Leveraging Consumer-Facing Technologies to Improve Health Outcomes

By applying advanced analytics, healthcare organisations can not only achieve healthy revenue gains but improve patient care.

Executive Summary
Healthcare spending will continue to rise, not only because of inflationary drivers but as a result of growing recognition by policymakers, worldwide, that improved health is inextricably linked to greater national wealth. Keeping the universal healthcare model throughout the European Union (EU) will require rationing of services and consolidation of healthcare facilities, as public resources fall short of demand. Consumer technologies, and consequently healthcare technologies, are becoming ubiquitous worldwide, changing the way we communicate, conduct commerce and provide care and services.

Some of the most compelling benefits of healthcare technologies are in the areas of disease prevention, chronic disease management and improving healthcare delivery. In addition to these benefits, innovative medical technologies, by providing more cost-effective patient care, can also contribute to a more efficient and targeted use of resources in healthcare. This also means an increase in productivity.

Difficult Times
The pharmaceuticals industry is going through a time of dramatic transformation. The pressure to cut costs while maintaining effectiveness has never been higher. The prescribing behaviour of physicians is increasingly being influenced by integrated delivery networks (IDNs), accountable care organizations (ACOs) and government prescribing guidelines. These external influencing factors are amplified by internal constraints, such as maturing portfolios, decreasing product margins, competition from generics, etc.

European healthcare systems are the pillars of the continent’s social infrastructure. Although they differ in terms of operational and financial structure, they share common goals and priorities such as universality, access to quality care, equality and solidarity. More importantly, European states also share common challenges. The first is an ageing population that is having a direct impact on the overarching dependency factor and pathological map of Europe.

It is also important to consider the rise of chronic diseases (for example, diabetes and cardiovascular conditions) that are directly related to unhealthy lifestyles. At the same time, citizens as a whole are receiving better information on healthcare issues, indirectly pushing national health systems to provide them with better quality and safety.
European Healthcare Systems Challenges

European governments face a growing number of major health challenges that place unprecedented pressures on public health systems. As main actors responsible for the delivery and financing of healthcare, generally based on the principle of social solidarity, national governments need to define policies to best address these challenges and mandate the relevant non-health sectors to implement them.

Despite limited competencies with regard to health, the EU can facilitate change by encouraging cooperation among member states to fund health programs and reinforce internal market rules.

The ageing population, health inequalities and the social determinants of health, however, present significant challenges to healthcare systems that in many cases go beyond medical ailments. Ensuring a multilevel and holistic government response will be important in tackling these challenges. The consideration of quality in healthcare requires an examination of the different dimensions of quality, the impact of rationing devices, professional organisations and new models of healthcare delivery.

Preventive measures will become more important as a way of promoting healthy behaviour. The World Health Organization (WHO) noted in 2005 that at least 80% of all cases of heart disease, stroke, and diabetes are preventable. This requires lifestyle changes, which can be influenced through a combination of public education, pricing, taxation, and various incentives and disincentives. In terms of prevention and early detection, most countries are trying to combat chronic conditions by experimenting with various programs. These approaches aim to reduce the burden of chronic disease through activities that avoid impairment to health, or make it more unlikely. Overall, prevention and early detection programs are promising, but far from well-developed in most countries. Given the severe medical, social and economic consequences of chronic diseases, more effort and resources need to be invested in prevention.

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Healthcare Information Technology

Healthcare information technology (HIT) can be defined as ‘technology used to collect, store, retrieve, and transfer clinical, administrative, and financial health information electronically’. Brailer and Thompson explained that HIT can be defined as ‘the application of information processing – through computer hardware and software – to the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making’.3

In accordance with the increased attention to patient care, new devices and technologies have provided more accurate information about patients for better healthcare delivery. Information technology plays a significant and evolving role in managing information.

