

Applying Big Data Analytics to Improve Public Health Services in Egypt

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Abstract: The increasing of applying big data analytics included in various fields in our lives such as economics, healthcare, learning, finance and marketing. Applying big data analytics in public health services has a special manner for collecting, handling, analyzing and using these heterogeneous and complex data in developing countries. In health sector, there are huge amount of complex data from different resources either these data automated or un-automated in developing countries. There is a need to new technologies to use these heterogeneous and complex in healthy living and life style. In developing countries there are more detailed and scattered data which are increasing the complexity of analyzing and using these data.

The applying of big data analytics in public health can benefit specially in developing countries for following up chronic diseases, predicting risk factors for some diseases like cancer, caring and supporting patients, preventing infectious diseases and doing researches. This paper shows the uses and opportunities of applying big data analytics in public health and exploits the new trends and technologies of using big data analytics and big data technologies such as Hadoop distributed file system, map reduce, streaming data and Internet of things in public health. Applying big data analytics Egypt will reflect on the quality and the speed of public health services in all sectors in health ministry.

Keywords: Big Data Analytics- Public Health- HDFS (Hadoop Distributed File System)- Map Reduce-IoT (Internet of things).

I. INTRODUCTION

Big data can be defined as a new approach, with a different view of data and how to analyze them, and a set of technologies designed to extract value from data, which could not possibly be gained using previously instituted techniques, given their volume, the speed with which they are acquired, and their diversity [1].

Big Data analytics has incredible business feed back in all fields. By using big data analytics, there are many processes can be offered collecting, arranging, extracting, integrating, and disseminating of huge amount of different data types through new on-line tools, hat will give knowledge and new insights to the decision makers in all tracks and levels. .

Nowadays, applying big data analytics in different sectors, gives great impact and importance to the organizations. These sectors include health, commercial, military, education and communication in order to add values to their customers and enhance presenting services.

Big data can be known as great amount of data, great velocity and including different types of information assets. So, big data presents cost effective and many new insights that can be useful in decision taking in all sectors. Also, big data can be defined as a huge datasets that can be used with different software tools that can be used in capturing, storing, managing and analyzing the data to reach to new insights [2].

Big data contains huge amount from different resources. The resources of data are complex, heterogeneous, noisy, and huge volume to assist and help for getting new insights for different fields. By using big data in public health can assist

not on the individual level but also for the whole healthcare sector. In developing countries there are huge volume and complex data sets which are difficult to process by using traditional tools and applications. Big data are important for planning and evaluating of health service delivery. Also using big data will get the effectiveness and efficiency for managing health-care systems and improving public health in developing. Using big data in public health need to collect and capture data from different new technologies such as mobile devices, wireless medical sensors, social communications and radio frequency identification technology. In health care, the complexity of Big Data analysis also arises from combining different types of information. Starting with the collection of individual data elements and moving to the fusion of multiple data sets, the results can reveal entirely new approaches to treating diseases [3].

With the development of these techniques, the acceleration of scientific discovery and innovation is expected, as well as improvements in the understanding of human processes and social interactions, the acceleration of economic growth and improvements in health and quality of life [4].

II. TRANDS OF APPLYING BIG DATA ANALYTICS

In the past, there was many areas isolated and didn't reach to any healthcare services. Currently, many wireless technologies through the spread of using mobile phone networks increases the healthcare services to many isolated areas in developing countries. The increasing of using wireless devices by people with low and medium income in developing countries provides an enormous flow of data about diseases, behavior, environmental factors and life style. Also, the World Health Organization (WHO) and others have demonstrated a large, increasing health trouble in developing countries. Many of these factors are related to the lifestyle and the environmental factors in the developing countries [5]. The World Health Organization has shown the importance of feedback of collecting and analyzing all the healthcare data from different resources to assist the objectives and outcomes in the healthcare sector [6].

