Mobile Technology's Promise for Healthcare

In collaboration with **tmng global** and **CSMG**
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Contents

Foreword

Mobile healthcare presents one of the largest growth opportunities for GSMA's member companies. In Europe, where the healthcare sector expenditure accounts for just under 8% of the GDP, the population is aging, chronic diseases are on the rise and there is a threat of skill shortages, mobile network operators can help deliver significant cost savings, improve the efficiency of healthcare industry, quality of service for patients, and benefits to the society.

MNOs have a number of unique assets, which gives them an important role at the centre of the mHealth ecosystem. Automation of simple health care processes through SMS applications and the use of mobile to enable remote patient monitoring are service examples that are already commercially available in developed markets. Expansive geographic coverage of mobile networks enables the delivery of healthcare services into the most remote and hard to reach areas, while the ubiquity of mobile devices provides a large addressable market for mHealth applications. What is more, embedding mobile modules into a variety of medical devices will leverage MNO assets such as security of data transfer, quality of service and close relationships with consumer and business end-users.

The time is right for MNOs to establish a bigger presence in the mHealth sector, which has already attracted a variety of companies, including equipment and device manufacturers, technology start-ups and software application players, such as Google and Microsoft. Several GSMA member MNOs have recently launched divisions dedicated to mHealth and are now trialling various mHealth devices, services and applications.

In order to achieve the full potential of mHealth, it is crucial to establish mutually workable rules, regulations and best practices that will allow the mobile and health care industries to reach high levels of adoption. Most existing mHealth services today are provided over vertically integrated systems based on proprietary standards and solutions. This model cannot deliver the scale and cost efficiencies required by the healthcare and mobile industries. Thus, GSMA and its MNO members are working to establish the foundation for the open mHealth ecosystem that promotes interoperable solutions and partnerships. As part of the GSMA's market evangelisation goals, this paper by CSMG provides a set of frameworks to evaluate the mHealth opportunity and some of the key challenges to be overcome. In parallel, mobile and healthcare industries will need to work together to dismantle the regulatory and technical barriers to the growth of mobile health, and on both sides, develop viable commercial models.

Alex Sinclair
Chief Technology and Strategy Officer, GSMA

Healthcare systems around the world face unprecedented challenges as healthcare spending surpasses national health budgets. Wireless technology will enable new high value healthcare delivery to mitigate some of these rising costs and embedded wireless devices will provide the platform, to create large market opportunities for a variety of potential players.

Embedded mobile technology and the widespread availability of mobile broadband networks are enabling a transformation of healthcare providing benefits never before imagined. Clearly the mobile industry is accepting the healthcare challenge as carriers, device manufacturers, system integrators, software developers and new start-ups begin to take an active and often leadership role in this transformation.

One of the biggest challenges for the healthcare industry, which the mobile industry must understand and appreciate, is the immense difficulty in providing healthcare to an aging population, with a rising incidence of chronic conditions. Equally challenging are the shortage of healthcare workers and the rising cost of healthcare delivery. Advances in healthcare technology, particularly in the broader mobile technology world, can significantly aid healthcare providers in addressing these challenges by improving patient coverage, monitoring, diagnostics and hospital management.

This paper focuses on Western and Eastern Europe and presents the main drivers of the mobile healthcare market. The revenue potential of mHealth for the European markets – $5.8bn by 2014 – presents an attractive opportunity for the mobile sector. However, MNOs will need to work hard to capture more than a small share of this total and expand their role beyond data transmission.

We also identify the challenges the mobile industry faces in developing mHealth solutions and bringing them to market. In the mobile healthcare value chain, device manufacturers, software developers and network operators must align their product and service offerings with existing healthcare systems or there is a danger of outpacing healthcare business models and the realities healthcare providers face every day. As an example, wireless devices may be available, but need clinical validation in the market. Finally, we believe that companies which make mHealth part of their core business will provide a valuable contribution to healthcare and create new sources of revenue if the products and services they provide are customer-focused, secure, authenticated, reliable, resilient and available.