During the last decades, various aspects of quality management have been introduced into healthcare organizations, and the notion of HIT has arisen as a way to dramatically change the entire healthcare landscape. Healthcare providers have applied diverse technological innovations that have influenced both clinical and administrative aspects of the delivery of medical services. HIT includes a variety of integrated data sources and has been shown as a solution that improves patient safety and reduces inefficiencies. Therefore, HIT has great potential to improve the quality of care, to support healthcare IT infrastructure and to save administrative costs.

A recent NHS England report, ‘The NHS Belongs to the people: a call to action’, discusses a potential £30bn funding gap by 2020/21.4 This report cites the need to focus on prevention, and asserts that to be successful the NHS will need to focus on harnessing transformational technology, exploiting the potential of transparent data as other industries have.

Benefits of HIT

In recent years, greater attention has been paid to the quality of healthcare. Numerous complaints have been aired (publicly and privately) that patients often do not receive proven therapies or preventive measures, and that the rate of preventable medical errors remains high. Healthcare organisations are now focusing on understanding how providers, patients and policies, and the factors they influence, can affect the quality of care. This includes the training of healthcare personnel, improving delivery system processes, and attention to systemic level factors such as technologies and medical records. The specific benefits of HIT are detailed below.

Medical Error Reduction

The Agency for Healthcare Research and Quality (AHRQ) noted that insufficient or improper point-of-care treatment information is a frequent and significant cause of medical errors.5 Communication problems and a lack of access to information can cause most medical mistakes. Therefore, new information management technologies must be implemented and smoothly integrated within the existing healthcare infrastructure. According to studies, HIT also decreased medical errors by improving medication dosing with such treatments as antibiotics and anticoagulants.6,7

Adherence Support

HIT can improve the quality of care by increasing adherence to guideline-based care. Decision support functions that were embedded in electronic health records (EHRs) and computerised physician order entry (CPOE) are parts of adherent studies that show the effect of HIT on enhancing preventive healthcare delivery.

Effective Disease Management

In addition to the benefits mentioned above, HIT systems also offer enormous potential in improving clinical decision-making and disease management. Effective disease management provides healthcare services with analysis of relevant data and cost-effective technology to improve the health outcomes of patients with specific diseases. According to one article, for example, the use of HIT systems was found to increase documentation advice and recommendations for laboratory testing and treatment.8

Efficiency Saving

The pursuit of efficiency has become a central objective within most healthcare systems. Efficiency mandates aim to achieve equivalent performance with fewer resources. Through HIT includes a variety of integrated data sources and has been shown as a solution that improves patient safety and reduces inefficiencies.

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The adoption of HIT, healthcare organizations can potentially reduce healthcare professionals’ administrative time such as documentation-related nursing time, the delivery of treatment through CPOE and reduced hospital stays resulting from increased patient safety and the coordination of patient care.

Remote Patient Monitoring
An increasing number of adults over 60 years of age are challenged by chronic and acute illnesses and/or injuries. A Center for Technology and Aging report explains that ‘chronic disease management, post-acute care management and safety monitoring are three important applications of remote patient monitoring (RPM) technologies for the older adult population’.9 RPM technologies have an important role to play in chronic disease management, slowing chronic disease progression and ensuring continued recovery after the patient is discharged from an acute care setting. RPM technologies could be utilised with alert systems, to prompt intervention from the patient’s physician when preset disease management criteria are met. For example, if a patient’s blood pressure is above a predetermined dangerous threshold for three days running.

The five steps of a remote patient monitoring system are: collect, transmit, evaluate, notify and intervene.

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Telehealth is a healthcare service, consultation and expertise delivered via a telecommunications medium, over any distance. Telehealth adds a new paradigm in healthcare, where the patient is monitored between physician office visits. According to a paper by Noel et al., telehealth has significantly reduced hospitalizations and visits to the emergency room, while improving patients’ quality of life.10 And the Whole System Demonstrator Programme showed that telehealth can deliver a 15% reduction in A&E visits, a 20% reduction in emergency admissions, a 14% reduction in elective admissions, a 14% reduction in bed days and an 8% reduction in tariff costs. More strikingly, they also demonstrate a 45% reduction in mortality rates.11 Telehealth also benefits patients where traditional delivery of health services is affected by distance and lack of local specialist clinicians to deliver services.

