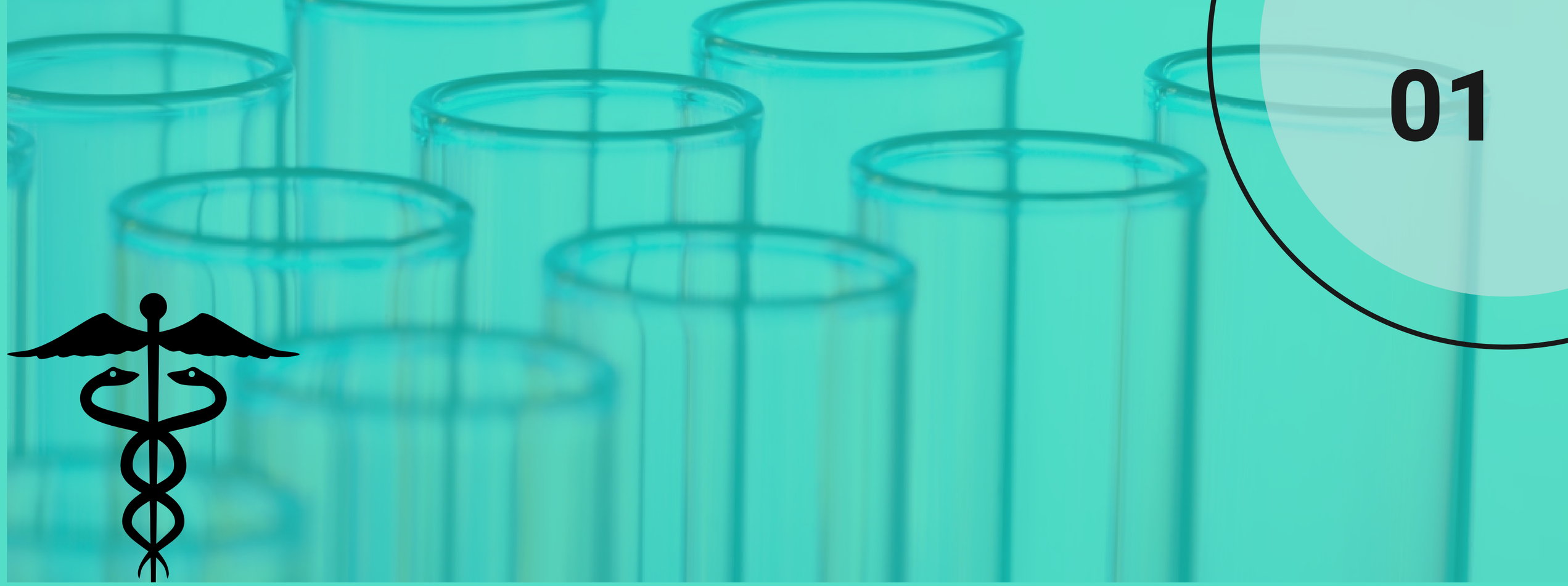


01

Is Diabetes Becoming the Biggest Epidemic of the Twenty-first Century?

Know Our Team

SATYA

....

HARSHVARDHAN

....

GOKUL

....

BOBBY

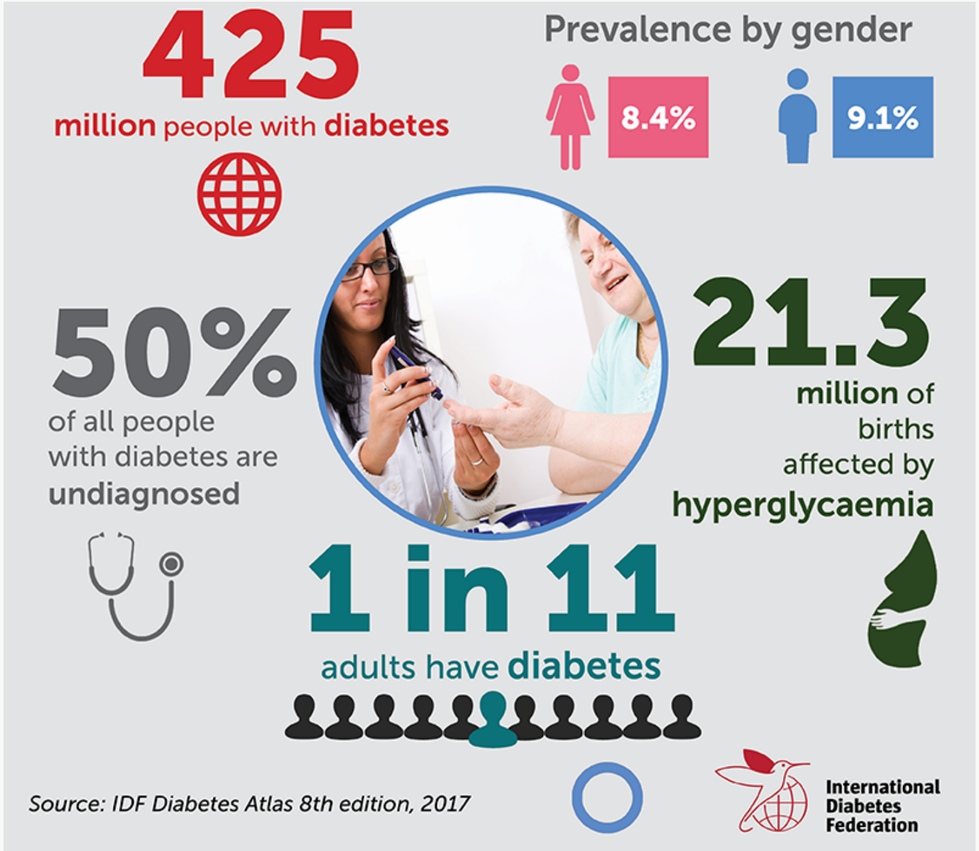
....

RISHABH

....

Diabetes - Not So Sweet !
Infographics & Facts Sheet

01



Facts

- Diabetes is one of the fastest growing health challenges of the 21st century, with the number of adults living with diabetes having more than tripled over the past 20 years.
- Associated with diabetes, hyperglycemia can cause vomiting, excessive hunger and thirst, rapid heartbeat, vision problems, and other symptoms.
- One in six people with diabetes in the world is from India.
- The prevalence of diabetes in India is 11.8%, according to the National Diabetes and Diabetic Retinopathy Survey report.

Diabetes - Not So Sweet !

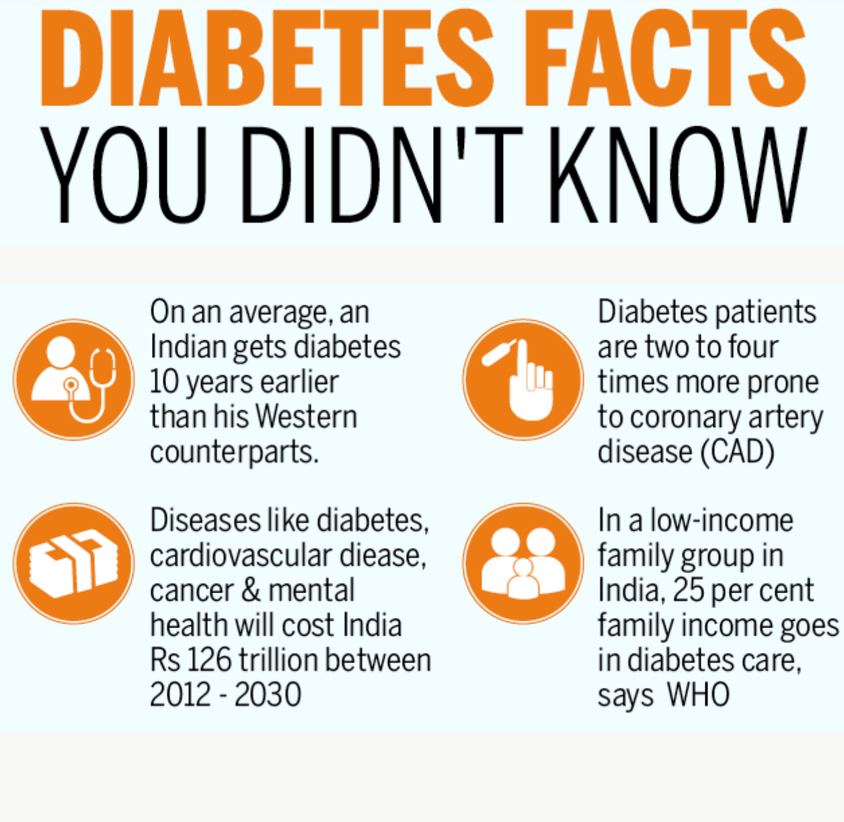
Facts

02

Facts - Type 1

- Over 100,000 children in India are living with Type 1 diabetes.
- India is listed among the top 10 countries for number of people under 20 years old with Type 1 diabetes.
- It also revealed that the average diabetes cost share is nearly 80% of the monthly income for someone with Type 1 among respondents.
- India comprises the WHO's South-East Asia region, which has a prevalence of Type 1 diabetes of 1,11,500 in children.

