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## AN INTELLIGENT DATA ANALYTICS SYSTEM FOR THERAPEUTIC OF ANGINA PECTORIS IN CARDIOVASCULAR DISEASE MANAGEMENT: A MODEL METHODOLOGY

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### Keywords:

Angina pectoris, Cardiovascular case taking, Real-time Digital system, Rule Engine, Expert System, Machine Learning

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**ABSTRACT:** Medical Case taking process in any field of medicine science is considered to be a significant stage for the treatment management of various diseases. Cardio Vascular diseases (CVD) are one of the life-threatening diseases across the globe, and its prognosis entirely depends on the right intuition of the clinicians; cases may account for 31% of deaths worldwide, based on a recent study. Big Data Management and Machine Learning Algorithms have reached paramount Computational Technological advancement over the last decade and capable of drive applications in diverse domains which can assist in the process of selecting proper medicines. The case-taking approach and selection of drugs were significantly correlated, and the skill of the physicians plays a very important role in the entire procedure blended with proper use of Smart Technology, Artificial Intelligence, and Cloud storage of huge volume of patient's physiological, clinical and pathological data. In this paper, we have made an attempt to build a digital system driven by smart technology to cater to this equation and explore the association and causation between patient case capturing of "Angina Pectoris" in "Cardio Vascular Diseases (CVD)" and its subsequent treatment selection process with the help of Machine Learning. We have present a methodology and approach roadmap driven by Analytics and Data science for handshaking between medical paradigms of CVD type of diseases, specifically patients suffering from angina pectoris, and Smart Technology to enhance the prediction of medicine for the physicians in order to achieve faster and quicker throughput time for patients.

**INTRODUCTION:** The legacy approach of the medical case-taking process towards the various medical therapies, including homeopathic management of any diseases like Angina Pectoris in Cardio Vascular Diseases (CVD) in a patient, is

considered to be a critical and human-driven process<sup>1</sup>. It sometimes involves undesired human errors as well from both ends, which leads to serious medical complications in follow-up cases.

The traditional approach is based on a detailed clinical and social interaction between the patient/family representatives and the corresponding clinicians which is based on certain pre-chosen criteria or human intuition<sup>1</sup>. It should be noted that the principal background behind the case-taking process is the detailed assortment of the data, so that drug selection can be done based on the



classical principles of the medical approach<sup>2, 3</sup>. However, it may be noted that the successful case taking process involves varied aspects, such as the expertise in the clinical field, detailed knowledge in foundations of the relevant medical domain, the subject control along with the most important criteria, *i.e.*, the “skills of correspondence”<sup>2, 3</sup>. The approach of “case taking” should be under the able guidance of expert medical professionals<sup>3, 4</sup>.

Our aim is to build real-time digital system driven by smart technology to explore the association and causation between patient case capturing of Angina Pectoris in “Cardio Vascular Diseases (CVD)” and its subsequent treatment selection process with the help of machine learning.

**Background:** In critical diseases like “Angina Pectoris”, the successful art of case taking allows the clinicians to get a vivid picture of the intrinsic state of the patient with the aid of any strategy which will help the clinicians to comprehend the patient and also the process needs to go well with both of their personality<sup>5</sup>. It should also be noted that during the “case taking” process for a chronic disorder using smart and digital techniques by developing a digital system, several criteria play an important part, such as the profession of the patient, the overall daily routine followed by the patient, the routine diet intake habit of the patient, and also the social and the domestic environment to which the patient belongs along with the symptomatic clinical manifestations to evaluate the root cause of the disease<sup>3, 6</sup>. There are also certain other aspects in the medical profession that a clinician should follow such as he or she should be free from any bigotry, should be attentive and must possess sound knowledge, and should sincerely maintain the shreds of evidence of any kind of variations<sup>2, 3</sup>.

Among several other non-communicable disorders, cardiovascular disease or disorders (CVD) and diabetes are considered to be two burdensome problems throughout the globe, as well as in India<sup>5, 6</sup>. CVD cases may account for 31 % of deaths all over the world, based on recent scientific confirmations. In India, the mortality rate of MI (Myocardial infarction) was considered to be 141/100,000 males, whereas among their counterparts, it is 136 out of 100,000 females. It should be noted that apart from this, another most

important concern is that the mortality of the people suffering from the CVD cases is about 52% all over India among those people who are within the age of 22 years<sup>5, 6</sup>. Among this particular category, the cases of acute myocardial infarction (AMI) are considered to be the most significant cause of mortality. However, though modern medicine is considered to be successful in tackling these rising challenges, it is estimated based on the past literature review that 8-10% of the cases face re-infarction within a span of one year<sup>5, 6</sup>. This particular scenario actually enhances the load on the emergency departments of the hospitals<sup>6</sup>. Along with the situations, other scenarios make the existing condition much more intricate, such as the “cardiogenic shock”, failure of the heart, and the rise in the cases of “arrhythmias”<sup>6</sup>.

Though following the successful treatment management of the MI, the physiological process of repairing of the tissues and the inflammation, following the MI is a marking process as it fails to stir up the same reactions within our physiological system. Moreover, it should also be noted that the pathway of “remodelling of the heart” is considered to be a harmful process along with several other components such as extracellular, cellular, and neuro-humoral components, and the size of the scar formed is considered to be comparative to the “severe degree” of the “heart remodelling”<sup>6</sup>. Among the varied CVD cases, the particular disease “Angina Pectoris” is considered to be significant one **Fig. 1**<sup>5</sup>. The symptomatic manifestations of the disease are chest pain which is sub-sternal in nature, along with pressure, and also accompanied by a certain level of discomfort that gets enhanced due to any kind of exertion or stress (emotional in nature).

The particular diseased condition lasts for about 30-60 seconds, and the patient gets relieved from the medical condition by rest and also with the aid of nitro-glycerin<sup>5</sup>. The most menacing fact is that there is an upsurge in the incidence rate of cardiovascular cases, and it should also be noted that the cases are rising in number rampantly within the last three decades<sup>5</sup>. As of now, the proposed epidemiological findings suggested that within the span of 1990 to 2020, there had been a rise of 117% and 105% in the rate of mortality cases among men and women due to CVD, of which

Angina Pectoris constitutes an important burden aspect in Indian cardiovascular healthcare sector<sup>5</sup>. However, it should also be noted that the prevalence or incidence rate of CAD (Coronary Arterial Diseases) among the people who are leading an urban lifestyle is 2.5% - 12.6%; whereas the percentage ranges from 1.4% to 4.6% among those people who are coming from rural background. It should be noted that this disease is associated with varied risk factors such as – age factor of the patients, dyslipidemia, high blood pressure, overweight or obesity, sedentary lifestyle, and also another significant factor, *i.e.*, high-stress level of the patients<sup>5, 6</sup>. The most notable form of angina is common angina, and it happens due to self-exertion; however, it goes away with rest. These are the major factors that enhance the chances the developing CVD in their life span. It should be noted that patients with these factors are supposed to suffer from at least two to four times higher risk of CVD or CAD much earlier in comparison to their non-diseased counterparts<sup>7</sup>.

