

Improved and Feasible Access to Health Care Services through Integration of Mobile Technology and Big Data (Indian Context)

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Abstract: Big Data is already changing the way business decisions are made, however, it is still early in the game. Big data has the potential to increase the capacity and capabilities of conventional storage, reporting and analytics system. With the convergence of powerful computing, advanced database technologies, wireless data, mobility, and social networking, it is now possible to bring together and process big data in many ways which are good for society. In the area of health services, all health-care constituents members, payers, providers, groups, researchers, governments, etc. will be impacted by big data, which can predict how these players are likely to behave, encourage desirable behavior and minimize less desirable behavior. These applications of big data can be tested, refined and optimized quickly and inexpensively and will radically change health-care delivery and research. Leveraging big data will certainly be part of the solution to controlling spiraling health-care costs in a developing country like India with billions of population.

Keywords: Big data, E-health, Health-care

I. Introduction

According to statistics (Ministry of Health and Family Welfare, 2012), India is the second largest mobile phone users [1] [11] with over 900 million users in the world. This tremendous growth in telecommunication has been inclusive in nature by taking account of the poorest household in the remote regions in the country. The mobile devices are getting cheaper with advancement in technology and the mobile tariff in India have become among the lowest in the world. Simultaneously, integration of internet in cellular devices has facilitated a great platform to build knowledge based society by providing cheapest form of communication across society.

We all have witnessed a phenomenal growth in Information Technology sector at international level. However, we are lagging behind in some critical areas, which are backbone of healthy society, and health care is one of them. Recent report from Institute of Health Informatics shows that 72% of rural Indian population has access to just one third of available hospital beds as oppose to 28% urban Indians who have access to 66% of total beds. It also emphasize that rural population have to travel more than five km to access proper health services. Also India spends only 4.1% of GDP on health-care [3] [10], which is very low as compared to other nations.

According to IMS report, the communicable; maternal; and nutritional disease accounts to 37% of total deaths, while Non-communicable disease (like cardiovascular disease, cancer, chronic respiratory disease, diabetes, and mental health conditions) accounts to 53% of all deaths. According to Indian Express News (2012), India is very likely to be the "heart disease"[2] capital of world. It is estimated that by 2020 cardiovascular disease will be the cause of over 40% deaths in India as compared to 24% in 1990.

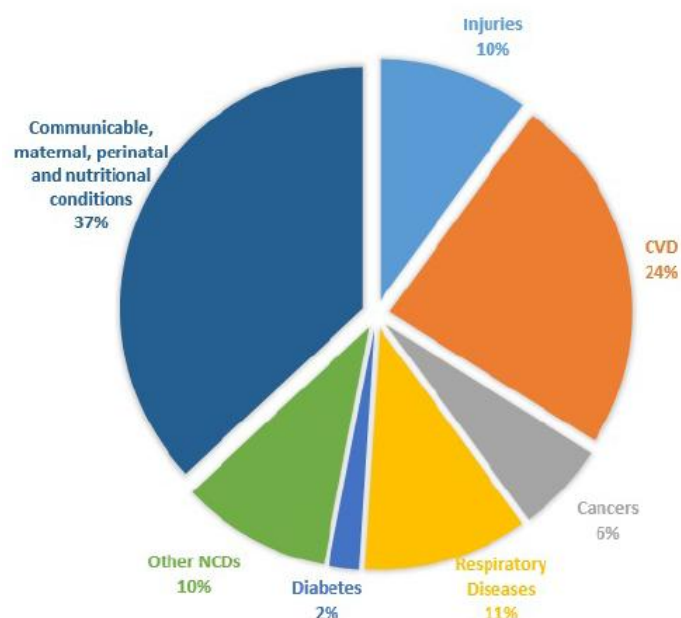


Figure 1. Proportional Mortality (% of total deaths, all ages)

As per IMS report, to combat this critical scenario, there are two key areas which require immediate focus:

- Universal access to quality health care.
- Training and distribution of health workforce.