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Executive Summary

Recent developments in embedded mobile technology and devices are beginning to provide a number of important benefits to healthcare organizations, intermediaries and society. As will be discussed in this paper, the benefits are not only information related (i.e. providing patients/ individuals with the necessary information to manage their lifestyle and health), but also and more importantly extending the reach and quality of healthcare services by facilitating more complex operations such as tracking of chronic patients, remote diagnostics and monitoring. Easy to use mHealth devices and applications, and efficient and secure healthcare services will facilitate monitoring of patients and help provide greater value to the patient.

Mobile healthcare services and applications demonstrate a clear benefit to all players in the value chain, ranging from MNOs and device manufacturers to patients. Mobile healthcare can provide significant savings for public and private health systems, whilst generating incremental revenue for device manufacturers and mobile network operators. However, business models that maximise both these principles are still in development and may be highly complex.

CSMG estimates that across Western and Eastern Europe, the mobile health market is currently worth $1.9B. However this still accounts for less than 1% of the European expenditure on healthcare. This is forecast to grow at a compound annual growth rate of 25% to reach $5.8B in 2014. Some portion of this amount will be available to mobile network operators and service providers, depending on the choice of a business model and the extent of their role in the mHealth value chain. Since mHealth can deliver significant productivity gains and cost reduction to the healthcare expenditure, even a small share of the gains available to insurance companies, government healthcare systems and healthcare providers can significantly boost the MNO mHealth business case.

In addition to financial incentives, mobile healthcare can deliver secure high-quality solutions and facilitate better overall patient care and working conditions for healthcare professionals. By minimising the time healthcare professionals lose in delayed test results, misplaced records, and missed appointments, mobile healthcare technologies can maximise productive working hours and mitigate the effects of ongoing labour shortages.

Similarly, mobile healthcare services and applications can aid in providing better preventative care and monitoring of chronic conditions. These in turn lead to a population that is healthier overall and a system that has fewer inefficiencies and lower costs. Thus, mobile healthcare enables rapid response information management, better communications and coverage for patients and the public, and improved care and treatment for all as well as broader benefits to society. These broader benefits could possibly include improved life expectancy, better management and insights into epidemics and diseases, improved information sharing on treatments and reduced absences from work. In summary we can create a smarter, healthier society.

Although the benefits of mobile healthcare are clear, processes and systems must be carefully managed to optimise efficiencies. There are several key challenges to consider in developing mobile healthcare solutions. A successful solution will need to overcome the challenges such as ease of use and clear demonstration of benefits versus costs. These challenges should be able to be overcome through careful planning and design.

The mobile industry needs to take to steps to address these challenges and establish its position in the mobile healthcare value chain. These include:

- Developing a clear understanding of the role operators wish to play in the mobile healthcare value chain
- Establishing partnerships to create an open mHealth ecosystem
- Working with the governments and regulators to provide "mHealth friendly regulatory environments" and eliminate any concerns about data privacy
- Developing business models to show clear benefits to healthcare organisations in introducing mHealth solutions
- Demonstrating the ways that mobile healthcare can integrate into the existing healthcare workflow
- Proving the reliability of mobile healthcare solutions

Introduction

Imagine that you've gone to see your GP (General Physician or Primary Care Physician) with chronic abdominal pain. Your GP sends you for some lab tests in order to confirm the preliminary diagnosis and asks you to make an appointment to review the results. The next available appointment for an X-ray is in 7 days and the next appointment to review the results with your GP is 5 days after that. On the day of the GP appointment, the doctor's office realises that it hasn't received your X-ray from the hospital and that the next available appointment is in another 10 days. You suffer through the next 10 days but are at least pleased that your GP will have had plenty of time to receive and the review the results. On the day of your appointment, you spend 30 minutes waiting at the doctor's office and then 10 minutes with the GP, only to be told that her initial diagnosis was correct and that you are being referred to a consultant/specialist. A week later, you receive a referral from the consultant's office confirming an appointment in two weeks' time, 43 days after you initially saw your GP. What if mobile technology could eliminate all the waiting, lack of coordination, and miscommunication?

Mobile healthcare solutions range from relatively easy-to-implement solutions to complex integrated ICT systems. Examples from around the world indicate a strong business case with rapid return on investment, plus substantial improvements in quality and efficiency.