	2019	
Rank	Country or territory	No. of people w diabetes (millions)
1	China	116.4
2	India	77.0
3	United States of America	31.0
4	Pakistan	19.4
5	Brazil	16.8
6	Mexico	12.8
7	Indonesia	10.7
8	Germany	9.5
9	Egypt	8.9
10	Bangladesh	8.4



Diabetes Infographics & Facts

03

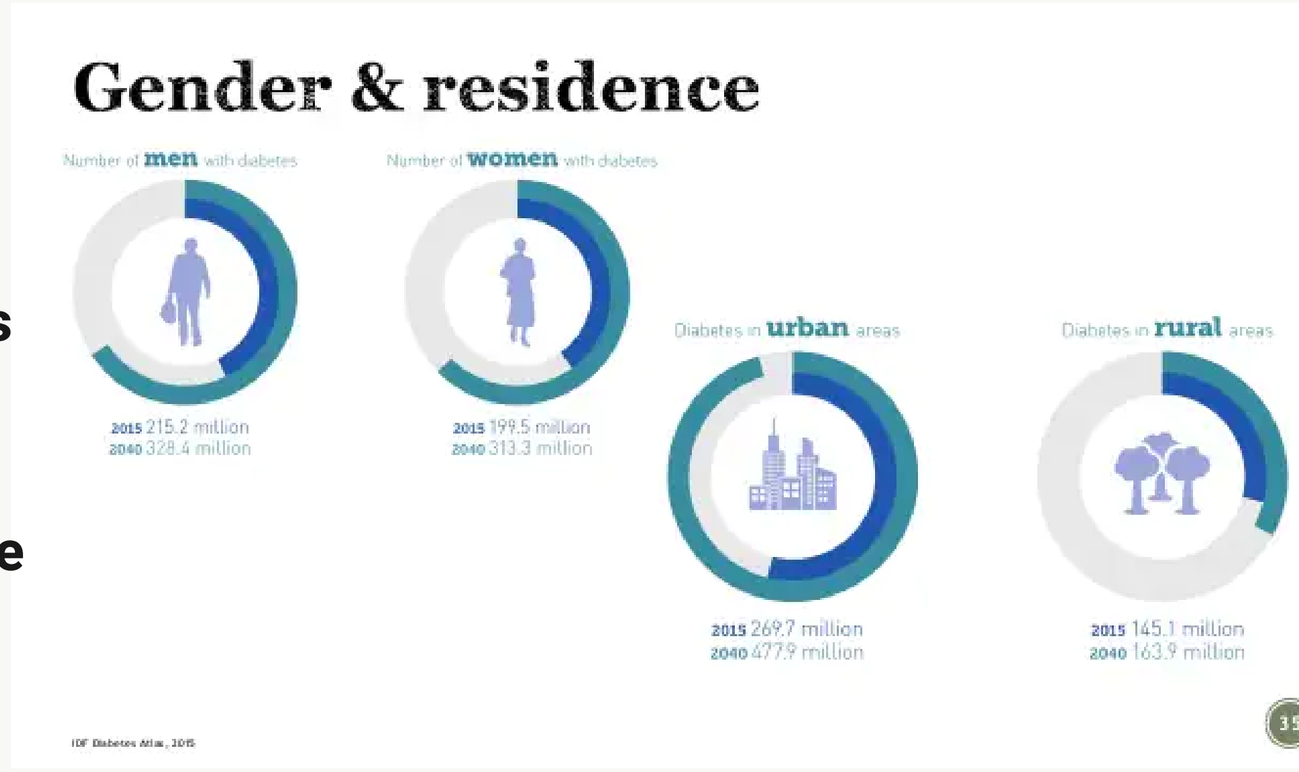
Key facts

- People with type 1 diabetes must take insulin daily. If left untreated, the excess sugar in the blood can cause severe damage to the body and may even be fatal.
- Type 1 diabetes often appears suddenly during childhood or infancy.
- Diabetes UK estimates that the life expectancy of someone with type 2 diabetes is likely to be reduced, as a result of the condition, by up to 10 years.
- People with type 1 diabetes, with life expectancy having been quoted as being reduced by over 20 years.

01

Diabetes Infographics & Facts Prevalence based on age and gender

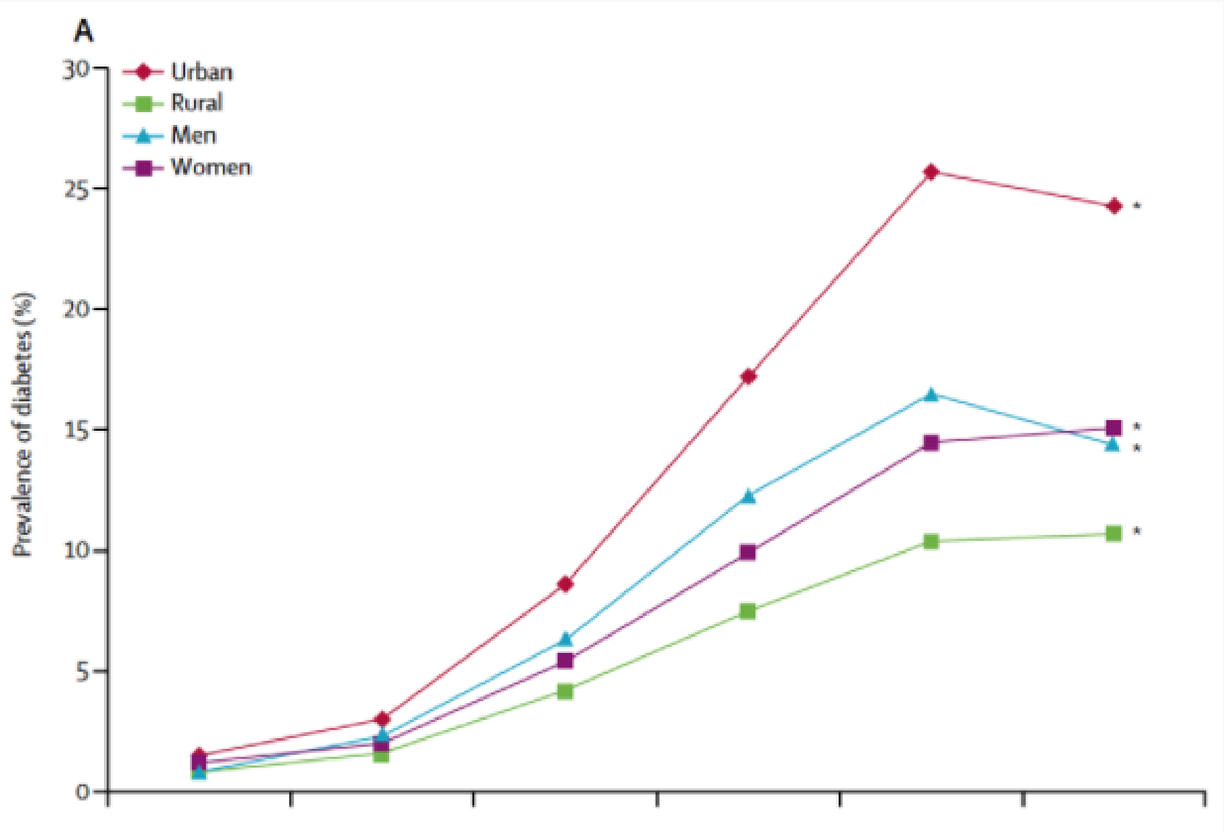
- The prevalence of diabetes increases with age and reaches the peak at 60–69 years of age followed by a decline at the 70 years of age in Indian subjects.
- The age at which the peak prevalence of diabetes was reached was ~10 years younger in Indian compared with other Asian countries.
- In developing countries, however, the majority are between the ages of 45 and 64 years .



Diabetes Infographics & Facts Local Data

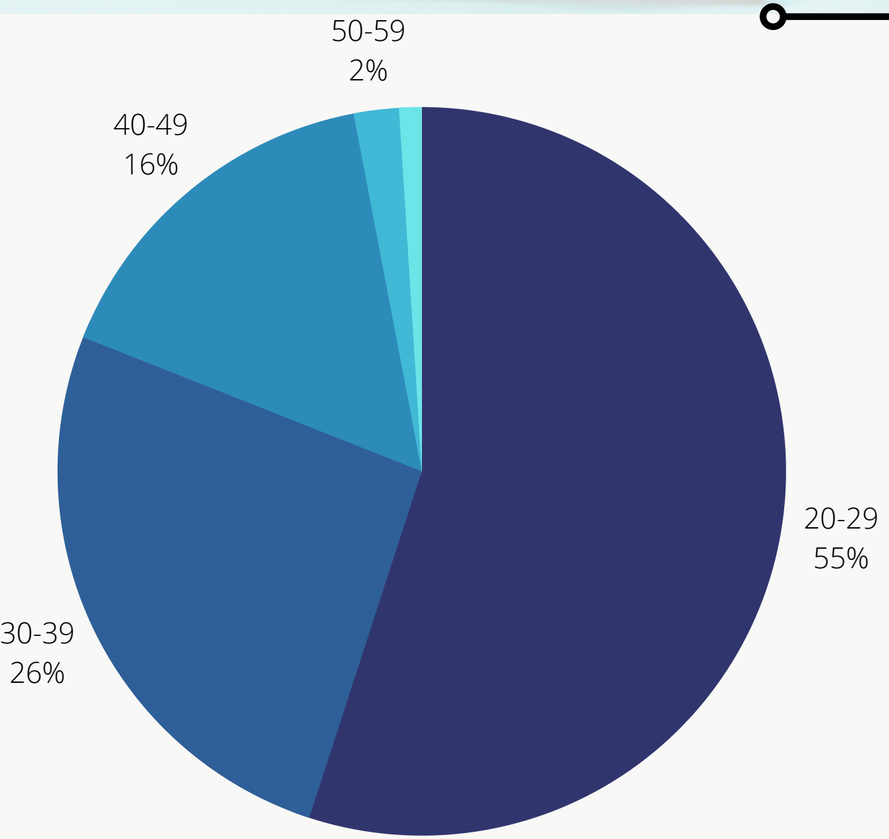
02

- The CPR (Crude prevalence rate) is thought to be 9 %in the urban areas and 3% in the rural areas of India.
- In India, type 1 is considerably more rare, and only about 1/3 of type II diabetics are overweight or obese.
- India has second highest diabetes patients in the world.
- The prevalence of IGT is thought to be around 8.7 per cent in urban areas and 7.9 per cent in rural areas, It is thought that around 35 per cent of IGT sufferers go on to develop type 2 diabetes.



