Mobile Technology and Public Health Organisational System

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Abstract

Information technology has a transformation power and it enables to conquer complexity. Public health system is very complex. Recently with a wide spread of mobile technology globally, public and private health systems have also seen its rapid growth and integration targeting to reduce the existing complexity, costs, human errors and as a result to simplify the processes, increase health professionals mobility and improve patient outcomes. The aim of this paper is to review the overall socio-economic impact, benefits and challenges of mobile technology integration into the public health system for all the stakeholders and to identify whether it simplifies their existing problems or "complexifies" them.

Keywords: Information Technology; Mobile Technology; Global Markets; Public Health; mHealth; Organization; Complexity; Market-Space Management

1. Health System Complexity

The environment in organizations is becoming more complex and changes more often and suddenly (Skarzauskiene 2012). Systems thinking has become increasingly popular because it provides a 'new way of thinking' to understand and manage complex problems, whether they rest within a local or global context and enables the formation of effective and long-term management strategies (Skarzauskiene 2012). The precise beginning of the systems thinking field cannot be pinpointed, as the beginning is a matter of perspective (Skarzauskiene 2012), but the first publication of the term 'systems thinking' in public health literature appeared in 2001 (Cabrera 2006).

The organizational system of the health organizations is characterized by significant levels of complexity that create a high need for integration and require the activation of a number of coordination mechanisms including also non-structural. In this system, the effectiveness of health organization depends less and less on the contribution of the individual professional, but on the efficient

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coordination of activities as between various parts of the organization as among the many operators involved to pursue the dual objective of therapeutic effectiveness and the efficient utilization of resources.

In Trochim et al. (2006), the public health system is characterized as complex: "Modern public health practice encompasses a complex, loosely coupled system of actors including governmental entities at the international, national, regional, and local levels; a diverse conglomeration of nongovernmental organizations (such as foundations, advocacy and special interest groups, coalitions and partnerships, for-profit and nonprofit medical systems, and businesses); and citizens in the public at large." In addition, public health arena deals with a "broad array of threats to well-being, ranging from obesity and tobacco use to violence and infectious diseases" (Trochim et al. 2006). Public health as well as many other fields may be considered 'early adopters' of systems thinking. On one hand this gives health professionals an opportunity to participate in shaping the field of systems thinking. On the other hand this means that health professionals will need not only to solve their complex problems, but also to take into consideration many challenges the field of systems thinking has not yet solved (Cabrera 2006).

The purpose of this interdisciplinary research is to review, from the systems thinking perspective, integration of mobile technology and its applications into public health industry, their socio-economic impact as well as concerns associated with their diffusion into such a complex and traditional sector.

2. Mobile Technology in the Health System

Although technological breakthrough innovations that have been triggered by Information technology (IT) are claimed to modify the competitive environment and the functioning of today's economies globally (Lambin 2014), the IT notion itself is quite recent. This term was 'officially' first introduced in a 1958 article published in the Business Review by Harold J. Leavitt and Thomas L. Whisler. Now IT has many definitions, from the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise (WIT Press 2014) to the technical view of the organizational learning (Huber 1991). It depends on the context in which the term is used. In public health publications this term first appeared in the 1960th (Haux 2010). 'Mobile' with respect to technologies generally means portable and personal, like a mobile phone, tablet or smartphone (Naismith et al., 2006). It is hard to find when and how exactly mobile technology started being used in public health, but today the alliance of mobile technology and healthcare is known as a mobile health or 'mHealth' (Lomotey, Deters 2014) although there is no official definition of this term in the Oxford dictionary.

Overall, mHealth paradigm represents an innovative and successful way to connect public health organizations to each other, to industries and to patients globally. Therefore, mobile technology adoptions in public health organizations as well as their possible benefits are widely discussed today by and between the following stakeholders:

- National Healthcare System (NHS), aiming to decrease the costs associated

- with delivering high quality service and improving overall patient experience;
- Public health management, pursuing the goal to enhance and modify healthcare practitioners professional skills as well as to increase their engagement with patients;
- Pharmaceutical companies, targeting to establish direct, long-lasting relationship with prescribers, NHS and patients;
- Patients, looking for innovative and cost efficient ways to manage their own health conveniently and proficiently, and as a result of it improve their overall quality of life.