First and foremost, mobile healthcare can improve geographic coverage by providing information and connectivity to healthcare professionals anytime and anywhere. Healthcare professionals can use non-integrated systems, such as laptops with mobile broadband, to link emergency response teams and field personnel to a doctor's office or hospital. Alternatively, healthcare-specific applications can enable secure access to information without being tied to an office or desk. Lastly, mobile technologies can aid hospitals and healthcare professionals in reducing paper consumption and waste by digitising complete patient records and histories. This in turn reduces the risk of error and lost information. Such improvements in information sharing facilitate faster diagnoses and treatment, better management of doctors' time, and expanded access to healthcare information for field workers.

Simple mHealth Solutions: SMS Appointment Reminders

Recent studies of the UK National Health Service (NHS) have identified major cost inefficiencies. London's Imperial College calculated the direct cost of missed appointments in England, excluding indirect costs associated with illnesses that become more severe due to lack of treatment, was £789M in 2006[1]. A service that sends patients SMS appointment reminders could greatly decrease the number of missed appointments, thereby maximising efficiency and reducing waiting times for hospitals.

Benefits for Healthcare Organisation: Better attendance at appointments, meaning higher physician utilisation.

Benefits for MNOs: SMS revenues from large volumes of text messages.

Advanced mHealth Solutions: Remote Monitoring

More advanced remote monitoring, involving devices that monitor blood sugar levels or heart rates and then transmit that information wirelessly to a physician, can also dramatically improve healthcare. A study of patients in the US with chronic heart failure found that remotely monitored patients had fewer and shorter hospital stays than a control group[2]. Another US study published by the Center for Technology and Aging noted that remote monitoring of patients with chronic heart failure could reduce re-hospitalisations by 72%[3]. Given the increase in heart disease and other chronic conditions in the last decade, remote monitoring represents both a large market opportunity for device vendors and network operators, and a major source of cost and efficiency improvement for patients, insurers, and healthcare professionals.

Benefits for Healthcare Organisation: Reduced costs through monitoring of patients at home rather than occupying a hospital bed.

Benefits for MNOs: Revenue from monthly service charge including data transmission as well as device sales or rental.

Regulatory mHealth Solutions: Patient Privacy Protection

Mobile healthcare solutions can also assist healthcare professionals, insurers, and patients in meeting privacy/confidentiality requirements for patient data. One of the recommendations of the Caldicott Report in the UK[4] has been to develop protocols to protect the exchange of patient-identifiable information between NHS and non-NHS bodies. As an example, prescription transfers between a GP's portable device and a chemist/pharmacist could be sent using encrypted data with logins that allow only registered personnel to access the prescription and patient information. Similarly, patients picking up prescriptions could have authentication applications on their mobile devices to ensure they receive the correct prescriptions.

*Benefits for Healthcare Organisation:* Regulatory compliance.

Benefits for MNOs: Monthly service charge, including data transmission, as well as incremental fees for encryption.

Understanding the Healthcare Challenges: Aging Population and Shortage of Healthcare Workers

Healthcare providers around the world are seeking to manage the needs of rapidly growing, and aging, populations whilst controlling costs, maximising efficiency, and reducing delays in treatment time. Although providers and patients in both developed and developing countries grapple with many of the same issues, they face significant differences in terms of needs and priorities. For much of the developing world, expanding coverage and accessibility to large swathes of the population is key, whilst efficiently providing treatment is the primary concern for the healthcare industry in developed countries. This paper addresses mobile technology's impact on potential healthcare challenges in developed countries and its benefits to society.

The major challenges for healthcare in developed countries are an aging population, coupled with rising incidence of chronic conditions, increasing costs associated with treating an older and less healthy population, and a shortage of healthcare workers. Chronic conditions already account for 52% of GP visits in the UK. This number is projected to rise with increasing incidence of chronic diseases, particularly diabetes, hypertension, cardiac conditions, kidney disease and chronic obstructive airways diseases (COADs).