The last two decades have seen an outburst in using Big Data analytics in healthcare sector. Through the using of new technologies, tools and methodologies in collecting a huge amount of structured and unstructured data, storing, analyzing and extracting the new insights. Big data used in different tacks in public health sector genomic analysis, patients record system, drugs doses, sharing patient data through different areas like X-rays, diagnoses, inpatient and outpatients clinics. By using new mobile technologies and wireless communications, which present new ways to extracting data and analyzing a huge amount of data [7].

The revolution of using big data in different sectors, according to the United Nations demonstrated to increase awareness of big data opportunities in order to increase the using of big data tools to help decision makers in real time [8]. Internet of things (IoT) is a new important that can support big data by using mobile devices and ubiquitous devices to collect and record big volumes of data that can be very useful in the emergence of network science with a high population in the developing countries [9].

By using big data analytics to analyze huge amount of health data in these areas will discover the benefits of using big data analytics in many factors such as detect and monitor diseases, reduce the costs of healthcare, track and detect the infectious diseases in near real-time. Big Data analytics can help in understanding of phenotypic, genetic, and treatment for chronic and infectious diseases to recommend medicine and medical treatment.

Big data analytics will improve the quality and accessibility to enhance of healthcare systems. All of these will impact on the public health overall. Big data analysis is growing by private hospitals, centers and clinics which have big data analytics capabilities and offer services to their patient.

There are many developing countries which started to use big data analytics as an example in Nairobi, Kenya. The project of using mobile phone to collect transactional data, can help the government to optimize resource allocation for infrastructural development and other resources [10].

WellDoc presents many capabilities for M-health in order to deal with big data which offers new opportunities by using new technologies. WellDoc can apply big data with its different challenges to gain the new insights that help in mobile health [11].



Figure 1: WellDoc application for M-health [11]

III. OBJECTIVES OF USING BIG DATA ANALYTICS IN HEALTH

Using big data analytics will assist from the first stage government and public sector for detecting, predicting and analyzing infectious and chronic diseases. Also, using big data analytics will help to change communities' awareness and commitment to achieving public health. Moreover, the private sector values the importance of understanding and analyzing data in developing countries to drive business outcomes.

So, Decision makers will take the decisions based on facts have measurable and meaningful impact on people's lives in the developing world that facilitates better decision-making.

The main objective of this paper is to use big data analytics for public health we need to achieve the following goals:

- Creating knowledge from huge complex heterogeneous patient sources.
- Capturing patient's data through the social networks and communications in order to track patient's behavioral data.
- Understanding unstructured clinical notes in the useful information.
- Collecting large volumes of medical imaging data and extracting efficiently useful information and biomarkers.
- Analyzing genomic data and combining with social and clinical data helps to get good insights.
- Facilitating the sharing of data in order to enhance public health.
- Reducing costs by lowering prices of the medical services.

IV. PREVIOUS STUDIES OF APPLYING BIG DATA ANALYTICS IN HEALTH

The World Health Organization and other worldwide organizations have mentioned on the great published importance of using new tools and technologies for health data collection in developing countries in order to present an ideal environment for epidemiologic studies and researches [12]. There are many medical and clinical researches in big data analysis in health sector. Many of these researches concerned on the impact of using big data analytics in many fields in health like medical diagnosis, X-rays imaging data in medicine, lifestyle, medications researches and disease researches to improving public health. Moreover, there are many previous studies for using big Data analytics in the prediction, prevention and monitoring of epidemics.

The new digital technologies and the internet of things can be used to detect and prevent some chronic diseases. The increasing of using internet of things reaches to billions that used to enhance the management of chronic diseases such as heart disease, asthma, and diabetes from the Goldman Sachs report in 2015 [13]. In South Asia, there is a study of using big data in order to register mortality data to develop a heat wave early warning system [14].

Another study in Haiti, which presented accurate indication of the spread of cholera disease by using data mining tools to analyze the outbreaks that showed by social networks and communication [15].

In another example from Tanzania, the big data was used to improve the availability and access to anti-malaria medicine. The data collected in real time from the health care providers. The generated data and the insights from the analysis were used to more accurately forecast the needs and improve the delivery of life saving medications, reducing re-stocking related incidents [16].