The health and life sciences industry is recognized as one of the top three fields (along with consumer products and the financial services industry) likely to propel mobile device growth in the next five years (Greenspun, Coughlin 2012). The global mHealth market was estimated at $1.2 billion in 2011 and analysts expect the market's value will increase to $11.8 billion by 2018; a compound annual growth rate of 39% (GlobalData 2012). Mobile point-of-care health solutions spending is predicted to grow from $2.8 billion in 2010 to $4.4 billion in 2015 (Dunbrack 2012). MHealth apps are also likely to show comparable growth: currently estimated at $150 million, mHealth apps industry is expected to grow by 25% annually over the next five years (Health Data Management 2012). By 2015, it is projected that more than a third of the 1.4 billion smartphone users will have at least one mHealth app (Greenspun, Coughlin 2012). Today there are approximately 100.000 mHealth apps both for Android and iPhone (Research2Guidance 2014). Their biggest group could be categorized as fitness apps (30%). The second and the third largest groups are Medical reference apps (16.6%) and Wellness apps (15.5%). Medical condition management apps represent the 5th largest group of mHealth apps (6.6%) and they track, display and share user´s health parameters, medicament intake, feelings, behavior or provide information on a specific health condition e.g. diabetes, obesity, heart failure. Even though they capture notable event and press coverage, all other mHealth app categories (PHR, CME, Diagnostics, Compliance, Reminders and Remote monitoring apps) are significantly smaller in size than the ones mentioned above (Research2Guidance 2014).

Mobile device is the product of the digital era. When the first mobile phone was created back in 1973 no one could imagine that it would become such a multifunctioning tool, which will be used in various industries including public health as it allows not only to do different things, but also to do them differently, in terms of consumption or usage (Dainesi, Zucchella 2002). In fact, James Burke, who traces the history of inventions and discoveries and the strange connections between ideas, writes: Things almost never turn out as expected. When the telephone was invented, people thought it would only be used for broadcasting. Radio was intended for use exclusively to onboard ships. A few decades ago, the head of IBM said America would never need more than four or five computers. Change almost always comes as a surprise because things don't happen in straight lines. Connections are made by accident (Cabrera 2006).

Just 40 years after its creation, at the end of 2012, there were around 6.8 billion

mobile phone subscriptions in the world (Sanou 2013), held by an estimated 3.2 billion subscribers —many people have more than one SIM card (GSMA Intelligence 2012) and today's mobile phone is no longer just a communication tool, it is really a smart device with the functionality of a mini computer, sensor, location device and many more.

Mobile technology and mobile devices in public health from the system theory perspective are functioning on the principle of challenging the "status quo" of the current processes, simplifying them, reducing existing complexity by cutting the costs, time, improving communication and speeding up the decision-making (West 2012). One large study of telemental health services found that videoconferencing-based sessions (i.e. Skype and etc.) reduced hospital admissions by 24% and decreased the average time spent in the hospital by 26% (Greenspun, Coughlin 2012). Other estimates suggest that remote monitoring can reduce costs for caring for the elderly in rural areas by 25% (West 2012). It is claimed that mHealth apps empower patients and health providers proactively to address medical conditions, through near real-time monitoring and treatment to take better care about their health (West, 2013), being more proactive and knowledgeable in the sickness preventive activities and achieving administrative simplification through enhanced efficiencies in routine processes such as billing, scheduling, supply chain management, documentation, claims processing, and purchasing (Greenspun, Coughlin 2012). It is also believed that mobile devices can help the health professionals to become really mobile and to access patient records, clinical exam results, prescription reminders, appointment notices, medical references, and trainings on the go and no matter the location. This list can go on and on, but summarized public health has 3 main fundamental sources of complexity: data, processes and medical knowledge. According to John Glaser, the CEO of Siemens Healthcare's Health Services in the USA, Information Technology, and as a part of it, mobile technology, can reduce or manage complexity via standardization and automation in all of these three sources (Bin et al., 2013) and give an industry productivity gain just as a result of utilization of mobile devices of around $305 billion over the next 10 years (to 2021) (Greenspun, Coughlin 2012).