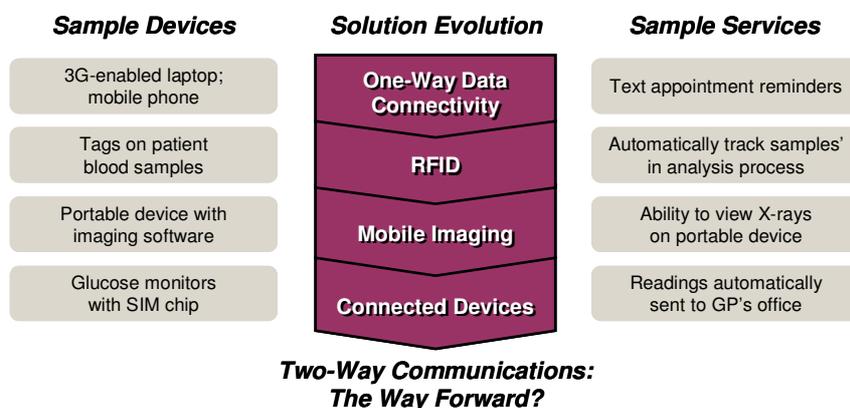**Figure 1: Number of People with Diabetes (2000-2030)**
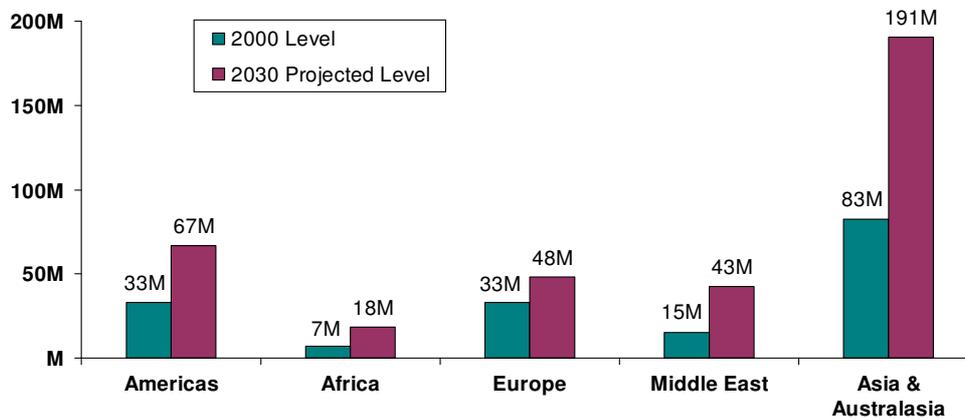
Source: World Health Organisation (2004)

In this environment, healthcare professionals will struggle to contain costs and maintain high quality diagnostic and ongoing care amidst qualified labour shortages. In 2007, the healthcare accounted for 7.9% of Gross Domestic Product in the European region (source: WHO Regional Office for Europe), translating into more than $1.5 trillion in public and private expenditure. Advances in healthcare technology, particularly in the broader mobile technology world, can significantly aid healthcare providers in addressing these challenges by improving coverage, patient monitoring and diagnostics, and hospital management.

Mobile Healthcare: Benefits for Healthcare Processes

Mobile health encompasses workflow services, applications, and networks used to optimise healthcare services, as well as devices designed specifically for mobile or portable healthcare usage. A service that sends SMS appointment reminders to patients lies at one end of the spectrum, whilst a remote monitoring device that regularly reports a patient's blood sugar level to the GP's office lies at the other (see Figure 2).

Figure 2: Mobile Healthcare Devices and Applications

Sample Devices	*Solution Evolution*	*Sample Services*
3G-enabled laptop; mobile phone	**One-Way Data Connectivity**	Text appointment reminders
Tags on patient blood samples	**RFID**	Automatically track samples' in analysis process
Portable device with imaging software	**Mobile Imaging**	Ability to view X-rays on portable device
Glucose monitors with SIM chip	**Connected Devices**	Readings automatically sent to GP's office

Two-Way Communications: The Way Forward?

Due to the clear benefits associated with mobile heath care, opportunities abound to implement solutions for specific conditions and generalized needs. Figure 3 lists a number of specific applications for mobile healthcare solutions.