The advantages of telehealth services include improvements in patient access to medical data, patient health outcomes and decision-making, and reductions in healthcare costs, travel time, redundant diagnostic procedures or tests and patient waiting time and eventually heightened early diagnostic, administrative, and communication capabilities. Implementation of telehealth could have other non-health-related beneficial impacts. For example, telehealth can lead to reduced travel from both patients and physicians, thereby delivering a greener solution.

The function of a telehealth network is to establish the link between the individual telehealth device and the decision-making unit. This will involve the electronic patient interfaces, repositories that will be required to store generated medical reports, the patients themselves and an amalgam of healthcare personnel, services and providers. For some time now, technologically advanced devices are increasingly being deployed for telehealth. Telehealth increasingly utilises technological advancements in physiological and clinical recording equipment, wireless communications and mobile phone capabilities (both hardware and software apps). Each advancement has led to enhanced telehealth services.
Emerging Healthcare Technology: Supporting Patients Beyond the Pill

Adherence to prescriptions is critical to optimal treatment and outcome. However, taking the right dose of the prescribed medication at the right time can be a challenge, particularly for older patients taking multiple medications. The World Health Organization (2003) defines adherence as ‘the extent to which a person’s behaviour – taking medication, following a diet, and/or executing lifestyle changes – corresponds with agreed recommendations from a health care provider’. Poor medication adherence can have negative consequences for individuals, families and society because it significantly increases the cost and burden of illness.

Wood highlighted that medication non-adherence contributes to 33% to 69% of medication-related hospital admissions and 23% of all nursing home admissions. McDowell and Barnett highlighted that in the UK medication contributes to 5% to 8% of hospital admission and readmissions, of which almost half (approximately 4%) are preventable. A 2010 Department of Health report postulated that poor adherence to medicines contributed a significant amount of the estimated £150m wasted medicines cost the NHS each year. Moreover, the New England Healthcare Institute (NEHI) estimates that $290 billion of healthcare expenditures could be avoided each year if medication adherence were improved.

Medical and health experts have recognised the importance of improving medication adherence in delivering improved patient welfare and in decreasing health costs. Increasingly poor medication adherence is often attributed to an ageing population with a parallel increasing occurrence of chronic conditions, and with many patients being treated for more than one condition. New healthcare technologies are seen as having a key role in improving adherence, leading to improved patient quality of life.

Quick Take

Representative Analytical Use Cases

From a traditional baseline of transaction monitoring using basic reporting tools, spreadsheets and application reporting modules, an IBM Executive Report highlights that analytics in healthcare is moving toward a model that will eventually incorporate predictive analytics and enable organizations to ‘see the future’, creating more personalized healthcare and predicting patient behaviour.

Medication Adherence Propensity Model

- **Business case:** As earlier noted, data shows that as many as 50% of all patients do not adhere faithfully to their prescription-medications. The result is that significant money is spent on unavoidable hospitalizations.

Engaging and supporting patients to increase their adherence is critical for improving health outcomes and reducing cost. In today’s system, however, there are neither the incentives nor the support systems to do so. Investments can be made to create a model that predicts the likelihood of patients not adhering to medication. Based on this, a personalized outreach program can be created that helps such patients.

