

# INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

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**AN ACCURATE HEALTHCARE COST PREDICTION USING VOTE BASED CLASSIFICATION TECHNIQUE**

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**ABSTRACT**

While the population growth rate for India has gradually gone down, it is still at over 1.3 percent and is not likely to go below one percent in the near future. Also, it is fascinating to note that our population aged above 60 years is likely to grow to around 193 million, compared with over 96 million in 2010. This transformation in the population pyramid is expected to fuel the demand for healthcare in general, particularly lifestyle diseases.

**KEYWORDS**

healthcare scenario, health cost prediction, Indian healthcare and lifestyle.

**1. INTRODUCTION**

**HEALTHCARE SCENARIO**

Being healthy is a requirement for a worthy breathing and a vital component to achieve countless things on world. With growing life expectation, an average Indian is now enthusiastic to involve in dynamic work much beyond his or her leaving age. But with exposure to contemporary ills and acquainted to a new routine, one cannot keep off visiting hospitals as a range of illnesses is bound to take a toll on the health system. The irony in the healthcare delivery is quite stark in India.

The progression of a country is not just about scheming its industrial, agricultural and services balance sheets. It is equally about scheming its monotonous on the human growth indices. The state of its healthcare is one of the serious methods of how a homeland state is acting. For a country the size of India, that is even more significant.

The Indian healthcare productivity is all set to raise to over USD 280 billion by 2020, which is an evolution of over ten times from 2005. This development has been determined by several factors, including demographics, increase in awareness levels and approachability of medical care in India.

Overall health care expenditure in the United States went from \$1.5 trillion in 2001 to \$2.9 trillion in 2013, with a forecast of expenditure \$4.8 trillion in 2021.1 "By 2023, health care spending will account for nearly a fifth of the annual Gross Domestic Product (GDP), at 19.3%, up from 17.2% in 2012."2 The U.S. is on a health care spending spree that out-paces most other develop countries and has one of the highest amounts spent on health care in relation to the GDP. In addition, the U.S. has the most expensive health care system in the world, yet ranks last amongst ten other modernized countries in overall quality, safety and access.3 between 1960 and 2010, healthcare's share of the GPD rose 12%. [9]

**FIG. 1**

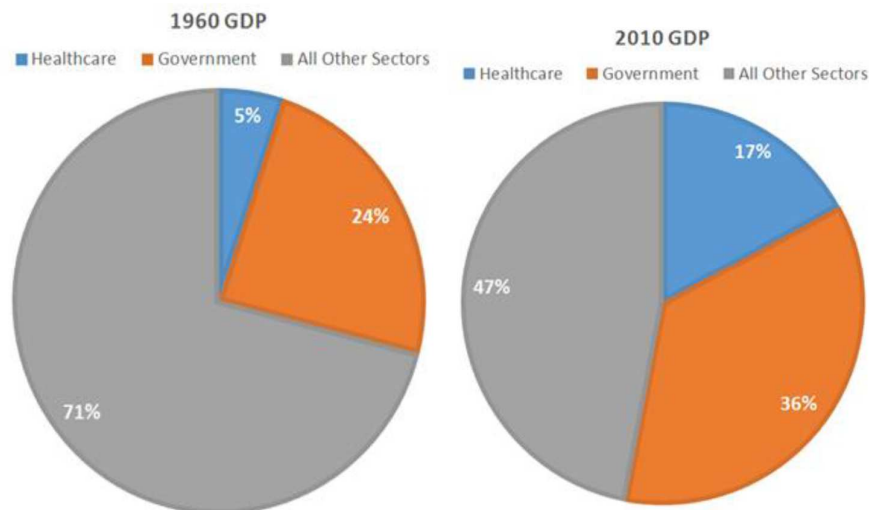
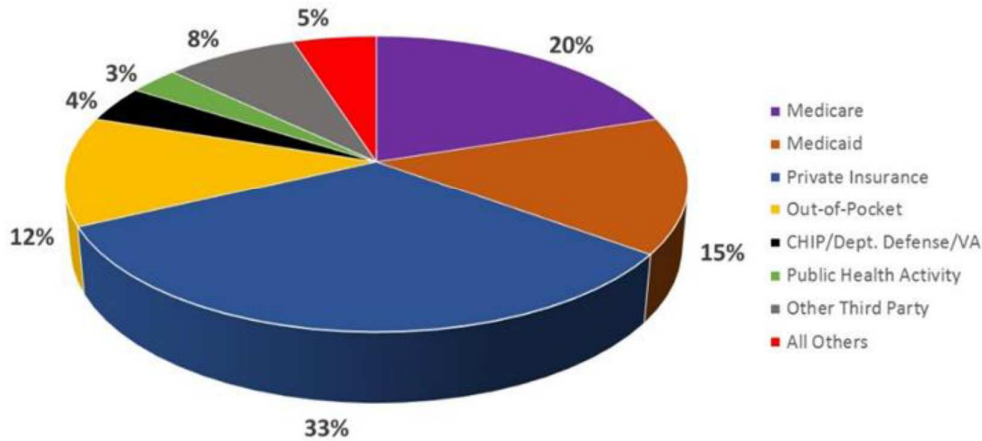