Diabetes Infographics & Facts Delhi NCR

03



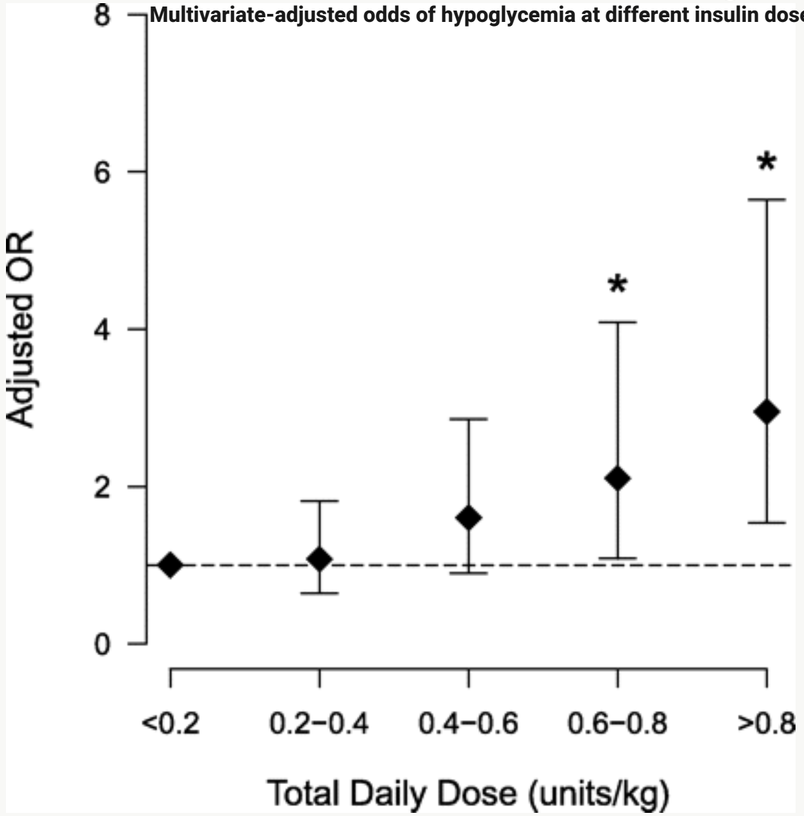
42.5 per cent of Delhi population suffers from diabetes, while in Mumbai and estimated 38.5 per cent of the total population is in the grip of the disease. In Ahmedabad 36 per cent people are diabetic, in Bangalore 26.5 per cent while in Chennai the percentage is estimated to be 24.5 per cent

The Study also show that with emploees from 18 broad Sectors the maximum Share of employees from IT Sector

Employees working in engineering and telecom sector contributed 9 per cent and 8 per cent respectively in the questionnaire. Nearly 6 per cent of the employees belonged from market research/KPO and media background each

17%

Diabetes Infographics & Facts Insulin Dose

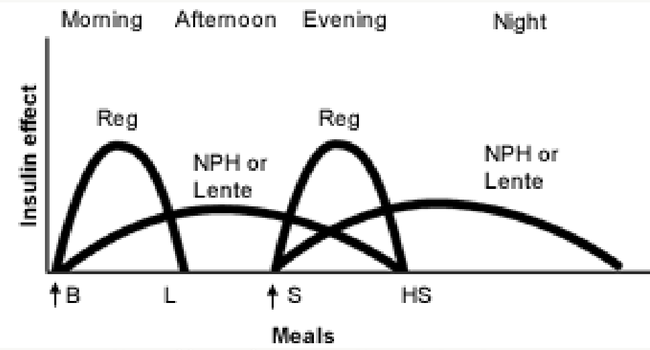


In type 1 diabetes, most people need a total of 0.5 - 0.8 units of insulin per kilogram of body weight each day

Calculation of Insulin Dose:

This takes into account

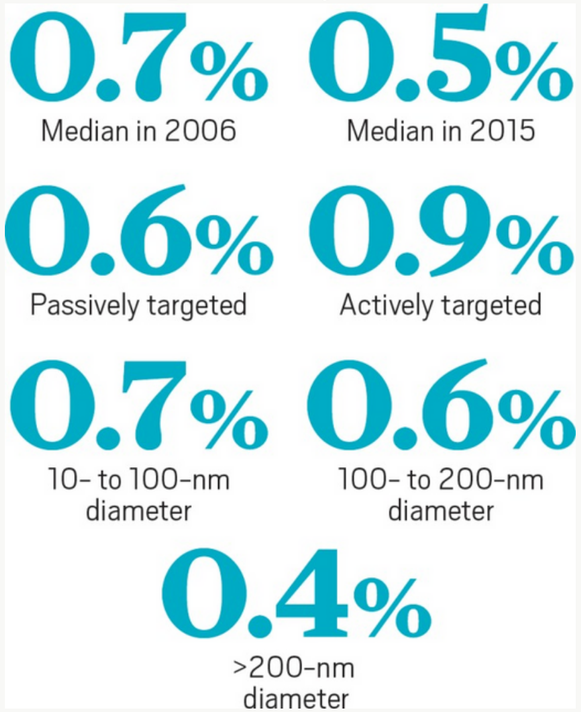
- **Carbohydrate coverage by meal**
- **High Blodd sugar Correction**
- **Total Mealtime Dose**
- **Base insulin need = 0.55*weight of person in kilogram**



Insulin Effect for Insulin with short term effect

Diabetes Infographics & Facts Nanomaterials

Efficiencey of Nano particle over different parameters in drug delivery at tumor sites.



However Industrial research shows that the efficiency of nanomedicine with size <100nm is 2%. With further increase in size, the efficiencies drop

The gold nanomedicine suggested has a particle size of 5nm -400nm depending on surface functionality and solvent.Therefore efficiency possible is

~ 2 %

Diabetes - Diagnosis & Treatments

00

Diabetes-related health expenditure		
Total diabetes-related health expenditure, USD million	2,815.1	7,057.4
Total diabetes-related health expenditure, ID million	7,819.9	27,205.0
Mean diabetes-related health expenditure per person, USD	55.0	91.7
Mean diabetes-related health expenditure per person, ID	154.0	353.3
Demographics		
Total adult population (20-79 y), in 1,000s	713,498.4	859,956.1
Population of children (0-14 y), in 1,000s	374,809.0	369,543.9
Population of children and adolescents (0-19 y), in 1,000s	-	495,127.8

Diabetes estimates (20-79 y)		
People with diabetes, in 1,000s	50,768.3	77,005.6
Age-adjusted comparative prevalence of diabetes, %	7.8	10.4
People with undiagnosed diabetes, in 1,000s	-	43,869.0
Proportion of people with undiagnosed diabetes, %	-	57.0
Impaired glucose tolerance (IGT) estimates (20-79 y)		
People with IGT, in 1,000s	39,471.8	25,207.3
Age-adjusted comparative prevalence of IGT, %	5.7	3.3
Mortality attributable to diabetes (20-79 y)		
Deaths attributable to diabetes	1,007,642.0	1,010,262.1
Proportion of diabetes-related deaths in people under 60 y, %	-	50.5

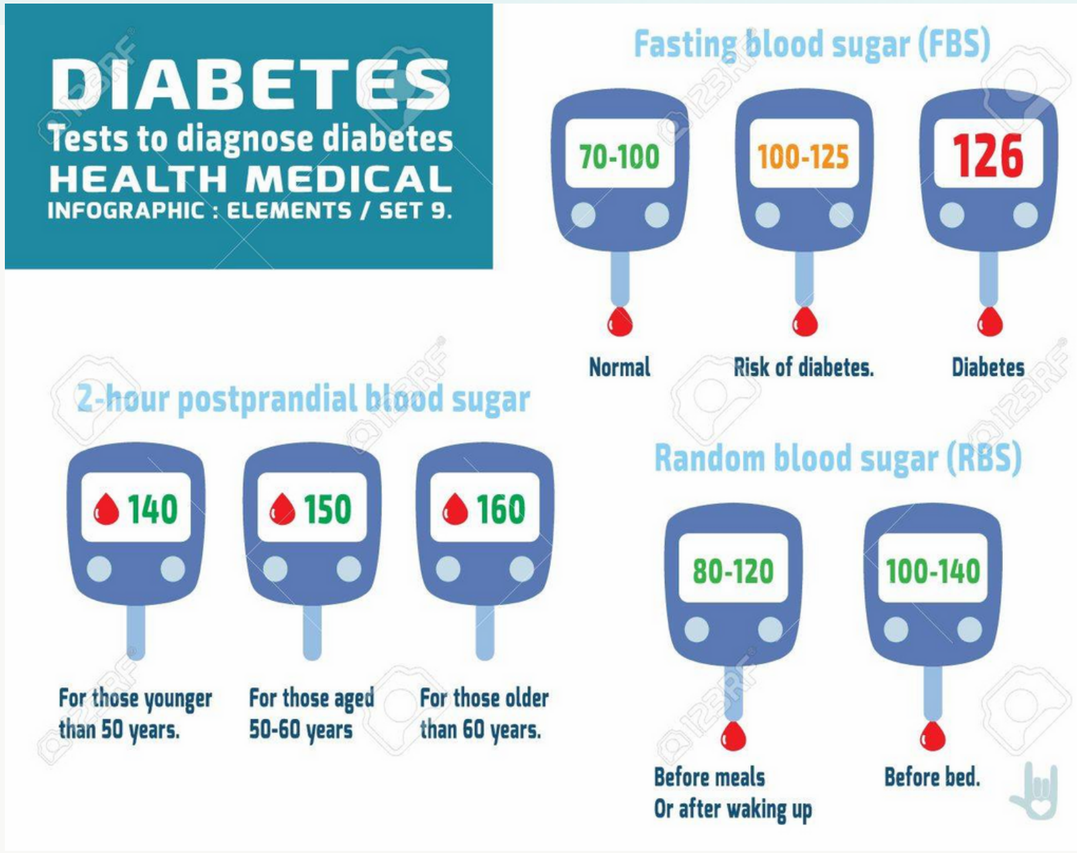
Type 1 diabetes estimates in children and adolescents	
New cases of type 1 diabetes (0-14 y), in 1,000s	15.7
New cases of type 1 diabetes (0-19 y), in 1,000s	-
Type 1 diabetes (0-14 y), in 1,000s	97.6
Type 1 diabetes (0-19 y), in 1,000s	-

01

Diagnostic test

Diagnostic test includes:

- **Glycated hemoglobin (A1C) test: It measures the percentage of blood sugar attached to the oxygen-carrying protein in red blood cells (hemoglobin). An A1C level of 6.5 percent or higher on two separate tests indicates diabetes.**
- **Random blood sugar test:**
- **sugar level of 200 mg/dL or higher suggests diabetes.**
- **Fasting blood sugar test:**
- **< 100 mg/dL is normal**
- **100 to 125 mg/dL -- prediabetes**
- **> 126 mg/dL -- diabetes.**