In this matter, top major contributors, are considered to be the risk associating factors for the CVD cases are:

- Age of an individual;
- Inherited disease features;
- Hypertension and high blood pressure;
- Some habit of patient like smoking and drinking alcohol;
- Increase in weight or “obesity”;
- Diabetic condition of a patient<sup>7</sup>.

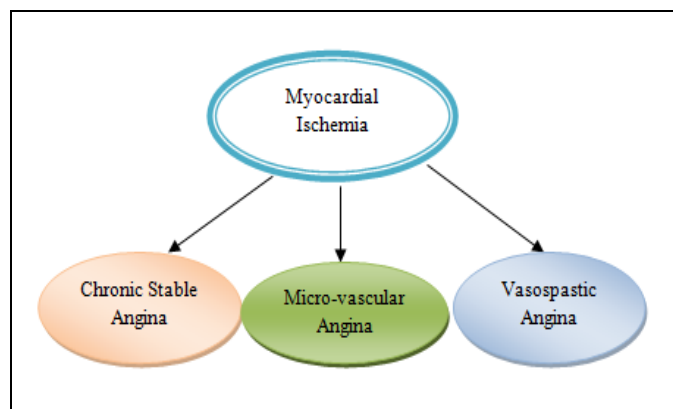


FIG. 1: DIFFERENT TYPES OF ANGINA PECTORIS<sup>5</sup>

In the field of “classical homeopathy”, the management of the treatment is considered to be based on principles, where the living organisms are driven by the “bio-energy” which allows the

safeguarding of health in the most excellent manner that depends on the factors of genetics and the “epigenetics” of an individual. However, when our physiological system is affected by any unfavorable forces, the energy disturbs our immune system, and therefore, it in return fights to revert back to its state of normalcy. Therefore, in this manner, the state of “homeostasis” can be re-established<sup>4, 8</sup>.

Therefore, the present article is written with the following objectives of a successful case-taking process that would determine the accurate diagnosis followed by appropriate selection of medicines using various digital systems and technologies **Fig. 3**.

**Machine Intelligence Helps in Improving the Therapeutic of Medical Science:** Through an advanced Machine Learning algorithm, the system is able to find the pattern from historical data to determine the therapeutic information of the disease without or with minimum any human instructions.

This Computer Human Interface (CHI) model helps the physicians and associated medical professionals to reduce their workload and repetitive actions with an additional benefit to minimize the human error for the patient. Based on the predictors of Angina Pectoris, with the combination of advanced statistical models and programming or computations, we are developing a complex and predictive system that is proficient in imitating Human or Physician Intelligence.

With a set of sample physiological predictors like “Types of CVD Pain”, “Location from where Pain originates”, “Particular incident-based Pain”, “Additional Symptoms Parallel with pain”, “Position of chest pain gets worsen or reduces”, “Extension of Pain to other parts of the body” *etc*, the computational model is tried to predict the therapeutic information of the patient with the help of advanced Analytical Algorithms.

**Hypothesis:** There is a definite positive correlation between the detailed case-taking approach and medicine selection during the treatment management strategy of homeopathy for angina pectoris cases<sup>11</sup>. We would run some statistical Hypothesis Testing with patient data to conclude the statement.

**Healthcare Analytics in Data Science:** With the help of deep learning, driven by actual patient data, we are going to present a smart system that can learn from patient data. We are exploring a statistical algorithm implemented to find some pattern among the features and develop a prediction model with learning from historical data.

**Aim of the Present Article:** To develop a protocol of the case taking an approach of the patients suffering from angina pectoris and prescription of medication (selectively homeopathy) to these patients<sup>11</sup> driven by advanced technology and Data Science.