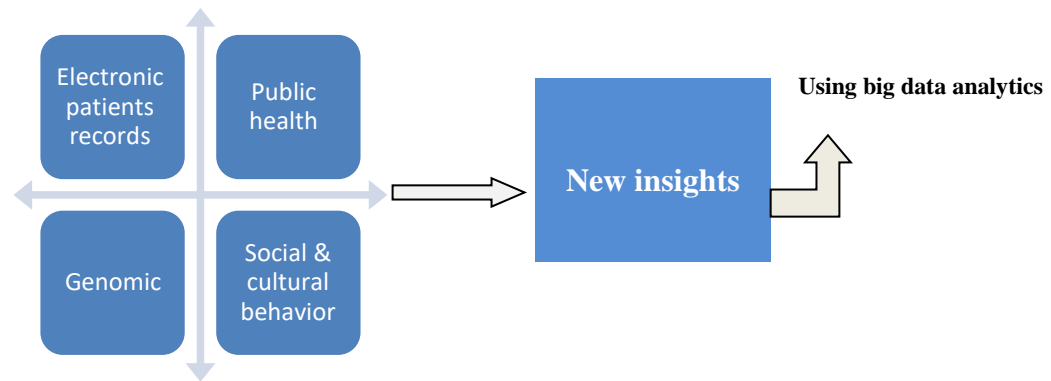


Figure 2: Goals of using big data analytics in healthcare

Also, Jimeng and Chandan showed the importance and take advantage of using big data analytics in healthcare in presenting a customization and personalized services to the patients in the real time. So that the impact of using big data analytics will impact on the whole stakeholders in the healthcare sector [17].

By using big data analytics the raw resource that people can use to discover new insights. At the individual level, devices are taking patient monitoring to new insights. A new mobile application, allows physicians to track their patients and help them with behavioral-health. The data has been collected from phone calls, texts and location. The new applications can be used to collect different types of data structured or unstructured data that give behavioral health to gain new insights [11].

There are also many studies utilizes cell-phone data for social network analysis. There is a study uses the data in analyzing by using many factors like space and time. Through the analysis of cell phone data, is getting new insights of patients behavior through a social network [18].

Although Big Data and data science can help the world to improve public health services in order to reach to healthier world. There are many applications of using big data analytics in health sector. These applications can be applied as following:

- Preventing the spread of infectious diseases
- Understand chronic and infectious disease on a population level
- Diagnosis, treatment and monitoring diseases
- Public health assessments
- Improve surveillance of disease and risk factors
- Improve investigate and control the infectious diseases
- Predict diseases
- Improve healthy public behavior Acknowledgements

V. PROPOSED FRAMEWORK OF APPLYING BIG DATA ANALYTICS

There are huge medical and behavioral data through the increasing of using electronics and wireless technology sensors in cell phones, security cameras, digital videos, digital photos, social networks, smart card readers, digital wallets, loyalty cards, GPS and location tracking.

This paper presents a proposed framework for applying big data analytics in the Egyptian health sector. This framework is depending on the main stages of big data analytics collect, store, analyze and use. Through the applying of the proposed Egyptian public health cloud, many public and private sectors can be benefited from the new insights by applying big data analytics.

VI. PHASES OF THE PROPOSED FRAMEWORK

In the proposed framework, there are four main phases as following as seen in figure 3:

Phase I: Collect

The first phase is collecting data from different huge heterogeneous and complex data from different resources through the following:

E-government (census data – policies- regulations-population rates)

E-commerce (customer behavior- income level)

E-Society (education level – food – life style)

E-health (electronic medical record – family history)

Phase II: Store

In the second phase is storing all these data in Egyptian public health cloud. This Egyptian public health cloud includes hardware and software resources that deploys either in a single data center, or across multiple geographically data centers that are connected over a network.

Phase III: Analyze

Big Data analytics solution includes storage, Map Reduce technologies, and query technologies.

Phase IIII: Use

This proposed framework can assist in various directions in public and private healthcare sectors. So, applying big data analytics in health sector can benefit hospitals, doctors, pharmacies, ministries, schools, universities- and social agencies.