Predict Future Medication for Better Health Outcomes and Costs

- **Business case:** Alerts are sent to a physician to inform him about a series of studies to demonstrate a connection between multiple rare mutations found in 10% of people and the likelihood that they might convert to type 2 diabetes. The physician has electronic medical records with the genome sequence of all his patients and runs a quick search (back-end analysis) and finds about 80 who are at risk. To 50% of patients, the physician sends a strong reminder and advice on diet and lifestyle choices they can adopt to avoid the disease. To the other half, whose medical records reveal pre-diabetic symptoms, he sets up appointments to consider more proactive treatment with drugs that can prevent the onset of disease. Such accurate diagnosis, prognosis and treatment can save lives.
In a review of 102 articles, Jin et al.\textsuperscript{16} show that patients have many reasons for not taking medications, such as cost, side effects, forgetfulness, cultural and belief systems, not feeling the need for medication, lack of concern for their condition, poor family/social support and more. The NEHI report cited above states that reaching the improved health outcomes offered by medications depends on patients following their prescription regimens. Patients with chronic conditions are especially vulnerable if they don’t adhere closely to these regimens. This is a huge concern for family member caregivers, who are charged with administering and monitoring medications.

Mobile-Enabled Diagnostic and Monitoring Devices

Many diagnostic and monitoring devices are mobile-enabled – i.e., they communicate with mobile devices or have mobile capabilities themselves. These peripheral devices can include sensors, accelerometers, remote patient monitoring technologies and environmental monitoring technologies. Among other devices, mobile-enabled diagnostic and monitoring devices have more recently been incorporated as part of current mobile devices (e.g., cell phones) or have been given the capacity to communicate with mobile devices.

The Center for Technology and Aging highlighted that m-health devices and technologies with mobile components may aggregate multiple forms of patient health data or may provide a platform to access this data.\textsuperscript{17}

These devices may also be used to send alert notifications based on patient health information or treatment needs. As health data and programs continue to move toward cloud-based systems, these mobile devices will become even more capable and convenient ways to view, access and enter health diagnostic and monitoring information, promoting anytime, anyway healthcare.

The recent expansion of mobile and communications technologies within health service provision has created a plethora of opportunities to deliver innovative, interactive health services to patients, clinicians and patient-caregivers alike. These technologies can assist all users with obtaining proper medication information, patient education, medication organisation, dispensing and dose reminders and notification when doses are missed.

Technology Trends Influencing the Pharmaceuticals Industry

Shifts in the behaviour of patients and healthcare professionals and emerging technologies are changing the relationship between pharmaceutical companies and their traditional customers and creating new opportunities for collaboration – which will have a fundamental impact on the future success of businesses.

Pharmaceuticals companies will be able to utilise emerging technologies – location-based capabilities and wide-scale use of smart phones and other 3G and 4G devices – to better engage patients and provide services and solutions that can improve their care and deliver better quality of life. For example, Merck Sharp & Dohme, the makers of Claritin, created an application that forecasts the pollen count in a user’s vicinity, providing features such as an allergy calendar and store locator for anti-allergy medication – all with the aim of helping seasonal allergy symptoms.\textsuperscript{18}

Beyond applications, technology can be used to collect patient data in real time – such as a blood glucose monitor that could detect dangerously high blood glucose levels and send this information to a smart phone. The devices could then sync and automatically make an emergency call to a specified healthcare provider, relative or patient-nominated contact.

Fischer highlighted that there is a wealth of tracking, monitoring and outcomes behaviour that mobile devices such as smartphones and tablets will increasingly be able to collect, convey and aggregate.\textsuperscript{19} This data, coming in particular from medical apps, will represent a prosperous research resource that once anonymised can be mined for efficiency and effectiveness data by...
pharmaceuticals companies. Patients will be able to provide real-time data, with minimal inconvenience that will aid patient care, research, efficacy and compliance.

Increasingly, disparate streams of data, patient records and real-time patient data, health outcomes, financial information, genetic disposition and at-risk factors will be brought together to deliver models and insights that will enable healthcare providers to make more informed decisions on which treatments deliver the most efficient and effective mode of care for both patients and the healthcare services that pay for the care.

