grow by 40% annually to reach GBP 3.1bn in 2024. Under the expectations that an AI-driven drug discovery process could halve the total time and cost required for drug development, the government passed a special act to support and nurture the pharmaceutical sector including plans to foster AI-driven programmes.

In response, several large corporations formed AI collaborations (CJ Healthcare & Syntekabio, Daewoong & UNIST, and Yuhan & Syntekabio) and have succeeded in launching their first products. In October 2018, SK Telecom's subsidiaries SK Biopharmaceuticals and SK C&C announced completion of an AI drug design platform technology which enables researchers to study the absorption, distribution, metabolism, excretion and toxicity of new compounds.

Beyond Korea's major conglomerates, a growing number of AI related start-ups and scale-ups are emerging in the healthcare products and services industry as well. By applying deep learning to X-ray, CT, MRI scans to the analysis of biological signals, Vuno Korea is an example of a start-up preparing a commercial AI product that can be used for lung and cardiovascular diseases, cerebral aneurysms and bone augmentation diagnosis. Lunit is also using deep learning for differential diagnosis of chest x-ray and mammography images to detect tumour location, size, tumour cells and specific tissues that are difficult to interpret visually. JLK Inspection, by combining deep learning technologies and image processing techniques, is developing the AIHuB, a medical diagnostics platform that will allow physicians to diagnose diseases such as ischemic strokes, haemorrhagic strokes, Alzheimer's disease, lung cancer, prostate cancer, and coronary artery disease.

Table 4: Current AI Developments in Hospitals

Hospital Name	Current Status of Development in AI Technology
Seoul National University	Developing an AI-based hospital information system
Yonsei University	Developing AI-based disease prediction service based on big data
Seoul Asan Hospital	Opening a business group for AI-based analysis of medical images
St. Mary's Hospital	Developing AI-based radiation cancer treatment technology with Stanford University
Ajou University Hospital	Developing AI-based solutions to predict the number ICU emergency patients

Source: Yonhap News

Opportunities

Korean big data initiatives related to healthcare have focused on creating precision medicine applications and programmes to tackle cancer, which is responsible for approximately 30% of total deaths in Korea. Hospitals, in collaboration with foreign digital healthcare companies such as Syapse, IBM Watson and Microsoft Azure, are currently working to establish their own personalised cancer medicine centers using big data technologies. Recent collaboration between the Korean government and Clinerion (Switzerland) to develop a precision medicine hospital information system and a precision medicine-based cancer diagnosis system indicates that the government is also open to embracing foreign technologies.

Several start-ups are emerging to leverage big data and AI in innovating advanced medical devices and equipment for diagnosis and treatment of serious illnesses. So far, the MFDS has approved three artificial intelligence-based medical devices – Lunit Insight, VUNOMed-BoneAge, and JLK Inspection's JBS-01K. Several platforms and medical devices using AI and big data solutions are being developed by other local companies and undergoing clinical trials to obtain approval.

Although the quality and quantity of medical data is of a high calibre due to Korea's national health insurance system, which has data for the entire population under its umbrella, the country has faced several challenges with realizing the potential of big data such as a shortage in the required human resources, regulatory barriers as well as accuracy of medical data interpretation. Korea's growing demand for big data related technologies, spurred by planned projects to build bio databases, precision medicine hospital information systems and AI-based healthcare solutions, creates opportunities for UK big data related companies.

With planned investment of GBP 678mn into the data industry, tailored support to AI-based medical device and drug design platform developers, as well as the predicted growth of the big data market it is anticipated that Korea will continue to look for external innovation sources to rapidly fill its gaps around big data applications. This active effort and support being coordinated by the Korean government will therefore result in significant opportunities for UK companies strong in the creation of precision medicine platforms, data analytics and data interpretation, as well as applying analytics to develop big data-based medical diagnostic and treatment devices which are all necessary to boost the adoption pace of big data solutions.

4.3   Blockchain in Healthcare

Korea is the third largest blockchain market in the world valued at GBP 35.7mn in 2018 and expected to grow to GBP 269mn by 2022. The Ministry of Science and ICT announced a budget of GBP 688mn solely devoted to blockchain development in 2019 and Korean conglomerates such as SK Telecom, Samsung SDS and LG CNS are moving quickly to adopt blockchain technology and preparing to launch products in the first half of 2019.

The Korean Ministry of Science and ICT announced KOREN in 2018, a blockchain-based medical data network that collects medical information on a decentralised system and allows the transfer of health data between hospitals. Following the KOREN announcement, the government revealed plans to build a blockchain-based medical big data centre run by St. Mary's Hospital, under which MediBloc, a blockchain healthcare solutions provider, will establish a big data centre and build a distribution platform for PHR data.