Figure 3: Examples of Key Mobile Health Solutions

Goal	Use Case	Justification
Diabetes monitoring	Remote sensors attached to glucose monitors can automatically transmit data to GP's surgeries via cellular networks and provide early warning of any abnormalities	Diabetes continues to rise at a rapid rate worldwide. t+ Medical has estimated that in the UK, the NHS could save ~£1B annually by reducing patient visits to GPs for diabetes
Asthma monitoring	A mobile phone application that allows patients to input readings from peak flow meters and transmits the data directly to GP's surgeries can provide consistent baseline data	Asthma and other COADs are among the most common diseases around the world. Consistent peak flow monitoring assists doctors in deciding when patients need medication
Medication compliance	Medication bottles with embedded mobile modules and SMS medication reminders can alert doctors and/or patients when a dose has been taken or skipped	Studies in South Africa and Thailand have shown medication compliance increasing under 50% to 90% through use of this technology[5]
Information dissemination	Interactive SMS services with questions on topics like swine flu, sexual health, etc. can direct patients to receive appropriate medical care based on their responses	Mobile technologies enable better communications with specific audiences (e.g., young women under 24 for Chlamydia screenings), and are already in use by many healthcare providers
E-prescriptions	Prescriptions can be signed and transmitted electronically directly from a doctor's surgery (or mobile device if out of office) to a patient's registered chemist	Offers benefits through reduced errors and loss of prescriptions. Also increases efficiency and accuracy of systems
Mobile imaging	Healthcare professionals can access patient test results and images anywhere, anytime	Assists remote workers and allows for improved patient care
Generic remote monitoring	Real-time data (e.g., foetal heart rate, cardiac monitoring) can be shared with healthcare professionals for both inpatient and outpatient services	Ideal for medical professionals who may not be in the ward or surgery all day. Provides sufficient data to enable early warning systems
Asset management	Tracking of assets such as patient samples can free nurses' time and improve turnaround times for testing, etc. Many additional uses exist for this technology	Offers greater efficiency through reduction of errors, fewer lost samples, fewer unused beds, etc.

In addition to these solutions, the appearance of the healthy lifestyle market segment is giving rise to a new range of wearable self-monitoring devices (e.g. pedometers and calorie counters). These may not be technically classified as medical devices, but are beginning to stimulate greater technological advancement as they can contribute to preventive healthcare in developed markets. Similarly, the appearance of new mobile applications facilitates and reduces some of the cost burden from the traditional healthcare sector.

Advantages of Mobile Healthcare for Patients

Mobile healthcare can deliver a number of important advantages that span a wide range of potential uses. These advantages fall into 3 main categories; i) better communication with patients, ii) improved care and treatment, and iii) broader benefits to society.

Better Communication with Patients

Mobile communications can greatly increase public awareness of health issues. An initiative in Uganda sent out an SMS quiz on HIV awareness, which resulted in a 40% increase in people requesting free HIV/AIDS testing[6]. In the UK, the NHS could take this a step further by adding SMS to the National Pandemic Flu Service's existing online and telephone resources. Similarly, the NHS consultation phone line (NHS Direct) could send an SMS after a phone consultation, directing patients to the nearest clinic or surgery based on their responses.

Simple programs like SMS reminders for patients taking medication on a regular basis have shown dramatic improvements in compliance with treatment programmes. For existing patients, SMS and other mobile communications can allow for closer contact with doctors' offices whilst simultaneously improving a surgery's efficiency. Tighter integration with patient records could produce SMS reminders for a number of routine events, such as appointments, repeat prescriptions, and the need for regular checks (for example, annual blood pressure or cholesterol tests).

Improved Care and Treatment

Mobile healthcare initiatives can provide for better overall care outcomes. Mobile healthcare programmes can not only improve compliance with treatment regimens – they can also ameliorate disease management through automated monitoring and data transmission.

In terms of overall disease management, remote monitoring can play a significant role in data collection and early warning systems, which are particularly critical for patients with chronic diseases such as heart conditions and diabetes. Test kits or monitors that transmit data directly to a physician's office provide a good source of baseline data. Medical software can then be used to analyze a time series of data and identify abnormalities or early signs of a worsening condition.

