



A New Era in Connected Health Care

How Mobile Network Operators can engage in m-Health opportunities



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Executive summary

Health Care is a key sector of the modern economy. It currently accounts for 10% of global GDP, and is projected to reach 23% of US GDP by 2023. Key players in the health sector will seek more sustainable solutions to overcome the challenges of high cost, low quality and poor accessibility. The development of the Internet of Things (IoT) will connect more people to health care in their daily lives, and the availability of medical monitoring devices, smartphone apps, wearables and implantable sensors – all with access to real-time information – will create a new era of health care.

This report focuses on how mobile network operators (MNOs) can engage in the m-Health (mobile health) sector, and analyses two dominant market segments: the remote monitoring market and the remote care market. In the remote monitoring market, we identify three potential business opportunities from MNOs, including chronic disease management, monitoring of specific groups, and health management. In the remote care market, we analyse three scenarios: remote care for rural and underserved regions; remote emergency care; and remote care utilising robotics.

Key messages of this report include:

1. Based on the estimated market size and demand for mobile network, we believe that remote monitoring and remote care markets (including remote diagnostic and remote treatment) contain the greatest opportunities for MNOs. According to EY's analysis, as the biggest vertical market of m-Health, remote monitoring's addressable market for MNOs will reach US\$69 billion in 2022.
 2. Constrained by the low maturity of business model (different payers for various segments in different countries, and uncertainty of willingness to pay) and technical difficulties (such as high power consumption), the current remote monitoring market is experiencing limited development. In addition to providing connectivity service, MNOs can also be the solution providers with a unified platform in remote monitoring market.
- Generally speaking, it is difficult to enter into the health care industry; but in some subsegments (such



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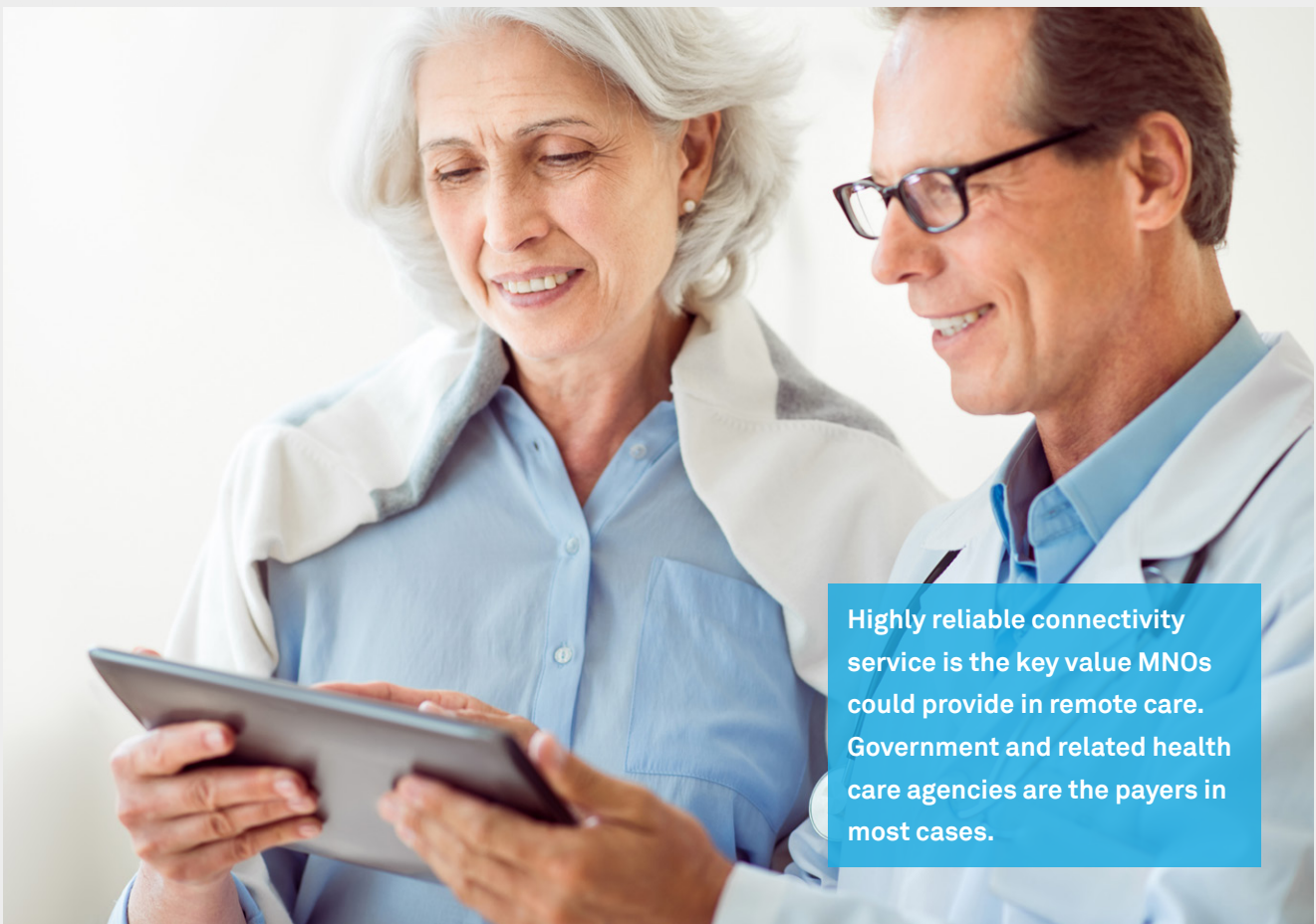
as health management, tracking and monitoring of the elderly/children), it is still possible for MNOs to explore the value chain. For instance, NTT DoCoMo and Omron have established a joint venture to provide health monitoring and management services for the general public; Telefonica obtained related capabilities through acquiring a telemedicine service provider.

- In terms of customer service, MNOs have solid resources and capabilities to provide emergency connection services – e-call on person and connecting to emergency rescue service network, especially in the extreme case, e.g. when the GPS (global positioning system) does not work, the MNOs' cellular network could still provide the location information.
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3. Highly reliable connectivity service is the key value MNOs could provide in remote care. Government and related health care agencies are the payers in most cases.

- In remote care market, MNOs could provide solutions with high security and stable connectivity to support remote diagnostic and even treatment, e.g., in underdeveloped areas where broadband is not available, and to solve the problem of uneven distribution of medical resources.
- In addition, remote care would help to improve emergency performance, e.g., increase patient survival rate through remote care in ambulance.

All in all, MNOs still have unique advantages, e.g., the trustworthy partner with government, the reliable data operator for customers, network resource for emergency service or remote care. In the coming years, MNOs are suggested to invest capital and also technology, continue to launch creative application and develop new business models to stimulate the development of m-health.



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Introduction

Health care is a topic that everyone pays attention to during their lifetime. With worsening pollutions and prevalence of unhealthy lifestyles (smoking and poor dietary habit etc.), people tend to have health problems frequently and easily. According to the research from World Health Organization (WHO), all over the world, obesity has more than doubled in 2016 since 1980. Nearly 1.9 billion adults (39%) were overweight in 2014, in which over 600 million were obese. These disorders caused chronic diseases like diabetes and hypertension. Another challenge is the worldwide trend of population aging. The United Nations (UN) estimated that worldwide population aged 60 or over is projected to increase by 56% to 1.4 billion in 2030 from 901 million in 2015.

1. Status quo of health care system

The current health care system is facing a lot of issues and, among them, the most difficult ones are the inherent design of the system, uneven distribution of medical resources, non-transparent resource information and low satisfaction of patients. Firstly, the irrationality of the existing health care system comes from the fact that the current system is designed for sporadic and acute diseases, which is not applicable for the treatment and management of chronic diseases. However, chronic diseases cost more than 70% of medical expense. The second issue of the health care system is the uneven distribution of medical resources. In developing regions, the best medical resources are centralized in a few cities or hospitals. For instance, most first-class hospitals in China are located in tier one with a few in tier two cities. Thirdly, information on medical resources are currently not transparent enough, which means it's difficult to find suitable doctors quickly. In addition, many patients have low satisfaction since the waiting time is too long. In some countries such as Spain, average waiting time for a surgical operation exceeds 100 days.