Numerous other companies specialised in blockchain-based healthcare applications including BICube, Prasm, ICON, Cube Chain and MedRec, have emerged and are working on creating secure data storage, integrated health record systems and safe data sharing platforms. Myongji Hospital has partnered with local tech company, BICube, to develop a platform based on blockchain technology to create an HIE system. Last year, Hanyang University Medical Center partnered with MediBloc to move its medical records onto a blockchain-powered platform. Going even further, KMP Health Seoul announced that the hospital would provide medical services to customers who pay in cryptocurrency.

Opportunities

The Korean healthcare sector is preparing for the roll-out of blockchain technology for the security and accountability of electronic health records, medical supply chains, payment methodologies, insurance claims, research capabilities, HIT and data ownership. Although many healthcare blockchain companies like Zikto, MediBloc and My23 launched their ICOs abroad because of an ICO ban in Korea, recent government support in the development of blockchain-based healthcare applications and platforms indicates that healthcare may be one of the first industries transformed by blockchain in the coming years.

Currently, several healthcare-related blockchain companies such as MediBloc, Prasm and ICONLOOP are building blockchain-based medical record databases and big data centres in collaboration with healthcare providers and businesses for hospitals to securely store, exchange and utilise patient health data as well as to enable life sciences companies to develop cutting-edge healthcare products such as blockchain-based disease prediction services.

These developments in the private sector combined with the government's continuous support through deregulation and investment create opportunities for the UK's healthcare-related blockchain companies to partner with local companies on both private and government projects. Recent tax relief (up to 40% of R&D expenses) offered to companies developing blockchain-based applications from February 2019 is expected to spur the application of blockchain technology further in digital healthcare, which will in turn provide a an expanded market for UK companies that have developed strong technologies that enable safe storage, secure transfer and control of medical records as well as flexible payment methodologies.

4.4   Telemedicine

Despite the fact that telemedicine between doctors and patients is still prohibited by Korean law, Korea has made significant technological advances in telemedicine and has a relatively long history of implementing pilot programmes as far back as 1990 for groups ranging from remote-island and disabled populations, to deployed soldiers and inmates of correctional facilities. Via limited pilot programs, Korea has been able to develop the tools and technologies required for wide-scale telemedicine to be implemented, and survey data from an Ipsos study in 2018 shows that the majority of Korean citizens (54%) are open to trying telemedicine.

Despite the continued development and improvement around the enabling technologies required, government plans to expand the usage of telemedicine in Korea have faced persistent opposition by medical professionals. Activists fear that telemedicine would lower the quality of medical services and jeopardise the operations of small local clinics and regional hospitals. It is estimated that around 50,000 medical industry workers could be put out of work by the legalisation of telemedicine.

Industry Insider's Thoughts

"It took more than two years to implement Mayo Clinic and InTouch Health's remote neonatal care programme mainly due to a large amount of effort required to persuade medical staff and creating a protocol. The implementation of Korean-style telehealth will require the cooperation of medical staff participating and the institutional support of the government."

Chairman Wang-jun Lee – Myongji Hospital.

Although President Moon Jae-in made a campaign promise not to allow telemedicine in December 2018, top government officials have announced that Korea plans to begin telemedicine services starting from March 2019, despite fierce opposition from medical doctors. The Ministry of Health and Welfare is planning to publish a manual in the first half of 2019 to clarify the scope of health management services that can be provided by non-medical institutions and is planning to ease regulations in the healthcare sector.

Opportunities

Full-scale telemedicine as a sector has yet to open due to the limitations stipulated by the Medical Services Act. However, start-ups such as Healcerion and M3DICINE, have teamed up with major Korean conglomerates and healthcare providers to export telemedicine technology and platforms overseas. Also, several local hospitals are testing telemedicine in collaboration with IT companies by offering limited-scope trial services that follow existing laws. For example, Myongji Hospital partnered with InTouch Health Inc. to create a remote healthcare ecosystem by linking affiliated medical institutions and nursing homes in 2018, and Seoul National University Hospital and Korea Telecom have been allowed to provide limited telemedicine services to help select remote areas in Korea.

According to the Hyundai Research Institute, telemedicine will create a new healthcare market of GBP 1.4bn if just 20% of Koreans use the new service, thus creating more jobs and reducing medical spending. Although current telemedicine services are limited to designated pilot projects and commercially banned by law, a review of existing regulations to further expand the presence of telehealth in Korea has been announced. It is therefore recommended that UK companies including manufacturers of medical equipment for tele-diagnosis and telemonitoring, consider partnering with local firms or have long-term market entry plans in place in anticipation of this market opening.