**Step Approach in High Level:**

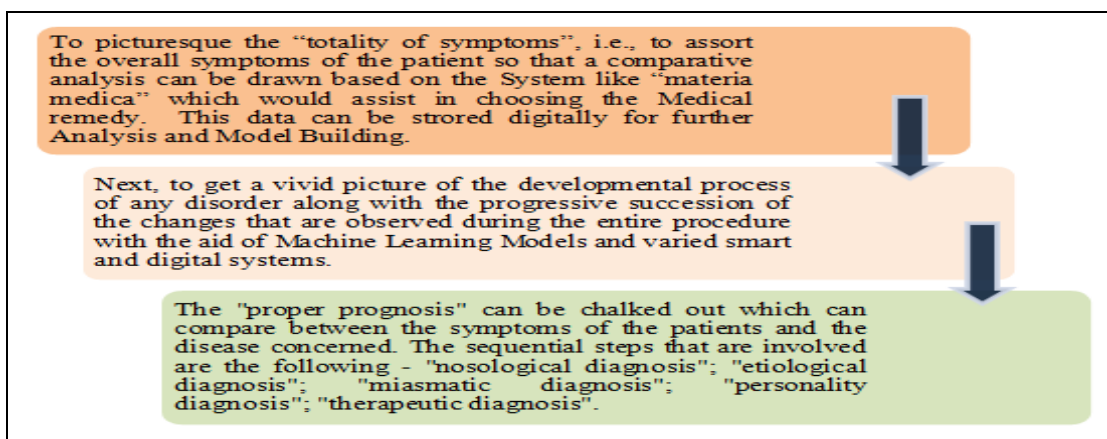
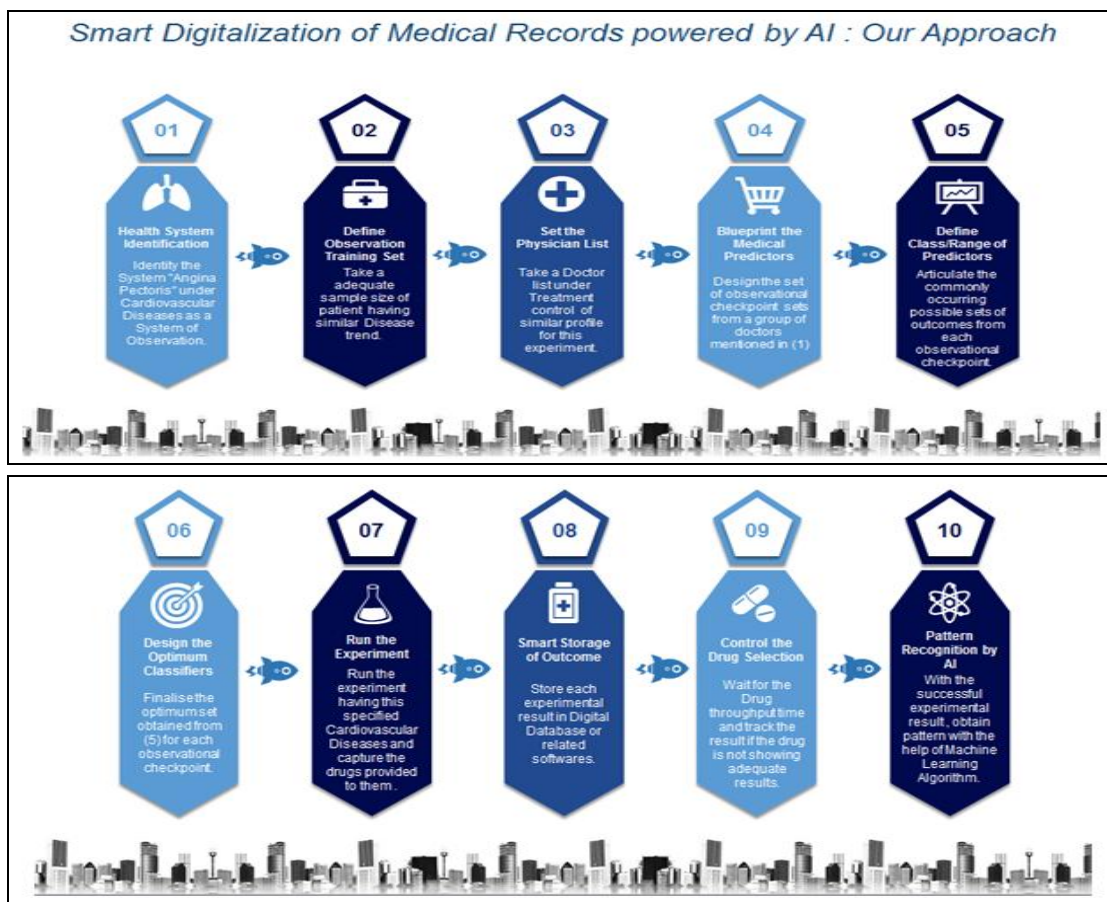


FIG. 2: APPROACH IN HIGH LEVEL

**METHODOLOGY:**

**The High-Level Overall Process of the System:**



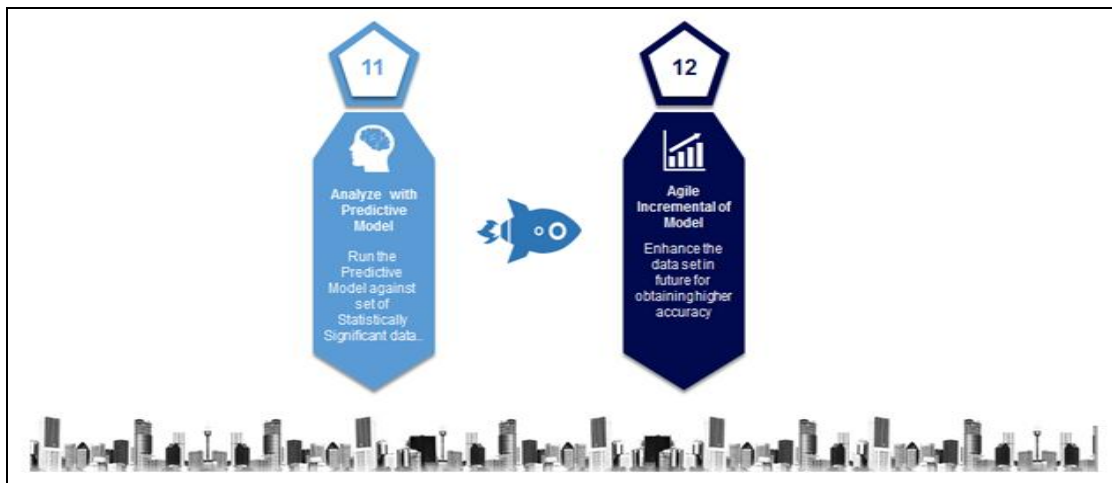
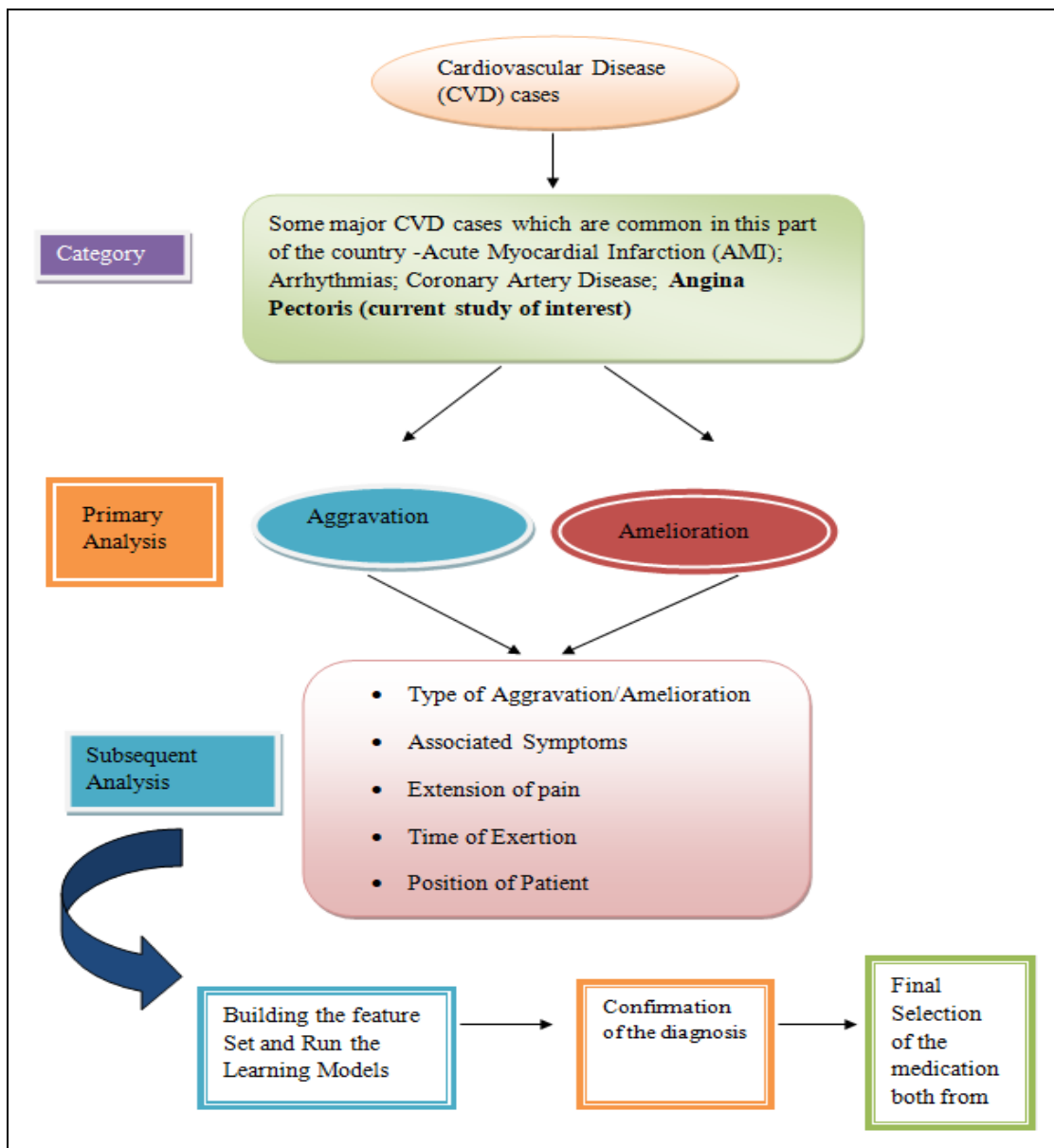