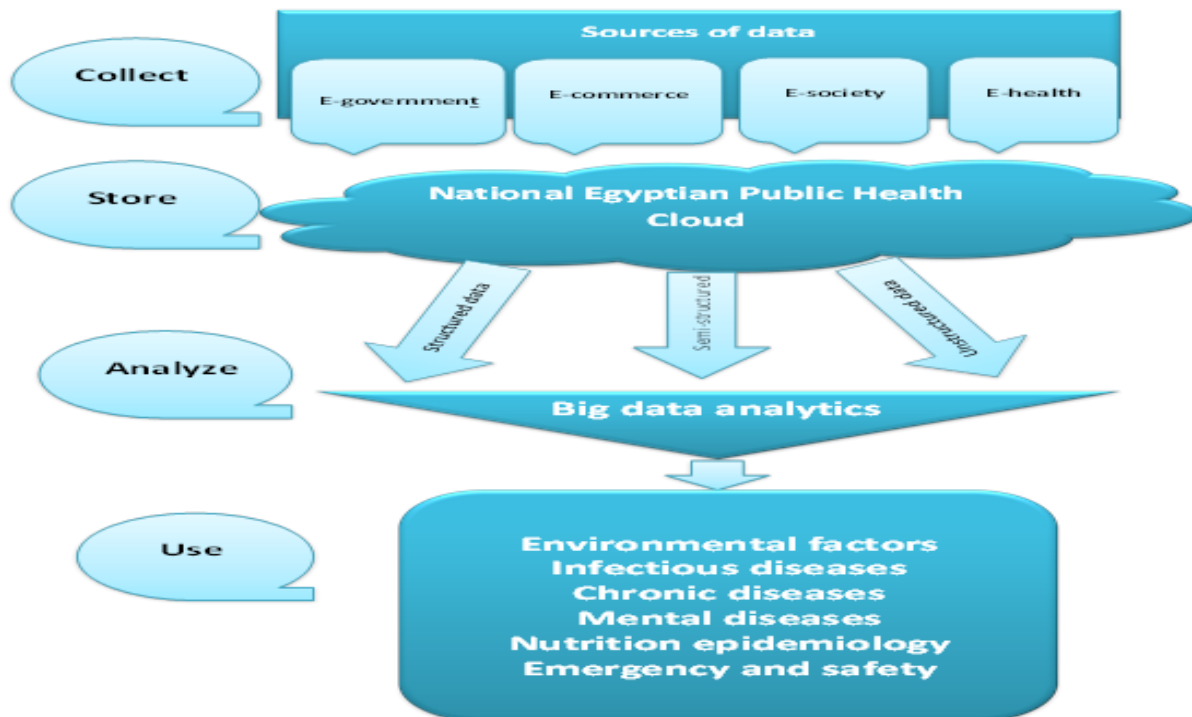


Figure 3: Proposed framework of applying big data analytics in Egypt

VII. BENEFITS OF EGYPTIAN PUBLIC HEALTH CLOUD

The huge amount of data available from many resources is presenting many new benefits and new ways of thinking. The rapid advances in using intelligent data analytics techniques by emerging concepts like artificial intelligence (AI) and machine learning (ML) that provide the ability to process massive amounts of different unstructured data that is now being generated daily to extract new insights. This provides a great opportunity to researchers to use this data for developing useful knowledge and insights [19]. The proposed framework can present new insights for enhance public health specially in the developing countries through the following points as following:

- Collaborate networks and partnerships
- Integrate health records with other personal and community data
- Detect, predict, analyze chronic and infectious diseases
- Change communities' awareness and commitment to achieving public health
- Improve community engagement and planning
- Spread best practices in public health
- Identify most cost-effective providers
- Evolve environmental health to reduce environmental pollutions' impacts and expand renewable energy
- Uses of Egyptian public health cloud
- Environmental pollutions
- Infectious diseases
- Chronic diseases
- Mental diseases
- Nutrition epidemiology
- Personal and public health
- Emergency and safety

VIII. ADVANTAGES OF APPLYING DATA ANALYTICS IN EGYPTIAN HEALTH SECTOR

Applying big data analytics will solve many problems and improve the efforts in health sector in Egypt. Definitely, the impact of applying big data technology in health sector can be reflected on technology, environment, society, and economic. The process of extracting useful information or knowledge from the structured/ unstructured data and databases gains new knowledge and insight. This knowledge and insight will be useful to predict, detect and prevent some diseases.