There have been several initiatives by central government as well as private sectors in recent years. For example, Mother and child tracking system (MCTS), which is based on messaging services on mobile phones to keep patient updated about their health progress. Such initiatives will have a positive impact on important health indicators like Infant Mortality Rate (IMR) and Maternal Mortality Rate (MMR).

However we do not able to change the whole scenario drastically as it requires huge spending from public and private sectors. But we can definitely take the advantage of Information Technology to improve the current scenario and the good news is that such non-communicable disease can be prevented at early stage by examining real time human behavior and life styles with the help of technology.

In this paper, I would like to argue that by using mobile technology and big data (explained in next section), we can trace the human behavior in real time based on respective demographics. And furthermore this big data can help our health care service provider to take proactive action at early stage. That may reduce some burden from government in terms of GDP expenditure.

II. Big Data

As stated by Alex Pentland et. al. (2006), Big data is information about human behavior in real time and it's not about their belief. It is not about the post posted on social networking sites, and searches on Google, instead it is data that comes from real time activities (location data, use of credit cards, pervasive sensing through mobile phones etc.) and all those data that you leave behind you as you move around in the world. In the context of health care, big data may help in identifying people life style (way of talking, expenditure pattern, eating habit etc.), which is possible by reality mining of those data obtained from health service providers, clinical research organizations [4], and peer to peer networks. Big data is increasingly about real behavior, and by analyzing this sort of data, scientists can tell an enormous amount about us. By analyzing your real time data (mobile uses, use of credit card etc.), they can tell you if you're likely to get diabetes. Big data can do this because individual's life style can largely be determined by his/her immediate social surroundings.

III. Reality Mining

As states above India is among the largest consumer of mobile services. Comparatively low tariff rates and cheaper technology have made it accessible to each household. On the other hand, research shows that mobile devices are the best source of reality mining [5].

Every time a person uses mobile phone, a few bits of information are recorded by respective service providers in nearest station. Advancement in mobile technology has enabled the service providers to record everything from their physical activity to their conversational cadence and geographical location. This process

of getting real time data from mobile devices is known as reality mining, which is a significant step towards personalized health-care.

IV. Role of Mobile in Personalized Health Care

Mobile is increasingly ubiquitous everywhere and same happening in India. With recent advancement in technology; mobile was used to play games, to browse social networking sites (see fig: 2), to help in e-commerce businesses, and now industry has come up with some health apps to improve health and wellness.



Figure 2. Mobile Health

Sensors-accelerometers, location detection, wireless connectivity and cameras offer another big step towards closing the feedback loop in personalized medicine. Sensors used to be exclusive to the laboratory or hospital (EEG, EKG). Now, body area network applications can be used not only for fitness/wellness, but also to identify, diagnose and manage acute and chronic diseases (Fig:3).

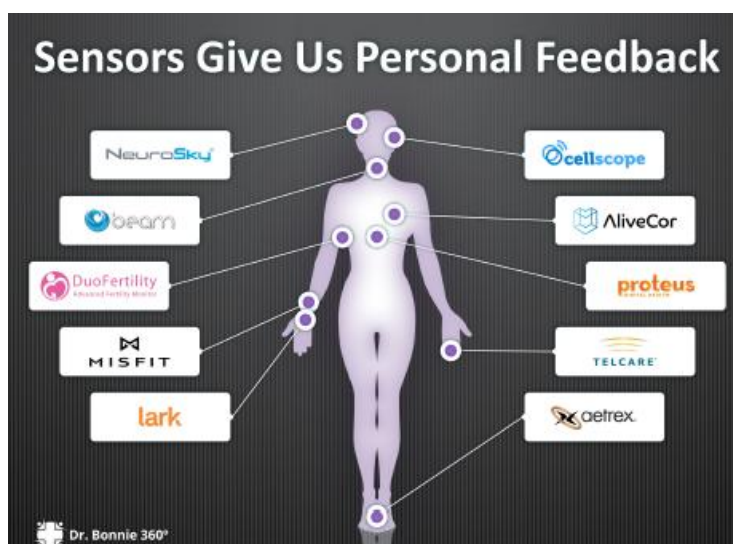


Fig 3. Sensors give us Personal Feedback

In terms of Big Data, mobile health is a new frontier, contributing new streams of data such as behavioral, biometric, and environmental in real time. Combining these new data streams with EMR/EHR data and giving patients/consumers access may enable us to make better-informed decisions and lead healthier lifestyle.