FIG. 3: PROCESS FLOW OF SMART DIGITALIZATION AND PREDICTIVE TREATMENT MANAGEMENT SYSTEM POWERED BY ARTIFICIAL INTELLIGENCE (AI)

Flowchart of the Methodology Followed in this Study:



In this paper, the case-taking approaches of the patients suffering from CVD cases, specifically patients suffering from angina pectoris are detailed

below in the form of a chart along with the selected panel of medications that might be suitable for the cases based on their phenotypic features only<sup>11</sup>.

**TABLE 1: SOME SAMPLE CASE TAKING PREDICTORS WITH POSSIBLE LEVELS FOR MEDICINE SELECTION PROTOCOL FOR THE FOCUS GROUP PATIENTS**

S. no.	Causing Factors	Factor Analysis	Sample Probable Association in Treatment Information (in Homeopathy)
1	Types of chest pain	Constricting and squeezing Shooting  Burning Stitching  Cutting	Cactus Grandiflora 200, Magnesia Phos 6x, 12x 30 Aconite Nap 200, Kalmia Lat 200, LactodectusMactans 0/6, 200, Spigelia 30,200 ArsAlb 200, Acon Nap 200 Kali Carb 200, Bry A 200, 1M, Spigelia 30,200, Digitalis 30,200 Kali Carb 200, Spigelia 30, 200
2	Location from where it originates	Left upper chest Left lower chest Epigastric area Middle of chest Right side of chest	Dig 30,200, Spig 30,200, Acon 30,200 Acon N 30, 200, Nat M 30, 200, Phos 30, 200 Spigelia 6, 30, 200 Alumina 30, 200, Kali C 30, 200, Spig 30 Chel 30, 200, Kali C 30,200
3	Chest pain after a particular incident	After straining/over-lifting After mental anxiety Grief or sorrow Sudden loss of family member (mental shock) After stress or overwork	Arn 30, 200, 1M, Caust 200, 1M, Arn M 0/ Aconite Nap 200 Ignatia 200 Arnica 200, Aconite 200  RhusTox 200
4	Additional symptoms occurring with chest pain	Joint pain Oppression of chest Anxiety Fear of death Fainting Difficult respiration Palpitation	Cimicufuga 200, LedumPul 200 Amyl Nit 6, 30, Spig 30,200 Aconite Nap 200, ArsAlb 200, Aurum Met 30,200 Aconite Nap 200, 1M, ArsAlb 200, 1M Arn M 200 ArsAlb 200, Kali Carb 200 Kali Carb 200
6	Position your chest pain gets worsens or reduces	Lying aggravation Lying amelioration Lying on left side aggravation Lying on Right side aggravation Amelioration Sitting aggravation With bend forward aggravation Ascending stairs aggravation Motion aggravation Sitting aggravation	Aurum Met 200, Spongia 200 Psor 200, 1M Lyco 200,1M, Naja 30,200, Spig 30,200 Alum 30,200, Lachesis 30,200 Naja 30; Spigel: 200 RhusTox 200, Spong 30 Viol T 6, 30 Aur Met 200,1M Cact 30,200, Bry 30,200,1M, Spig 30 RhusTox 200, Spong 30
7	Pain extends to other parts of the body	Up to shoulder and Left clavicle Up to back Extends upward on neck and head From base of heart to apex of heart From apex of heart to base Extends to scapula Right	Latrodactus M 200 Kali C 30, 200, Naja 30 Naja 30, Spigelia 30,200 Syphil 200 Medorrhinum 200 Spigel 200 Aconite nap 200, 1m
8	Hypertrophy of heart	Palpitation, anxiety, cardiac pain, shooting down to left arm, numbness and tingling in fingers	
9	Cardiac pain	Pain along with the numbness of left arm and shoulder	Kalmia lat 200, Aconite 200, 1m, Rhustox 200, pulsatilla 200, 1m
10	Sensation	Sensation as though the left arm is tightly bandaged to the body	Actea race 6,30
11	Palpitation	Palpitation weak feeling in chest, caused by over exertion, rheumatic diathesis	Rhustox 200, 1m
12	Sharp pain in heart	Sharp pain in heart , dyspnea , all	Kalmia lat – 200, 1m

13	Suddenly aroused from sleep	most suffocative feeling, pulse slow, heart affected following gout in rheumatism, tingling and numbness of left arm Feels heart will stop beating, must move around, in order to keep the heart in action, nervousness tremor of limbs , lack of muscular control	Gelsimium – 6,30
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**Formation of Rule-Based Expert System:**