Overall, many consulting companies made their best attempts to study mHealth and especially its socio-economic impact on public health industry. One of them is PWC, which in its 2013 report for European Union has estimated that using mHealth solutions to their potential can help to save 99 billion EUR (76 billion EUR of public and 23 billion EUR of private expenditures) in total annual healthcare spend in 2017, even after deducting cost of extra workforce required to support mHealth. PWC also claimed that mHealth can create a socio-economic impact across the following four dimensions by improving the effectiveness and efficiency of care:

- Wellness and prevention: Supporting citizens in making lives healthier by improving lifestyles and reducing the incidence of disease through education, awareness and behavioral changes.
- Diagnosis: Expediting the diagnosis of chronic diseases in order to limit their severity and associated treatment costs.
- Treatment and monitoring: Administering care remotely through mobile-based communication technologies that support patient mobility

and reduce the need to visit hospitals.
- Stronger healthcare systems: Enhancing clinical decision-making and improving the utilization of physical and human healthcare resources by providing the system and staff more information and analysis (PWC 2013).

Another comprehensive study on socio-economic impact of mHealth was conducted in 12 countries (Denmark, Hungary, Montenegro, Norway, Serbia, Sweden, Malaysia, Russia, Thailand, Bangladesh, Pakistan and India) in 2012 by the Boston Consulting Group. The findings of this research stated the following main benefits: citizens are familiar with using their phones for a range of services, necessary infrastructure is widely available and there is a high mobile penetration in both developed and developing countries. Moreover, this study found some striking predictions especially for developing nations, i.e. perinatal and maternal morality can be significantly reduced and as a result of it two years can be added to the average life expectancy in India and Bangladesh and three years in Pakistan. This was claimed to be possible with the help of centralized, governmental SMS campaigns, which deliver prenatal advice to pregnant women. In fact, Ministry of Health and Family Welfare in Bangladesh has immediately responded to this opportunity and launched a pilot project to increase population health awareness via SMS. This study also claimed that by 2025, the number of cured tuberculosis patient's could rise to about 1.1 million in Bangladesh, India and Pakistan just as a result of SMS-based reminders for patients to take drugs (The Boston Consulting Group 2012).

3. Concerns Associated with the Mobile Technology Utilization in the Health System

These studies evidence that there are numerous advantages of the integration of mobile device as a healthcare tool (The Boston Consulting Group 2012); however, during this process it is also crucial to consider existing concerns related to the wide adoption of this technology in such a traditional industry as public health which uses less IT than any other industry (Hackbarth 2004).

The main group of these concerns is related to privacy, user security and ethics. In general, when installing any app on the mobile device a user is expected to be able to evaluate the permissions requested by an app and determine whether he or she feels comfortable granting them. However, the research by Kelley et al. (2012) as well as by others, has shown that most users generally paid limited attention to permission screens, had poor understanding of what the permission implied, did not understand the implications of their decisions and are not given a chance to revisit them later on (Bin et al. 2013). In general, users keep a great deal of very sensitive information on their mobile devices (contact lists, personal photos and financial information saved on their bank and shopping accounts) and these devices are able to continuously track the location and build a profile of the user activities (Mayer 2013). This is also a very big concern from an ethical point of view in health organizations together with the fact that IT developers frequently put mHealth

systems on the market before they are completely tested, which in case of the medical information system can potentially endanger patient's lives. It is also important to consider that people create and spread viruses that can cause considerable trouble for those using and maintaining IT systems, including sensitive medical information systems. Finally, many people copy, use and distribute software to which they have no rights and very sensitive user personal and medical information can be sold to or collected by third parties again without the user's prior consent (Groen et al. 2008).

Another very important concern is that mHealth apps developers are not doctors or people with specific medical education, i.e. only 3.4% apps are designed by the pharma, hospitals, health insurance and Med-Tech companies and only 20.2% by Medical specialists. All the rest apps are designed by so called "helpers" (companies or individuals with the primary motivation of publishing mHealth apps in order to help others), connecters (create value-rich apps by enabling connection to other apps, sensors and databases) and fitness specialists (Research2Guidance 2014). These applications look like they simplify patients lives and professionals work, but in reality most of them have a clear goal to generate financial revenue and/or to increase awareness about their brand and just very few of them aim to really solve the complex problems of patients and health professionals. With the help of the corporate apps, companies develop two-way communication between them and individual targets and disseminate to the outside world, in effective and cost-efficient way (Salvioni, Bosetti 2014), latest news, updates about events and symbolic elements that together try to positively impact on the expected response from the outside world to the company itself, or to what it has to offer (Brondoni 2006). In addition, apps are usually not integrated with the other mHealth applications and/or hospital IT infrastructure or in most cases not compliant with the hospital procedures and policies, if any in place. This is a very big concern for government and health organizations compliance authorities. Mobile technology progresses too fast and any policymaking is a very long process; therefore regulation falls behind as the new technology constantly emerges (Ernst,Young 2014). Another concern is that people who create and approve these policies do not always have essential knowledge, resources and time to review pros and cons of every mobile device utilization approach in public health and every mHealth app and to predict what risk they can potentially cause. Policy developers can also be lobbied by the stakeholders such as mobile device producers, network carriers and/or apps developers.

