

# **Medical Data Analytics for Sophisticated Health Infrastructure: A Critical Analysis of Curriculum Components of International Universities**

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## **ABSTRACT**

Health Data Science is an interdisciplinary practicing domain these days and combines with both Health Science and Data Science. It is a systematic and scientific processing activity with data, knowledge of health and medical systems with the use of intelligent systems. Health Data Science may be considered as a Medical Informatics in some context, though gradually the advancement of science has been revealed that the Health Data Analytics is a part of Health Informatics and importantly it becomes common name in modern healthcare system. There are many reasons for introducing Health Informatics and Big Data introduction in academic community. In many international universities Big Data Management and allied programs become integral part of emerging program. The present study is dedicated to exploring Big Data and Data Science related education, training and research in International Universities. The paper is highlighting the core areas of Health Data Analytics including components in Masters program in International selected universities. A brief overview on Health Data Analytics is also provided in this paper.

## **KEYWORDS**

Data Science, Analytics, Big Data, Computing, Information Technology, Health Systems, Telemedicine, E-Data

## **1. INTRODUCTION**

Big Data integrates healthy and smart solution in information management in healthcare segment. It also helps in enhanced and better planning. Some of the reputed organizations in the world *i.e.*, PwC, IBM, Accenture, Infosys etc are offering various Health Data Analytics related services to its clients. Among the important areas of Big Data Management healthcare segment is most emerging. Health Data Science programs are available in different platforms in different areas viz. Management, Science, Technology, Commerce etc. Role and aim of the health data scientist is emerging day by day due to need of technologies into Medicine [3, 5]. It is important that Health Data Analytics professionals should learn how they fit into the broader healthcare scenery. The values of patient centric systems and solution from the Data Analytics and Healthcare Data Sciences are in fact an important fact initially it is treated as a training field and gradually it becomes an important field of applied science. Most of the universities offer programs in this field with Bachelors, Masters and Doctoral level [5, 7].

## **2. MISSION OF THIS WORK**

This paper discusses several issues in conceptual nature and knowledge survey related to the Medical Data Analytics, Health Big Data programs in international context. Moreover, paper is also planned to deal with the following:

- To know about the Principles and main functionalities of Data Science in relation to Medical Sciences, or simply Health Data Science.
- To dig out the potentialities of the Health Data Science in contemporary context. Moreover it is responsible to learn about the Healthcare in Big Data Management.
- To learn about the emerging educational systems specially higher education in the areas of Health Science related with the Big Data and Data Sciences around the world.
- To find out the main and core educational degrees and programs available in international universities in the areas of Big Data Science and Big Data Management.
- To learn about the main challenges and training programs in the areas of Health Data Science in developed nations including in developing countries, if opted by the selected sample.

## **3. BIG DATA & DATA SCIENCE**

Health Data Science, is a combination of Health Science with Data Science and it also handles unstructured and textual data and is responsible for the healthy Data Science practicum. Big Data Management is measured and may be dealt by as an expert, who is called Data Scientist. A Data Science principle mainly deals with the Data Management. However, here Mathematical and Statistical facets play a wonderful role with ability to analyze data and similar content. Health Data Science adopts emerging and crucial vital methods for more specialized study in Data Management. Health Data Science is related with the Data Analytics and Big Data Management related with the Health and Medical Sciences [1, 6]. It also develops the in-depth knowledge with considerate and investigative for health data successfully for better and sound healthcare delivery using intelligent systems. The Big Data becomes an important knowledge domain gradually and field of interdisciplinary studies.

## **4. METHOD ADOPTED**

As it is a conceptual work and thus is responsible to deal with several aspects of Health Data Science. The work is theoretical and here several research methodologies play a valuable role. For designing and preparing this research work various primary and secondary sources of knowledge play a vital role and thus several components and facets are being employed which include journals, handbook, encyclopedia etc. Regarding the domains apart from traditional Big Data and Data Sciences areas of Health Data Science, Big Data, Health Informatics, Tele-Medicine etc played a vital role. To learn about the current areas and educational situation Health Informatics association website have played a valuable and important role. For better designing of research simple search strategies have been used and fifteen pages with tag 'MSC-

Health Data Science' 'MSc-Health Big Data' have been also used and best result has been selected. Here 15 pages have been treated as main source to learn the latest programs on Health Data Science and Medical Big Data [2, 8]. The web based curriculum have been analyzed and reported in the text with specific heading.