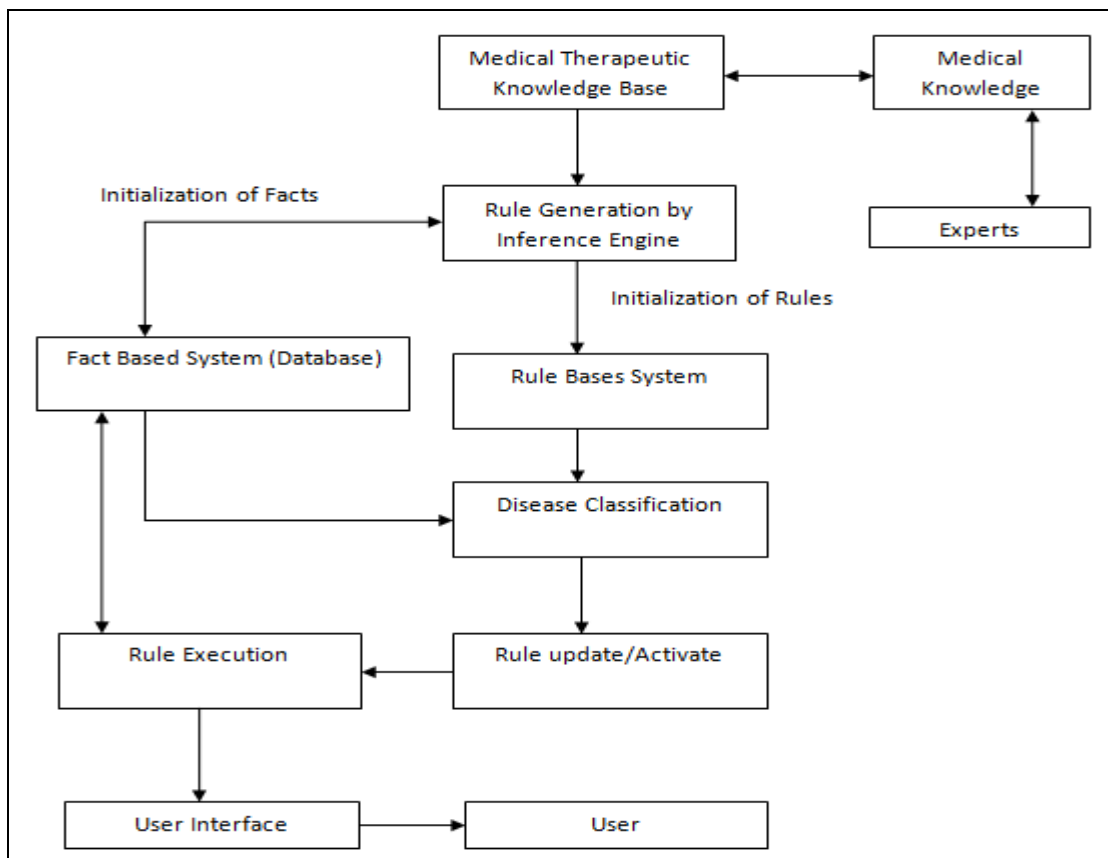
Knowledge representations from Medical information encoded within the system to solve the knowledge-intensive complex human problem. Our expert system represents knowledge as a “set of rules” (of IF-THEN) and “set of facts” which will drive the therapeutic management in a different situation based on input variations. The “set of rules” consist of Medical Therapeutic actions which are present in our scope of Angina Pectoris with a set of sample physiological predictors like

“Types of CVD Pain”, “Location from where pain originates”, “Particular incident-based pain”, “Additional symptoms parallel with pain”, “Position of chest pain gets worsen or reduces”, “Extension of pain to other parts of the body” etc. The “set of facts” are the assertions, derived from the set of data and “rules” that provide the information on therapeutic information. In our heuristic and flexible expert system, few terminating conditions will terminate the rule-based system.

**TABLE 2: OUR EXPERT SYSTEM TASKS**

1	Interpretation	Analyze the correctness and consistency of the input predictors.
2	Monitor	Report the event and store.
3	Diagnostics Management	Analyze and find the fault.
4	Predict	Expect the future based on knowledge
5	Plan	Define the desired actions to meet the goal
6	Conclude	Requirement is satisfied and the design is full proofed.