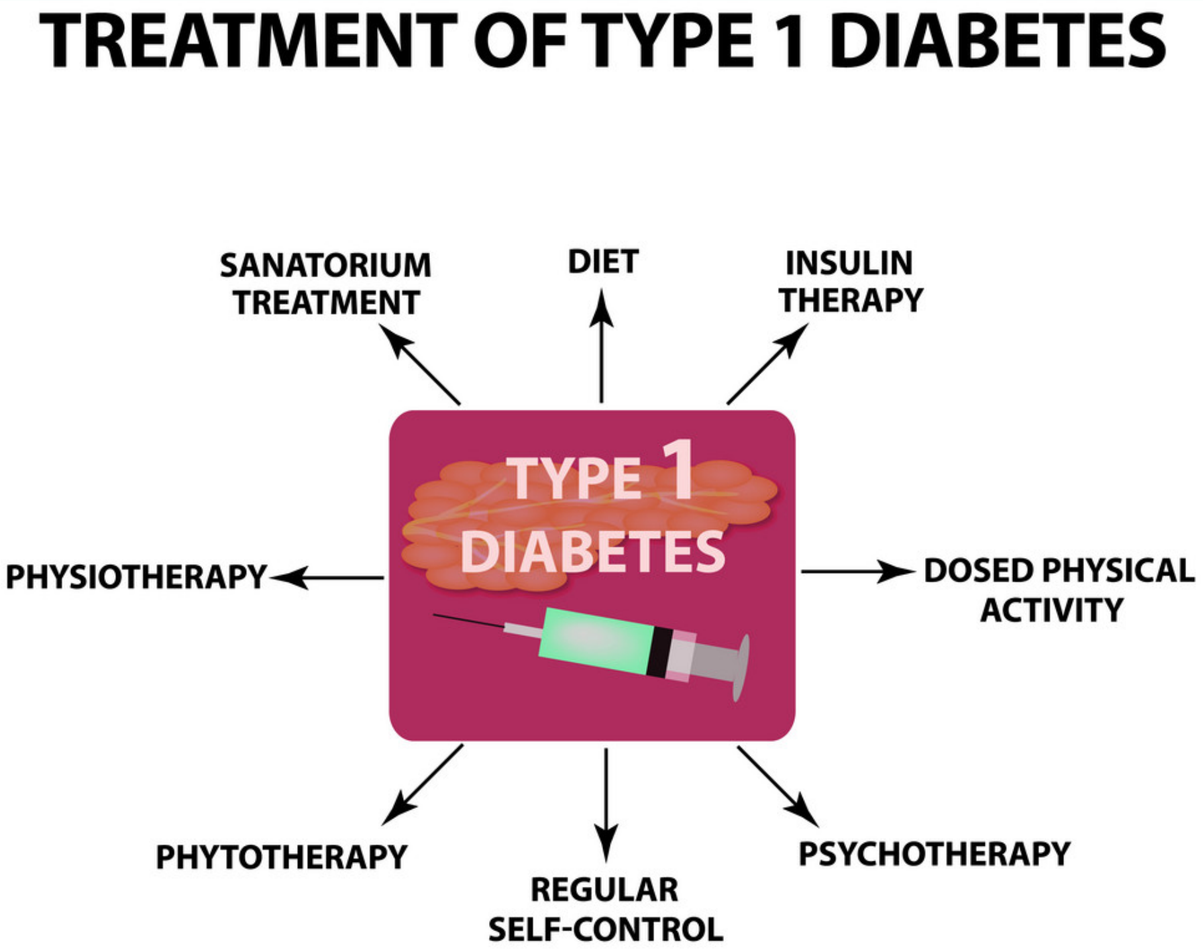


Treatments

02

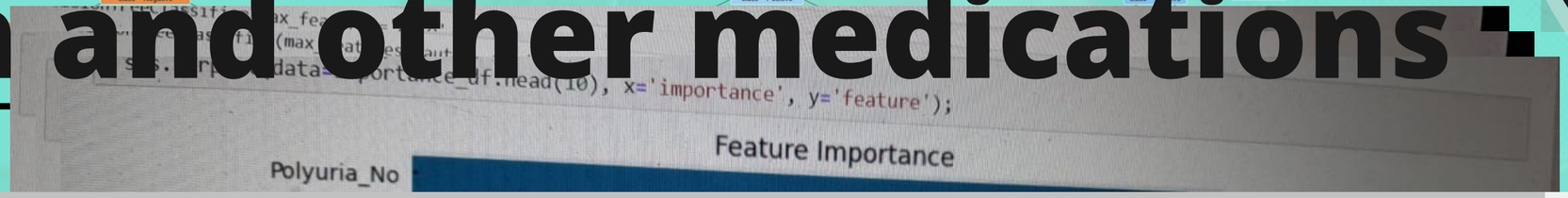
Treatment for type 1 diabetes includes:

- Carbohydrate, fat and protein counting
- Frequent blood sugar monitoring
- Eating healthy foods
- Exercising regularly and maintaining a healthy weight
- Taking insulin.



03

Insulin and other medications

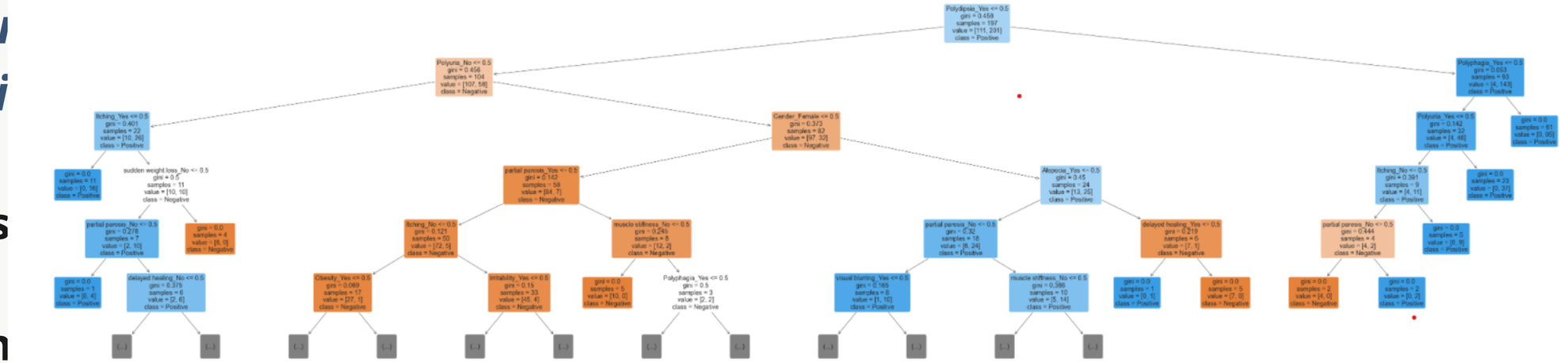


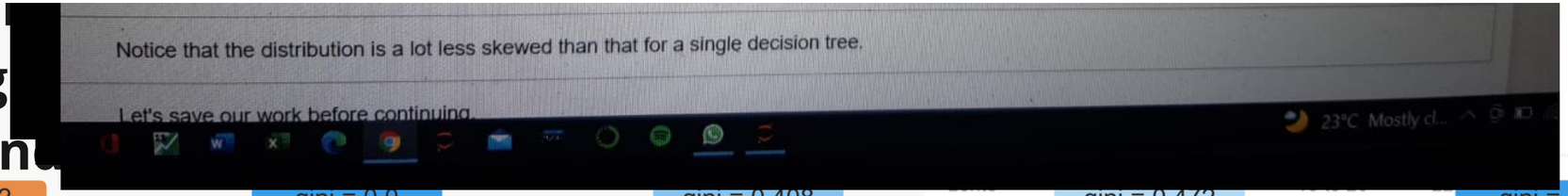
Anyo
insuli

Types

- **Sh**
- **Intermediate-acting (N sulin**
- **Long-acting insulin: glargine , insulin determir.**

American Family Physician Foudation





Gender_Male <= 0.5
gini = 0.33
samples = 139
value = [110, 29]
class = Negative

gini = 0.142
samples = 104
value = [96, 8]
class = Negative

gini = 0.0
samples = 13
value = [0, 13]
class = Positive

gini = 0.408
samples = 7
value = [2, 5]
class = Positive

gini = 0.0
samples = 116
value = [0, 116]
class = Positive

gini = 0.472
samples = 21
value = [8, 13]
class = Positive

gini = 0.0
samples = 16
value = [0, 16]
class = Positive

insulin (Humulin L)			hours	
Ultralente insulin (Humulin	2 to 4 hours	8 to 14 hours	20 to 24 hours	22

MMON PITFALLS

poglycemia occurs if the lag time is long or the patient exercises within hour of administration; with high- meals, the dose should be adjusted ward.

0.5 is not used appropriately; the ould be given 20 to 30 before the patient eats.

In many patients, breakfast injection does ng meal; admin ing meal does on awake

suspension binds with regular n, which loses its effect if it is left syringe for more than a few tes.

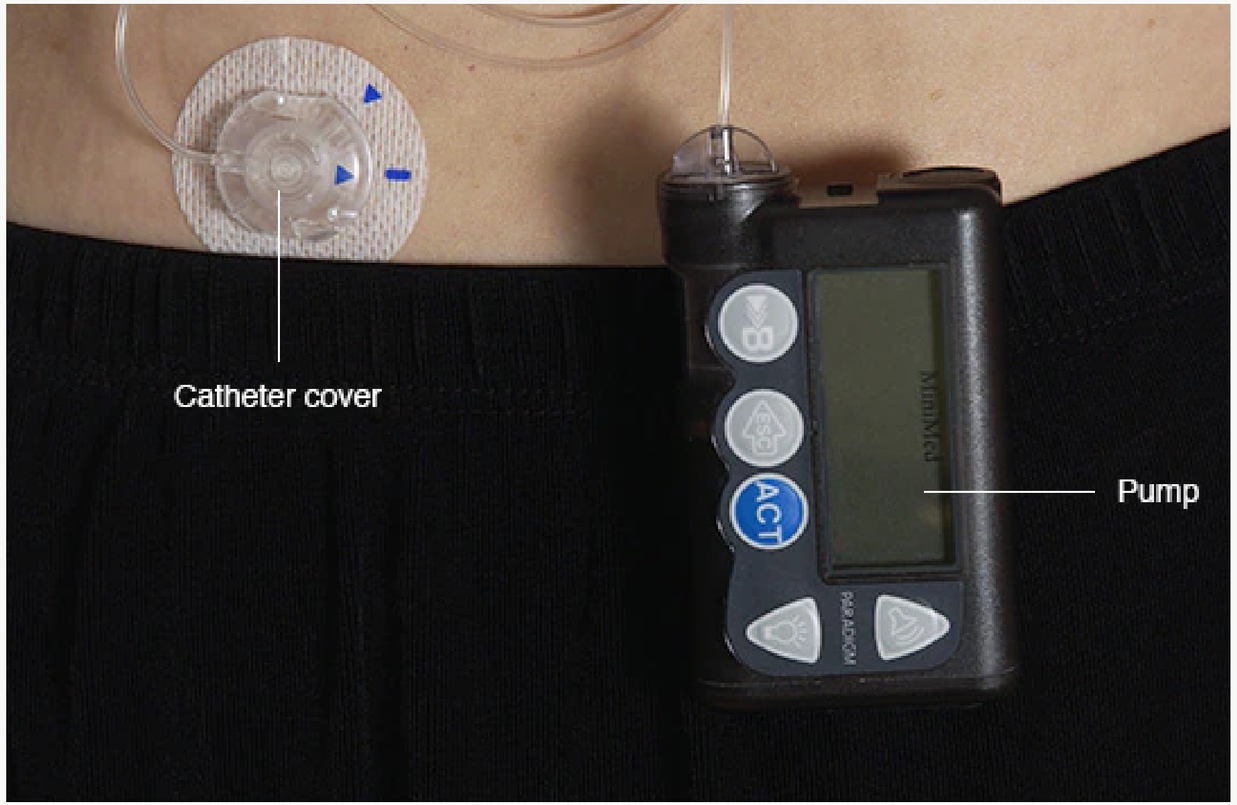
Same as for lente insulin; in addition, peak of action is erratic in some patients.

