Analysis of Periodontitis using R in Big Data

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Abstract- In our paper we integrate big data in Peridontal infection using R programming to help in the prediction of future gum infection, and this way we can help the medical sector to make a safe decision and help prevent the infection. Big data is an emerging technology which provides huge collection of statistical data. It is by far the most specialized and latest technology and can be used in dentistry to prevent the disease occurrence in advance before it arises and help create treatment strategies for future prevention of the disease. This will help in making decisions by examining or analysing the whole disorder and plan the treatment to prevent its occurrence in future. This method could be tested with the huge collection of ancient statistics of dental diseases to check the effectiveness of the technique and based on the generated end result; precision of prediction can be executed in future. This study is aimed to review the trend and the progress of R programming to cope with big data challenges in periodontal disease.

Keywords: R, Big data, Gum infection, Dentistry, Periodontitis, Oral health, Periodontal infection.

INTRODUCTION

Oral health means more than just an attractive smile. Poor oral health and untreated oral diseases and conditions can have a significant impact on quality of life. And in many cases, the condition of the mouth mirrors the condition of the body as a whole. Recent reports indicate a relationship between periodontal (gum) disease and stroke, heart disease, and pre-term low-birth-weight babies. Unhealthy gums and teeth can cause painful infections, tooth loss and difficulty eating and speaking. These can lead to nutritional and digestive problems, a low self-image and social isolation. Poor oral health also puts seniors at greater risk for developing, or making worse, serious health problems such as heart disease, stroke, pneumonia and diabetes.

The word periodontal literally means “around the tooth.” Periodontal diseases, also called gum diseases, are serious bacterial infections that destroy the gums and the surrounding tissues of the mouth. If the inflammation is left untreated, the disease will continue and the underlying bones around the teeth will dissolve, and will no longer be able to hold the teeth in place. Chronic inflammation, resulting from a periodontal disease, is responsible for 70 percent of all adult tooth losses, and affects 75 percent of people at some point in their lives.

Oral health is an essential and integral component of health throughout life. No one can be truly healthy unless he or she is free from the burden of oral and craniofacial diseases and conditions. Millions of people experience dental caries, periodontal diseases, and cleft lip and cleft palate, resulting in needless pain and suffering; difficulty in speaking, chewing, and swallowing; increased costs of care; loss of self-esteem; decreased economic productivity through lost work and school days; and, in extreme cases, death. Oral refers to the mouth, which includes the teeth, gums, and supporting tissues. It is easy to take your oral health for granted, but it is key to living each day comfortably. These tissues allow you to speak, smile, sigh, kiss, smell, taste, chew, swallow, and cry. They also let you show a world of feelings through expressions. Taking good care of these tissues can prevent disease in them and throughout your body.
disease may require extensive treatment or teeth may be lost.

Although periodontal disease is common, it can be prevented. In most cases, it results from neglect or improper care of the mouth. You can avoid the needless loss of teeth to this disease by understanding what causes it, learning and practicing good oral health habits, and seeking regular professional care.

Attention to everyday oral hygiene (brushing and flossing), coupled with professional cleanings twice a year, could be all that's needed to prevent gum disease—and actually reverse the early stage—and help you keep your teeth for a lifetime.

Disease prediction usage is one among the highly exciting and rewarding strategy in Big data Analysis. The shortage of specialists and excessive wrong disease identified instances has necessitated the need to develop a fast and efficient detection gadget. The main objective of this analysis is to become aware of the key styles or features from the scientific statistics which forms a pattern using the clustering model. The attributes which might be extra relevant to Dental disease will be found. This will assist the scientific practitioners to understand the basis of the causes of sickness and its extensiveness.