**Block Diagram of Therapeutic Rule Base System: <sup>8</sup>**



**Sample Output / Blueprint of the Rule based System:**

IF Types_of_pain=Constricting and squeezing : THEN Possible_Drug_1=Cactus Grandiflora 200 AND Possible_Drug_2 = Magnesia Phos 6x 12x 30
IF Types_of_pain=Shooting : THEN Possible_Drug_1=Aconite Nap 200, AND Possible_Drug_2 = Kalmia Lat 200
IF Types_of_pain=Burning : THEN Possible_Drug_1=Ars Alb 200 AND Possible_Drug_2 = Acon Nap 200
IF Types_of_pain=Stitching : THEN Possible_Drug_1=Kali Carb 200 AND Possible_Drug_2 = Bry A 200 1M
IF Types_of_pain=Cutting : THEN Possible_Drug_1=Kali Carb 200 AND Possible_Drug_2 = Spigelia 30, 200
IF Location_Pain_originates=Left upper chest : THEN Possible_Drug_1=Dig 30,200 AND Possible_Drug_2 = Spig 30,200
IF Location_Pain_originates=Left lower chest : THEN Possible_Drug_1=Acon N 30, 200 AND Possible_Drug_2 = at M 30, 200
IF Location_Pain_originates=Epigastric area : THEN Possible_Drug_1=Spigelia 6, 30, 200
IF Location_Pain_originates=Middle of chest : THEN Possible_Drug_1=Alumina 30, 200 AND Possible_Drug_2 = Kali C 30, 200
IF Location_Pain_originates=Right side of chest : THEN Possible_Drug_1=Chel 30, 200 AND Possible_Drug_2 = Kali C 30,200
IF Particular_incident_based_Pain=After straining/over-lifting : THEN Possible_Drug_1=Arn 30, 200, 1M, AND Possible_Drug_2 = Caust 200, 1M,
IF Particular_incident_based_Pain=After mental anxiety : THEN Possible_Drug_1=Aconite Nap 200
IF Particular_incident_based_Pain=Grief or sorrow : THEN Possible_Drug_1=Ignatia 200
IF Particular_incident_based_Pain=Sudden loss of family member (mental shock) : THEN Possible_Drug_1=Arnica 200 AND Possible_Drug_2 = Aconite 200
IF Particular_incident_based_Pain=After stress or overwork : THEN Possible_Drug_1=RhusTox 200
IF Additional_Symptoms_Parallel_with_pain=Joint pain : THEN Possible_Drug_1=Cimicifuga 200, AND Possible_Drug_2 = Ledum Pul 200
IF Additional_Symptoms_Parallel_with_pain=Oppression of chest : THEN Possible_Drug_1=Amyl Nit 6, 30 AND Possible_Drug_2 = Spig 30,200
IF Additional_Symptoms_Parallel_with_pain=Anxiety : THEN Possible_Drug_1=Aconite Nap 200 AND Possible_Drug_2 = Ars Alb 200
IF Additional_Symptoms_Parallel_with_pain=Fear of death : THEN Possible_Drug_1=Aconite Nap 200, 1M AND Possible_Drug_2 = Ars Alb 200, 1M
IF Additional_Symptoms_Parallel with pain=Fainting : THEN Possible_Drug_1=Arn M 200
IF Additional_Symptoms_Parallel with pain=Fear of death : THEN Possible_Drug_1=Aconite Nap 200, 1M AND Possible_Drug_2 = Ars Alb 200, 1M
IF Additional_Symptoms_Parallel with pain=Fainting : THEN Possible_Drug_1=Arn M 200
IF Additional_Symptoms_Parallel with pain=Difficulty in respiration : THEN Possible_Drug_1=Ars Alb 200 AND Possible_Drug_2 = Kali Carb 200
IF Additional_Symptoms_Parallel with pain=Palpitation : THEN Possible_Drug_1=Kali Carb 200
IF Position_of_chest_pain_gets_worsens_or_reduces=Lying aggravation : THEN Possible_Drug_1=Aurum Met 200, AND Possible_Drug_2 = Spongia 200
IF Position_of_chest_pain_gets_worsens_or_reduces=Lying amelioration : THEN Possible_Drug_1=Psor 200, 1M
IF Position_of_chest_pain_gets_worsens_or_reduces=Lying on left side aggravation : THEN Possible_Drug_1=Lyco 200,1M, AND Possible_Drug_2 = Naja 30,200,
IF Position_of_chest_pain_gets_worsens_or_reduces=Lying on Right side aggravation : THEN Possible_Drug_1=Alum 30,200, AND Possible_Drug_2 = Lachesis 30,200
IF Position_of_chest_pain_gets_worsens_or_reduces=Amelioration : THEN Possible_Drug_1=Naja 30; AND Possible_Drug_2 = Spigel: 200
IF Position_of_chest_pain_gets_worsens_or_reduces=Sitting aggravation : THEN Possible_Drug_1=Rhus Tox 200, AND Possible_Drug_2 = Spong 30
IF Position_of_chest_pain_gets_worsens_or_reduces=With bend forward aggravation : THEN Possible_Drug_1=Viol T 6, 30
IF Position_of_chest_pain_gets_worsens_or_reduces=Ascending stairs aggravation : THEN Possible_Drug_1=Aur Met 200,1M
IF Position_of_chest_pain_gets_worsens_or_reduces=Motion aggravation : THEN Possible_Drug_1=Cact 30,200 AND Possible_Drug_2 = Bry 30,200,1M
IF Position_of_chest_pain_gets_worsens_or_reduces=Sitting aggravation : THEN Possible_Drug_1=Rhus Tox 200 AND Possible_Drug_2 = Spong 30
IF Extension_of_Pain_to_other_parts_of_the_body=Up to shoulder and Left clavicle : THEN Possible_Drug_1=Latrodactus M 200
IF Extension_of_Pain_to_other_parts_of_the_body=Up to back : THEN Possible_Drug_1=Kali C 30, 200 AND Possible_Drug_2 = Naja 30
IF Extension_of_Pain_to_other_parts_of_the_body=Extends upward on neck and head : THEN Possible_Drug_1=Naja 30, AND Possible_Drug_2 = Spigelia 30,200
IF Extension_of_Pain_to_other_parts_of_the_body=From base of heart to apex of heart : THEN Possible_Drug_1=Syphil 200
IF Extension_of_Pain_to_other_parts_of_the_body=From apex of heart to base : THEN Possible_Drug_1=Medorrhinum 200
IF Extension_of_Pain_to_other_parts_of_the_body=Extends to scapula Right : THEN Possible_Drug_1=Spigel 200

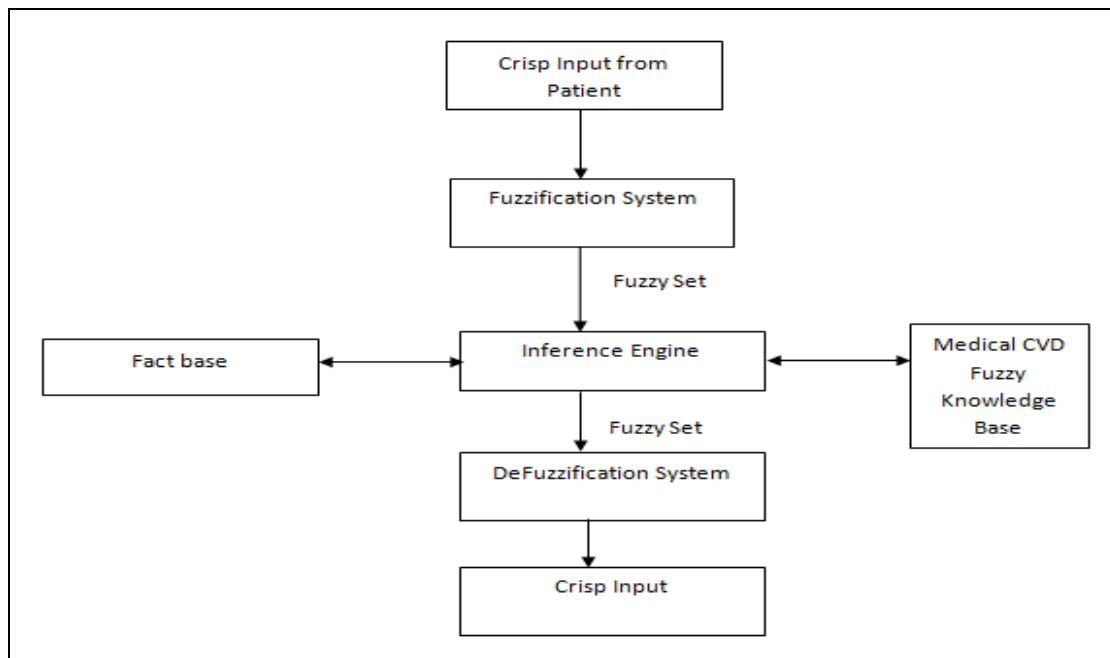
**Fuzzy Inference Engine for Disease Management:** In our system, the Rule-Based expert system, in the form of AI, uses Rule as, in our Fuzzy Inference Engine, we are trying to generate the mapping from a set of fuzzy features of cardiovascular disease to a set of output classes

with the help of fuzzy logic to generate the contextual and appropriate decision. Our Fuzzy inference engine consists of Member functions, Logic operators, IF –THEN set of rules. Initially, we perform aggression followed by fuzzy set for output variable and finally Defuzzification<sup>9</sup>.