04

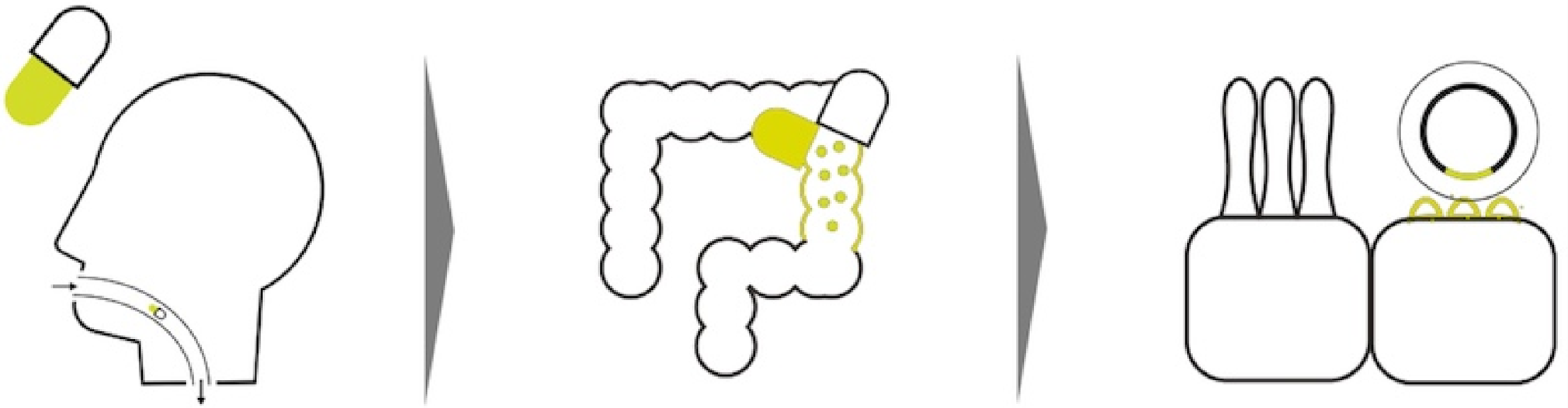
Insulin and other medications

Insulin administration

- **Injections- You can use a fine needle and syringe or an insulin pen to inject insulin under your skin.**
- **A regimen of three or more insulin injections a day has been shown to improve blood sugar levels.**
- **An insulin pump-**
- **Pumps are programmed to dispense specific amounts of rapid-acting insulin automatically.**
- **Mayo Foundation Research has found that in some people an insulin pump can be more effective at controlling blood sugar levels than injections.**



Potential Treatments - Ongoing Research



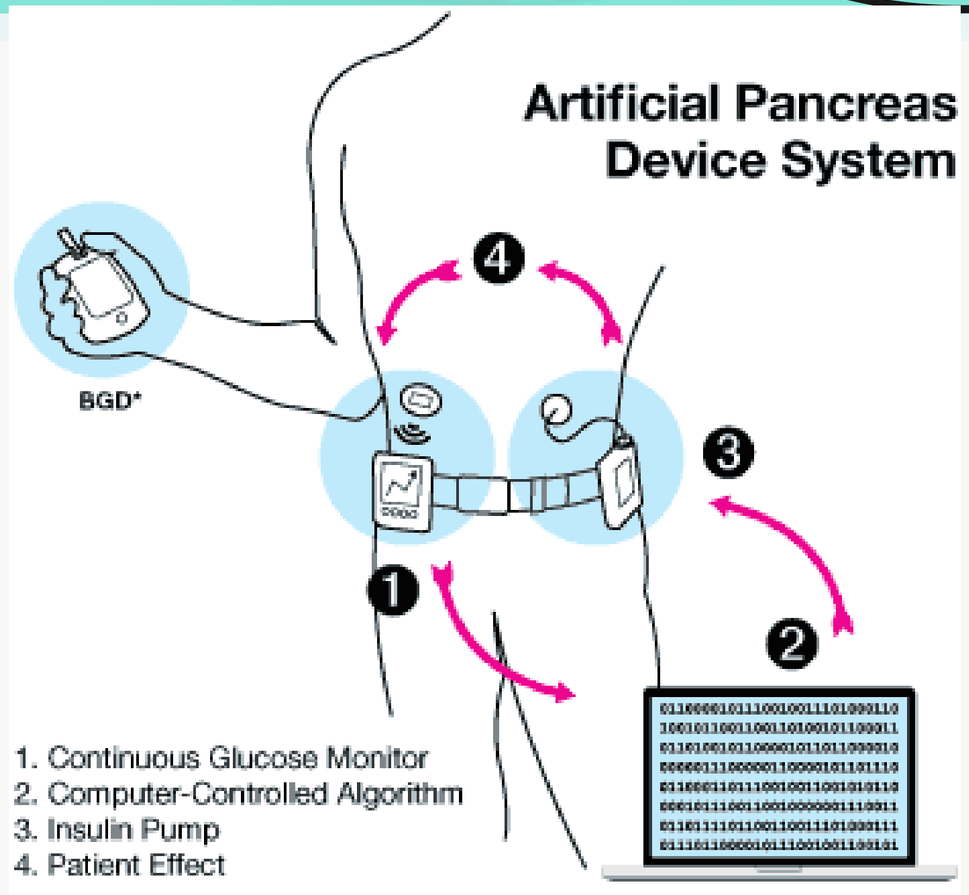
1. Genetically engineered bacterium freeze dried and inserted into enteric coated capsule

2. Capsule opens and releases the bacterium directly at the disease target

3. Bacterium releases the therapeutic agent locally at target site (e.g. in GI tract)

Artificial Pancreas - Ongoing Research

- It is a closed-loop insulin delivery.
- The implanted device links a continuous glucose monitor, which checks blood sugar levels every five minutes, to an insulin pump.
- The device automatically delivers the correct amount of insulin when the monitor indicates it's needed.
- There are more artificial pancreas (closed loop) systems currently in clinical trials.



Additional Medications

07

Additional medications also may be prescribed for people with type 1 diabetes, such as:

- **High blood pressure medications - angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) to help keep your kidneys healthy.**
- **Aspirin - in case of increased risk for a cardiovascular event**
- **Cholesterol-lowering drugs - for people with diabetes because of the elevated risk of heart disease.**

References

- https://www.google.com/search?q=diabetes+diagnostic+insulin+infographics&tbm=isch&ved=2ahUKEwjR8seyi43zAhWBiOYKHejHCAAQ2-cCegQIABAA&oq=diabetes+diagnostic+insulin+infographics&gs_lcp=CgNpbWcQA1C8zCBYgNwgYJeDIWgAcAB4AIAB1QSIAdIRkgEHMi03LjUtMZgBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=P0BIYZHXAoGRmgfojyM#imgrc=H1fuE33tIMStbM
- https://www.google.com/search?q=diabetes+diagnostic+treatment+infographics&tbm=isch&ved=2ahUKEwjy2emJio3zAhW1iOYKHQiFAKsQ2-cCegQIABAA&oq=diabetes+diagnostic+treatment+infographics&gs
- https://www.google.com/search?q=diabetes+diagnostic+treatment+infographics&tbm=isch&ved=2ahUKEwjy2emJio3zAhW1iOYKHQiFAKsQ2-cCegQIABAA&oq=diabetes+diagnostic+treatment

Predict Diabetes From Medical Records

01

- The Pima Indians Diabetes Database can be used to train machine learning models to predict if a given patient has diabetes.
- For prediction we need a good data set having different predictors(independent variables)
- For example to predict diabetes we could need a dataset containing measurements relating to Glucose, BloodPressure, SkinThickness, Insulin, BMI Pregnancies, and Age.

Data Analysis

02

- Step 1. Import Python Packages
- Step 2. Define helper functions
- Step 3. Inspect and clean data: When starting a data analysis project it is important to inspect, understand, and clean the data.
- Step 4. Prevanting data leakage: Sometimes data is missing or erroneous. We implement some Statistic concepts to get it.
- Step 5. Evaluate classification models: Because we have replaced all of the erroneous, missing, and null values with median values we are now ready to train and evaluate our models for predicting diabetes.