FIG. 2  
2013 U.S. Health Spending by Major Sources of Funds



**2. CHANGING WITH THE TIMES**

**HOW HEALTHCARE COST IS INCREASING DAY BY DAY**

In the past decade, India has observed a rapid growth in levels of capital and disposable incomes. Together with a better standard of living and health attentiveness, this has led to an increase in expenditure on healthcare and wellness.

Lifestyle-related diseases comprised 13 percent of total disorders in India, according to a 2008 data, and this figure is expected to increase to 20 percent by 2018. This is projected to trigger an supplementary demand for expert treatment, which in turn, will lead to improved margins for hospitals since these diseases lie at the high margin end of the continuum.[8]

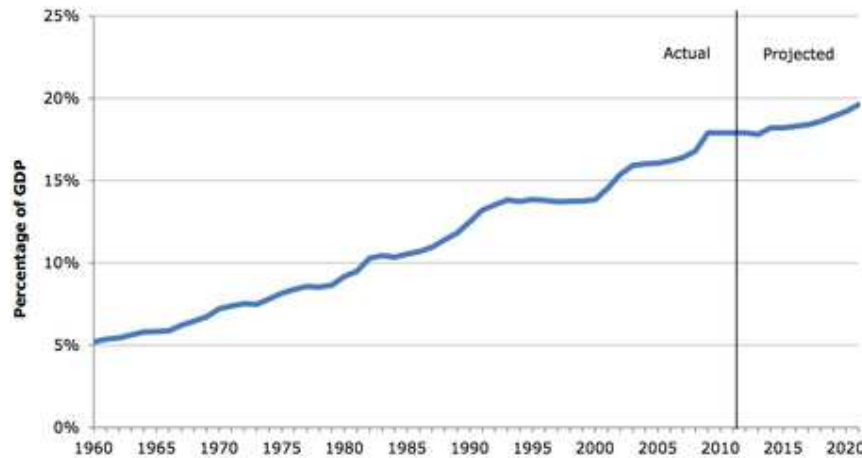
While out-of-pocket expenditure remains the backbone of healthcare expenditure, health insurance is gaining motion in India. The increasing perception of health insurance is projected to meaningfully increase the affordability of healthcare services, driving up the demand for preventive healthcare and curative services. Health tourism is also motivating the healthcare market in India.

The fact that the cure for major surgical treatment in India costs approximately 20 percent of that in advanced countries; coupled with the high superiority of care in Indian tertiary and specialty hospitals makes health tourism attractive for patients from developed as well as emerging economies.

