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## Application of Big Data in Decision Making for Emergency Healthcare Management

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**Abstract:** Application of big data in healthcare has enhanced efficiency and decision making. This is of critical benefit to patients, healthcare professionals and the healthcare institution. Although various research studies have examined the application of big data analytics in healthcare, few studies have explored its application in emergency medicine. This research study explored the application of big data in emergency medicine in facilitating decision making among paramedics and other healthcare practitioners. Appropriate research studies were identified and reviewed systematically to explore the theme of the study. The study found that big data promoted decision making in emergency medicine through the predictor models, which enabled the healthcare practitioners make informed judgments concerning patient care.

**Keywords:** *Big data for healthcare management, unstructured data in decision making, data analysis in emergency services, ambulance paramedic data analytics.*

### I. BACKGROUND

Various research studies have highlighted potential impacts of applying big data in healthcare. In healthcare, application of big data analytics is especially critical, to enhance decision making in an industry that is characterized by large volumes of information pertaining to patient care and other records. Although a significant amount of healthcare records are in hardcopy, the need to digitize the data has become more urgent, to facilitate efficient decision making. In spite of the identified benefits of applying big data in healthcare its application in emergency health services remains marginal.

Application of big data in healthcare, including emergency medicine has become more apparent due to unique

challenges and opportunities facing the sector at large. The need to provide high quality healthcare services at an affordable cost and the changing healthcare needs of patients have created the need to have more effective data storage mechanisms to facilitate better decision making process in delivery of healthcare services<sup>1</sup>. The versatility in the application of big data in healthcare, such as provide support to a wide spectrum of clinical functions including decision making, undertaking epidemiological surveillance and management of various health indicators in the population makes it an ideal technological application in emergency medicine. Empirical research evidence indicates a growing volume of health data volumes in healthcare, with United States recording over 150 Exabyte in the last 7 years, which is estimated to grow to hundreds of yottabytes by 2020 [1].

In healthcare, big data comprises of huge electronic data sets that cannot be managed using the conventional informational and technological information systems, such as software or the traditional filing systems [2]. In healthcare, big data is not only voluminous, but it contains a wide spectrum of information that is critical in management of the patients. The data includes prescription records, health assessments, physician appointments, pharmaceutical and prescription records, health insurance information, machine generated data for monitoring various vital organs and other forms of information, which is directly or indirectly related to health of the patient.

Management of such information requires systems that enhance security and efficiency especially in retrieval and proper management, to enhance decision making by the healthcare professionals. In this regard, big data analytics in emergency medicine provides opportunities of finding relationships between various information about the patient, which facilitate decision making regarding the patients wellbeing.

To paramedics, big data analytics presents a unique opportunity of enhancing their efficiency in delivering of quality services, in the respective responsibilities before the patient is attended in the healthcare institution. Paramedics can enhance the quality of care delivered to patients through exploration and discovery of relationships of various indicators through data analytics [1,2]. By proper understanding of the evident trends demonstrated in the big data analytics, emergency medical professionals can be able to not only enhance the quality of care delivered to the patients, but also help in reducing mortality and morbidity associated with pre-hospital care, in addition to reducing health costs.

Various research studies have explored the potential benefits and also limitations of applying big data in making decisions in emergency healthcare services. A study conducted by Meltzer and Pin [7], on the potential benefits and limitations of big data in emergency medical services generated several interesting findings. One of the strengths of using big data analytics that enhance its application in emergency medicine is its ability to identify various relations and association of patients' information or data over period of time. This attribute is advantageous to medical health practitioners especially those who only access to patient information is through visitations to emergency departments. The ability of big data to create associations is crucial because patients normally present similar health complaints to the emergency department, which makes it difficult to have a holistic view of the patients' health state through electronic health records alone.

The second benefit of applying big data in emergency medicine is its ability to point out various relationships reported in a wide population or geographical regions and then determine the applied care patterns with high precision [7]. This information is critical for emergency health professionals, because they can establish the appropriate intervention of affected patient with high degree of certainty. To other emergency health practitioners, the information generated from the analytics facilitates effective communication between the stakeholders involved in the delivery of emergency healthcare services from the onset until the patient is discharged [7]. Additionally, the healthcare practitioners can be able to device an appropriate care plan and follow up for patients particularly those without access to quality outpatient care. In this case, data analytics facilitate accurate communication between the paramedics and the attending healthcare professionals in outpatient care setting, which result to improvement in the quality of healthcare services delivered to the patient, which ultimately enhances the health outcomes.

In spite of the apparent benefits of applying big data in emergency medicine, the technology has various

demonstrable shortcomings. Empirical research evidence indicates that although big data is beneficial in case finding or as an indicator of the need to undertake further assessments, it is not accurate in determining the quality of care delivered to patients in emergency medical setting. This was demonstrated in a research study conducted by Meltzer and Pin [7] in emergency department of an organization in California, whereby serious health conditions of patients visiting it were not diagnosed using the technique. In this case, data analytics failed to identify potentially lethal conditions in vulnerable patients, such as cardiac infarction, fractures and internal hemorrhage among patients making several visits to the emergency department [7].