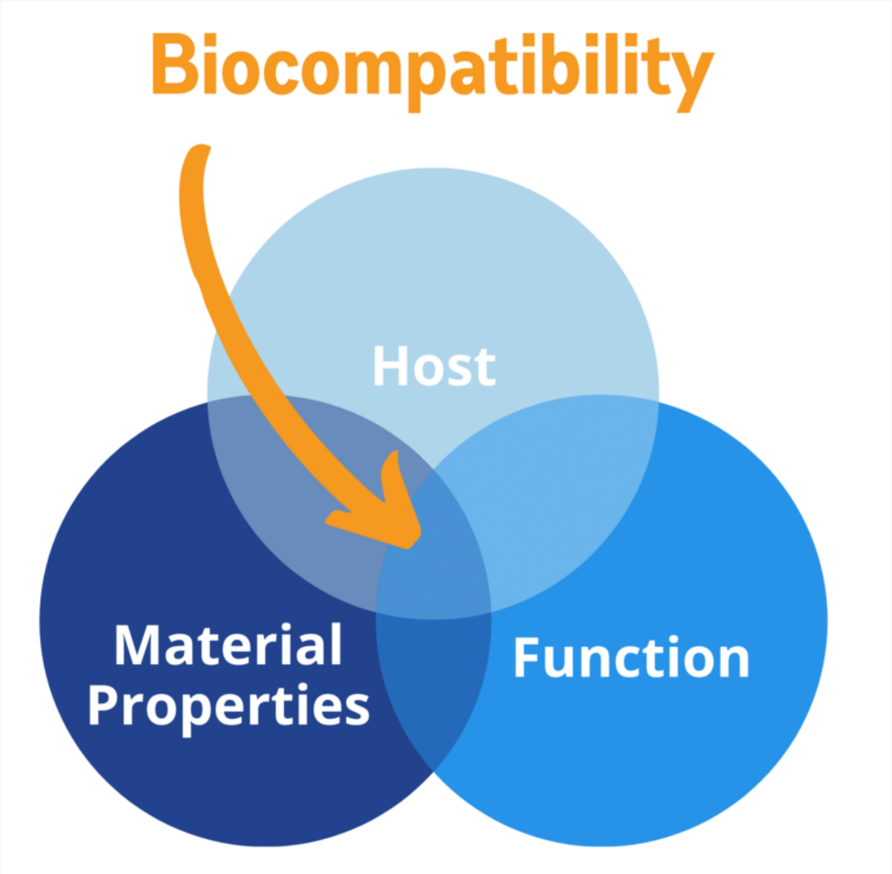
Data Analysis

03

- This dataset contains measurements relating to Pregnancies, Glucose, Blood Pressure, Skin Thickness, Insulin, BMI, Diabetes, PedigreeFunction, and Age.

Challenges Faced...

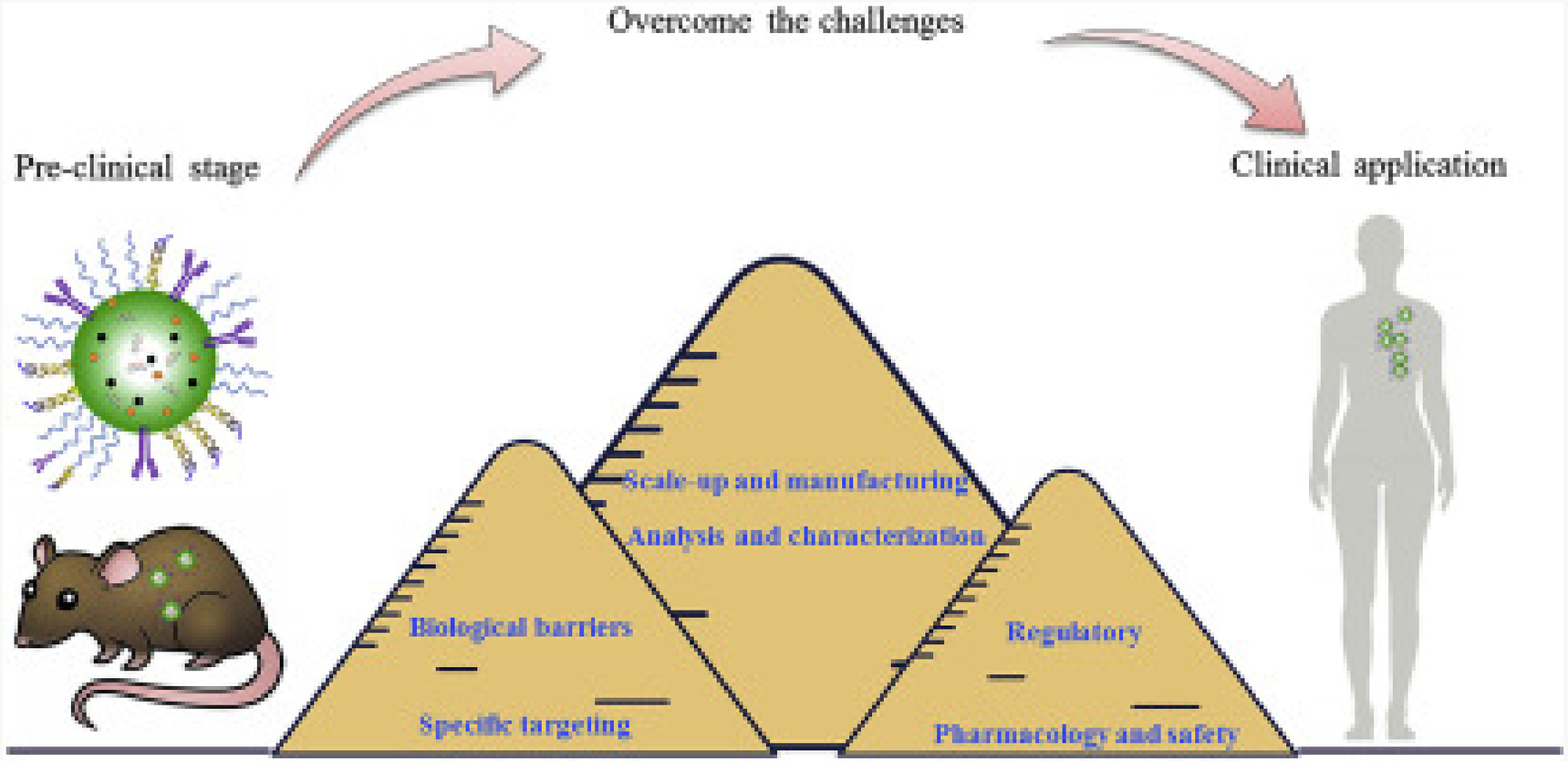
- The nanomaterials after getting injected to body which may cause some allergy or generate some other disease due to the foreign thing getting inside the body and reacting with it.
- Nanomaterials can be toxic at the potential concentrations at which they might be used. However, to determine and understand the toxic effects of nanomaterials, strategies and interpretation of the data must be done correctly and assumptions taken into consideration.



Challenges Faced...

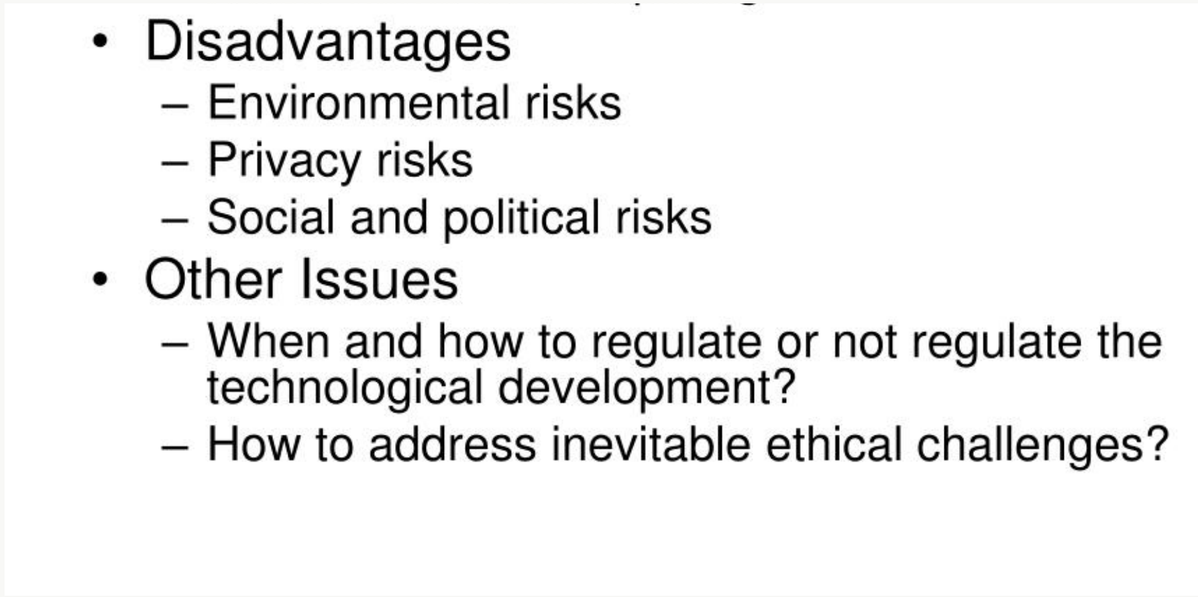
- If sensors work only for short time then it will cost more to patient. So highly efficient sensors are required.
- Any mistake in data collection and processing will lead to wrong timings of insulin release from sensor into body, making patients more prone to death so one has to ensure perfect data collection and processing so that insulin is released at the right time.
- Sensor should indicate if there is any malfunction because malfunctioning may have dire consequences and can also be fatal in worst scenarios.
- This dataset provided by the sensor will contain measurements relating to Glucose, Blood Pressure, Insulin, BMI, Diabetes, Pedigree Function, and Age.

Challenges & Concerns...



Ethical Issues

- **At present, the most significant ethical issues relating to nanomedicine involve risk assessment, risk management, and risk communication in clinical trials.**
- **In the future, nanomedicine is likely to raise questions of physical enhancement, social justice and access to health care.**
- **Some other issues are biological challenges, large-scale manufacturing, government regulations, and overall cost-effectiveness in comparison to current therapies**



