



## Process Analytics Model for Health Care using IoT and Big Data Techniques

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**ABSTRACT:** An increased old age population created the pressure to depute more manpower and technological support in society. The occurrence of acute and chronic illnesses in the early age population in the world leads to an increase in health care assistance. The health care industry is relying on technological support for advance treatment and to avoid complications. Advanced medical assistance is available in developed cities where the people have to come with clinical records for further treatment. The digitization of patient data enables to access medical support from farthest distances are possible. It reduces the process steps in the overall health care system. The chronic diseases need treatment during the lifetime of a patient in which indulges to store patient records electronically. The process analytics build relationship between the doctor, diagnostic centers and patient. The primary advantages of using process analytics in health care are expert guidance, global medical assistance, and possible alternate treatment mechanisms. The secondary advantages are the analysis of the same type of disease complications and the creation of a disease-based health care data repository. This paper focuses to process model-based approach for health care analytics. The two emerging techniques Big data and IoT need to be incorporated with the process model for sourcing, storing and analyzing the health care data.

**Keywords:** Process Mining, Process Analytics, Health care, Big Data, IoT.

### I. INTRODUCTION

Medical industry is the third largest sector in the world. Each country is spending more money on health care and invest huge funding for health care research. The industry directly or indirectly affects the GDP and economy of a country. The development of technology in the medical industry influences to monitor and treat diseases efficiently at lesser costs [1]. The 21st century and the year 2019 are contributed to value-based care in health. Today personalized care using machine intelligence and artificial intelligence are growing in remarkable heights [2]. Continuous monitoring of a patient provides good medical care and enables to get a huge amount of data called big data. The collected data is compared, analyzed and used to take decision on time.

Health Care Analytics is a new solution for emergency and critical health assistance where the patient is monitored using technological support. The increase of the old age population, chronic disorders, and causes of acute illness due to lifestyle change and other reasons are the new threatening factors in this era. According to the WHO report [3], the aging population care and support have become one of the most significant social threats in this twenty-first century, with implications for nearly all sectors of society. The health care support for the aging population becomes riskier because of the nuclear family setup and most of the old age people are helpless and living without any family support. Medical assistance with human support is not possible for all people. For that remote medical assistance or mobile health care support will be very useful to ensure good

medical support to them. In another case, chronic illness and other sudden illnesses like diabetic, Blood pressure, Accidents are to be treated periodically and immediately. Presently the diagnosis is done with the equipment and technical support [4]. But personal healthcare is based on treatment and prescription with manual support. The manual assistance is risky and cannot able to predict the critical condition of a patient in most of the cases. It is hard to make decisions with the help of present reports and the condition of the patient. The process analytics gives access to the old medical history of a patient and compares with the present which is very useful for a further step in medical complications [5]. To solve that, technical support is needed to monitor, diagnose and treat the patient. The current treatment method or process is a complex task whereas the patient has to start the treatment from the initial level in each level of medication. The present work is aimed to develop a process analytics model for health care.

### II. RELATED STUDY

IoT in Health care is an emerging field that is familiar in the recent years. In 2011, before the smartwatch [6] and fitness tracker entered the commercial market, the number of internet-connected devices worldwide outnumbered the people who possessed them. The IoT has had a particularly profound impact on healthcare, as has been demonstrated by The Allure Group. In July 2018 [7], Allure became the first Brooklyn-based skilled nursing facility to implement EarlySense, a remote monitoring system that tracks patients' vital signs and movements courtesy of sensors placed under mattresses and pillows.

Since its introduction at the Bedford Center [7, 8], one of six facilities in the Allure network the EarlySense has correlated to widespread results showing a 45% reduction in patient falls, a 60% reduction in bedsores, and an 80% reduction in code blue events. By 2020, the Federal Trade Commission [9] predicts that there will be 50 billion internet-connected devices ranging from cars to toasters to pet monitors, cameras and many others. By 2021, Tractica predicts that wearable devices will surpass 97.6 million. IoT's prominence in our society is only going to increase [9, 10].