2. Address the challenges through m-Health solutions

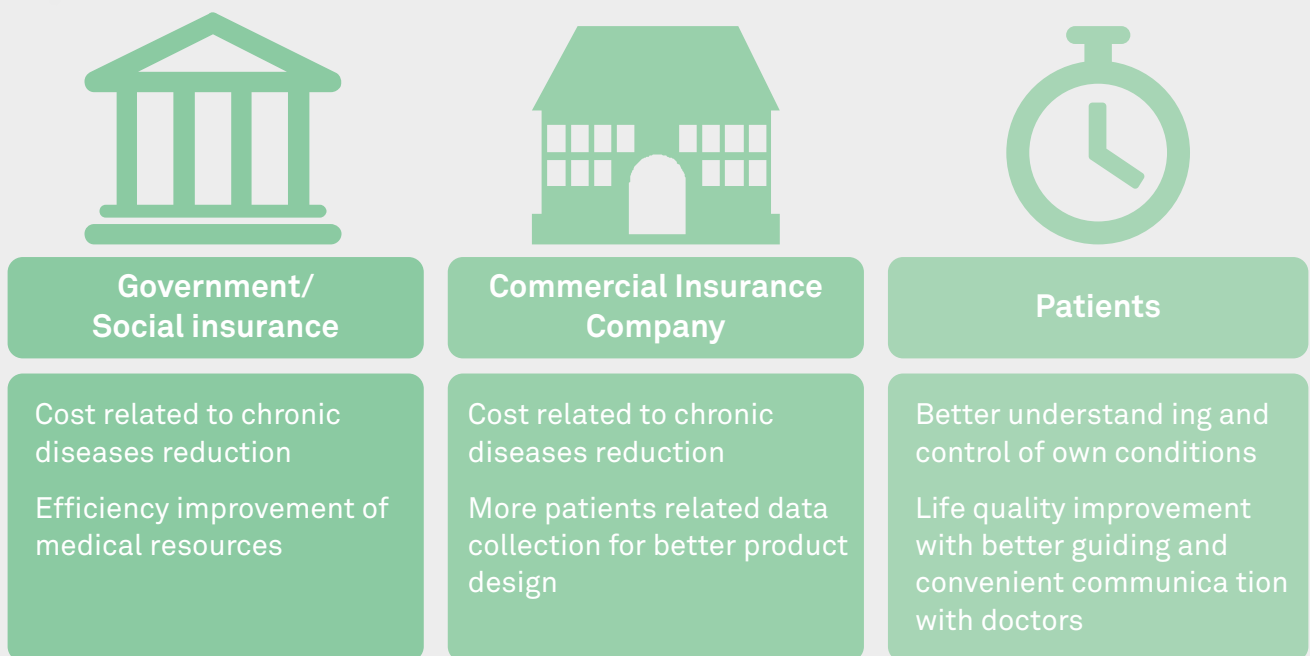
M-Health, a component of eHealth, is defined as medical and public health practice supported by mobile devices, such as mobile phones, monitoring devices, patients' digital assistants, direct provision of care devices and other wireless devices. M-Health solutions are not only include patients' health care services, but also people health management services. With the unprecedented development of mobile technologies as well as the penetration of smartphones, m-Health solutions have become popular in recent years. Over time, such new technology takes us to a new era of health and a fundamentally different model for health care. Instead of being passive recipients of care, patients will become empowered consumers, with more information and control in making their health decisions. Sophisticated analytics will allow providers to focus on the prevention of diseases outside of hospitals and clinics as health care will be available wherever the patients are located. M-Health solutions are proved to be effective for the health care system as they can help to address current health care challenges in three ways:

- › **Save cost:** The GSM Association (GSMA) estimated that m-Health can save US\$18 billion for existing health care systems in Brazil and Mexico, and create 200,000 jobs in the emerging m-Health sector by 2017 . The US Federal Communications Commission (FCC) predicted that remote patients monitoring for four main diseases: heart disease, diabetes, pulmonary disease and skin disease could save US\$197 billion nationwide over 25 years .
- › **Improve health care efficiency:** M-Health solutions enable health care practitioners to diagnose, treat and monitor more patients than using traditional methods such as face-to-face consultations. Thereby, it could free up time and resources and enable more resources to be focused on complex cases. In 2011, trials in Nordic countries found that m-Health could achieve a 50-60% reduction in hospital nights and re-hospitalization for patients with chronic obstructive pulmonary disease (COPD) .

- › **Improve quality of long-term cure:** Real-time data capture and analysis, better accessibility to information, enhanced patient ownership and understanding of their own conditions, support with diet/lifestyle changes, overall care is realized via m-Health solutions. It allows patients manage their health more independently, easily and conveniently.

Healthcare systems vary widely between countries and are extremely complex, there are various types of payers and they have different ways to pay in different scenarios. Various parties could be payers, including governments, social welfare agencies, commercial insurance agencies, and individual customers. Identification of payers and their motivation to pay are the keys to business success with different customer bases and different application scenarios. Understanding the payment pattern and payment willingness, which is significant for MNOs to build success business model.

Figure 1: Willingness to pay for m-Health



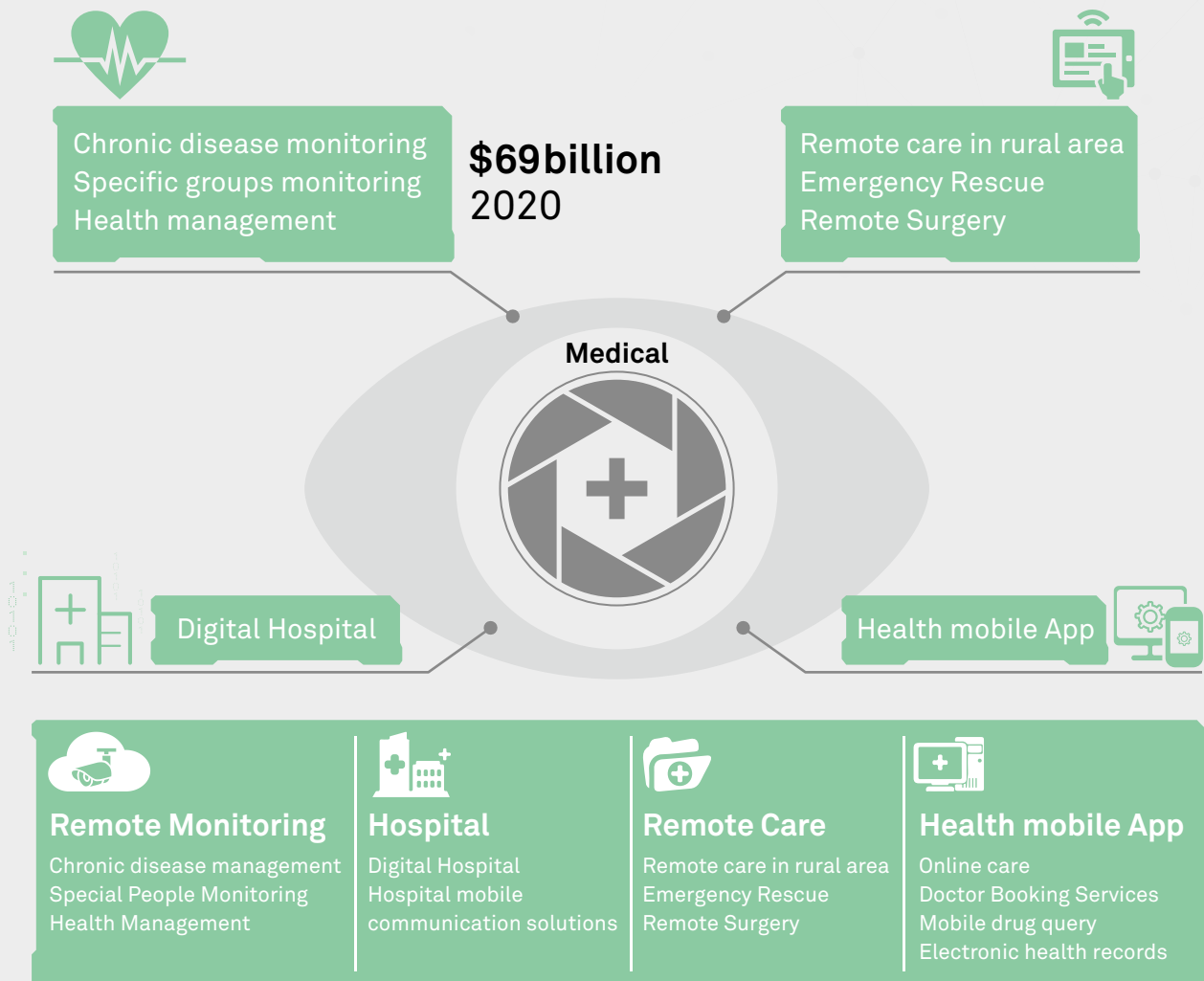
Entrants from once far-removed sectors – technology and telecommunications are moving in. The ecosystem of m-Health is becoming more and more complicated, including governments, medical authorities, hospitals and clinics, insurance companies, pharmacies, health care providers (HCPs), device suppliers and mobile operators. Among the various stakeholders and players, governments and insurance companies are primary beneficiaries, as in most cases they are the payers for civils' health care. In addition, patients and end users obtain benefits mainly from care quality improvement and convenient health management, which appeals them to pay for m-Health applications.