**3. CONTRIBUTING FACTORS TO THE RISING COST OF HEALTHCARE**

There is no one villain in the clash against mounting health care costs. Currently, the United States employs more on health care amenities than any other country, exceeding \$2.6 trillion, or about 18 percent of gross domestic product. Most years, medical expenditure rises faster than inflation and the economy as a whole. Many factors — and nearly everyone — contributes to those increases. [11]

FIG. 2



Source: U.S. National Health Expenditures as a Share of GDP, 1960-2021

*We pay our counsellors, hospitals and other health providers in ways that compensation doing more, rather than being effective:* Most insurers including outdated Medicare pay counsellors, hospitals and other health providers under a fee-for-service system that compensates for each test, method or visit. Coupled with a medical scheme that is not united, this inspires overtreatment, including tiresome tests, the report says. New determinations in the federal health law and among some private insurers aim to move expenses toward a flat rate for a specific condition, such as a knee replacement, or for a patient’s entire chapter of care, in order to modernize costs. Medical systems and specialists are also looking to electronic medical records as a way to improve synchronization and reduce pointless, repeated tests.

*We’re increasing older, sicker and fatter:* As we get older, we tend to need more health care. The baby boom generation is heading into retirement, with staffing in Medicare set to grow by an average of 1.6 million people yearly. Additionally, nearly half the U.S. residents has one or more chronic conditions, among them asthma, heart disease or diabetes, which drive up costs. And two-thirds of grownups are either overweight or obese, which can also lead to long-lasting illness and additional health spending.

FIG. 3

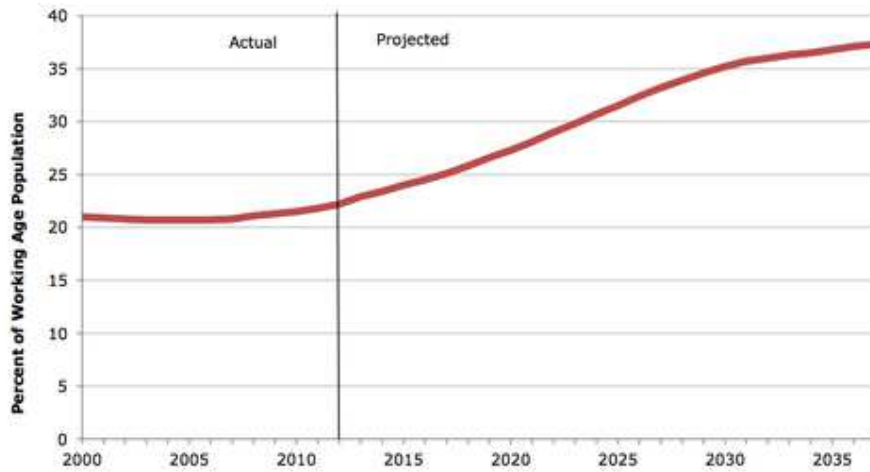
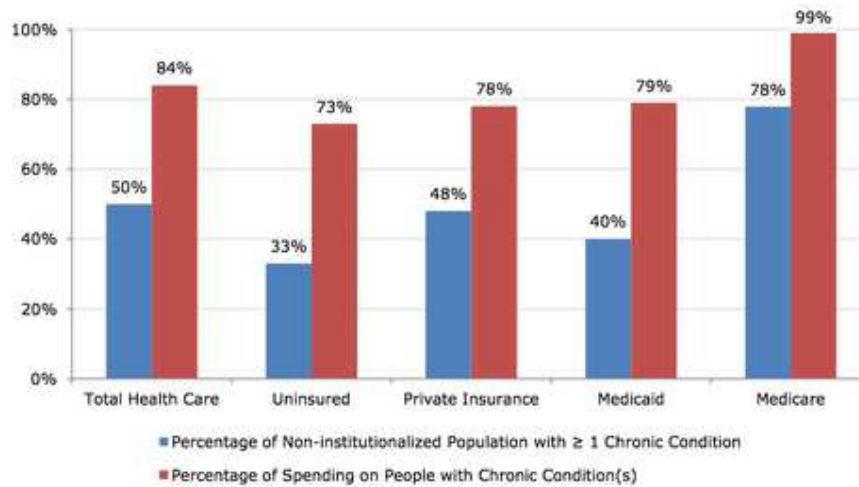


FIG. 4: POPULATION OVER 65 AS SHARE OF WORKING AGE POPULATION



People with Chronic Conditions Account for 84% of National Healthcare Dollars & 99% of Medicare Spending