## 5. HEALTH INFORMATICS & DATA ANALYTICS

As a discipline, Medical Informatics has been originated few decades back with the process of systematic and scientific processing of data, information, knowledge. Both Health Informatics and Medical Informatics treated as a domain of Applied Science but Health Informatics is big one than Medical Informatics. Health Big Data Management and Medical Data Analytics become important and valuable part of emerging Health Informatics for managing and dissemination of the information for health and medical segment with fastest growth. Health Data Science is a combination of the domains of Information Science, IT, Computing, Medical Science, Management Science along with Statistical and Mathematical Sciences. Health Data Analytics has no doubt power to boost the medical systems of the nation and most of the developed nations have adopted the same. Health data science is geared with Big Management due to bellow mentioned following—

- Health Big Data Management is helpful for improved and sound healthcare system building with the treatment of individuals to the larger sector.
- Health Data Analytics helps in creation of good governance system as it is responsible for development of smart frameworks with health data in the healthcare sector as well as area.
- Medical Data Analytics is responsible for analyzing, manipulating of health data for better and enhanced healthcare systems towards prosperity.

- To get the breadth and also depth of application methods and systems for its potential utilization of health related data and content.

Data Science is a kind of approach for quantitative analysis of data and thus various statistical methods are being engaged basically required for blending classical statistical methods. Emerging and recent advances in computational systems have rejuvenated Health Data Science. Now it becomes more advance with proper practicum due to its Big Data Management tools and systems. In this system are data basically analyzed as well as dealt by the Big Data Tools like Hadoop for improved medical systems, decision making and patient safety [5, 9].

## 6. EDUCATION IN HEALTH ANALYTICS

Health Data Science is the analytical method based on datasets. Latest methods of Statistics, Management and Database Systems etc have been employed in using Data Management for the healthcare systems. The advancement of knowledge i.e. science, technology and education have results Health Big Data and Health Analytics as a full-fledged domain. Data preparation, processing with databases (structured) formatted data and information etc are the core course of action required by the Healthcare Analytics. Today many universities have started programs on Health Data Science and allied fields with different nomenclature [6, 10]. Surprisingly most of these are offered by the developed countries. And among the developed countries United Kingdom ranks No.1. The details of sample programs with offered titles, university, duration and mode of studies are listed bellow in table (Table 1). The list of selected universities and program output is based on the selected methodology adopted.

**Table 1: Few Health Data Science and Analytics Program**

Programs	University	Duration	Mode
<b>MSc Health-Data Science</b>	Swansea University	1 to 3 Years	Full Time or Flexible Education but On-Campus (it takes higher time)
<b>MSc Health-Data Science</b>	The University of Manchester London	1 to 2Years (Or up to 5 years)	Full Time or Flexible Education but On-Campus (it takes higher time)
<b>MSc-Data Science for Research in Health and Biomedicine</b>	University College London, London	1 Year to 2 Year	Full Time or Flexible Education but On-Campus (it takes higher time)
<b>MS- Health Data Science</b>	Saint Louis University, Spain	2 Year or More	Full Time or Flexible Education but On-Campus (it takes higher time)
<b>MSc- Health Data Science</b>	Harvard University, US	2 Years or More	Full Time or Flexible Education but On-Campus (it takes higher time)
<b>MSc-Data Science (Health)</b>	Lancaster University, UK	1 Year to 2 Year	Full Time or Flexible Education but On-Campus (it takes higher time)

## 7. CURRICULUM ANALYSIS OF MEDICAL DATA ANALYTICS

Regarding the curriculum and components of the program it is noticed that most of the universities offer some of the common programs which include (but not limited to) the following—

- Health Data Manipulation
- Health Information Systems
- Public Health
- Basics of Statistics
- Health Data Management

- AI/ES for Medical Data Analytics etc

It is important to note that most of the universities have adopted the computing, informatics and health science gradients in general. However gradients on Management Science, Mathematical Sciences etc are also most common in Health Data Science curriculum. Sometimes the nature of curriculum also depends on the entry level qualification. As per the research in adopted and selected methodology (mentioned in the section of Methods adopted), the core curriculum of the Health Data Science programs are listed in Table 2.