Broader Benefits to Society

Finally, not only will patients benefit from improved access to information, better care and treatment and improved communication, but mHealth will translate into broader benefits to society. These broader benefits could include; (i) improved life expectancy (ii) quicker diagnostics of potential epidemics and management of associated risk (iii) better insight into the causes of certain diseases, (iv) greater and quicker information sharing to identify appropriate treatments, (v) reduced absences from work. In summary we can create a smarter, healthier society.

The Mobile Healthcare Value Chain

Six major segments in the mobile healthcare market will be working to deliver the above mentioned benefits to healthcare organisations and patients: device/chip vendors and manufacturers, software and application developers (including IT systems integrators), network operators, healthcare professionals, healthcare insurers (including government health systems), and patients. Each of these segments and sub-segments has distinct, albeit overlapping, needs, which result in varying approaches and business models to extracting market value.

Figure 4: Mobile Healthcare Value Chain in the UK
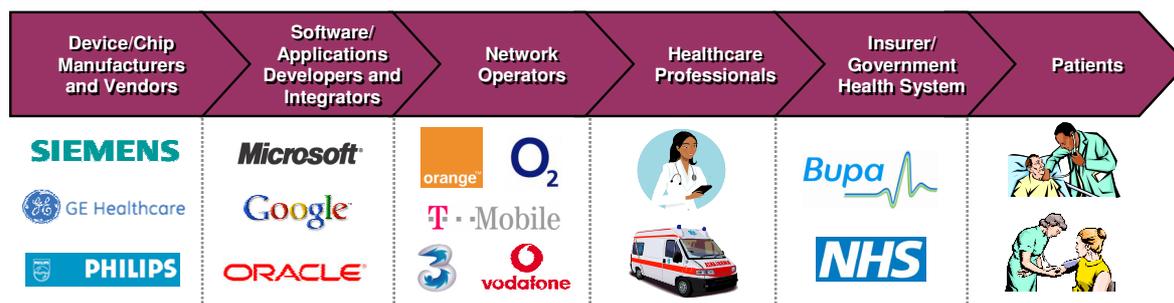
Hospital administrators are likely to be most concerned with maximising the return on investment for mobile healthcare technology, whilst doctors and patients will place more importance on rapid diagnoses and patient monitoring. Insurers lie between healthcare professionals and patients, and focus on providing the most cost-effective care with minimal follow up treatments. Whilst players at the beginning of the value chain, namely software and device vendors and network operators, are focused on revenue generation, those at the end focus primarily on quality of care and cost effectiveness. Although business models for mobile healthcare are heavily dependent on relationships with both the patient and insurer, effective adoption of mobile technology can provide competitive advantages, as well as economic efficiency gains, to all players within the value chain.

Critical to the success of the mHealth industry is the establishment of an open ecosystem within the value chain with multiple players delivering parts of the overall, highly specialized, solutions. Network operators' central place in the ecosystem ideally enables them to establish such an open ecosystem, reducing industry fragmentation, delivering interoperable healthcare solutions and thus accelerating the adoption of new services and attracting higher levels of investment into the mHealth sector.

MNOs bring many potential assets to the mHealth market. Their core entry point into mHealth is their 3G mobile broadband network coverage (and soon 4G). However, they also possess a number of other key assets: emerging M2M experience, collaboration experience, strong consumer brands, large customer bases, and broad retail distribution footprints. The latter are key to providing healthcare self-management tools to consumers. MNOs are also best positioned to provide such services as authentication and security, as well as billing and customer care on behalf of healthcare organisations.

MNOs can occupy a key place in the mHealth ecosystem, but need to assess the risk/reward relationship in moving beyond their core business focus of providing network connectivity. Collaborative strategies will inevitably vary by mHealth solution area and be critical to moving MNOs higher in the value chain.

The Opportunities in Mobile Healthcare: Network Operators & Healthcare Organisations

Total mHealth Opportunity

Cost savings are widely seen as the main opportunity arising from the introduction of mobile health services. Insurance companies, government healthcare systems and healthcare professionals will be the main beneficiaries of the reduction in costs of patient services and process efficiencies. However, given appropriate business models MNOs could capture a significant portion of the value delivered to the healthcare sector, most notably through the introduction of remote patient monitoring solutions.