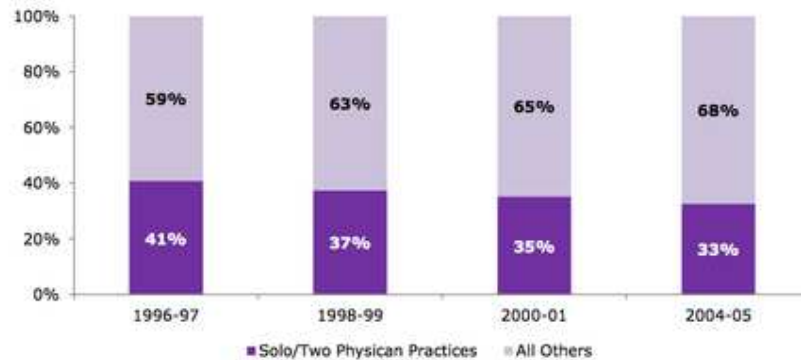
*We want new treatments, skills, amenities and procedures:* Medical advances can help us get well, avoid illness and delay death, but they also drive up expenditure. Much new expertise comes on the market after being experienced only for safety or whether the new conduct is equivalent to existing ones or even placebos. Patients and doctors often demand the newest treatments, even if there is little or no proof that they are better. Prices for newer treatments are often higher than for the products they replace.

*We get excise breaks on obtaining health insurance — and the cost to patients of seeking care is often low:* The majority of people with insurance get it through their jobs. The amount employers pay toward coverage is tax deductible for the firm and tax exempt to the worker, thus inspiring more luxurious health plans with richer benefits, the report says. How that treatment is designed also plays a role: Low deductibles or small office co-payments can inspire overuse of care, the report says. Increasingly, however, employers are moving toward high-deductible coverage as a way to slow premium growth and require workers to pay more toward the cost of care.

*We don't have enough evidence to make conclusions on which medical care is best for us:* While medical periodicals, the Internet and the popular press are awash in health information and studies, professionals and patients find there is no broad standard for assessing individual treatments, or how precise treatments compare with others. Even when evidence shows a treatment isn't effective, or is theoretically harmful, it can take a long time for that information to actually change how doctors practice or what patients demand, the report says. Additionally, Americans vary broadly in how they view end-of-life issues, with some desiring every possible medical involvement to stave off death in every state, no matter how small the prospect of success.

*Our hospitals and other providers are increasingly gaining market share and are better able to claim higher prices:* While mergers or partnerships among medical providers or insurers may improve effectiveness and help drive down prices, amalgamation can also have the conflicting effect, allowing near-monopolies in some markets and driving up prices, the report says. Increasingly, hospitals are buying up rivals and directly engaging physicians, creating larger health systems.

FIG. 5



The percentage of Physicians in Solo/Two-Physician Practices Dropped by One-fifth from 1996-97 to 2004-05

*We have supply and demand problems, and legal issues that obscure efforts to slow spending:* Malpractice premiums and jury awards are part of what drives spending. A larger problem, although hard to quantify, is “defensive medicine” — when doctors prescribe pointless tests or treatment out of fear of facing a lawsuit, the report says. Fraudulent billing or unnecessary tests by medical providers seeking to “game the system” are another concern.

Finally, the report notes that state laws occasionally limit the capability of nurse consultants or other medical professionals, who are paid less than doctors, to fully accomplish work for which they are trained. The U.S. faces a shortage of primary care doctors, so more advanced practice nurses and others will be needed to help care for patients who gain insurance coverage under the federal health law. Conversely, the U.S. has a higher ratio of specialists than other countries, which can serve to drive up spending. Specialists have more advanced training than primary care doctors, and are paid far more.

#### 4. BACKGROUND

##### HEALTHCARE COST PREDICTION

While over \$28 Billion has been expended so far on applying health information technology, particularly Electronic Health Record Systems (EHR), these systems are not interoperable, meaning that information does not flow effortlessly between them. Earlier this year, the Office of the National Coordinator for Health Information technology (ONC) released a report on health information blocking that has been undermining healthcare reform and called for congressional intervention to address the issue.