4.5   Consumer Health Electronics

According to a 2018 Pew Research Center report, Korea ranks first worldwide in terms of smartphone ownership (94% of adults own a smartphone and use the internet, significantly ahead of the UK's 72%), and this high penetration of smartphones has enabled the rapid integration of wearable devices. Korea's major consumer electronics giants, Samsung Electronics and LG Electronics, are investing heavily in healthcare applications and wearable devices such as the S Health application and the smart watch. In addition, SK Telecom and Seoul National University Hospital have established a joint venture, Health Connect, which provides hospital management and ICT-based diabetes management solutions in Korea and China.

Products in the Korean consumer healthcare market include wearables such as sweat rate sensors in the form of a watch, patches for non-invasive blood sugar monitoring, painless drug-delivery using sweat and biosensing smart contact lenses capable of detecting glucose levels in patients with diabetes. Insulin delivery systems including insulin injection pens and portable insulin injectors are also being digitalised to include functions such as dosage tracking, glucose level monitoring and alarm signals. Other products include disposable sweat-analysis strips integrated into a wearable smart band for heart rate monitoring, blood oxygen saturation level, and other vital signs.

Most Korean consumer health product companies are now looking to develop more innovative solutions and are building partnerships with both local and overseas companies. In 2018, Lineable, a Korean wearable device company, announced a partnership with IoTeX using the latter's blockchain technology to keep patients' data safe. In 2017, Lineable partnered with Korea's largest telecom provider, SK Telecom, and the National Police Agency of Korea to launch Lineable Silver, a smart watch designed to help seniors suffering from memory loss (e.g., dementia, Alzheimer's). Another Korean medical device company that received regulatory clearance from the MFDS in 2018, EOFlow, has collaborated with the Juvenile Diabetes Research Foundation (JDRF) to develop a small, wearable insulin pump called EOPatch. The pump comes with a smartphone-like colour touchscreen controller and advanced managing software tools and is a significant step towards digitalising diabetes care.

Opportunities

Korea is estimated to be the fourth-fastest-growing market in the Asia Pacific region for wearable devices. In addition to the growing healthcare industry and consumer awareness towards health and fitness, increasing government support through deregulation and several policy initiatives are driving this sector. Samsung Electronics and LG Electronics' investment into healthcare applications and wearable devices has led to new and growing market opportunities in the consumer health electronics sphere.

In an effort to boost consumer health management applications and wearables, the government announced in 2018 that personal healthcare management systems such as blood pressure, pulse and stress sensors are to be the focus areas of new policy initiatives around smart healthcare technology. Progress has already begun as the first regulation waiver to Memowatch, a wearable electrocardiogram measuring device, was granted under the government's regulatory sandbox program in February 2019, opening further opportunities for future digital healthcare companies in the sphere.

Korean conglomerates have signalled that they are seeking collaboration with companies in the digital health sector to leverage new and innovative technologies in their products. This need for collaboration is being driven by the rapid increase in regulatory waivers being allotted for personal health management devices, as well as the growing wearables market which is expected to reach to GBP 176.1mn with 3.2mn users by 2023. Opportunities are continuing to arise for new technologies for monitoring vital signs and devices such as automated digital insulin delivery systems with dosage regulation and tracking. The Korean consumer health electronics market also offers strategic opportunities for UK companies that have strong technologies enabling health related connectivity devices, and the secure transfer and maintenance of patient data on wearable devices.

4.6   Overview of Opportunities

The government sees the digital healthcare industry as an important new growth engine for the Korean economy. According to an August 2018 MFDS report, the government is prioritising businesses that are active in the field of healthcare-related big data, AI and IoT. Precision medicine and personal healthcare management systems such as blood pressure, pulse and stress sensors were explicitly mentioned as the main drivers of smart healthcare technology and so a focus for the policy initiative, as is the development of AI-based medical devices and medical 3D printing.

In the face of fierce and growing competition, large and established Korean companies are eager to cooperate not only with domestic start-ups but also with foreign digital healthcare companies. As a result, large companies are anxious to acquire or form partnerships with start-ups and scale-ups with promising technology to reduce the technological gap with countries that have more advanced digital healthcare expertise. This development represents a strong opportunity for UK digital healthcare companies seeking investment or partnership opportunities in Korea.