### III. PROCESS ANALYTICS IN HEALTH CARE

Process analytics is an automated process useful for deciding with the use of machines that needs data as input. Today data is one of the driving factors in all fields. Health data is inherently complex, needs computation techniques to analyze and apply the data to the next level [11, 12]. The data obtained from various resources like clinical trials, Physician observation, medical diagnostic devices need to be stored and analyzed. The maintenance of health data as Electronic Health Records (EHR) is more effective for further reference and usage in distinct locations. Recent studies have shown that the rapid growth of IoT and Big Data Technologies are playing a significant role in process analytics. Today predictions of disease with earlier symptoms are the most needed factor in the health care industry. The increase of the elder population needs advanced technological support to predict, treat and identify the diseases and critical conditions at the right time. For that periodical monitoring of patients using GPS enabled with internet support. The generation of data is stored periodically in a database or cloud storage [13]. The data generated by the humans are monitored using appropriated diagnostic tools and the proposed analytic models notify when the data input is getting wrong or going beyond the level. The devices like pressure tester, glucometer are connected with the proposed model and it gives notification when the blood pressure or glucose level of a patient is abnormal.

#### **About Process Analytics Models in Health Care:**

Business process modeling is a combination of different or related modeling approaches to find solutions in a real-time environment [14,15]. It uses process modeling languages to define and analyze the problems. The process modeling approaches are used for understanding the process flow and functionality. The health care system requires that kind of model with flexibility. Since health care analytics is emerging technology there are no standard models for implementing health care processes automatically. For that data mining techniques are collectively used along with business models in health care analysis. Process Analysis is the basic step of all business processes in which the processes are divided into sub-processes. Each sub-process consists of inputs, outputs, and operations as a part of process analysis. The subprocess is sequentially organized as phases. A process analysis can be used to improve understanding of how the process operates, and to determine potential targets for process improvement through increasing efficiency [16,17]. When the process analysis is done with a machine that is self-automated and decision-

oriented, then it is called process analytics. The process analytics is implemented in manufacturing applications and industries which need to require the least dynamic changes and decision making. The fields like health are highly sensitive and realistically connected to humans and the decision making and activities can be done based on the real-time inputs obtained from humans. In this case, the high intension and least failures should be achieved during implementation. At present the generalized models are not available for health care analytics, hence the common mechanism and model is the current need which can be used as a preliminary model in health care. The proposed model should be flexible and can be customized to any health-related management applications.

### IV. PROPOSED HEALTH CARE ANALYTICS MODEL

The proposed model consists of IoT, Big Data, Data Bases and Cloud Storage techniques are used. The model incorporates patient, physician, Hospital, Test Labs and Medical Houses as stakeholders. The management and controlling of health care model can be done by either private service providers or hospitals. The personalization of data is maintained by the user (Patient) or an authorized person of a patient. The data can be stored with the use of private data repositories using distributed databases or in a cloud environment. The personalized data can be shared for medical assistance with the appropriate access levels authorized by the user.

#### **Role of IoT in Health Care Process Analytics Model:**

The connection of devices using the internet recently created a big impact in the Health care industry. Now a day's wearable web-enabled devices are increasingly common which is used to accomplish the day to day tasks. The patient with implanted devices in his body which makes to stay comfortable in his home and with used monitoring devices the remote monitoring can be possible. The IoT minimizes the management and monitoring costs. The patient can also monitor himself by installing a mobile application on his Smartphone. In the automated health care process, the patient can stay at home without any physical assistance and the medical care is possible. The test, monitoring and decision making is possible from remote places. Instead of direct medical attention, remote medical assistance is possible now. The use of IoT and Big data in Health care analytics is common for any kind of patient who is anywhere at any time. This technology provides medical assistance in better, safer and simpler ways. For that, the different smart sensors are used in and around the patient body. The sensors send and receive information from the health care monitoring center. This facility provides better decision making in the least time. The quick response and support are possible in this technology. The medical experts can spend less time monitoring and more time for treating the patients during critical conditions.