In Europe, the total inpatient expenditure in 2006 was as high as $600bn, or 40% of the total healthcare expenditure. If replacement of hospital stays with home care remote monitoring solutions saves healthcare providers as little as 2% of this total, capturing 20% of this value could translate into a $2.4bn revenue opportunity.

CSMG estimates that across Western and Eastern Europe, the mobile health market is currently worth $1.9B, accounting for less than 1% of the European expenditure on healthcare. This is forecast to grow at a compound annual growth rate of 25% to reach $5.8B in 2014. The forecast excludes mobile operator voice revenue, for example, generated by mobile phones issued to doctors for paging and on-call purposes, but includes the revenue from connectivity services, such as messaging solutions or data transmission, end-user service revenue, device and application revenues.

More specifically, the forecast includes revenue from the following:

- Remote patient management
- Personal emergency response systems (PERS)
- Mobile personal monitoring

- SMS appointment reminders and other messaging solutions, although this doesn't require embedded mobile technology
- Imaging software to view X-rays on portable devices
- Placement of M2M modules on hospital beds to monitor usage, etc.

Figure 5: European Mobile Healthcare Revenues ($B)
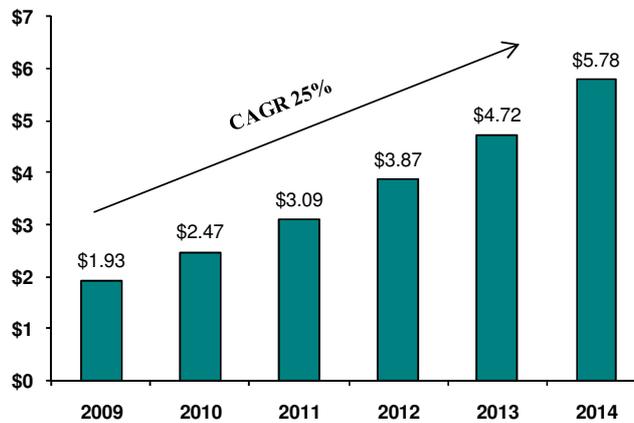
Source: CSMG analysis

From a mobile operator's perspective, the connectivity services represent the main source of mHealth revenue today. However, in some of the existing mHealth services, connectivity accounts for as little as 5% of the total revenue. CSMG estimates that by 2014, MNOs will be able to capture 15-20% of the revenue. However a larger opportunity will be available if they can establish themselves at the core of the mHealth ecosystem rather than as pure transport players.

Thus, MNOs will need to consider a range of additional services to capture the value of healthcare savings. Potential revenue services include reselling portable consumer health devices, charging a set up and monthly service fee associated with devices, similar to satellite / cable TV companies which lease set top boxes. Other revenue sources can include setting up monthly billing relationships for end-users, for example, for personal emergency response systems (PERS), as well as such IT services as user authentication, network performance monitoring and device management delivered to healthcare organisations.

Ultimately, the size of the revenue available to mobile network operators and service providers will depend on the choice of a business model and their role in the mHealth value chain.

Opportunities for Network Operators: Deciding on the Choice of a Business Model

Within the consumer market, MNOs could collaboratively develop and offer branded or co-branded mHealth solutions to their customer bases. For instance, MNOs could offer a basic version of PERS as an add-on to existing wireless subscriptions, leveraging either specially designed handsets/wearable devices or always-on software on higher-end Smartphone devices. Given current pricing for PERS at $30 per month on average, MNOs would have significant room to penetrate this market. However, this could expose them to new risks, such as regulatory compliance requirements.

MNOs have numerous opportunities to support mHealth solutions within hospitals, physician practices and through home healthcare providers. The key question is not what but how.

MNO as a connectivity provider: First and foremost, MNOs have the opportunity to earn recurring monthly revenue streams for the large range of emerging connected mHealth devices. As the number of devices, such as body sensors, proliferates, the revenue growth could be significant.

MNO as application and solution provider: At a much higher level of involvement, MNOs could leverage mHealth applications as part of an enterprise vertical differentiation strategy that could drive pull-through for core enterprise wireless business. This would require identifying individual software solutions and bundling them as part of a mobile health-centric enterprise offering, including voice, messaging, data access, security, etc. Such solutions could include extensions of current clinical software solutions or standalone solutions that facilitate mobile prescriptions or mobile telemedicine. Converged solutions could include in-building WiFi/WAN asset tracking as well as mobile health information systems.