Another shortcoming associated with the application of big data in emergency medicine is that it does not capture the entire data, regarding the interaction the patient or interactions with the various healthcare providers [1]. This partial capture of information could undermine the quality of healthcare services delivered to the patients in the emergency setting by the paramedics especially in the outpatient care. A study found that big data analytics failed to capture critical data pertaining to the patient, such as the number of visitations to emergency departments and the type of interventions applied outside the hospital settings [7].

Additionally, big data has been found to provide inadequate information in its identified variables of patient care. Some of the data deducible from big data includes the patient diagnosis, date of visitations to the emergency department and medical tests applied, and in some cases, the healthcare costs [2]. However, the information is sometimes not adequate especially in situations where patients make several visits to the emergency department. The reasons for repeat visits are critical especially to the paramedics and other healthcare practitioners attending the client in the outpatient care setting in determining the type of intervention to apply. Similarly, several research studies have indicated that big data does not provide information regarding results from laboratory tests and other diagnostic procedures, a situation that could potentially undermine health outcomes of the patient in prehospital care setting.

Application of big data in emergency medicine, especially by the paramedics has been reported to be quite low. Although the use of data analytics in healthcare is yet to be fully utilized, there is need to explore available evidence based practices that have been associated with the use analytics in emergency medicine. This paper explores the application of the big data in emergency medicine in facilitating decisions making among the paramedics and other professionals involved.

## II. METHODOLOGY

This study applied a systematic review research design in the published literature that investigated the application of big data in making decisions in emergency medicine. To identify the relevant articles of the study, electronic search was conducted in several data bases including PubMed, Google Scholar, CINAHL and EMBASE. The search was conducted using selected search words associated with the topic of the study. To select the relevant articles, the abstract and the entire article was obtained and then reviewed to determine its suitability to the topic.

Articles that did not meet selection criteria were excluded from the review. An initial search generated about 51 articles, which eventually reduced to four articles that met the selection criteria. The selection criteria applied included the articles must have been published within the last 8 years, provide level 1, 2 or 3 evidence and focused on the thematic area of the study. The articles that met the criteria included '*Predicting Asthma Related Emergency Attacks Using Big Data*' by Ram, Zhang, Williams and Pengetnze, '*Embracing Big Data For Simulation Modeling Of Emergency Department and Activities*' by Kuo and colleagues; '*System Design And Improvement Of An Emergency Department Using Simulation Based Multi-Objective Optimization*' by Uriarte and colleagues; '*Big Data Approaches To Trauma Outcomes Predictions And Autonomous Resuscitation*' by Yang and colleagues.

## III. FINDINGS

The review demonstrated several factors that facilitated the application of big data in making decisions in emergency departments. Ram, Zhang Williams and Pengetnze [6] explored how big data could be applied in making decisions regarding asthma attacks in emergency care setting. The study found that big data could be applied in predicting and in the surveillance of asthma attacks in emergency services. This enabled paramedics and other healthcare professionals prepare and plan to deliver appropriate care to the affected patients. The findings are in agreement to an empirical research study by Uriarte and colleagues [4], which found data analytics to be useful in implementation of various healthcare processes in emergency department, which resulted to improvement in efficiency and patient outcomes. Application of data analytics in the study by Kuo [5] and others was found to enhance decision making, reduce the time and cost of care in addition to the other resources in the emergency care department.

The research study by Yang [3] and others found that big data helped in making decision pertaining to predictions of the health conditions of the patients admitted in the care setting. For instance, big data facilitated in the collection of

data on the patients' condition in real time, which enabled the use of the information in making critical decisions, involving patient care and knowledge acquisition by the emergency care professionals including paramedics. A study by Ram [6] and others indicated that application of big data enabled the emergency care professional in making early trauma forecasts in the affected patients. The use of data analytics was also found to enhance the quality of healthcare delivered to the patients and the prediction of death rates of patients in emergency care admitted for various conditions, including sepsis [3,5].

## IV. DISCUSSION AND CONCLUSION

Empirical research evidence regarding the application of big data in emergency medicine indicates potential benefits to both paramedics, and other healthcare professionals in addition to the patient. Application of big data, especially by relating information enables emergency healthcare practitioners deduce critical information regarding the patients' condition, which ultimately helps in planning and making critical decisions regarding the care.

In this case, studies indicate that application of big data enables emergency health care professionals use forecast models to establish the various elements associated with providing care in the emergency setting. These include forecasting the patients' visits to emergency department in a specific area of interest. This helps in observing and monitoring trends regarding emergency care, such as patient admission. Secondly application of big data enables paramedics and other healthcare practitioners predict the outcomes of patients, which enables in developing appropriate care plan of the affected patient. The varied application of big data in emergency department result to various desirable outcomes, including improving the quality of care delivered to patients and improving decision making process, which could also result in reduction of healthcare costs.

In spite of the potential benefits of applying big data in emergency medicine, its application remains low. This is attributed to various factors, which include low participation of paramedics in continuous professional education, which hinders their ability to embrace the technology in the respective workplaces. Moreover, lack of sufficient research studies in application of big data in healthcare remains a major hindrance to its application in emergency departments.

## V. DECLARATION

All authors disclosed no conflicts of interest.

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