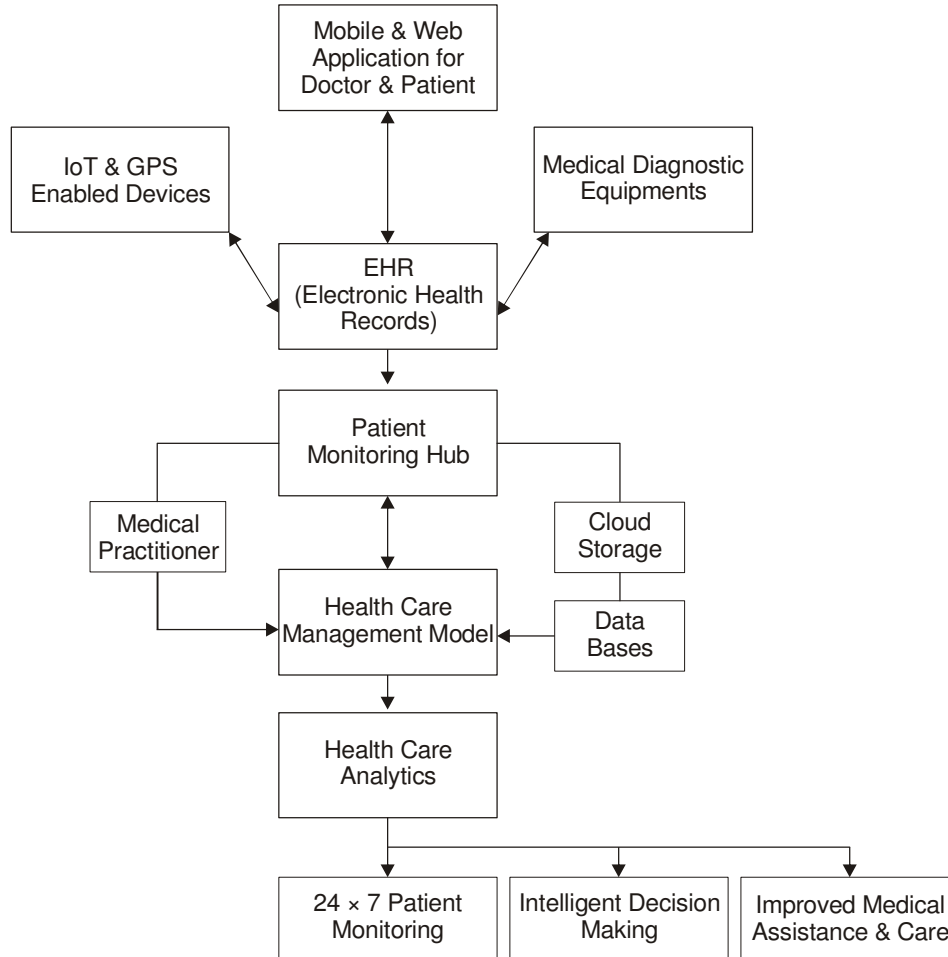
#### **Role of Big Data in Health Care Process Analytics Model:**

In the present scenario, the data collection is done by human and stored in digital devices. For monitoring and transforming the data, the manual work is needed. The IoT enables to collect, store, monitor and helps in decision making automatically when it is required.

The exchange of patient information is possible in a fraction of second with the use of technology. Continuous monitoring of a patient can generate huge volumes of data. The data storage requires more space and it should be dynamic. Distributed and Cloud storage techniques can be used for efficient memory utilization.

The patient can store the personal information in a different location which can be maintained by different data service providers. During the integration of data for medical diagnosis or decision making, the big data techniques are used. The cloud storage can be used for storing and sharing the personalized patient information.

### Proposed Model for Health Care Analytics



### V. CONCLUSION

The proposed approach is an initial step for building a standard model for Health care analytics with the support of IoT and Big Data. The use of recent technologies enables to monitor the patients from remote places. The proposed approach provides a good opportunity to save the lives of many patients by identifying problems in advance. Continuous monitoring and effective communication technology lead to giving immediate medical assistance and improved health care. The proposed model can be applied with existing mechanisms in health care analytics.