According to GSMA's analysis, for MNOs remote monitoring and remote care are two largest sub-sectors

of m-Health, which is expected to represent 65% and 25% respectively of the total revenue. The remote monitoring service is mainly driven by the increasing demand of chronic disease management, remote monitoring for aging people and children, and public interests of daily health management. Under remote care w

e talk about remote diagnostic and also remote treatment. High technology is used in three typical scenarios: rural and underserved communities' remote care, emergency especially in-ambulance emergency and remote care in surgeon.

Figure 2: MNOs opportunities in m-Health





Vertical market analysis

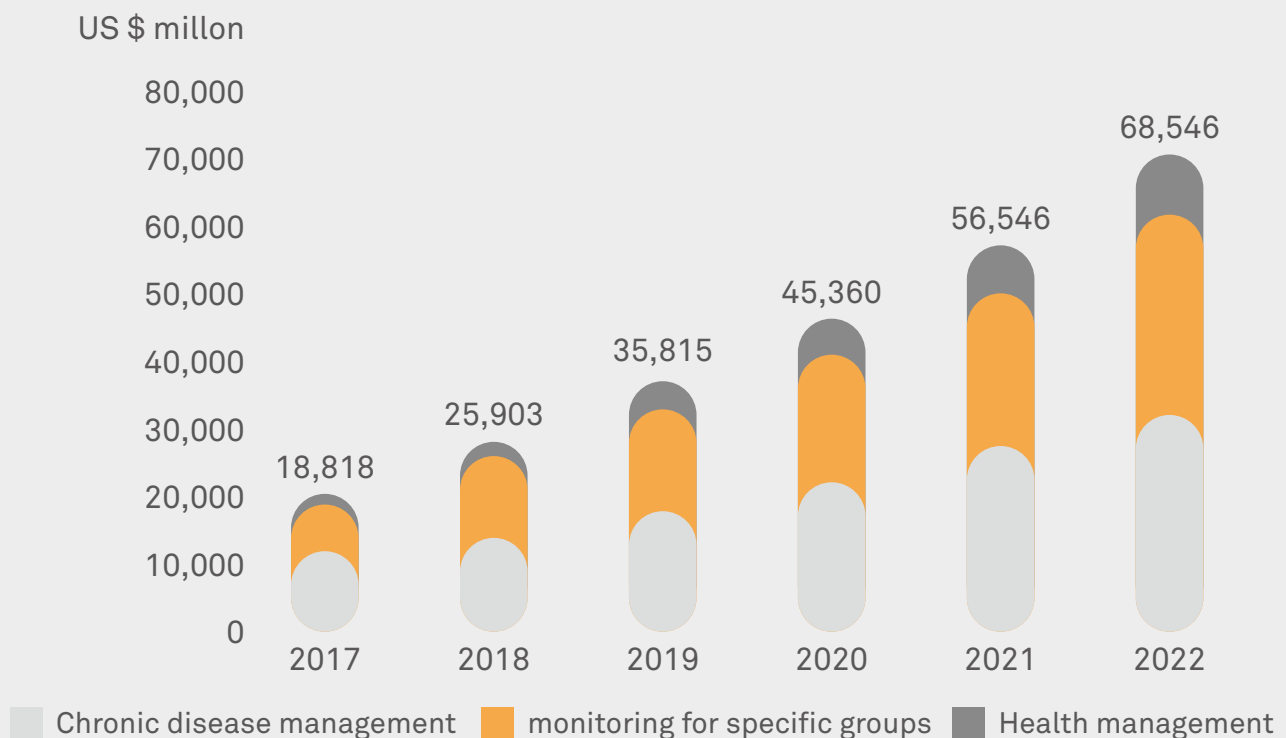
1. Remote monitoring

Regardless of the severity of their diseases, every patient hopes to be taken good care of by health care professionals during the whole journey of medical care. However, it's not efficient or economical to keep all the patients in hospitals until they are fully recovered, especially for patients with chronic diseases who need to be monitored and treated for a long period of time – sometimes a whole lifetime. For some specific groups such as elderly people or children, whose emergency situations need to be informed to their caretakers or professional agencies, an online device providing real-time data would be essential for their safety and health. Even for healthy people, in order to maintain wellness and minimize emergency situations, a record with more intensive and accurate biomedical data besides regular health check would be helpful. Remote monitoring technology can realize all the demands mentioned above.

Such monitoring technology can vary in complicity from simple monitoring of physiology data such as blood pressure, pulse, blood sugar and body weight, to implantable devices (such as heart pacemakers or defibrillators), whose work condition can be monitored remotely. In 2015, an astonishing 165,000 mobile health apps were available on the iOS and Android platforms – about twice as many as just two years earlier.

According to EY's analysis, the addressable market of remote monitoring for MNOs would reach US\$69 billion in 2022. Chronic disease management service will be the biggest sub-segment in remote monitoring service. With the mature technology and increasing awareness of safety for elderly people, children and other specific groups – such as sports enthusiasts, remote monitoring will grow more quickly in the future. By 2022, this sub-segment will account for 40% of the whole remote monitoring market. Besides, the willingness to pay for health management would continue to rise.

Figure 3: Addressable market of remote monitoring service for MNOs 2017-2022



1.1 Chronic diseases management

Chronic diseases such as diabetes, heart diseases, stroke and cancer are diseases that may persist for a long time and generally can't be completely removed or cured by medication. The WHO stated that chronic diseases are by far the leading causes of mortality in the world, directly or indirectly leading to 60% of all deaths. Globally, chronic diseases are prevalent and costly; about 10-20% people are suffering from chronic

diseases, while almost 70-80% health care spending is ascribed to related medical care. General existing treatment solutions for chronic diseases are costly and less efficient, while the mobile capability to monitor key signs and provide remote advice are the key methods to reduce system costs, improve health care efficiency and provide better cure quality for patients.

60%

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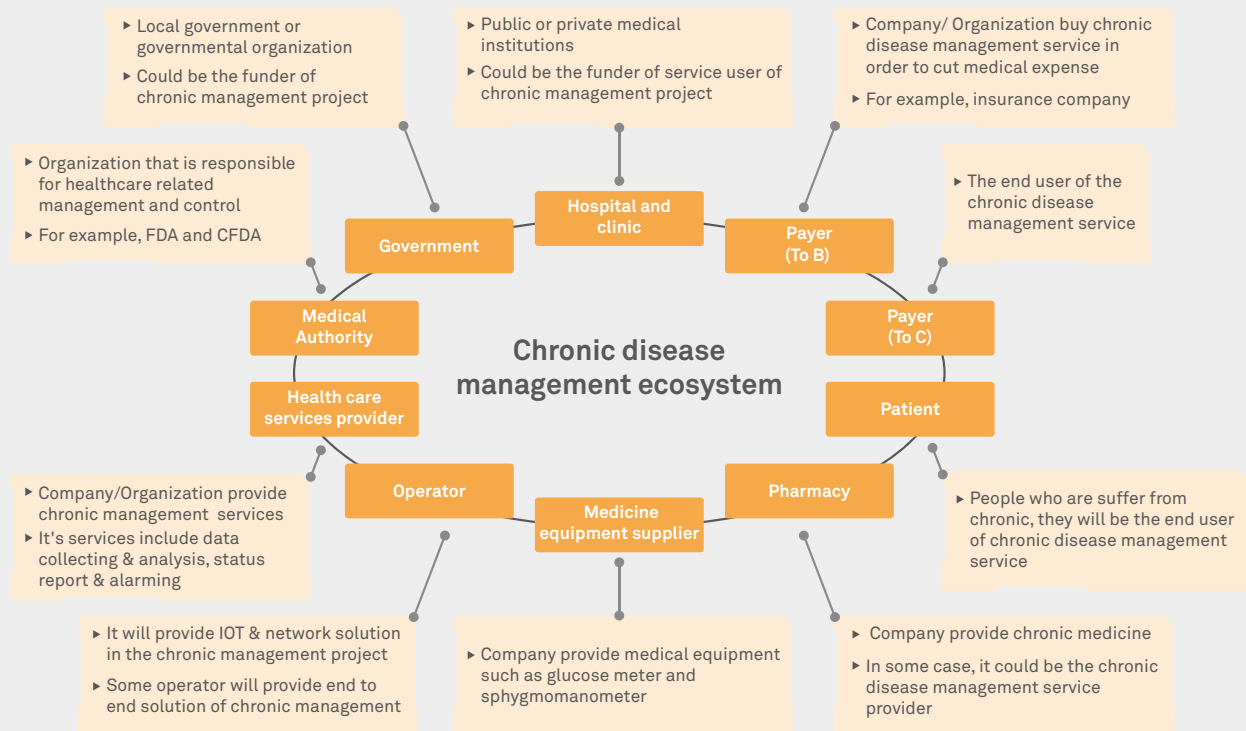
10-20%

about 10-20% people are suffering from chronic diseases, while almost 70-80% health care spending is ascribed to related medical care.