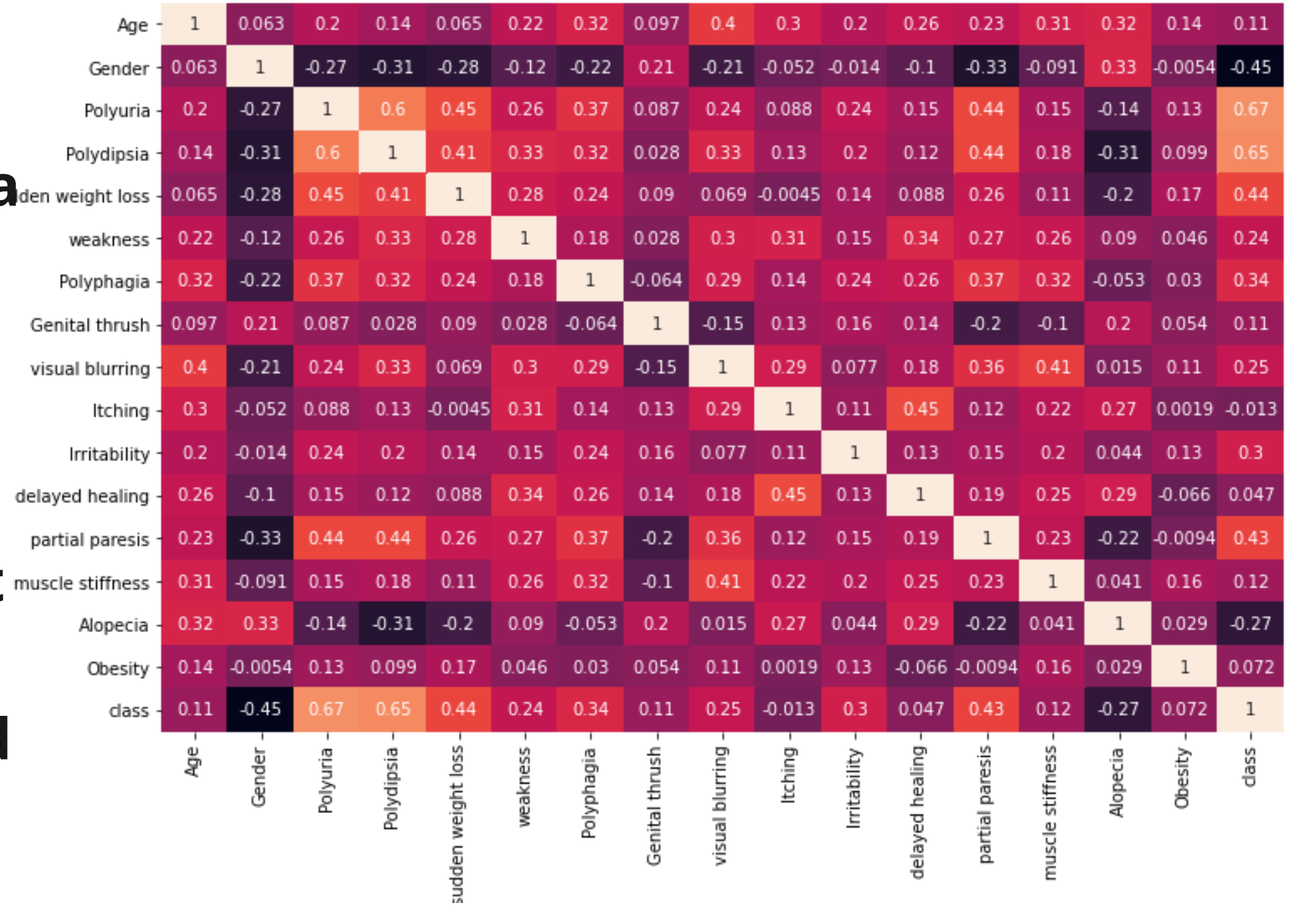
- Disadvantages
  - Environmental risks
  - Privacy risks
  - Social and political risks
- Other Issues
  - When and how to regulate or not regulate the technological development?
  - How to address inevitable ethical challenges?

01

DataSet

- **The data is compiled by National Institute of Diabetes and Digestive and Kidney Diseases and will also collect data from our respondendants.**

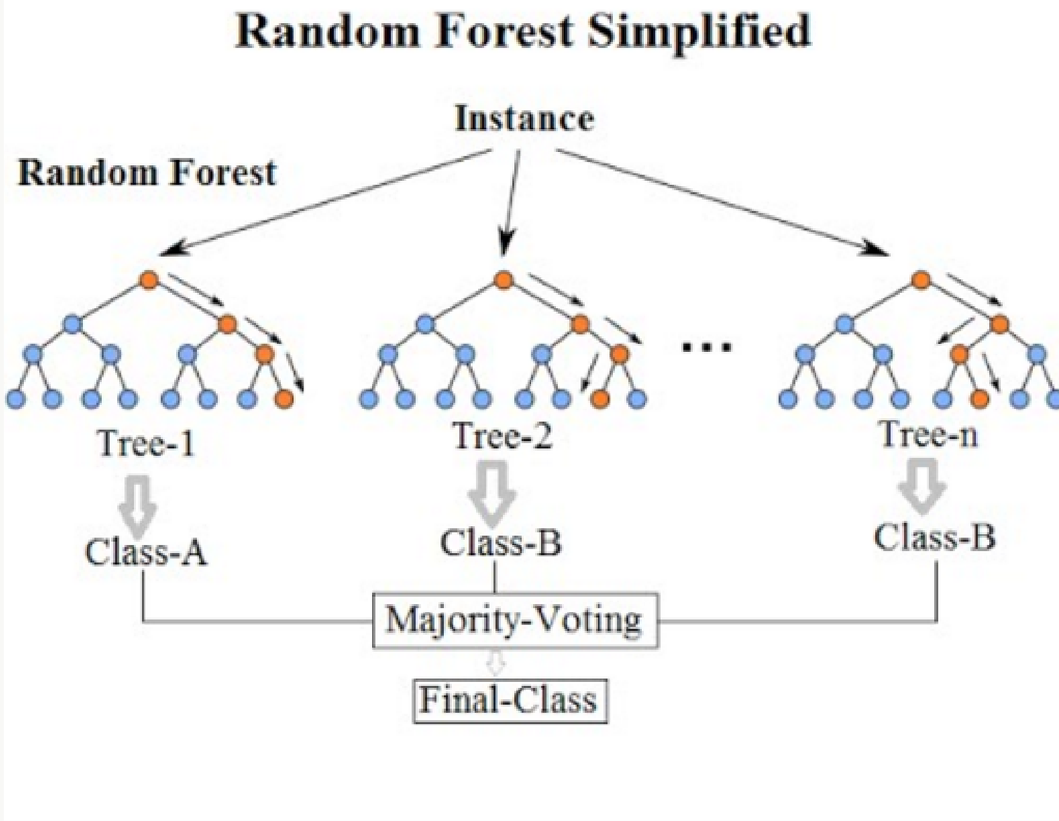
- **This dataset contains measurements relating to Age, gender, Polyuria, Polydipsis, genital thrust ,sudden weight loss, weakness, visual blurring loss ,muscle stiffness ,obesity, Glucose, Blood Pressure, Skin Thickness, Insulin, etc .**



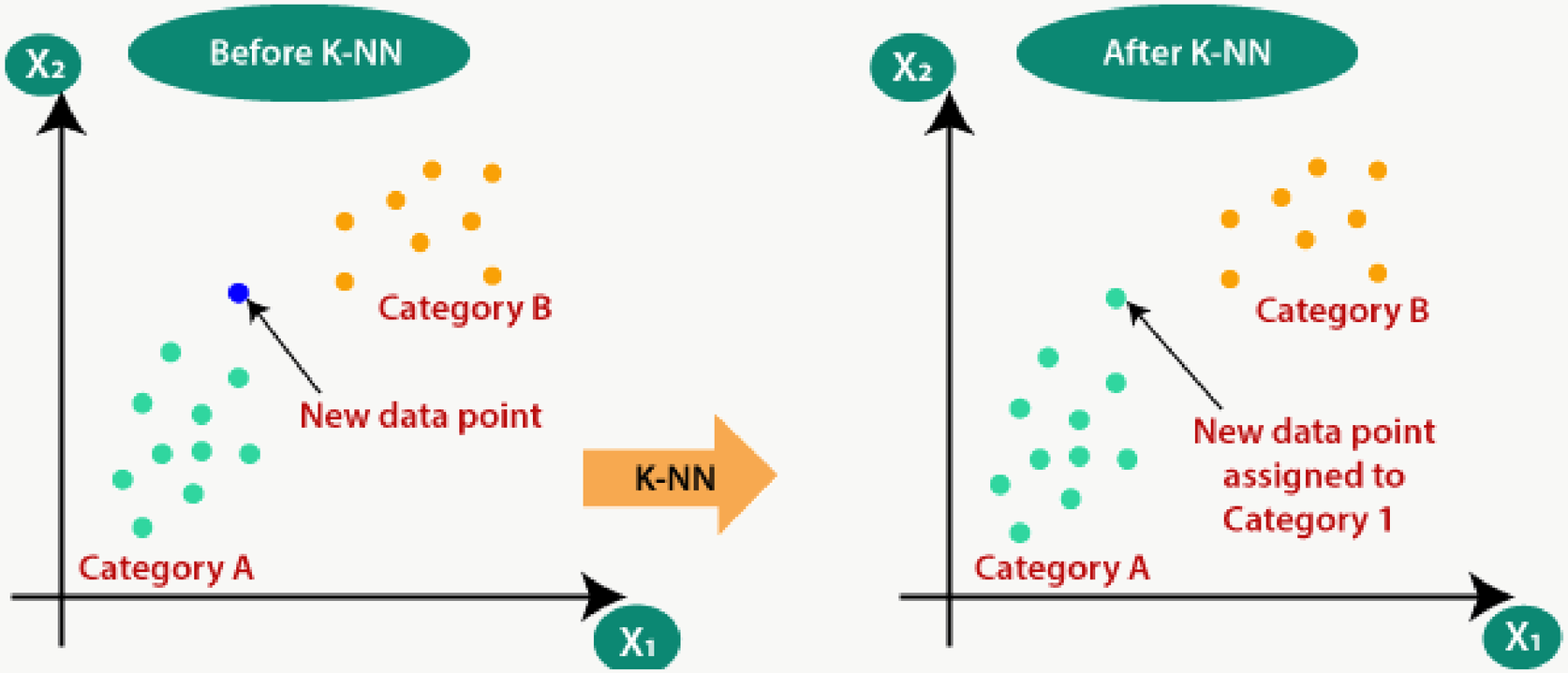
02

ML ideas

- Data Mining and machine learning algorithms like KNN, Random forest, and Naïve Bayes technique have been used for the prediction of Diabetes, where users provide input in terms of patient records for finding that either the patient has Diabetes or not. While applying more and better data, we collect better will be the efficiency of our algorithms in diabetes prediction.