Broadcasting coverage on healthcare cost prediction indicates that many health systems and networks are developing workarounds using available standards to exchange clinical information within and among themselves to improve the patient experience and reduce costs. However, the healthcare IT landscape is far from seamlessly integrated at this point with major EHR vendors and health systems driving independent agendas. The same report notes that 63 percent of hospitals and 69 percent of health systems expect interoperability to be one of the top three data-related challenges over the next three years in performing analytics.

Healthcare Consumerism will gain ground, enabled by increased investment in digital technologies.

A recent study seems to signpost that consumerism and consumer appointment in healthcare are currently way behind the rhetoric. However, Digital Health funding has been on a tear in 2015, and the rise in funding for on-demand health startups indicates that consumers want healthcare distributed to them – which is a very different standard from the way healthcare works today. The lack of reasonable insurance on ACA exchanges, low price transparency around healthcare costs, and increasing economic burdens on consumers will drive the shift towards consumerism in 2016.

##### 5. HOW DO HEALTH CARE COSTS AFFECT AVAILABLE INCOME?

Health care costs affect family finances in four ways:

- The family's share of the health insurance premium (not taxed)
- Out-of-pocket spending e.g., for co-pays, deductibles, and prescriptions
- The employer's share of the health insurance premium (not taxed)
- The portion of the family's federal and state taxes devoted to government health programs e.g., Medicaid, Medicare, veterans' health care, and public health.

These first two groups of these costs family premiums and out-of-pocket expenditure are readily visible to families. But the other two are largely secreted from view. Although employers pay a large share of employees' health insurance premiums, most economists agree that this money would otherwise be paid out as additional wages. And few taxpayers realize how large a share of their state and federal taxes goes to cover the costs of Medicare, Medicaid, and other government health programs. [10]

##### 6. STRATEGIES FOR HEALTHCARE PREDICTION

**THE BASELINE METHOD:** To make meaningful evaluations, we define a baseline method against which we link the results of the prediction models. As our baseline method, we use the healthcare cost of the last 12 months of the observation period as the forecast of the overall health-care cost in the result period. Because current health-care cost is a strong indicator of a person's health, this baseline is much stronger than, for example, random assignment.

**CLASSIFICATION TREE:** Classification trees (Breiman et al. 1984) have been applied in many fields such as finance, speech recognition, and medicine. As an example, in prescription they have been applied to develop classification criteria for medical circumstances such as osteoarthritis of the hip (Altman et al. 1991), the Churg-Strauss syndrome (Masi et al. 1990), and head and neck cancer (Wadsworth et al. 2004). Classification trees recursively partition the member population into smaller groups that are more and more uniform in terms of their known result period cost. This partition can be represented as a tree. This graphical illustration makes classification trees easily interpretable, and therefore models that build on them can be medically verified.

**CLUSTERING:** Clustering algorithms organize objects so that similar objects are together in a cluster and dissimilar objects belong to different clusters. Our prediction clustering method centres around the algorithm behind Eigen Cluster, a search and cluster engine developed in Kannan et al. (2004). The clustering algorithm, when applied to data, automatically detects patterns in the data and clusters together members who are similar. We adapted the original clustering algorithm for the purpose of health-care cost prediction.[7]

##### 7. LITERATURE REVIEW

This section provides the different studies on the health care cost estimation techniques and the recently developed approaches on which the performance of prediction is enhanced.

Since the 1980s, there has been research on the predictive modelling of medical costs based on (health insurance) claims data using heuristic rules and regression methods. These methods, however, have not been appropriately validated using populations that the methods have not seen. *Dimitris Bertsimas[1]* utilize modern data-mining methods, specifically classification trees and clustering algorithms, along with claims data from over 800,000 insured individuals over three years, to

provide rigorously validated predictions of health-care costs in the third year, based on medical and cost data from the first two years. The key findings are: (a) our data-mining methods provide accurate predictions of medical costs and represent a powerful tool for prediction of health-care costs, (b) the pattern of past cost data is a strong predictor of future costs, and (c) medical information only contributes to accurate prediction of medical costs of high-cost members.