In most countries, chronic diseases are covered by basic medical insurance systems, thus the main payers are governments and social security organizations. Cost saving and efficiency improvement are the key drivers for them to implement m-Health solutions. Meanwhile,

commercial insurance companies and consumers are also possible payers in some regions or for part of the solutions, who are care about the cost, the experience and also the life quality.

Figure 4: Chronic disease management ecosystem



There are a lot of trials of chronic disease management which can be summarized into two types of business models: government-led models and devices/solution provider-led models.



1.1.1. Government-led chronic disease management

Under the government-led model, MNOs play an important role beyond providing pipes, and are considered as reliable partners for government with high-tech characteristics. One typical example is the series of chronic diseases management projects in Spain, implemented by Telefonica in partnership with the local government, hospitals and related commissions. In Spain, 80% of primary care consultations, 60% of hospital admissions, and two-thirds of emergency services are provided to patients with chronic diseases. In order to improve the efficiency of health care system and cut cost, a pilot project was launched in 2011 in Valcronic, an autonomous region of Spain. Valcronic program focused on multiple chronic diseases management. The project involved four primary care centers and two hospitals, and is targeted on four types of chronic disease (diabetes, hypertension, COPD and heart failure), and 12,000 patients.

In this case, the recruited patients with one or multiple chronic diseases were divided into three groups based on different risk level. For the top 5% most severe patients, who need to be monitored all day long wherever they go, tablets and relevant biometric devices such as glucometers and digital blood pressure monitors were provided. Their real-time biodata would be sent to the platform for analyzing and reporting. In case any indicator goes wrong or unusual, the patient and related health care services agency would be informed immediately, and the corresponding emergency mechanism would be activated. For the

15% moderately severe patients, moderate monitoring with in-person medical appointments and call center services with proactive follow up of the patients were provided. For the remaining 80% least severe patients, self-care support and prevention education through web portal and mobile app were provided.

After one year of operation, the pilot program achieved progress in three perspectives: lowered death rate, lowered admissions and lowered hospital visits for over five hours and avoidable hospitalization. In addition, according to satisfaction surveys, 93.8% of the enrolled patients would recommend this program to others. And they also emphasized that they were satisfied with the experience that disease control measures could be conducted at home without having to go to health centers. At the same time, they also learned some essential self-care techniques.

Valcronic government and Telefonica were the co-sponsors of this program. Valcronic government was responsible for patient recruitment while Telefonica was responsible for device provision, deployment and providing data related services. The primary care centers and hospitals would deliver health care professional services, when emergencies occur. In this case, Telefonica played the role of a solution provider as well as several other roles, e.g., medical device provider. In order to provide a more integrated m-Health solution, Telefonica obtained relevant capabilities through acquiring chronic management service provider Axismed. In 2013, Telefonica acquired 50% stake of Axismed, and the remaining 50% stake was acquired in 2016.

Another government-led case is BT Cornwall project. Cornwall government expected to reduce public expense through outsourcing public sector services. BT set up a joint venture company with Cornwall council and took over all the outsourcing services. From July 2013, the telemedicine service for more than 10,000 users were provided by the joint venture. To run the service successfully, Peninsula Community Health and Cornwall Partnership NHS Foundation Trust were also involved to provide professional services. The whole program contained two segments: telecare includes the services of home alarm with emergency buttons and other equipment such as fall sensors for independently living aging people; and telehealth provides long-term remote monitoring service for patients with chronic diseases, e.g., COPD, diabetes, heart failure, recurrent urine infections and falls. It's a welfare program, thus all these services are free for end users. Among the 1,007 patients, 579 responded to the 2013 patients' survey. The results indicated that 60% patients felt that the program made them feel more supported and/or safe, 48% patients thought that BT Cornwall program was helpful for managing their conditions.

UK is running the National Health System (NHS), under which patients do not need to pay for any medical expenses. In this case, the local government could be the main payer for the whole program. As the service operation provider, BT took over the existing platform from Cornwall council, which means that they earned some critical capabilities such as medical data analysis capability at the same time. Besides, BT also took over the established business relationship with HCPs, which is usually not so easy to obtain.



1.1.2 Device/solution provider-led chronic disease management

In m-Health's ecosystems, device or solution providers are also active players as they have core competency in the specialized medical sector. With the development of IoT, device or solution providers generally provide integrated solution that connect patients and professional HCPs by offering remote monitoring equipment to collect body vitals and transfer them to back-end servers over mobile networks.

Sorin Group is a global medical device company and a leader in the treatment of cardiovascular diseases. Besides, it has expertise in treatment algorithm and data analysis intelligence. In 2012, Sorin chose to cooperate with Orange Business Service to launch a remote monitoring solution – Smartview for patients with implanted cardiac devices. Smartview is a home-hub device, which can capture data from the defibrillator via Sorin's radio-frequency (RF) protocol. The data is then transmitted from the home-hub device to a cloud-based application, which enables the information to be available to the clinicians and patients. Smartview can capture the data not only about the implanted device itself, such as battery and working status, but also the health condition of the patients. The real-time remote monitoring replaced periodic check of device and it can give an alarm once the device goes wrong or the electrocardiogram is unusual. Smartview has got the FDA (Food and Drug Administration) approval and CE Mark System approval, and is currently available in France, United Kingdom, Spain, Germany, Italy, United States and Canada.

We also noticed that the connectivity service via mobile network is not used in some remote chronic disease management solutions. But with further development of those solutions, we believe that mobile network technology would play more important roles for them. BlueStar is a very interesting case as a diabetes management product, provided by Welldoc. It's the first m-Health solution that received FDA 510 (K) clearance. BlueStar is a mobile health monitoring app and it is the first prescription therapy in the American mobile health care history. The type 2 diabetes patients with prescription need to download the app firstly and then intensively record their blood sugar data in the



system. It provides real-time motivational, behavioral and educational coaching for diabetes management. BlueStar helps doctors and patients to work together by sharing, analyzing and translating patients' data into valuable information. Both the patients and the HCPs such as doctors will receive specific recommendations for each individual patient. Since BlueStar has proved that this solution can help insurance company to reduce their long term spending on diabetes patients, two insurance companies had agreed to pay more than US\$100 a month for each patient. In addition, targeting at maintaining the health of employees and reducing long term total health care spending, a few Fortune 500 companies also bought BlueStar services, including Ford Motor Company, Rite Aid and DexCom. They decided to offer the service as a reimbursed program for their employees and their dependents with diabetes.

Another interesting remote monitoring case based on cellular technology is MedPod — a medication dispenser and communication hub, designed to simplify medication therapy management for patients, especially for patients with chronic disease or acute conditions. It's a hand-held terminal, which is filled with drugs based on patient's needs. It would remind patients to take medicine in right dosage at right time, and alert concerned parties when patients don't comply with their treatment plans. In addition, when the patients have any question or doubt about the medicine, they could press a button to connect to their doctors or pharmacist. The MedPod is currently in beta testing phase and AT&T provides wireless connectivity service for it.

1.1.3 Key success factors and further implications for MNOs

Based on our case study of remote chronic disease management, we summarized below key success factors for this market:

- Obtaining approval from health care authorities: Government authorities such as FDA are responsible for protecting public health through ensuring the safety, efficacy and security of food, drugs and medical devices. The drug or medical device with FDA's approval would be better accepted and trusted by consumers.
- Making HCPs as key sales channel: Patients tend to trust medicine or medical solutions provided by HCPs, especially when such medicine or cure solution are prescribed by practicing physicians.
- Identifying the payers and convince them with the benefits in different scenarios: In most countries, beneficiaries of the medical cost cut are typically government or the health insurance system ("payers"). In other markets, the payers could likely be a mix of government/insurance agencies and consumers. For different scenarios, the payers could be totally different. Identification of payers and their willingness to pay is the key to business success.

We have some further suggestions for MNOs as bellow:

- Start from MNOs' core competency, i.e., connectivity and emergency response service, then expand to data

storage and analysis service. Acquiring or partnering with specialty players are possible ways to obtain relevant capabilities.