The Normal Structure – Periodontium
Normal Healthy Gums

Types of Periodontal Disease

There are many forms of periodontal disease. The most common ones include the following.

a) Gingivitis
Gingivitis is the mildest form of periodontal disease. It causes the gums to become red, swollen, and bleed easily. There is usually little or no discomfort at this stage. Gingivitis is reversible with professional treatment and good at home oral care.

b) Aggressive Periodontitis
A form of periodontitis that occurs in patients who are otherwise, clinically healthy. Common features include rapid attachment loss and bone destruction and familial aggregation.

c) Chronic Periodontitis
A form of periodontal disease resulting in inflammation within the supporting tissues of the teeth, progressive attachment and bone loss and is characterized by pocket formation and/or recession of the gingiva. It is recognized as the most frequently occurring form of periodontitis. It is prevalent in adults, but can occur at any age. Progression of attachment loss usually occurs slowly, but periods of rapid progression can occur.

d) Periodontitis as a Manifestation of Systemic Diseases
Periodontitis, often with onset at a young age, associated with one of several systemic diseases, such as diabetes, cardiovascular disease.

e) Necrotizing Periodontal Diseases
An infection characterized by necrosis of gingival tissues, periodontal ligament and alveolar bone. These lesions are most commonly observed in individuals with systemic conditions including, but not limited to, HIV infection, malnutrition and immune suppression.

Big data

Big data is an emerging technology which provides huge collection of statistical data. Big data can be characterized by 3Vs: the extreme volume of data, the wide variety of types of data and the velocity at which the data must be must processed. Although big data doesn't refer to any specific quantity, the term is often used when speaking about petabytes and exabytes of data, much of which cannot be integrated easily.

Because big data takes too much time and costs too much money to load into a traditional relational database for analysis, new approaches to storing and analyzing data have emerged that rely less on data schema and data quality. Instead, raw data with extended metadata is aggregated in a data lake and machine learning and artificial intelligence (AI)
programs use complex algorithms to look for repeatable patterns.

Big data analytics is the process of collecting, organizing and analyzing large sets of data (called big data) to discover patterns and other useful information. Big data analytics is often associated with cloud computing because the analysis of large data sets in real-time requires a platform like Hadoop to store large data sets across distributed cluster and MapReduce to coordinate, combine and process data from multiple sources.

Big data analytics helps organizations harness their data and use it to identify new opportunities. That, in turn, leads to smarter business moves, more efficient operations, higher profits and happier customers. In his report Big Data in Big Companies, IIA Director of Research Tom Davenport interviewed more than 50 businesses to understand how they used big data.

He found they got value in the following ways:

1. Cost reduction. Big data technologies such as Hadoop and cloud-based analytics bring significant cost advantages when it comes to storing large amounts of data – plus they can identify more efficient ways of doing business.
2. Faster, better decision making. With the speed of Hadoop and in-memory analytics, combined with the ability to analyze new sources of data, businesses are able to analyze information immediately – and make decisions based on what they’ve learned.
3. New products and services. With the ability to gauge customer needs and satisfaction through analytics comes the power to give customers what they want. Davenport points out that with big data analytics, more companies are creating new products to meet customers’ needs.

R program

R is a language and environment for statistical computing and graphics. R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, …) and graphical techniques, and is highly extensible.

One of R’s strengths is the ease with which well-designed publication-quality plots can be produced, including mathematical symbols and formulae where needed.

R is an integrated suite of software facilities for data manipulation, calculation and graphical display. It includes

- a suite of operators for calculations on arrays, in particular matrices,
- a large, coherent, integrated collection of intermediate tools for data analysis,
- graphical facilities for data analysis and display either on-screen or on hardcopy, and
- a well-developed, simple and effective programming language which includes conditionals, loops, user-defined recursive functions and input and output facilities.

Proposed Work:

In this project, We have proposed that integration of clinical decision support with computer based patient records could reduce medical errors, enhance patient safety, decrease unwanted practice variation, and improve patient outcome. This suggestion is promising as data modelling and analysis tools, e.g., data mining, have the potential to generate a knowledge rich environment which can help to significantly improve the quality of clinical decisions.

Disease prediction using is one of the most interesting and challenging tasks. The shortage of specialists and high wrongly diagnosed cases has necessitated the need to develop a fast and efficient detection system. The main objective of this work is to identify the key patterns or features from the medical data using the clustering model. The attributes that are more relevant to Dental disease can be observed. This will help the medical practitioners to understand the root causes of disease in depth.