If (Disease Symptom Feature-1 is a membership function) and/or (Disease Symptom Feature-2 is membership function 2) THEN (N<sup>th</sup> output is output membership function of set N)<sup>9</sup>.

**Our Fuzzy Inference Engine Workflow<sup>10</sup>:**



Our Computer-based fuzzy system primary focus to adopt human behaviour to provide faster and effective therapeutic. It takes the decision to remove human errors for diagnosis. The inventor of

Fuzzy System, L.A. Zadeh in the year 1965 helps a machine to think like a human with indeterminate information for our Angina Pectoris use case<sup>10</sup>.

**TABLE 3: FORMATION OF FUZZY INFERENCE ENGINE – GENERATION OF “SAMPLE” OR “MOCK” ANTECEDENT AND CONSEQUENT MATRIX FOR DETECTING INTENSITY OF DISEASE AS INTENSE, MODERATE, MILD (A SNAPSHOT OF SAMPLE and TRIAL RULES)**

Fuzzy Antecedent Matrix							Consequents
Rule Sl. no.	Types of pain	Location pain original	Particular based pain	Additional symptoms parallel with	Position of chest pain gest worsen	Extension of pain to other parts of th	Intensity of the disease
1	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Up to shoulder left clavicle	Intense
2	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Up to back	Intense
3	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Extends upward on neck and heart	Intense
4	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	From base of heart to apex of heart	Intense
5	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	From apex of heart to base	Intense
6	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Extends to scapula right	Intense
7	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Up to shoulder and left clavicle	Intense
8	Constricting and squeezing	Left upper chest	After straining / over lifting	Joint pain	Lying aggravation	Up to back	Intense
Fuzzy Antecedent Matrix							Consequents

Rule Sl. no.	Types of pain	Location pain original	Particular based pain	Additional symptoms parallel with	Position of chest pain gest worsen	Extension of pain to other parts of th	Intensity of the disease
52493	Cutting	Right side of chest	After stress or overwork	palpitation	Motion aggravation	From apex of heart to base	Moderate
52494	Cutting	Right side of chest	After stress or overwork	palpitation	Motion aggravation	Extends to scapula right	Moderate
52495	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	Up to shoulder left clavicle	Mild
52496	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	Up to back	Moderate
52497	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	Extends upward on neck and heart	Moderate
52498	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	From base of heart to apex of heart	Mild
52499	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	From apex of heart to base	Mild
52500	Cutting	Right side of chest	After stress or overwork	palpitation	Sitting aggravation	Extends to scapula right	Mild

### Sample Case Study on How the Inference Engine Can Work for a “New Patient” with Some Health Complications:

Let us assume hypothetical patient demography with the profile details used to determine the intensity of the disease and the possible drugs. Considering a hypothetical patient is having an age of 52 years with gender as male and he a typist in a Government bank by profession is being examined by the system. His father and mother have no history of cardiac complications. The patient is having a pulse rate of 75/minutes and BP is considered as 80/120. The Pain type is reported as “Cutting” and the pain is originated at the “Right Side” of the chest. During the last 2 weeks, the patient has a “stressed life” at work. Additionally, his family member revealed that he has some “palpitation” along with pain having some personal-life problems. During the conversations with medical staff, he revealed that chest pain gets worsens with “Motion aggravation”. Usually, this pain doesn’t occur at any specific time of the day but it “extends to right scapula” to another part of the body. After examined by our developing Inference engine by various rules driven by antecedent factors, the expert system reveals, the Intensity of the Disease for this patient is moderate. In terms of high-level drug selection, the developing system can reveal from the Mock Rule engine and the fact table that the sample trial drug can be “Kali Carb 200” and/or “Chel 30 /200” and/or “RhusTox 200” and/or “Spigel 200” (purely

sample and trial and non verified by Doctor now) subjected to further detailed examined by specialist physicians.

**DISCUSSION:** As we have already stated before that the classical medical science tries to preserve health in the best possible manner with the aid of genetics and epigenetics. Therefore, the energy stored is also being referred to as the “vital force of life”<sup>8, 11</sup>. In response to any foreign substance or deviation from the natural state, the immune system constantly fights to revert back to its state of normalcy, and therefore, during this process, it generates the force that all the individualistic symptoms, *i.e.*, the stronger the health, the better the immune response. It should be noted that the classical homeopaths follow a pattern or protocol to evaluate the level of health of the patients. This process occurs during the initiating phase of case taking an approach to accomplish the possible routes of therapy for the patients. The diagnosis helps to evaluate the pathological condition of the patient, whereas; the prognosis helps to evaluate the degree of health of the patient. According to past scientific confirmations, homeopathic medications provide relief to patients who possess severe pathological signs and symptoms and repair the damage conditions. Therefore, it can be concluded that homeopathy can show impressive improvement if the symptoms of the individuals follow a pattern within homeopathy<sup>11, 12</sup> **Table 1.** With the help of our advanced algorithm, we are

exploring those patterns in the digital medium. Nitro-glycerin is considered the mainstream treatment for patients of Angina Pectoris<sup>13</sup>. It was discovered prior to the 20<sup>th</sup> century and is still mentioned in the pharmacopeia. This particular medication was used with the conviction that it would dilate the arteries and thus, in turn, reduces atrial tension. Thus in this whole process, the regular physicians and the classical homeopaths revealed significant interest in the recovery of the disease “angina pectoris”. It should also be noted from the past literature that the homeopathic medications which are mentioned within the “Materia Medica” of homeopathy can be utilized successfully as a complementary strategy with surgery in the broader field of “Cardiovascular disease” like Angina Pectoris<sup>13</sup>. However, it is the physician’s discretion to look out for evidence-based therapy along with individual laboratory reports **Fig. 1**.

There is a handful of papers that describe the efficacy of high dilution of medications for patients suffering from Coronary Artery disease. **Table 1** gives details about the varied signs and symptoms of the disease and their probable medications that might be prescribed in correlation with multiple questions<sup>13,14</sup>.