- Cooperate with other health care stakeholders to convince the government and related payers that m-Health is a cost saving solution for chronic disease management. The strong willingness to pay would accelerate the market development.
- Cooperate with device or solution providers to improve the current solutions with more connectivity technology. For example, BlueStar users have to be very self-disciplinary, and the intensive testing and recording is the essential success factor for the solution. If all the medical testing devices are connected to the app or a new hub, the data would be recorded automatically, and patients' acceptance might increase.
- Generate revenue as system integrators and platform operators for multiple chronic diseases management. For MNOs, it's hard to compete with device/service providers for a specific chronic disease. But MNOs can cooperate with government to build a monitoring and control system for multiple diseases, which considers

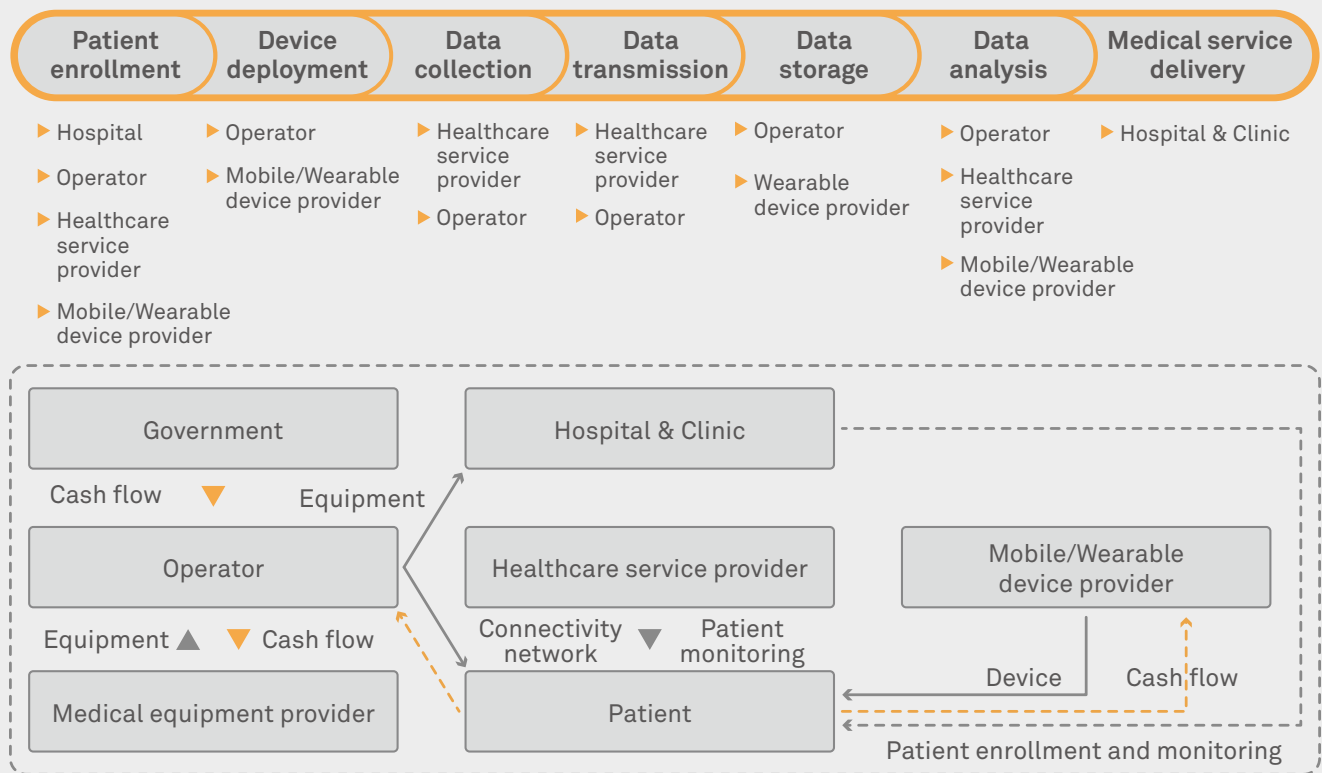
the remote solution from a high-level perspective. The integrated program could disrupt the advantages of device or service providers in terms of user experience for a specific chronic disease.

The above-mentioned suggestions point out the ideal business model for MNOs. As government is the actual payer or at least the most important influencer, to cooperate with government to launch an integrated program is a good entry point. With government involvement, it might be easier to build partnership with HCPs. And as solution providers, MNOs could make all the medical equipment providers, wearables providers and even telemedicine service providers to be their vendors.

Start from MNOs' core competency, i.e., connectivity and emergency response service, then expand to data storage and analysis service.

Generate revenue as system integrators and platform operators for multiple chronic diseases management.

Figure 5: Ideal business model of remote chronic disease management provided by MNOs





1.2 Wearables

Wearables means embedded sensors, wireless communications, multimedia and other technologies in people's eyewear, watches, bracelets, clothing and footwear and other daily wear. People wear them to measure various body signs. For example, clothing monitors body oxygen and riding position; shoes calculate calories consumed and movement distance; while glasses record rounding scenery automatically. According to an Ovum report, the wearables will continually experience rapid growth in the next five years. The sales volume of wearables will reach 277 million units by 2020 from 97million units in 2015 .

On the other hand, the development of wearables market also faces a lot of challenges. An Ovum's survey (2014) indicated that 84% of consumers had no intention to buy a wearables in the next two years . Currently, most wearables operate as a smartphone companion device, like phone alternatives rather than consumers' really necessities. Cellular and Wi-Fi modules are too large, too costly and too power-hungry for most wearables. Ovum expected that better battery and component design should help boost sales in this category from 2017 onwards.

Wearables will gradually make a revolution in health care. They will be used not only for recording blood sugar,

blood pressure, heart rate, oxygen content, temperature, respiratory rate and other indicators of health, but also for treatment of various diseases. According to a study of marketing research institution Transparency Market Research, health is the most promising application area (followed by fitness and entertainment) of wearables . Several MNOs have launched their programs to explore considerable potential of wearables, like NTT DoCoMo, SoftBank, SK Telecom and Deutsche Telekom (DT).

1.2.1 Monitoring of specific groups

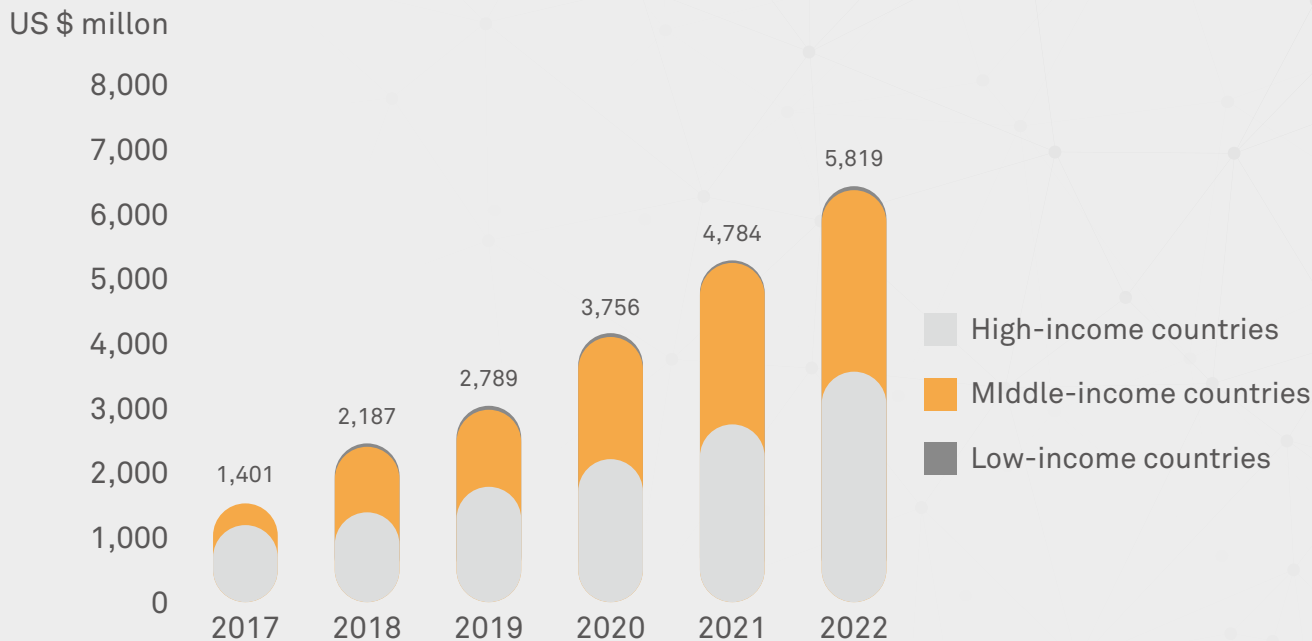
By specific groups we mean people who have high risk in safety or health and usually insufficient ability to solve problem or save themselves when emergency occurs. Elderly people live alone, children under 14 years old and outdoor enthusiasts are the typical groups we target.