Take advantage of the huge amounts of data will provide lower cost and right decisions. The revelation of big data analytics is very necessary to analyze the huge amounts of information that will be used to reach to new insights and knowledge. Moreover, big data can be used to enhance the public health services through the huge amount of data that improve the performance of Patients outcomes [20].

Big data helps translate personalized medicine into clinical practice by offering the opportunity to use analytical capabilities that can use patient's data and the genomics data in order to get knowledge [21].

So, by applying big data analytics for health sector in the developing countries, we can conclude the following advantages:

- Improving public health and increasing Awareness and patient Care
- Developing of new advanced analytical models
- Customization healthcare for each patient

- Supporting researchers, providers, governments and individuals
- Getting the right treatment for patients.
- predicting the number of chronic and infectious diseases patients
- Decreasing the costs of healthcare.
- discovering new methods to treat, cure, and prevent some diseases specially infectious diseases
- Integrating and analyzing various types of data over a period of time.

XI. CHALLENGES OF APPLYING BIG DATA ANALYTICS IN EGYPTIAN HEALTH SECTOR

The growing of data sets which seem to be difficult to manage by using traditional capabilities. As a result, organizations are faced with difficulties to capture, store, manage, and analyze data in the real time to get the right actions [22].

The huge amount of genomic, behavioral, environmental, public health data and electronic patient records which include numerous data i.e. structured data through public patient record, unstructured clinical treatments, X-rays imaging data, genetic data, population, epidemiology & behavioral data, social network data, mobility sensor data, and medical Images. According the huge amount of data, there are many challenges of applying big data in Egyptian public health sector as following:

- Limited internet access in some regions
- Ensure the accuracy of data
- Legal legacy barriers
- Ethical and cultural barriers
- Ensure the privacy concerns of the patients data
- Technological barriers
- Consistency standards
- Capturing and storing data

X. THE FUTURE OF APPLYING BIG DATA ANALYTICS IN HEALTH SECTOR IN DEVELOPING COUNTRIES

In the future the healthcare systems will increase the communication with their through social networks thus online patient communities will grow and present a huge volume of data from different sources. Advanced big data analytics will provide real time treatment and early alerts on diseases. New business and provider models will improve medical services and reduce cost. The governments will cooperate with other medical organizations. Increasing the using of electronic health records will assist in big data analysis.

XI. CONCLUSION

Using big data in public health need to collect and capture data from different new technologies such as mobile devices, wireless medical sensors, social communications and radio frequency identification technology. A big data analytics are useful for capturing and storing healthcare data in total and in real time. Getting real time and predictive medical data are challenges but have great benefits to improve public health.

So, applying of big data analytics in public health can benefit for following up chronic diseases, predicting risk factors for some diseases like cancer, caring and supporting patients, preventing infectious diseases and doing researches. Moreover, big data analytics will assist the decision makers to take the right actions rapidly in order to present the best public health services.

XII. RECOMMENDATIONS

From this paper, there are some recommendations of applying big data analytics to improve public health services in Egypt as following:

- Advanced big data analytics will provide real time treatment and early alerts on diseases.
- New business and provider models will improve medical services and reduce cost .
- The government will cooperate with other medical organizations .
- Increasing the using of electronic health records will assist in big data analytics.
- Machine learning and artificial intelligent will lead to the evolution of data science and big data analytics in Healthcare.

From the above, the applying of big data analytics will improve all the public health services for all categories of citizens in Egypt.