### VI. FUTURE SCOPE

The next step of the work is to compare the proposed health care model with existing business process models and Data mining techniques. The model can be experimented using the real time data with performance measures.

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### REFERENCES

- [1]. Thierer, A. D. (2015). The Connected World: Examining the Internet of Things. U.S. Senate Committee on Commerce, *Science, and Transportation*.
- [2]. Anantharam, P., Banerjee, T., Sheth, A., Thirunarayan, K., Marupudi, S., Sridharan, V., & Forbis, S. G. (2015). Knowledge-driven personalized contextual mhealth service for asthma management in children.

In 2015 *IEEE International Conference on Mobile Services* (pp. 284-291). IEEE.

[3].

<http://documents.worldbank.org/curated/en/816281518818814423/pdf/2019-WDR-Report.pdf>

[4].

<https://www.forbes.com/sites/reenitadas/2018/11/13/top-8-healthcare-predictions-for-2019/#72374d23700e>

[5]. Islam, S. R., Kwak, D., Kabir, M. H., Hossain, M., & Kwak, K. S. (2015). The internet of things for health care: a comprehensive survey. *IEEE Access*, 3, 678-708.

[6]. Henriksen, A., Mikalsen, M. H., Woldaregay, A. Z., Muzny, M., Hartvigsen, G., Hopstock, L. A., & Grimsgaard, S. (2018). Using fitness trackers and smartwatches to measure physical activity in research: analysis of consumer wrist-worn wearables. *Journal of medical Internet research*, 20(3), e110.

[7]. <https://www.allurecare.com/about/history/>

[8]. Verma, K., & Malviya, P. (2017). A literature review on feature Selection in Big Data. *International Journal of Electrical, Electronics and Computer Engineering* 6(1), 37-44. ISSN No. (Online): 2277-2626.

[9].

[https://www.ftc.gov/system/files/documents/advocacy\\_documents/ftc-comment-national-telecommunications-information-administration-communicating-iot-device-security/170619ntiaiotcomment.pdf](https://www.ftc.gov/system/files/documents/advocacy_documents/ftc-comment-national-telecommunications-information-administration-communicating-iot-device-security/170619ntiaiotcomment.pdf)

[10]. Rajpoot, S. S., & Khandelwal, A. (2018). Home Energy Control System Using Wireless Smart Socket

and IoT. *International Journal of Electrical, Electronics and Computer Engineering*, 7(1), 14-20. ISSN No. (Online): 2277-2626.

[11]. Meena, S. D., & Revathi, M. (2015). Predictive analytics on healthcare: a survey. *International Journal of Science and Research (IJSR)*, 4(9), 1495-1498.

[12]. Alharthi, H. (2018). Healthcare predictive analytics: An overview with a focus on Saudi Arabia. *Journal of infection and public health*, 11(6), 749-756.

[13]. Wang, L., & Alexander, C. A. (2013). Medical applications and healthcare based on cloud computing. *International Journal of Cloud Computing and Services Science*, 2(4), 217-225.

[14]. Abramowicz, W. (Ed.). (2007). A Survey of Comparative Business Process Modeling Approaches", Conference: *Business Information Systems: 10th International Conference, BIS 2007, Poznan, Poland. Proceedings* (Vol. 4439). Springer.

[15]. Ruiz, F., Garcia, F., Calahorra, L., Llorente, C., Gonçalves, L., Daniel, C., & Blobel, B. (2012). Business process modeling in healthcare. *Stud Health Technol Inform.*, 179, 75-87.

[16]. Batalden, P. (2018). Getting more health from healthcare: quality improvement must acknowledge patient coproduction—an essay by Paul Batalden. *BMJ*, 362, k3617.

[17]. Orellana, A. G., Pérez, D. A., & Larrea, O. A. (2015). Analysis of Hospital Processes with Process Mining Techniques. *Studies in health technology and informatics*, 216, 310-314.

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