However, the recent advancement of technology also plays a significant growth in the field of medical science as it not only helps us here to digitalize the huge detailed volume of the records of the patients but also become an aid to process, store, analyze and mine the data with the help of advanced data science. Storing of such data is sometimes concluded as Electronic Health Records (EHR)<sup>14,15</sup>. With EHR, we had tried to develop a Health Care Analytics Smart System to predict the real-time prediction of drugs. It should be noted that the EHR also performs sharing the data with the aid of other associated technologies to provide an efficient service to the healthcare workers and also offers quality care to the patient population at a cost-beneficial approach. It is observed that healthcare analytics has already started evolving in a wide range of countries. Moreover, with the huge volume of data collected both from the patient and the clinicians, the system is able to store and process the data to build deep learning. Prediction models can have helped medical science as a whole

to offer a quality care service to human mankind. It should also be noted that these medical datasets play an instrumental role in generating and offering an efficient Diagnostics Management System to achieve enhance accuracy in the treatment selection process trained by historical data **Fig. 3**. It also helps in finding the association and causation between patient case capturing and treatment selection process with the aid of the latest healthcare computational technologies and it helps in the compilation of all-inclusive information. Therefore, with the aid of this particular technological approach, reasonable guidance can be achieved for the appropriate making of decisions in terms of medications and also guides us towards adapting to the procedure of modernity<sup>14,15,17,18</sup>.

**CONCLUSION:** We tried to depict the picture of how we can associate between the medical case capturing of “angina pectoris” and its subsequent homeopathic medicine selection in a treatment management system which is powered by Smart Digital system with the help of Advanced Machine Learning<sup>16,19,20,21</sup>. This experiment is purely done with non real, trial and mock data only to built the system and every dataset/drugs used in the papers are purely trial, random and not fully proven by expert doctors.

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**STRENGTH:** The experiment is based upon information and findings and also for the benefit of the Institution, Dr. Bholanath Chakravarty Integrated Medical Research & Medical Centre, West Bengal, India. However, all Data connected in this paper are purely mock and random data for experimental and trial purpose only as of now.

**LIMITATION:** As it is a protocol-based paper, the real patient / drug analysis is not given within this paper and this papers help to create a model methodology purely with non-real patient data/drugs for experimental purpose only.

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## REFERENCES:

1. Tidiri K, Chatti N, Verron S and Tiplica T: Bridging data-driven and model-based approaches for process fault diagnosis and health monitoring: A review of researches and future challenges. *Annual Reviews in Control* 2016; 1(42): 63-81.
2. Ghosh AK: A short history of the development of homeopathy in India. *Homeopathy* 2010; 99(2): 130-6.
3. <https://www.homeobook.com/effective-homeopathy-case-taking/> (Accessed on 1.02.2021)
4. Hahnemann S: *The Lesser Writings of Samuel Hahnemann*. W. Headland 1851.
5. Jadhav U, Pinto B, Jayagopal PB, Nair T, Kumar P, Sahoo PK, Ganguly A, Srivastava S, Kapoor S, Davidson D and Ahuja RC: Indian Consensus on Optimal Treatment of Angina (OPTA). *The Journal of the Association of Physicians of India* 2018; 66(12): 95-103.
6. McAloon CJ, Boylan LM, Hamborg T, Stallard N, Osman F, Lim PB and Hayat SA: The changing face of cardiovascular disease 2000–2012: An analysis of the world health organisation global health estimates data. *International Journal of Cardiology* 2016; 224: 256-64.
7. Tardif JC: The pivotal role of heart rate in clinical practice: from atherosclerosis to acute coronary syndrome. *European Heart Journal Supplements* 2008; 10(suppl\_F): F11-6.
8. Mitchell R, Michalski J and Carbonell T: *An artificial intelligence approach*. Berlin: Springer 2013.
9. Najjar YS and Amer MM: Using a smart device and neuro-fuzzy control system as a sustainable initiative with green cars. *Journal of the Energy Institute* 2016; 89(2): 256-63.
10. Terrada O, Cherradi B, Raihani A and Bouattane O: A fuzzy medical diagnostic support system for cardiovascular diseases diagnosis using risk factors. In 2018 International Conference on Electronics, Control, Optimization and Computer Science (ICECOCS) 2018; 1-6.
11. Schmidt P: *The Art of Case Taking*. New Delhi: B.
12. Robert HA: *The Principles and Art of Cure by Homeopathy*. New Delhi, India: B.
13. De Silva K and Perera D: Myocardial ischemia. *Landmark Papers in Cardiovascular Medicine* 2012; 27: 44.
14. Horne J, Gilliland J, O'Connor C, Seabrook J, Hannaberg P and Madill J: Study protocol of a pragmatic randomized controlled trial incorporated into the group lifestyle Balance™ program: the nutrigenomics, overweight/obesity and weight management trial (the now trial). *BMC Public Health* 2019; 19(1): 1-0.
15. Castillo VH, Martínez-García AI and Pulido JR: A knowledge-based taxonomy of critical factors for adopting electronic health record systems by physicians: a systematic literature review. *BMC Medical Informatics and Decision Making* 2010; 10(1): 1-7.
16. Tenzera L, Djindjic B, Mihajlovic-Elez O, Pulparampil BJ, Mahesh S and Vithoulkas G: Improvements in long standing cardiac pathologies by individualized homeopathic remedies: a case series. *SAGE Open Medical Case Reports* 2018; 6: 2050313X18792813.
17. Scala PB: Homeopathic treatment of two patients with coronary artery disease: case-report. *International Journal of High Dilution Research-ISSN 1982-6206*. 2009; 8(27): 45-9.
18. Singh A and Kumar R: Heart disease prediction using machine learning algorithms. In 2020 international conference on electrical and electronics engineering (ICE3) 2020; 452-57.
19. Shah D, Patel S and Bharti SK: Heart Disease Prediction using Machine Learning Techniques. *SN Computer Science* 2020; 1(6): 1-6.
20. Krittanawong C, Virk HU, Bangalore S, Wang Z, Johnson KW, Pinotti R, Zhang H, Kaplin S, Narasimhan B, Kitai T and Baber U: Machine learning prediction in cardiovascular diseases: a meta-analysis. *Scientific Reports* 2020; 10(1): 1-1.
21. Obasi T and Shafiq MO: Towards comparing and using machine learning techniques for detecting and predicting heart attack and diseases. In 2019 IEEE international conference on big data (big data) 2019; 2393-2402.

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