**Table 2: Few Health Data Science and Analytics program**

Programs	Core Structures
<b>MSc Health-Data Science,</b> Swansea University	Health Data Science and Scientific Computing in Healthcare, Health Data Manipulation, Analysis of Linked Health Data, Machine Learning Applications in Health Data, Health Data Visualization, Advanced Analysis of Linked Health Data, Health Data Analysis-Dissertation
<b>MSc Health-Data Science,</b> The University of Manchester London	Principle of Digital Biology, Introduction to Health Informatics, Fundamentals of Epidemiology, Health Information Systems and Technologies, Tutorial in Health Data Science, Understanding Data and Decision Making, Fundamentals of Mathematics and Statistics for Health Data, Biomedical Modeling for Health Data,
<b>MSc-Data Science for Research in Health and Biomedicine,</b> University College London, London	Principle of Applied Epidemiology Applied to Electronic Health Records, Data Management for Health Research, Statistics for Epidemiology and Public Health, Statistical Methods in Epidemiology, Health Data Science Topics, DMBS, IR & Data Mining, Principle of Health Informatics, ML in Healthcare etc
<b>MS- Health Data Science,</b> Saint Louis University, Spain	Programming for Data Scientist, Foundations for Outcomes Research I, Analytics and Statistical Programming, Analytics and Statistical Programming, Foundation of Medical Diagnosis and Treatment, Inferential Modeling of Health Outcomes, Health Data Management and Standard, High Performance Computing in Healthcare Industry, Communication and Leadership in the Healthcare Industry, Predictive Modeling and Machine Learning, Capstone
<b>MSc- Health Data Science,</b> Harvard University, US	Introduction to Data Science, Data Science-II, Basic Statistical Inference, Applied Regression and Machine Learning, Introduction to Epidemiology Methods, Computing for Big Data and any 5 Computing Courses-Data Structure, Computational Statistics for Biomedical Science, Privacy and Technology, Software Engineering, Data Systems, Machine Learning, Computational Linguistics, Project
<b>MSc-Data Science (Health),</b> Lancaster University, UK	Data Science- Fundamentals, Programming for Data Science, Data Mining, Linear Models, Likelihood Inference, Clinical Trials, Principles of Epidemiology, Environmental Epidemiology, Longitudinal Data Analysis

It is an important fact that still availability of Health Data Science and allied programs is very much limited. But there are many programs available on Information Technology and allied fields including Computing etc. Apart from these programs Health Informatics is also available in many universities worldwide, In India and

other developing countries. Hence, programs may be offered on Health Data Sciences in these subjects with specialization or major [5]. The following tables (Table 3, 4 and 5) depict few programs on Health Data Science and/or Medical Analytic.

**Table 3: Health Data Science related program in Science platform**

Possible Masters Degrees in Science Platform
MS/MSc (Research)- Health Data Science MS/MSc -Medical Big data MSc- Information Technology (Health Data Analytics) MSc-Computing (Health Data Analytics & Management) MSc-Information Science/Systems (Health Data Management) MSc-Computer Application (Data Systems and Telemedicine)

**Table 4: Health Data Science and allied programs in Engineering and Technology platform**

Possible Masters Degrees in Engineering Platform
M.Tech/ME- Health Data Sciences M.Tech/ME-Health Data Science & Informatics MTech/ME-Health Analytics & Cloud MTech/ME-Computer Science (Medical Big Data Analytics)

**Table 5: Health Data Science and allied programs in Engineering and Technology platform**

Possible Masters Degrees Management & Commerce Platform
MBA (Health Data Analytics & Management) MBA (Medical Big Data Management) MBM (Informatics with Health Big Data) M.Com (Health Management using Data Analytics)

The universities have to take potential planning and educational strategies to offer Medical Big Data and analytics programs in collaboration with other related and allied departments.

## 8. SUGGESTIONS AND POTENTIALITIES

There are huge potentiality waiting for developing and offering Medical Analytics and Health related programs in universities and other institutes of higher learning. Few possible measures may be undertaken—

- Universities should take proper steps for initiation of programs in the areas of Health Informatics and Big Data Analytics.
- Proper collaboration needs to establish with other universities and allied departments such as Medical Science with Computing/IT for offering the program.
- Governments need to take proper planning to start program and policies to improve public health and in this regard Medical Data analytics may be treated as important and valuable.
- Proper research initiatives may be taken with other research centers for conducting research based degrees and industrial training etc.

## 9. CONCLUSION

Health Data Science is the analytical methods based on datasets and thus it combines with the several interdisciplinary facets. All modern institutes are moving towards real implementation of the curriculum hence for practical solutions universities have to put importance on industrial tie-ups and collaborations. Public health now-a-day's an important facet and here huge potentialities are waiting for the development of intelligent medical systems powered by big data analytics. Governments and other foundations need to take proper steps for solid implementation of curriculum. For a solid and interdisciplinary curriculum all the related and allied departments need to work together for better and healthy result.

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