The aim of *Hung-Lin Chen*[2] study is to test the validity of adapted Diabetes Complication Severity Index (aDCSI) in predicting the risk of hospitalization and healthcare cost in type 2 diabetic patients using a nationally representative claims database. Retrospective cohort study used 4 years of claims data from Taiwan's National Health Insurance Research Database (NHIRD). Type 2 diabetic patients who had 4-years of enrolment were identified as study subjects (N=136,372). The aDCSI score (sum of diabetic complication with severity levels, range 0–13) and complication count (sum of diabetic complications, range 0–7) were generated using diagnostic codes for each patient. Poisson model and linear regression model were conducted to predict risk of hospitalization and healthcare costs associated with aDCSI score and count of diabetic complications. It may serve as an efficient tool for stratifying type 2 diabetic patients for disease management programs and population-based studies.

*Boris Milovic*[3] investigates about the data mining and health care management and describes as Tendency for data mining application in healthcare today is great, because healthcare sector is rich with information, and data mining is becoming anecessity. Healthcare organizations produce and collect large volumes of information on daily basis. Data mining can enable healthcare organizations to predict trends in the patient conditions and their behaviours, which is accomplished by data analysis from different perspectives and discovering connections and relations from seemingly unrelated information. Raw data from healthcare organizations are voluminous and heterogeneous. They need to be collected and stored in the organized forms, and their integration enables forming of hospital information system.

Clinical prediction models are increasingly used to complement clinical reasoning and decision-making in modern medicine, in general, and in the cardiovascular domain, in particular. To these ends, developed models first and foremost need to provide accurate and (internally and externally) validated estimates of probabilities of specific health conditions or outcomes in the targeted individuals.

In this second paper, *Karel G M Moons*[4] an overview is provided of the consecutive steps for the assessment of the model's predictive performance in new individuals (external validation studies), how to adjust or update existing models to local circumstances or with new predictors, and how to investigate the impact of the uptake of prediction models on clinical decision-making and patient outcomes (impact studies). Each step is illustrated with empirical examples from the cardiovascular field.

The main objective of *Shadab Adam Pattekari*[5] research is to develop an Intelligent System using data mining modelling technique, namely, Naive Bayes. It is implemented as web based application in this user answers the predefined questions. It retrieves hidden data from stored database and compares the user values with trained data set. It can answer complex queries for diagnosing heart disease and thus assist healthcare practitioners to make intelligent clinical decisions which traditional decision support systems cannot. By providing effective treatments, it also helps to reduce treatment costs.