The aging of population is a global phenomenon. Elderly people would need long-term monitoring service, which could not only ensure the safety for elderly people themselves, but also free up their supporters' energy and time. Remote monitoring management for elderly people contains a broad set of services, applications and devices which include elderly safety monitoring,

fall detection, location tracking, daily activities tracking and emergency service. The rapidly ageing population in Europe, North America and Asia is further driving the global monitoring service market. In 2020, the

population of global elderly people is expected to reach about 1.05 billion. **The elderly people market size could reach US\$5.8 billion in 2022.**

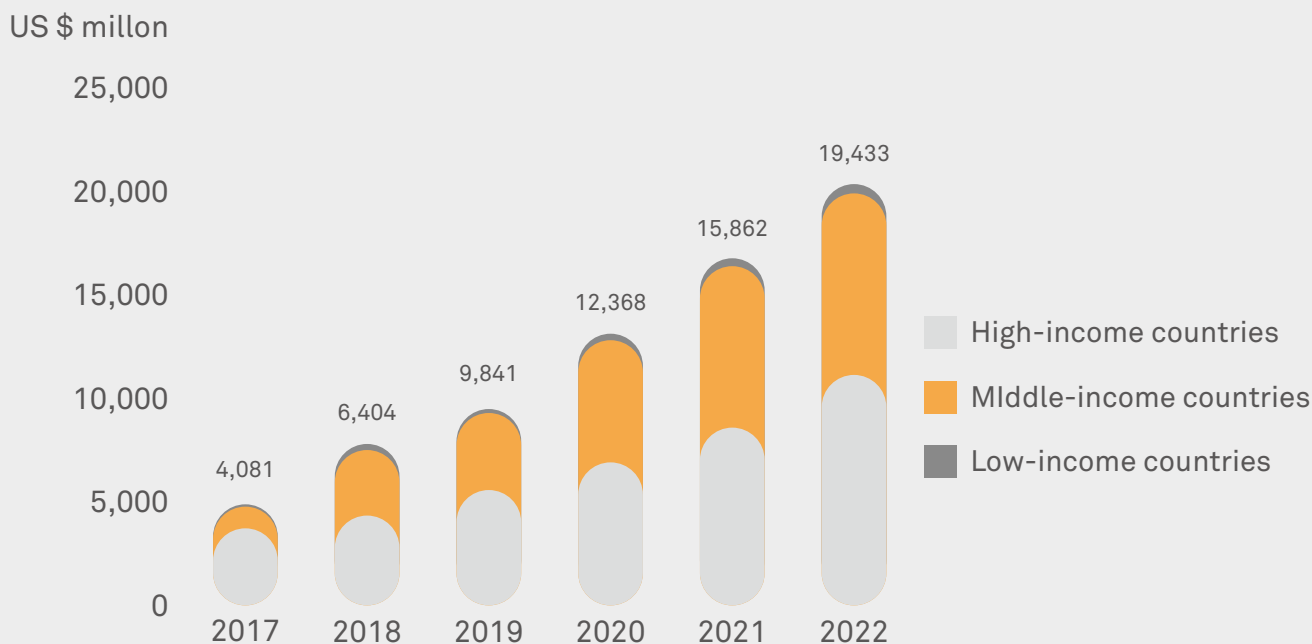
Figure 6: Addressable market of remote monitoring market for elderly people



In addition to the huge market of the elderly people, the market of children under 14 years old is even larger. In 2020, there are expected to be more than 1.98 billion children aged 0-14 years old. With different penetration

of the remote monitoring product due to income level, and **the market size of remote monitoring for children is expected to reach US\$19.4 billion in 2022.**

Figure 7: Addressable market of remote monitoring for children (0-14 years) 2017-2022



In general, there are two business models for specific group monitoring: MNOs-led model and device provider-led model. Under MNOs-led model, MNOs provide the products to end customers via their own channel. They cooperate with devices or solution providers to provide the simple and convenient monitoring service for independently living elderly people, children or other targeted groups. Typical cases of this business model are O2 Help at hand and AT&T EverThere (mPERS).

O2 Launched Help at hand in UK in March 2013, which was a remote fall detector for elderly people living alone. Once the sensor detects unusual data, which possibly means the wearer falls down, Help at hand will send an alarm to call center immediately. And then, the call center will call back to confirm the situation and check if it's necessary to contact the rescue team. But this project ended in July 2013. There are a lot of comments on the business failure of this product, e.g. the lack of marketing promotion resulted in insufficient customer awareness of this product, and ultimately affected the sales revenue; the total price is too high and affected the customers' willingness to try; the sales channel such as chain store is unsuitable and the direct B2C mode of such product is difficult to implement in UK. In this case, O2 tried to provide an end-to-end solution, from customer attraction to monitoring service operation. Only the rescue service was provided by professional agencies.

Another similar case is EverThere, launched by AT&T. In 2013, AT&T (Numera's white-label customer) launched EverThere - a small wearable device - which can detect falls and quickly identify location based on GPS service when a fall occurs, and automatically connect to a 24/7 call center for response and support based on AT&T wireless network. The device is hands-free and allows two-way voice communication with the call center for fast assistance.

Actually many MNOs take in the market of elderly people and children remote monitoring, in which all the wearable device providers could be their partners just as in the cellphone market. For example, in 2012, the Swiss watchmaker Limmex launched a watch with mobile emergency call service in Germany. Different from an ordinary watch, Limmex emergency call watch has a separate SIM card and can be used as a cellphone. In emergency, the wearer presses the button on the watch to call the emergency contact persons one by one, until anyone answers the phone. And there is also a direct link to the emergency switchboard of German Red Cross, which is manned 24/7. The watch targets the elderly, children, security staff, police officers and people suffering from illnesses such as epilepsy, heart problems or strong allergies who might need urgent help in emergency. In this case, Limmex has a close partnership with DT and Red Cross, and DT is also a distribution channel for the product.



1.2.2 Health management

The growing health consciousness of the public stimulates the demands for wearables, which provide people convenient methods to receive accurate health information of themselves. In this market the business models are similar with those of the specific groups monitoring: MNO-led model and device/solution provider-led model.

MNOs in Japan started to enter the wearables market several years ago. NTT DoCoMo launched Moveband series health trackers for both individual customers and business clients. It cooperated with Omron, an electronics manufacturer, to provide an end-to-end service to customers. Data collected by DoCoMo Moveband or Omron portable equipment will automatically be transmitted to DoCoMo's application, which provides a full range of health management. Successfully, the free health management application WM developed by DoCoMo, attracted two million users by December 2015. SoftBank also released its health management application Health care in May 2013, partnering with Fitbit. Users monitor their health data through SoftBank Health care App, which received data from Fitbit band. However, this service was announced to be closed in October 2016.

In general, DoCoMo and SoftBank provide similar services to customers. However, based on its basic service, Docomo also provides specific services for specific groups, e.g., Body Feeling for pregnant women, which largely increases customers' willingness to use and pay for the services. Besides, Docomo started to cooperate with insurance companies, exploring the value of these data so as to maximize profits.

In South Korea, SK Telecom has established a joint venture – Health Connect – with Seoul National University Hospital (SNUH). This company focuses on providing individual health care program – Health-On Wellness, and ICT smart hospital services. Health-On Wellness offers three programs to corporate clients to help to cut health related expenses by managing employees' health. Besides, SK Telecom sells a lot of wearables on its digital channel. In March 2016, SK Telecom launched a smart watch – Luna Watch – by cooperating with TG&Co and Foxconn. The watch supports sending texts and making phone calls through

an SK Telecom SIM card. Luna Watch is positioned as an economic fashion smart watch, targeting young female adults. Benefiting from selling contract smart watches, SK Telecom provides telecom services to 375 thousands customers, accounting for nearly 90% of smart watch telecom users in South Korea.

In Feb 2016, the US Musician-turned-entrepreneur Will. I.Am developed a new voice-activated smartwatch. The 'Dial' smartwatch accommodates a Nano SIM card and operates independently. The product can be used to call, text, e-mail, track fitness and take photos. The greatest attraction of this watch is 20 million songs for free, which are provided by Will.I.Am. Taking advantages of MNOs local expertise, Will.I.Am lined up MNO Three to sell his 'dial' smartwatch in UK and cooperated with DT to sell smartwatch in other European countries. Both Three and DT provide connectivity services and act the role of marketing and sales channel.