Advanced risk assessment tools are currently at disposal, mainly based on statistical techniques. Another approach for addressing the problem, which is gaining increasing interest, is the use of methodologies coming from the fields of knowledge discovery. They built a collaborative assessment, based on the Filtering and Map Reduce and R Programming, to predict future diseases. The proposed works relies on the Clubcf and R programming used for producing recommendations to people by collecting preferences from users having similar behaviors.

In our proposed System, We generate the statistical report using R program. From that report, doctors will give the treatment to their patients.

Periodontitis Attribute value (MEDIUM):

Treatment: Scaling and root planning

Once someone develops periodontitis, it isn't as easy to control. Usually there is widespread infection of the gums that needs to be treated. This may require several special treatments either by a dentist or a
periodontist, an expert who specializes in the care of gum disease.

Note how the red, puffy gums have resolved following an improvement in the patient's daily homecare and a "deep cleaning".

Periodontitis Attribute (HIGH):
Treatment: Cleaning, Scaling, and Curettage
Scaling, polishing, and sometimes curettage are used to manage periodontal disease. They are usually accomplished in a series of three to four visits spaced about a week apart.

Cleaning and Scaling. The dental hygienist or practitioner generally uses both ultrasonic and manual instruments to remove calculus.

- Calculus above the gum is easily seen. The dental professional usually detects calculus using both ultrasonic and manual instruments to remove calculus below the gum by careful probing with a dental instrument.
- The hygienist or dentist may use an ultrasonic instrument for removal of the more accessible calculus. This probe-like device vibrates at a frequency range higher than is audible to the human ear. Some people with low tolerance for the ultrasonic probe may wish to request nitrous oxide.
- When the probe contacts the rock-like calculus, deposits fracture off the tooth fairly efficiently.
- Povidone-iodine (PVP-I), a potent antiseptic, can reduce the level of gingivitis and may be more beneficial than water as the irrigant used during ultrasonic treatment.

Periodontitis Attribute (VERY HIGH):
Treatment: Bone Graft
A bone graft is a surgical procedure used to fix problems with bones or joints. Bone grafting, or transplanting of bone tissue, is beneficial in fixing bones that are damaged from trauma, or problem joints. It's also useful for growing bone around an implanted device, such as a total knee replacement. A bone graft may fill a void where bone is absent or help provide structural stability.

The bone used in a bone graft can come from your body, a donor, or it can be entirely man-made. The bone graft can provide a framework where new, living bone can grow if it’s accepted by the body.

The two most common types of bone grafts are:
- An allograft uses bone from a deceased donor or a cadaver that has been cleaned and stored in a tissue bank.
- An autograft comes from a bone inside your body, such as your ribs, hips, pelvis, or wrist.

The type of graft used depends on the type of injury your surgeon will be repairing. Allografts are commonly used in hip, knee, or long bone reconstruction. Long bones include arms and legs. The advantages are there’s no additional surgery needed to acquire the bone. It also lowers your risk of infection since additional incisions or surgery aren’t required.

Periodontitis Attribute (SEVERE):
Treatment: Extraction
A dental extraction (also referred to as tooth extraction, exodontia, exodontics, or informally, tooth pulling) is the removal of teeth from the dental alveolus (socket) in the alveolar bone. Extractions are performed for a wide variety of reasons, but most commonly to remove teeth which have become unrestorable through tooth decay, periodontal disease or dental trauma, especially when they are associated with toothache.

Sometimes wisdom teeth are impacted (stuck and unable to grow normally into the mouth) and may cause recurrent infections of the gum (pericoronitis). In orthodontics if the teeth are crowded, sound teeth may be extracted (often bicuspids) to create space so the rest of the teeth can be straightened.

EXPECTED RESULTS
The proposed solution contains the following results where each of them depicts the results obtained.

Figure shows various level of statistical report as a result of R. That has been processed in Fig.1(a), 1(b), 1(c), 1(d), 1(e).
CONCLUSION
We have entered a time of Big Data, preparing huge volumes of data has never been more prominent. This paper exploits the R programming for productive analysis of enormous data and for settling testing data preparing issues on huge scale datasets in diverse spaces. In this process, statistical reports will be generated based on the reduced data using R. From that report, doctors will provide the treatment based on the requirements of the patients.

REFERENCES