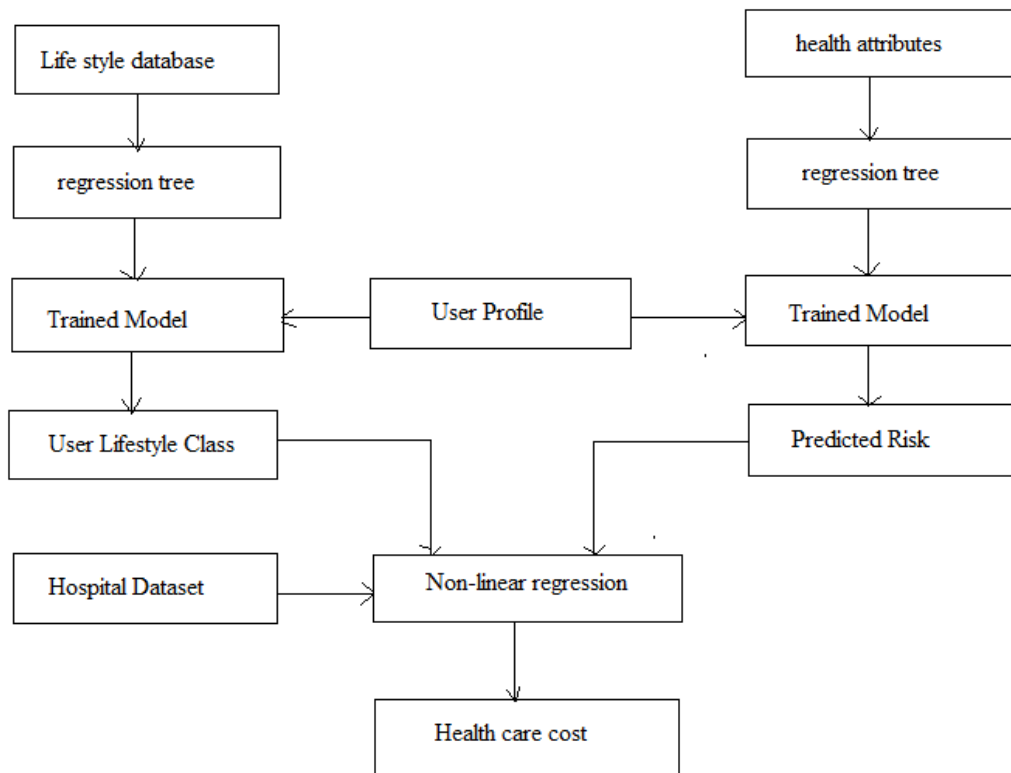
In this demonstration proposal *James Marquardt*[6] describe Health- SCOPE (Healthcare Scalable COst Prediction Engine), a frame-work for exploring historical and present day healthcare costs as well as for predicting future costs. HealthSCOPE can be used by individuals to estimate their healthcare costs in the coming year. In addition, HealthSCOPE supports a population based view for actuaries and insurers who want to estimate the future costs of a population based on historical claims data, a typical scenario for accountable care organizations (ACOs). Using interactive data mining framework, users can view claims (sample files will be provided), use HealthSCOPE to predict costs for the upcoming year, interactively select from a set of possible medical conditions, understand the factors that contribute to the cost, and compare costs against historical averages. The back-end system contains cloud based prediction services hosted on the Microsoft Azure infrastructure that allow the easy deployment of models encoded in Predictive Model Markup Language (PMML) and trained using either Spark MLlib or various non-distributed environments.

## 8. PROPOSED WORK

The proposed work is motivated from the article related to HealthSCOPE. In this article a health care cost prediction model is provided using the linear regression and the regression tree data model. The given model composed by the linear regression model is suitable for linear approximation of data but not much suitable for unstable data sets or fluctuating characteristics of the user behavioural attributes therefore a multi-stage classification data model is required to develop by which the performance of current predictive data is can be improved.

The proposed health care cost prediction data model is demonstrated using the figure 1. The given system provides the formal working of the proposed system.

FIGURE 6: PROPOSED DATA MODEL



The above described data model first need to create a user profile which contains both kinds of attributes health attributes (i.e. sex, age, weights, etc) and life style attributes (i.e. work, profession, car, house, etc.). These profiles are used to predict the health care cost and using the working model. Therefore three different kinds of databases are prepared in first health attributes are associated and the classes of this data set provides the risk of any disease. In the similar ways the life style database contains the defined attributes with the class labels as (A, B or C). These values are provides the leaving slandered of the concerned person. Both the datasets are analysed using the regression tree data model and the trained data model is prepared. On the bases of the user profile the decision tree is traversed and associated risk and the life style is predicted. A third data set that contains hospitals and their attributes (i.e. hospital class, treatment cost, treatment time, etc.) is used with the predicted class labels of previous classifiers and the final cost using the non-linear regression model is estimated which is best suited according to the input user profile.

## 9. CONCLUSION

The healthcare scenario in India is at an articulation point. While the situation for the healthcare industry is positive, there is a need of transmission towards an integrated healthcare delivery system, which impacts expertise and has the patient at its centre.

In the present situation, people are very much attentive and foresighted to have a prediction of their health and the cost related to it. This has given escalation to the better health care plans, beneficial to masses and the industry. And so this paper will be a step towards making a critical valuation of the health care features and the preference of individuals.

This paper is an attempt to explore the health care scenario, its collective cost, and major contributing factors responsible in increasing the health care cost.

This paper is also an effort to generate Models that can predict human actions, various characteristics related to life style and based on these data, it is an attempt to forecast the future health care cost.

This research study can help an individual to foresee the future cost incurred in health care and so can help him analysing dealing with the same.

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