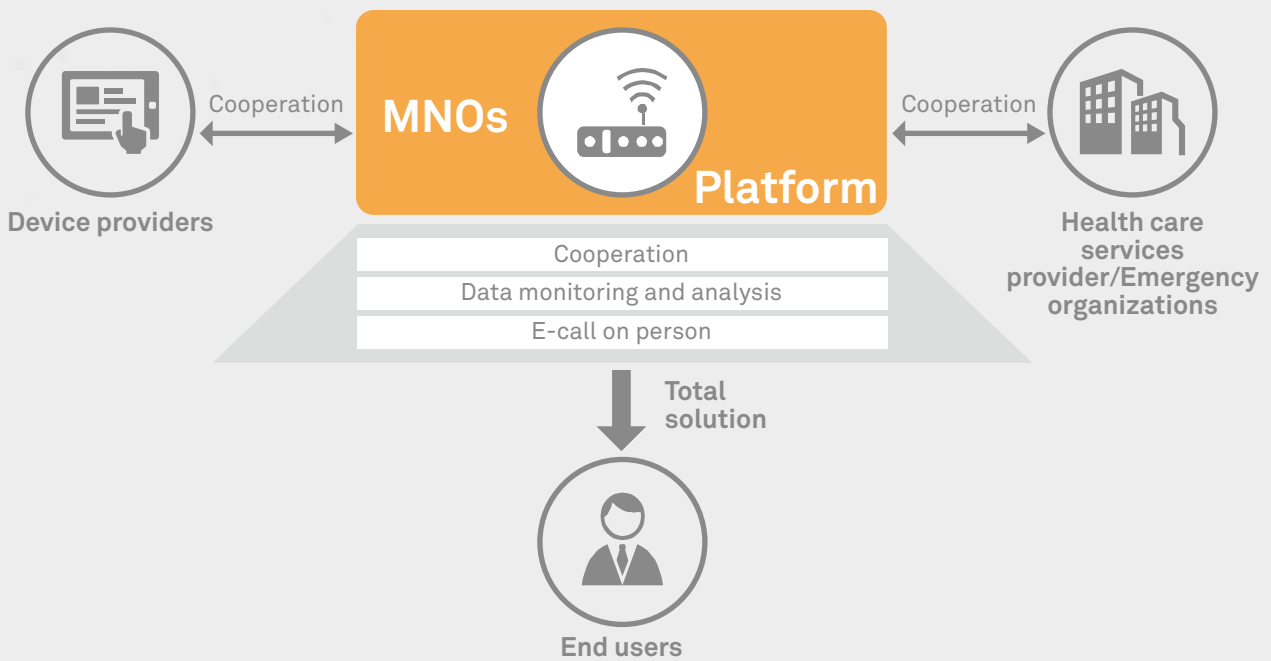
1.2.3 Implication for MNOs on wearables market

The remote monitoring service for specific groups and healthy people is not as technical as that for chronic disease management. Connectivity service and highly reliable network provision in emergency are the core competencies in this market, which happen to be the unique advantages of MNOs. MNOs should take the “open-door” strategy to provide the platform service for all the wearables providers and also the total solution to end consumers, such as connectivity service, data monitoring and analysis service and call center service in emergency. Besides, MNOs could cooperate with wearables providers to promote and sell this service “e-call on person”, which would draw attention from various specific groups. Because they have high willingness to pay regular fee for their safeties just in case, especially in the developed regions.

MNOs should take the “open-door” strategy to provide the platform service for all the wearables providers and also the total solution to end consumers

MNOs could cooperate with wearables providers to promote and sell this service “e-call on person”, which would draw attention from various specific groups.

Figure 8: Ideal business model for MNOs on wearables market



2. Remote care

Regardless of the severity of their diseases, every patient hopes to be taken good care of by health care professionals during the whole journey of medical care. However, it's not efficient or economical to keep all the patients in hospitals until they are fully recovered, especially for patients with chronic diseases who need to be monitored and treated for a long period of time – sometimes a whole lifetime. For some specific groups such as elderly people or children, whose emergency situations need to be informed to their caretakers or professional agencies, an online device providing real-time data would be essential for their safety and health. Even for healthy people, in order to maintain wellness and minimize emergency situations, a record with more intensive and accurate biomedical data besides regular health check would be helpful. Remote monitoring technology can realize all the demands mentioned above.

According to WHO definition, remote care means “The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of HCPs, all in the interests of advancing the health of individuals

and their communities.” In one word, remote care could overcome geographical and time barriers between health-care providers and patients. GSMA forecast that remote care market is expected to reach US\$5.7 billion in revenue in 2017.

Although remote care might bring about lots of benefits, several key barriers strangle its wide promotion.

- › Firstly, remote care is usually designed as non-profit program for underdeveloped regions, in which the sustainability of financial investment could hardly be guaranteed.
- › Secondly, there's no international legal framework to protect patients' privacy and clarify health care professionals' liability, which means patients and HCPs are both facing risks to receive or provide remote care services.
- › Thirdly, due to linguistic and cultural differences, patients and service providers can't communicate efficiently, particularly in underserved areas such as Africa.
- › Besides, rural hospitals are lack of maintenance support. High-tech equipment for remote care need IT specialists and medical engineers to maintain regularly.

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2.1 Scenario 1: Remote care in underdeveloped regions

Remote care is usually implemented in underdeveloped regions without broadband access, where mobile network is the only way to achieve remote care. Paraíba's program is a typical case in underdeveloped regions. The State of Paraíba, located in north-east Brazil, has 3.7 million inhabitants. In this State, about 70% of the children are cared under the public health system, and many of them live in rural areas with very poor backgrounds. In Paraíba, there is no structured pediatric cardiology, which leads to lack or late diagnosis and treatment for children with heart disease.

In order to improve the early diagnosis rate of congenital heart disease of children, the local government partnered with *Círculo do Coração*, a non-government organization from the neighbor State of Pernambuco, to establish a pediatric cardiology program in October 2011. The pediatric cardiology network connected a specialist team in Pernambuco and 12 largest public maternity centers in the local state. In consideration of immature broadband network in Paraíba, this program used tablet computers with 3G network as the primary communication tools. Physicians in Paraíba examine children and conduct echocardiograms with online supervision provided by cardiologists. When the online specialist is not available for the time being, the whole examination process would be video-taped and reviewed by cardiologist in a timely manner. To reduce travel costs and provide timely treatment, cardiovascular surgeons will go to the pediatric hospital in the state capital once a week to perform heart surgeries. From 2012 to 2014, the pediatric cardiology program have examined 73,751 babies, identified 857 abnormalities, and carried out 330 surgical operations. The diagnosis rate of congenital heart diseases is increased from 4.09 to 11.62 per 1,000 births. By 2014, the program expanded to 21 centers and perinatology services.

In underdeveloped regions with limited infrastructure, most remote care pilots are non-profit, sponsored by non-government organizations or local governments. Several pilots have proven to be useful, feasible, and sustainable, but due to lack of continuous funds, remote care in underserved regions has not been promoted widely.

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2.2 Scenario 2: Remote care in ambulance

The advanced ICT is also used to facilitate early diagnosis and treatment for emergency patients not yet arriving at the hospital – usually on ambulance. In several countries, emergency system will dispatch ambulance crews rather than doctors to deliver the patients. On-site treatment will not be provided during the delivery process. But for some urgent diseases such as myocardial infarction, the sooner the diagnosis is conducted, the better the prognosis will be.

In Norway, ambulances are equipped with electrocardiography (ECG) capture and transmit devices. After receiving the images, cardiologists in hospital can immediately diagnose and prepare for further treatment as soon as the patient arrives. Remote connecting and consulting with cardiologists significantly improve the paramedic's medical care. The tele ECG system shortens the time between the emergency call and the treatment, resulting in faster treatment and better outcomes. The tele ECG has been continually funded by Norway government since 1995 after its initial pilot, with plans to be available in all districts of Norway between 2015 and 2020. In addition, several regions such as Texas in the US, Melbourne in Australia and Berlin in Germany have similar solutions. The ambulance are equipped with computed tomography (CT) scan, which could take examination timely for patients with stroke.

Remote treatment and patient's data collected during emergency rescue significantly improve critical patients' survival rate and cure rate. At the same time, the patients' real-time data collection and record would be very important for the hospitals and ambulance operators, in case the medical disputes happen. Convincing related parties to provide mobile solution in the ambulance is an opportunity for revenue increase in the short term.

2.3 Scenario 3: Surgical system with mobile network

Combined with advanced robotic technology, remote care will experience increasing development. Market research firm MarketsandMarkets reported that the global medical robots market is expected to reach US\$11.4 billion by 2020 from US\$4.2 billion in 2015, at a CAGR of 22.2%¹⁸. As the representative of the surgery robot, da Vinci System facilitated a magnified 3D high-definition vision system. It is powered by robotic technology that allows the surgeon's hand movements to be translated into precise movements of tiny instruments inside the patient's body. Tiny wristed instruments bend and rotate far greater than the human hand. With da Vinci Surgical System, surgeons operate through just a few small incisions. Currently, the surgeons operates the robot via a control platform, which is located near the operating table. In the near future, we could imagine that the control platform and surgery robot are available in different hospitals with far distance. All the realtime data transmission could be achieved through nextgeneration mobile network.

2.4 Implications for MNOs in remote care market

MNOs could provide solutions to solve the problem of uneven distribution of medical resources, improve emergency performance to increase patient survival in scenarios like underdeveloped areas (with no broadband coverage) and medical rescue services, based on their advantage in terms of mobile network connectivity.

From the business model perspective, the majority of these applications are non-profit pilots. Payers could only be the government, relevant medical institutions, as well as some social welfare organizations. For some applications, MNOs may be unable to provide highmargin services directly. However, it may help mobile operators to promote and deliver next-generation network services in these areas. Remote care in emergency has much more demand everywhere. MNOs should cooperate with HCPs to lobby the government to equip more ambulances with remote diagnostics and treatment machines, which could significantly improve critical patient survival rate and cure rate.