One of the last, but not the least concern, applicable to any industry including public health, is associated with the fact that the adoption of the mobile devices has increased an access to tremendous amount of information and has also prolonged the working hours, especially "outside office" (Jones 2013). Naturally, from companies point of view it increases the productivity in office (Sanghani 2014), but the reality is that health professionals can still continue responding to work emails, answer to patient calls or perform some administrative tasks on their mobile devices even outside the office without being acknowledged or compensated for this work. This phenomenon opens a complex debate on well-being and healthy work life balance of health professionals as it can cause such unintended consequences as the burnout, decrease in job satisfaction and high turnover.

Mobile technology is already increasingly integrated into the flow of the patient encounter (Meneghetti 2013). According to Deloitte (2012) the drivers for this growth are similar to those in other industries: rising consumerism, increasing information dependence, and the need for greater efficiency. This was also confirmed by the study of PwC Health Research Institute, which stated that the momentum for mobile technology in health care has been mostly pushed by technology and telecommunication companies (Dolan 2010). Other scientific research data (Hackbarth 2004) state that the spread of the technology in general is widely promoted by various types of initiatives including, but not limited to the developing or adopting standards stimulating the usage of technology, providing incentives for providers to use health IT and/or giving grants for research and implementation of the technology. Consequently, it can be concluded that mobile technology and its integration is pushed both by "those in power" via "top-down" approach in private and public sectors and by health professionals and patients via "bottom up" approach. It is necessary to consider here that it is almost impossible that every mobile device and mHealth app can equally serve the wants and the needs of all the stakeholders (hospitals, health professionals and patients). Therefore, when integrating this technology into complex public health system, any health organization should consider such important factors as privacy, security, ethics, quality of technology, ability of the vendor to provide contingency services and users readiness and capability to utilize this innovation, essential training needed together with the cost of implementation as initially it can also imply an increase in the resources employed (Tesser 2002). Inappropriate use of the technology can bring the unintended consequence, which is known in public health industry as a "Borneo" effect, scenario often used as an example of the perils of simple-minded reductionism and the triumphs of systems thinking, and also of the tendency of solutions to generate new problems (Cabrera 2006). Lead users among health professionals, who are already actively utilizing the technology, should always consider that mobile technology and mobile device are just tools and that if inappropriately used can create risks. However, also patients on their end should not become too dependent on mobile technology, nor too proactive in self-care. They should always keep in mind the central role of the doctor, who needs to be always consulted first, before taking any medicine or making any health decision, but not the mHealth apps.

4. Emerging Issues

The Institute of Medicine 'Crossing the Quality Chasm report' evidences that "The challenge of applying information technology to health care should not be underestimated. Health care is undoubtedly one of the most, if not the most, complex sectors of the economy. The number of different types of transactions (i.e. patient needs, interactions, and services) is very large. In future sizable capital investments and multi-year commitments to building systems will be required. Widespread adoption of many information technology applications will require behavioral adaptations on the part of large numbers of patients, clinicians, and organizations (Institute of Medicine 2001). Therefore, even mobile technology and

systems thinking approach have a clear and noble aim to reduce complexity in public health, at the end the result can be even bigger complexity as we are adding one complexity to another. The unintended consequence of inappropriately applying mobile technology can be just the "outsourcing" of a problem or complexity from health professionals to additional players – 'IT specialist' or even machines (Glaser 2013). To conclude, public health and mobile technology are very complex systems, which require contemplated choices and being considered interdependent. Both mobile technology and systems thinking in public health industry are in a nascent state and there is still long way ahead of them to show their validity, credibility and chance for existence (Cabrera 2006). In future, they can either surpass all the skepticism and evolve into a trusted and helpful "tool" or they might cease to exist if they don't endure the "survival of the fittest" test or if any other competitive approaches or technologies emerge.

Future research on the implication of the mobile technology in such a complex industry as public health should take into consideration that most of the current studies were conducted voluntarily and via the Internet and should be concentrated on more in depth, empirical studies to obtain qualitative and quantitative data which will not be just biased toward more advanced usage of IT.

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