MNO as an application and solution reseller: Alternatively, MNOs could strike preferred reseller deals with other players in the mHealth value chain. To avoid missing the opportunity for a more central position in mHealth delivery models, MNOs could take on an increased share of risk and upside by taking on lead collaborator or co-collaborator positions in enterprise solutions. For instance, MNO could partner with vendors of RFID tags, remote m-health sensors/systems and developers of analytical software to sell branded mHealth solutions directly into enterprise.

Conclusion: Challenges and Next Steps

There are several key challenges to consider in developing mobile healthcare solutions and delivering the promised mHealth benefits.

Whilst mobile healthcare can provide incremental revenue for network operators and vendors, the consumers of healthcare services (namely healthcare professionals, insurers, and patients) are more concerned with its impact on the system itself. Thus, a successful solution will need to overcome the following challenges which can be effectively managed through careful planning and design:

- mHealth devices and services must be easy to use and provide clear benefits
- mHealth solutions need to be tightly integrated into existing healthcare professionals workflow
- The cost-benefits of the mHealth solutions need to be clear
- mHealth solutions must comply with all necessary privacy obligations
- mHealth solutions must demonstrate the reliability of their connections

Ultimately, mobile healthcare services and devices are only effective if adopted by healthcare professionals and patients. Healthcare solution providers must therefore focus on developing products and services that are easy to use, without additional layers of complexity. Healthcare professionals must see clear and immediate benefits from any new device before adding it to an already bulging doctor or nurse's bag. Devices (such as smart phones that allow mobile access to patient records and contain imaging software) can improve healthcare worker efficiency and also make doctors' and nurses' jobs easier, thereby mitigating chronic labour shortages and increasing employee retention. Similarly, devices that are easy to use are most likely to facilitate patient usage and encourage adherence to treatment programmes.

At the same time, highly usable devices still face a major challenge from established vertically integrated technologies used in existing systems. Ease of integration with existing systems is a critical selling point for hospitals and healthcare professionals, which emphasises the need to establish open interoperable systems. It is understandably easier for a hospital, insurer, or heath care professional to launch a modular component of a healthcare system rather than replace the entire system itself. Yet, even modular components require clearly defined policies and work flows to facilitate integration and uptake. For example, a hospital that provides doctors with mobile smart phones without eliminating pagers must consider protocol of contact in an urgent situation.

A third challenge to mobile healthcare adoption is cost-effectiveness. Mobile healthcare solutions must demonstrate an unambiguous return on investment with visible improvements to efficiency and patient care. Vendors and network operators need to work with healthcare professionals and insurers to develop and prove the business case for their solutions. Research in Motion recently conducted a study with a leading Canadian healthcare organisation to assess the impact of a shift from pagers to devices that enabled two-way communications within a hospital. The study found that the use of 2-way devices for mobile voice and text alone freed up 12% of a nurse's time, resulting in an annual savings equal to the work of 192 full-time nurses[7]. However, a further challenge lies in developing business models that work for all players in the overall healthcare value chain. This can often be a significant obstacle due to the complexity and differences in healthcare ecosystems.

The two remaining major challenges both concern the integrity of IT and telecoms networks, particularly with regard to privacy and data/connection reliability. Healthcare professionals must abide by numerous privacy regulations, whilst ensuring data integrity through clear audit trails and reliable connections. Both of these factors can be appropriately managed using existing IT processes, but do require careful consideration of impacts on existing work flows and policies. In the UK, privacy-enhancing technologies such as data encryption, secure private networks, and authenticated log in information can be used, in full accordance with the recommendations of the Caldicott Report[4] regarding patient confidentiality.

Lastly, device manufacturers and network operators must ensure that devices and connections are both reliable and resilient. Serving the healthcare vertical requires additional measures to ensure limited interruption to data transmission and accuracy. For example, network operators could keep secure backups of data whilst maintaining redundant systems that would function in case of a primary network or device failure.

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