This information will be especially vital under healthcare reform and the current move to clinical commissioning groups (CCGs) in the UK, for example, which encourage better patient outcomes by enabling healthcare providers to commission services, based on quality outcomes and measures of that service. Using EMR data and e-prescribing information, physicians and healthcare providers can better track patient outcomes over the long term, a critical element for providers to demonstrate their performance and therefore the value they bring to the patient.

Pharmaceuticals companies will need to collaborate on this front as well and use this targeted data to improve areas such as drug development, meet the needs of insurers and provide compelling evidence of a drug’s benefits.

Opportunities for Pharma
As we have discussed, healthcare technologies provide a number of obvious benefits for patients, healthcare systems and healthcare professionals; but what’s in it for pharmaceuticals companies?

Pharmaceuticals companies face numerous challenges. Chief among them: increase revenues in an era of fewer blockbuster products. They also need to help governments reduce the cost of providing healthcare, deliver more support to healthcare professionals and demonstrate they are fully patient focused.

If pharmaceuticals companies embraced new healthcare technologies and advanced analytics they could conquer all of these challenges. Pharma companies should look beyond existing patients and view the entire population as potential patients; moving their focus from illness, through wellness to well-being.

To do this, they should develop, in partnership with specialist organisations, healthcare technologies and advanced analytics that deliver multi-faceted benefits. These could help healthcare professionals identify citizens at risk of developing a disease; help these at-risk citizens manage their health so they don’t need drug intervention; ensure better compliance/health management for those patients already undergoing drug treatment, so the patient doesn’t need to be given a higher dose or more expensive medication; and provide healthcare professionals with real-time updates on the wellbeing of their patients, highlighting potential needs for intervention.

For example, a pharmaceuticals company may specialise in diabetes. Through the employment of healthcare technologies and analytics it could help keep at-risk citizens off diabetes medication both by helping healthcare professionals identify these citizens, and then by helping the citizens take preventive actions to minimize their risk of developing diabetes. It could ensure that those already on less expensive products, such as Metformin, don’t need to increase the dose or move to more expensive medication, and can reduce complications that would require expensive hospital visits.

The above would meet all of the challenges previously identified, apart from increasing revenues for pharmaceuticals companies. These companies would then need to work with government healthcare agencies on ways to obtain payment when they can prove they have reduced healthcare expenditure — in other words, ‘outcomes-based pricing’. This isn’t as far-fetched as it might initially sound. Pharmaceuticals companies already receive payment for certain drugs only when the drug has shown to have a benefit for a patient. Cimzia in the UK is one example. Under the Cimzia Patient Access Scheme, UCB will not charge the NHS for the first 12 weeks of treatment. Available data for Cimzia suggests that clinical response is usually achieved within 12 weeks of treatment. UCB will not charge the NHS for the first 12 weeks of Cimzia, so that the prescribing clinician can judge if a clinical response has been achieved and if continued therapy is appropriate.
If pharmaceuticals companies adopt a stepwise collaborative approach – involving government agencies, healthcare professionals and patient groups – they could, through embracing healthcare technologies and advanced analytics, deliver what can initially appear as a disparate set of goals for all healthcare stakeholders.

**Looking Ahead**

Healthcare technologies are becoming ubiquitous, changing the way we communicate, collate information and provide care and services. A draft proposition paper by the Center for Technology and Aging proposes that some of the most compelling benefits of healthcare technologies are in the areas of disease prevention, chronic disease management and improving healthcare delivery. In addition to these benefits for patients, through providing more cost-effective patient care, innovative medical technologies can also contribute to a more efficient and targeted use of resources in healthcare, which also means increases in productivity.

Other benefits of healthcare technology to the healthcare industry include much simpler access to data, and greatly enhanced storage capabilities for that data, statistically enhanced modelling and much greater insight driven by the ability to see patterns between what have historically been disparate data sources. Healthcare providers should also see the key benefit – that the information is patient-centric and should be accessible to all providers within a patient’s care pathway.

**Footnotes**


7 Evans, R. et al., ‘A computer-assisted management program for antibiotics and other antinfec-


About the Author

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