Industry Insider's Thoughts

"_We seek diverse global business models under cooperation with partners with innovative technologies in the digital healthcare sector. Starting from providing early diagnosis and prevention of infectious diseases and chronic illnesses and improving the environment for maternal and child healthcare, we will continue to expand our digital healthcare services business._**"**

Yoon-jeon Koh, Senior Vice President, KT

Table 5:   Opportunity Areas for UK Companies

Sectors	Market Size	Remarks
Health IT	GBP 273mn	Wide-spread prevalence of clinical IT systems, growing investment in patient monitoring accessories, EMR/EHR, etc; Growing trend of fully digitizing the hospital operations as well as low rates of HIE expected to be resolved by upcoming deregulations create opportunities for the UK HIT companies
Big Data	GBP 242mn	Strong government support for precision medicine & genomics, AI-based health products and services, etc; Lack of capable professionals, accuracy and speed in technology create opportunities for overseas companies
Blockchain	GBP 35.7mn	Growing investment in Blockchain-based medical record database, disease prediction services, etc; Recent government support through deregulations, provision of tax relief as well as huge investments make the market attractive
Telemedicine	Estimated GBP 1.4bn at a 20% adoption rate	Currently blocked by regulation, but active pilot programs in patient monitoring systems, chronic disease management systems, etc; Recent signal from government indicate that deregulation could occur as early as 2019
Consumer Health Electronics	GBP 136.7mn	Currently dominated by health activity monitoring applications from major smartphone companies, the market is expected to see growth in vital signs monitoring and diagnostics products in near future

Source: Intralink Research

5. Digital Health Regulations

- Strict and/or vague regulations around data privacy and data sharing pose barriers for digital healthcare companies in Korea
- Deregulation on data sharing, deidentification and telemedicine are expected throughout 2019
- AI-based medical devices now receive tailored government regulatory support from the MFDS
  - Review of application for certification should not take more than 60 days

Several laws and acts in Korea regulate the personal and medical information required to provide medical and healthcare services. Experts describe the regulations surrounding the sharing of patient data, which is important for the development of health IT and big data (AI, deep learning)-based technologies as well as precision medicine platforms, as being both complicated and vague. The guidelines surrounding deidentified data, as well, is unclear, and therefore leaves healthcare providers and companies at risk if they were to interpret the guidelines incorrectly. The current administration has committed to removing excessive regulations on the data industry to boost the growth of the sector, especially in relation to the healthcare.

5.1 Data Privacy Regulations

Personal Information Protection Act (PIPA)

Enacted on September 30, 2011, Korea's Personal Information Protection Act (PIPA) is considered to be one of the strictest data protection regimes in the world. Under the Network Act, which supplements PIPA, personal information includes name, national identification number, letter, voice, visual image, and all other information that can be easily combined with other information to identify a specific individual. According to the Act, any information that, if revealed, may considerably infringe on the data subject's privacy, such as information related to an individual's health or medical treatment, genetic profile, sexual orientation, criminal records, ideology and faith is considered sensitive data.

PIPA requires doctors to obtain explicit prior consent of patients to the use of data by third parties for stated purposes. Since, in the past, the law did not require patient's prior consent, the information (EMR, EHR and other clinical data) obtained before the PIPA passed, cannot be used by third parties for any purpose. All of this continues to make it difficult for healthcare organisations and companies to use data for outside research and diagnostics purposes.

Medical Services Act

The Medical Services Act regulates matters related to quality of medical services, requirements for hospitals and medical records as well as prohibition against disclosure of confidential patient information such as treatment options and drugs prescribed. In 2002, the introduction of a telemedicine clause into the Medical Services Act allowed telemedicine consultations between physicians and health care providers only. Under Article 34 of the Act, doctors, dentists and oriental medicine doctors are allowed to discuss with their patients and share treatment options with other doctors by using information communication technology such as computers or visual communication systems, however they must diagnose and treat patients in person.

Guidelines for the De-Identification of Personal Information (GDPI)

Korea's Ministry of Public Administration and Security has not published anything beyond guidelines when it comes to the sharing of private data. The government has continued to delay the responsibility of making a clear decision regarding liability as data is a very sensitive issue in Korea. The guidelines cannot settle the ongoing debate between healthcare establishments and civil interest groups.

The current regulatory environment offers the following two solutions for hospitals to share their data with third parties: (1) revise new consent forms which explicitly specify that data will be shared with third parties for the purpose of research and diagnosis (legacy data can only be used if a hospital went through the costly process of seeking new consent of all its previous patients); (2) pass new legislation allowing the sharing of deidentified data for research and diagnosis purposes. However, as the government continues to fund digital healthcare related programmes, experts are optimistic that the government will create new legislation resembling other advanced digital healthcare markets.