Big data which is based on real time data mining (data obtained from real time activities by individual on daily basis) has great future potential to get us a new level of insight into problems of interest to public health and medicine. Mobile phone location and movement data [6], call logs, voice analysis during calls, and email records allow a detailed picture of face to face, voice, and digital communication pattern at every second.

V. Assessment of Individual Health

Advanced mobile technology (like accelerometers, GPS etc.) has the power of sensing voice and physical activity of an individual's. Reality mining of these behavior signals may be correlated to the function of some major brain systems. Research shows that there is strong relation between brain state and corresponding behavior, which finally leads to early indication for certain mental or physical illness.

Arousal of the autonomic nervous system produces changes in activity levels. These changes can be measured by audio or motion sensors, and have been successfully used to screen for depression (Stoltzman, 2006; Sung, Marci, and Pentland 2005; France et al. 2000).

Consistency or fluidity of movement or speech production is a well-known measure of cognitive load: novel physical activities or those 'loaded' by other mental activity have greater entropy (randomness) than activities that are highly practiced and performed with a singular focus. This relationship has long been used for diagnosis in both psychiatry (Teicher, 1995) and neurology (e.g. Klapper, 2003).

These qualitative measurements of brain function have been shown to be powerful, predictive measures of human behavior (Pentland, 2008). They play an important role in human social interactions, serving as 'honest signals' that provide social cues to dominance, empathy, attention, and trust, and may offer new methods of diagnosis, treatment monitoring, and population health assessments.

VI. Mapping Social Networks

One of the most important applications of reality mining may be the automatic mapping of social networks (Eagle and Pentland, 2006). Smart phone that is programmed to sense and continuously report on its user's location, who else is nearby, the user's call and SMS patterns, and (with phones that have accelerometers) how the user is moving. Careful analysis of these data shows different patterns of behavior depending upon the social relationship between people. Such real time data can be aimed at understanding health-related behaviors and infectious disease propagation [7].

VII. Future Opportunities and New Deal on Big Data

Recent low cost innovation in mobile and laptop technologies have opened the door for all class of society to use these technologies [8]. Mobile devices have become the basic necessities for each household. I hope that with advent of 3G & 4G services, mobile may capable of doing complex computing tasks at affordable cost.

India is a country of 1.2 billion populations, so providing hospitals and other medical facilities at such a large scale will take some time but we are in a good position to tackle this challenge by using such technologies and make people aware about such devices. The system's software can use these data to build a personalized profile of an individual's physical performance and nervous system throughout the entire day. If these rich data streams were combined with personal health records, including medical tests taken and the medicines prescribed, there is the possibility of dramatic improvements in health care.

Creating such information architecture, however, requires safeguards to maintain individual privacy. And for that governmental and non-governmental sectors have to play a proactive role [9]. They have to come up with a comprehensive system, which may share and distribute information and at the same time it may also trace the individual's privacy. As more and more business, financial, civic and governmental services use personal data, the integrity and interoperability of a global authentication and claims infrastructure will be of paramount.

VIII. Conclusion

Revolutionary new measurement tools provided by mobile telephones and other digital infrastructures are providing us with a God's eye view of ourselves. For the first time, we can precisely map the behavior of large numbers of people as they go about their daily lives. For society, the hope is that we can use this new in-depth understanding of individual behavior to increase the efficiency and responsiveness of industries and governments.

As these new abilities become refined by the use of more sophisticated statistical models and sensor capabilities, we could well see the creation of a quantitative, predictive science of human organizations and human society. At the same time, these new tools have the potential to make George Orwell's vision of an all-controlling state into a reality. As a consequence, we need to think carefully about the growth and increasingly broad usage of personal data to drive societies systems, and particularly about the safety, stability, and fairness of their design.

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