Convincing related parties to provide mobile solution in the ambulance is an opportunity for revenue increase in the short term.

For some applications, MNOs may be unable to provide highmargin services directly. However, it may help mobile operators to promote and deliver next-generation network services in these areas.





Managing the m-Health journey

Objectively speaking, the development of m-health is still constrained by limitation of business model, technology, laws and regulations.

› Business model:

- › For those who suffer from chronic diseases and have a rigid demand for m-health, most medical expenses are paid by government/public fund. Patients are less likely to pay if healthcare is provided in a direct B2C mode, which means patients bear the full cost of medical service.
- › On the other hand, for government/public fund to accept m-health and be the major service payer, further validation of m-health's medical and economic value is still needed.

› Technology

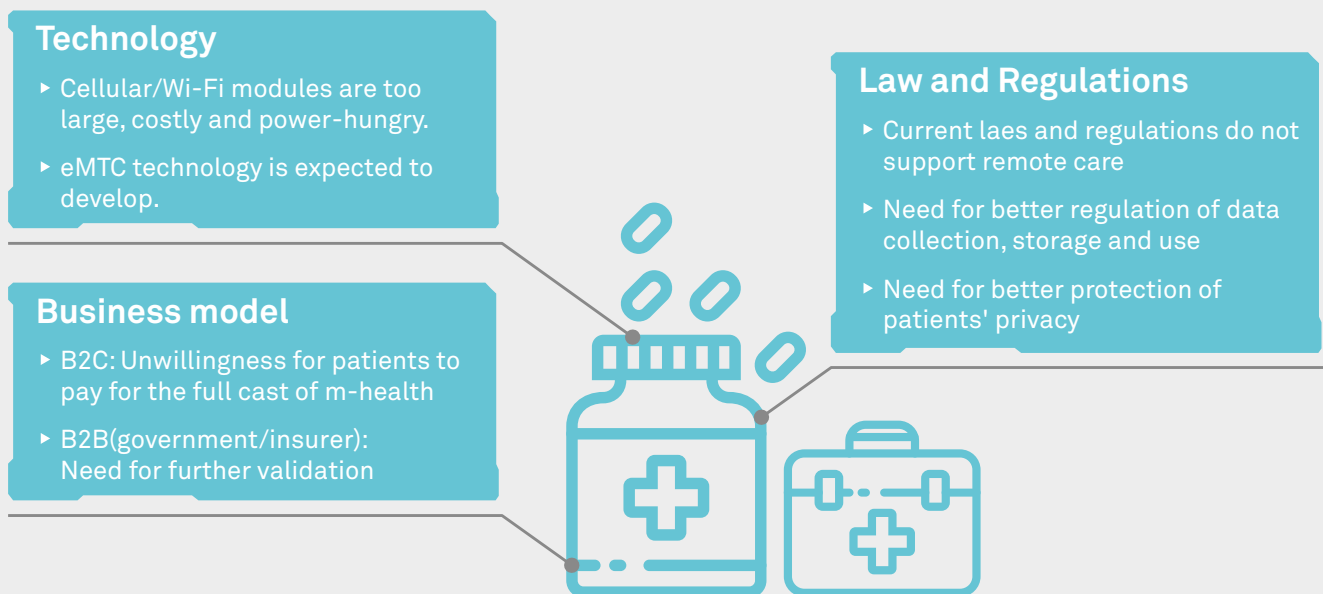
- › Cellular and Wi-Fi modules are too large, too costly and too power-hungry for most wearables. As a new technology in the IoT field, eMTC (enhanced Machine-Type-Communications) supports

connectivity of low-power devices in the wide area of cellular network. As technology advances and business scenario enriches, eMTC is expected to develop along with the LTE protocol, and technology will drive the development and application of wearables.

› Law and regulations

- › In most countries and regions, current laws and regulations do not support the application of remote care. Limited to pure consultancy rather than actual diagnose or treatment, online healthcare service can hardly reduce the operating load of medical institutions.
- › Both remote monitoring and remote care will have to visit large amount of patients' confidential data. How to regulate the collection, storage and use of data, as well as protect patients' privacy, is yet another challenge for policymakers.

Figure 9: Limitations on the development of m-Health



In addition, health care is usually considered as a domain with high-level specialization, which is hard to enter for many players. But MNOs still have a number of unique advantages that would enable them to play a significant role in the m-Health ecosystem. The mobile network with features such as broad coverage, high stability and high security enables the health care services in underdeveloped regions and emergency rescue in ambulance. In addition, the capability of network resource allocation and existing powerful call centers enable the value-added emergency services for specific groups. Beyond technology advantages, the huge customer bases and close relationship with governments are essential resources, which would help to attract other stakeholders.

Based on analysis of customer demand, technology difficulty, business model maturity, and challenges from political and regulatory perspectives, we suggest that MNOs take a progressive strategy for m-Health business development.

- In the short term, MNOs could leverage their advantage in network and call center to provide end-to-end solution of remote monitoring for specific groups. As solution providers, MNOs could use the “open door” strategy of developing platforms for all

device providers. The SIM card for safety purpose could be sold to the children, elderly people and also outdoor enthusiasts. After purchasing SIM cards from providers, customers should be able to activate services such as tracking, emergency service, etc. At the same time, MNOs could proactively cooperate with government, hospitals to promote the emergency remote diagnosis and treatment in ambulance with high-performing network.

- In the mid-term, based on data collected from different groups and sources, MNOs could develop data analysis capability, and contribute to health risk control and disease prevention. On the other hand, MNOs could cooperate with professional agencies and key stakeholders in lobbying governments/ public funds to accept m-Health as regular treatment solutions in chronic disease management. Meanwhile, MNOs can develop more sustainable business models for m-Health services.
- In the long term, based on highly reliable and high-performance next-generation network, more applications such as remote surgery and better business models could emerge, which could even extend to other business.



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based on data collected from different groups and sources, MNOs could develop data analysis capability, and contribute to health risk control and disease prevention.

Figure 10: Roadmap for MNOs to play a valuable role in m-Health

	Short	Mid term		Long term
	Remote monitoring for specific groups	Remote monitoring for the healthy	Remote monitoring for chronic diseases	Remote care for all
Customer demand	<ul style="list-style-type: none"> ▶ Safety, e.g.e-call on people 	<ul style="list-style-type: none"> ▶ Better life quality, e.g remote monitoring for daily health data 	<ul style="list-style-type: none"> ▶ More awareness and control of health status ▶ To save time and cost 	<ul style="list-style-type: none"> ▶ Access to medical service, e.g., in the undeveloped areas, or remote surgery
Government/ Insurer demand	<ul style="list-style-type: none"> ▶ Better service for emergency, e.g. remote diagnosis on ambulance 		<ul style="list-style-type: none"> ▶ Higher efficiency of healthcare system ▶ Lower cost 	<ul style="list-style-type: none"> ▶ To provide more medical service with limited resource
Products/ Services	<ul style="list-style-type: none"> ▶ Voice/data plan for emergency service 	<ul style="list-style-type: none"> ▶ Telemedicine service 	<ul style="list-style-type: none"> ▶ Telemedicine service for all 	<ul style="list-style-type: none"> ▶ Data plan ▶ Telemedicine service
Role of businesses	<ul style="list-style-type: none"> ▶ Solution provider ▶ High quality network provider 	<ul style="list-style-type: none"> ▶ Solution provider ▶ Telemedicine service provider 	<ul style="list-style-type: none"> ▶ Solution provider ▶ Telemedicine service provider 	<ul style="list-style-type: none"> ▶ network provider ▶ Solution provider ▶ Telemedicine service provider
Network requirement	<ul style="list-style-type: none"> ▶ 2G-4G 	<ul style="list-style-type: none"> ▶ 3G-4G 	<ul style="list-style-type: none"> ▶ 4G-5G 	<ul style="list-style-type: none"> ▶ 4G-5G

In this report, we discussed the potential opportunities for MNOs in two vertical markets of m-Health – remote monitoring for chronic disease management and wearables, and remote care in three scenarios. We analyzed the ecosystems, key players and current business models for each market and gave suggestions to MNOs, e.g., take open-door strategy in wearable

markets for both specific groups and healthy people. Considering regional policies and regulations, market environment and different strategies of MNOs, we hope this report could stimulate your inspiration to explore or create more use cases, leading us to a new era of health care.

Acknowledgments

This report provides a unique perspective in analyzing MNO's new business proposition and addressable market based on the value chain analysis of m-Health. The paper points out a new way on how the health industry could realize digital transformation by leveraging the capabilities of MNOs.

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X Labs is a brand-new platform designed to get together telecom operators, technical vendors and partners from vertical sectors to explore future mobile application scenarios, drive business and technical innovations and build an open ecosystem. X Labs have set up three laboratories, which aim to explore three major areas: people-to-people connectivity, applications for vertical sectors and applications in house hold.



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