6. Market Entry Strategies

5.2 Big Data/AI-based Medical Devices and Solutions

The MFDS established formal approval criteria for the new generation of medical devices using big data and AI technology in November 2017. According to the guidelines, software developed for the diagnosis, treatment and prevention of individual patients' illnesses can conventionally be categorised under medical devices. These include devices that make use of biological signals measured via electroencephalograms or electrocardiograms, to offer supportive information for disease diagnostics and treatment. For instance, software that analyses lung scans to determine the development or status of cancer, products that look at electrocardiogram results to diagnose or predict arrhythmia and software trained to predict skin cancer by analysing skin lesion images are considered medical devices.

At the same time, products used for health maintenance or for automatically searching through archives of medical information and treatment options are not considered medical devices. These include products that help with health insurance processing, health maintenance gadgets used for exercise and daily life, devices built for research purposes by academic institutions, as well as products that help doctors shift through medical records and supportive materials.

The review process for certification, which should not take more than 60 days, includes inspection of several functionalities and features of the products in question such as sensitivity, specificity, positive predictive value, negative predictive value, receiver operating characteristic (ROC) curve, as well as area under the curve (AUC).

Korea offers strong opportunities for UK digital healthcare companies with the government, major hospitals, large conglomerates and a growing number of tech start-ups all investing heavily in the field. The country is grappling with rapidly-increasing medical costs due to its ageing population and an increased rate of chronic disease and this, coupled with its highly-developed ICT infrastructure and willingness to embrace new technologies, makes Korea an attractive market for UK digital healthcare businesses. British businesses can approach the Korean market through direct sales from the UK, by appointing a partner or by setting up an office in Korea.

Direct Sales from the UK

The simplest market entry option is for UK companies to sell or license a particular digital health technology directly to Korean end-users. The main downside of a direct sales approach is the lack of local language and time-zone support, as Korean customers tend to be particularly demanding of their suppliers. This can be mitigated by using a local agent or business development consultancy, capable of bridging time-zone, language and cultural gaps without the long-term commitment of local incorporation and hiring. Marketspecific factors to consider include:

• Do we have a strong differentiator – something that sets us apart from our competitors in the market?

• Do we have a strong track record in other major markets?Korean companies are not easily convinced to use a new, disruptive technology as a first-mover without case studies

• Are we willing to localise the product for the market and/or for local regulations, if necessary?

• Are we ready to provide a Proof of Concept (PoC) at little or no cost to the customer? Korean companies will look to drive the price down and will not commit before proving the value through testing

• How do we provide after-sales support? Korean customers expect high-quality, local-language support

• Do we understand the local regulations, particularly in relation to data? Do we need to adjust our business model to adapt?

Appointing a Reseller or Distributor

A more common way to approach the market is to seek a partnership with an established local company which complements your product, has experience in the target sector and can help navigate the legal environment. A local channel partner can provide services such as certification, registration, pre-sales, sales, consulting, installation, technical training, service maintenance and technical support in the Korean market. Even large multinationals take this route in the early stages of market entry. Market specific factors to consider when seeking a partner include:

- Does the partner already serve the type of customer that we do?

- Does the partner have a good understanding of the market in general and my particular application?

- Does the partner already offer solutions similar or complementary to our offering?

- Is the partner focused on short-term wins or will they be able to drive our business in the long run?

- Does the partner have specific experience with public sector projects?

- Are we comfortable communicating with the local partner and are they transparent with us?

Establishing a Local Presence

There are broadly three ways of establishing a local presence: (1) a liaison office, (2) a branch office or (3) a local corporation through foreign direct investment (FDI). Setting up a liaison office is a simple process; but a liaison office can only perform non-profit generating activities in Korea such as market surveys, research and development and quality assurance. Setting up a branch office can be a complicated process that requires documentation to be translated, but it allows for sales activities and the exchange of revenues with the head office. The most common process for an overseas company to open a branch office in Korea is through FDI, where an initial investment exceeding approximately GBP 68,000 is made by the head office, which in return owns stock in the branch. The local corporation leads independent activities and is authorised to perform direct transactions. Market-specific factors to consider when establishing a local presence in Korea include:

- Is our business generating enough revenue in Korea to consider a local presence? Businesses usually consider establishing a local presence after several years of sales (either direct or through a partner)

- Is Korea a strategic market for us, either in terms of securing use-cases or securing further funding?

- Do we need to engage in profit generating activities?

- Will we transfer staff from our head office or hire local staff? In Korea, visas can be difficult to secure for foreign employees and social insurance contributions and severance pay must be paid to all staff that complete one year of employment. An employer's share of these costs equates to 18% of salary

- What location shall we pick for our local presence? Scouting, negotiating, and conclusion of contracts are time-intensive processes that often are hard to conclude without local support.

Exchange rates used in the report:
GBP 1 = KRW 1,470

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