REFERENCES

- [1] D. R. Luna, J. C. Mayan, M. J. García, A. A. Almerares, M. Househ (2014). Challenges and Potential Solutions for Big Data Implementations in Developing Countries, IMIA and Schattauer GmbH,2014.
- [2] McKinsey Global Institute (2011). Big data: The next frontier for innovation, competition, and productivity in Report. 2011.
- [3] May, M.(2014). Life Science Technologies: Big biological impacts from big data. Science, 2014. 344(6189): p. 1298-1300.
- [4] National Science Foundation (2012). Core Techniques and Technologies for Advancing Big Data Science & Engineering (BIGDATA) [Internet].Available at: <http://www.nsf.gov/pubs/2012/nsf12499/nsf12499.pdf>
- [5] Lim, S.S.; Vos, T.; Flaxman, A.D.; Danaei, G.; Shibuya, K.; Adair-Rohani, H.; AlMazroa, M.A.; Amann, M.;Anderson, H.R.; Andrews, K.G.; et al. (2010). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: A systematic analysis for theGlobal Burden of Disease Study 2010.Lancet2012, 380, 2224–2260.
- [6] World Health Organization. Improving Data Quality (2003). A Guide for Developing Countries; World Health Organization: Geneva, Switzerland, 2003.
- [7] Szlezak, N. et al.(2014). The role of big data and advanced analytics in drug discovery, development, and commercialization. Nature, 2014. 95(5).
- [8] UN Global Pulse (2013). Big Data For Real-Time Awareness. Available at: http://www.unglobalpulse.org/sites/default/files/Primer%202013_FINAL%20FOR%20PRINT.pdf
- [9] Barabási A-L (2013). Network Science. Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences. 2013;371(1987):20120375
- [10] Bays, J. (2014). Harnessing big data to address the world's problems. Available at: <http://voices.mckinseyonsociety.com/harnessing-big-data-to-address-the-worlds-problems> Big Data in Healthcare
- [11] Bonnie Feldman et al. (2012). Big Data in Health care Hype and Hope, October 2012.
- [12] The World Bank. Data Programs (2015). Available online: <http://data.worldbank.org/about/data-programs>.
- [13] Goldman Sachs (2015). The Digital Revolution Comes to Healthcare, 2015.
- [14] Knowlton, K.; Kulkarni, S.P.; Azhar, G.S.; Malvalankar, D.; Jaiswal, Al; Connolly, M.; Nori-Sarma, A.;Rajiva, A.; Dutta, P.; Deol, B.; et al.(2014). Development and implementation of South Asia's first heat-fealth action plan in Ahmedabad (Gujarat, India).Int. J. Environ. Res. Public Health 2014, 11, 3473–3492.

- [15] Chunara, R., Andrews, J. and Brownstein, J. (2012). Social and news media enable estimation of epi-demiological patterns early in the 2010 Haitian cholera outbreak. *American Journal of Tropical Medicine and Hygiene* 86, 39–45. Available at: <http://www.ajtmh.org/content/86/1/39>.
- [16] Newton, Alice (2012). Big data for development: Beyond Transparency. *The World Bank Blog* . 23-July. <http://blogs.worldbank.org/psd/big-data-for-development-beyond-transparency>
- [17] Jimeng Sun and Chandan K. Reddy (2013). big data analytics in health care, 2013.
- [18] Candia J, González MC, Wang P, Schoenharl T, Madey G, Barabási AL(2008). Uncovering individual and collective human dynamics from mobile phone records. *J Phys A: Math Theor.* 2008;41(22):224015.
- [19] Hilbert M (2013). Big data for development: From information-to knowledge societies. 2013. Available at SSRN 2205145.
- [20] Podesta, J., et al., Big data: seizing opportunities, preserving values. Executive Office of the President. Report.
- [21] Murdoch, T.B. and A.S. Detsky (2013). The inevitable application of big data to health care. *JAMA*,(13)309, 2013, p. 1351-1352.
- [22] Villars RL, Olofson CW, Eastwood M (2011). Big data: What it is and why you should care [Internet]. IDC; 2011 [cited 2013 Dec 10]. Available at: http://sites.amd.com/us/Documents/IDC_AMD_Big_Data_Whitepaper.pdf