ML ideas


Before K-NN
X2
Category B
New data point
Category A
X1
K-NN
After K-NN
X2
Category B
New data point
assigned to
Category 1
Category A
X1

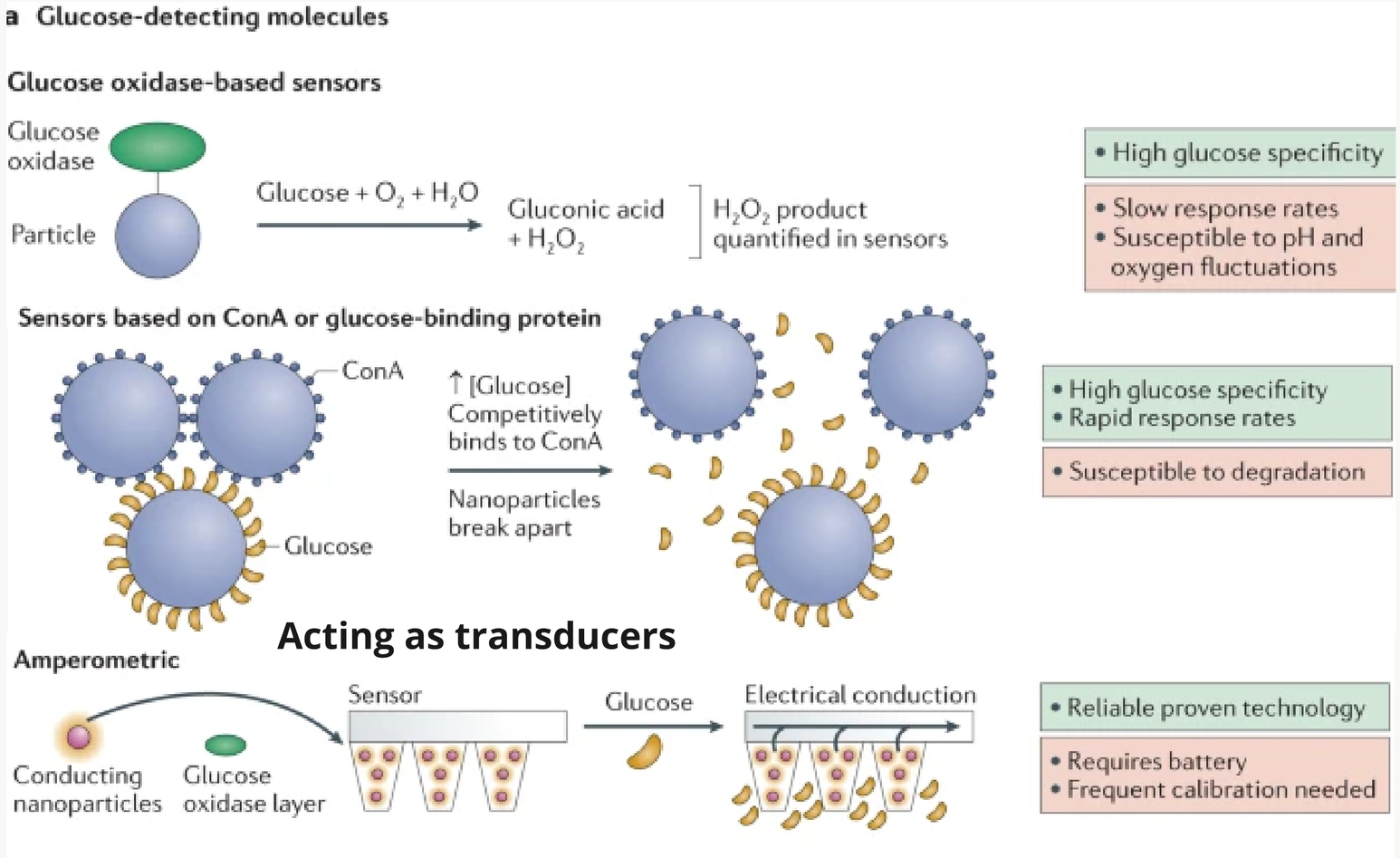
Nanotechnology-based glucose sensor technologies

03

- Sensing devices are constructed by assembling a detector that measures blood glucose concentrations and a transducer that converts measurements into output signals. There are three main classes of glucose-sensing molecules that are being used to engineer nanoparticle-based glucose sensors: glucose oxidase, glucose-binding proteins and glucose-binding small molecules.
- These glucose-detecting molecules can be coupled to nanoparticles engineered as transducers with unique optical or electrical properties like gold nanoparticles.
- potential to be more patient-friendly, provide rapid measurements and improve precision

Nanotechnology-based glucose sensor technologies

04



ML ideas

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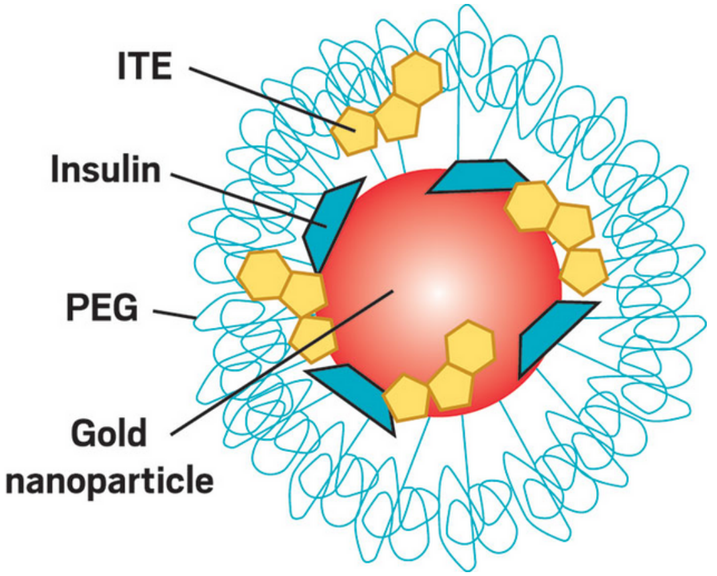
Gold Nanomaterials

05

Insulin-coated gold nanoparticles as a new concept for personalized and adjustable glucose regulation

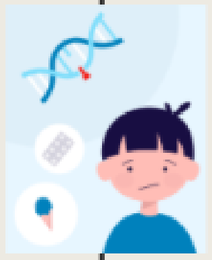
Administration of insulin-coated gold nanoparticles (INS-GNPs) showed that both intravenous and subcutaneous injection of INS-GNPs into a mouse model of type 1 diabetes decreases blood glucose levels for periods over 3 times longer than free insulin



PEG - polyethylene glycol)
ITE 2-(1´-H-indole-3´-carbonyl)-thiazole-4-carboxylic acid methyl ester

Overview

01



1 Type I Diabetes

Understanding Type I Diabetes, its prevalence, also about problems faced by patients, insulin administration challenges, efficacy of existing treatments, and research about diagnosis and treatment.

2 Early Stage Prediction

Early prediction of Diabetes with the help of datasets available & data collection. Understanding different factors and using ML algorithms to aid the same.

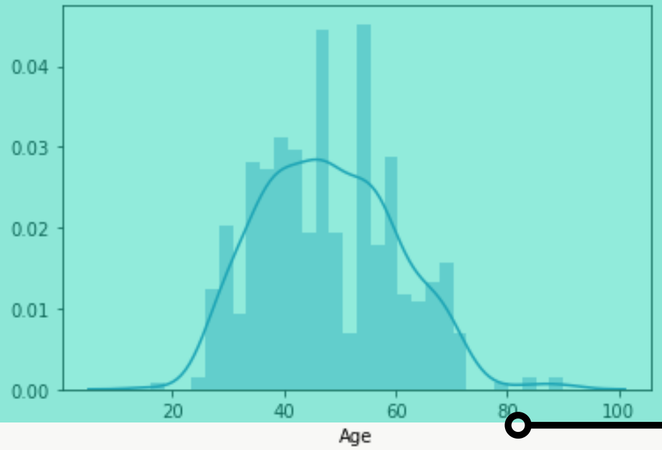
3 Gold Nanoparticles

Usage of gold nanoparticles in effective management of Diabetes, nanomaterial sensors that directly measure glucose as well as nanomaterials that improve glucose sensor function.

Database Development

4

Developing a database using the data collected by glucose sensors, insulin administered, patient records, respondents, paving a path for further enhancements in diagnosis and treatment of Type I diabetes.



EDA

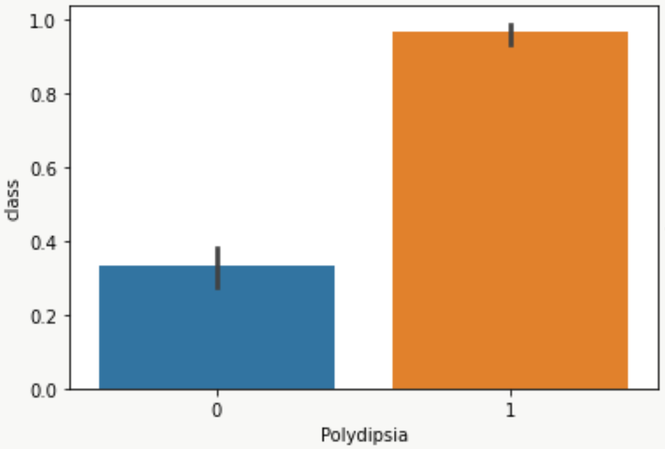
03

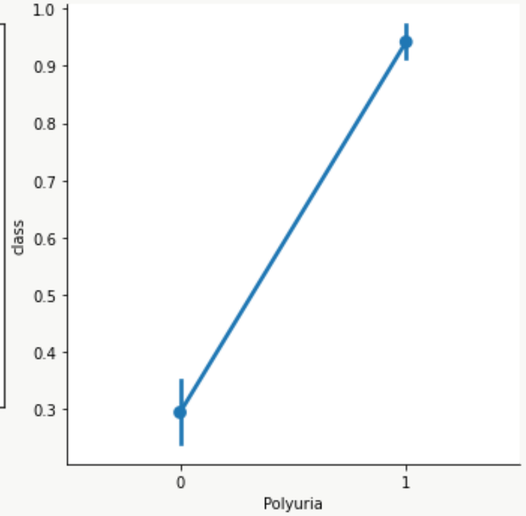
Relation between dependence of polydipsia and Diabets existence
Class 0- Absence
Class 1 - Presence

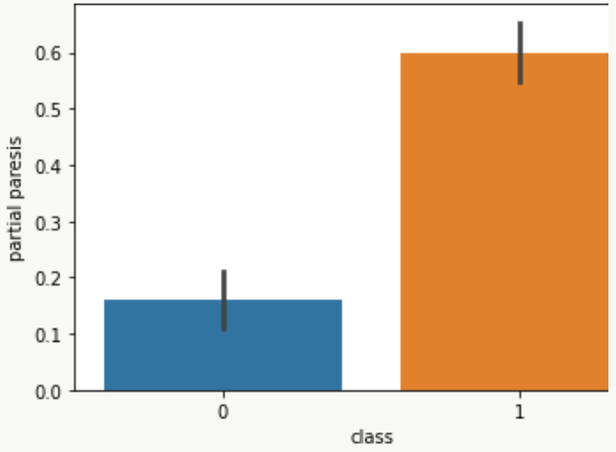
Realtion between dependence of polyuria and Diabets existence
Class 0- Absence
Class 1 - Presence

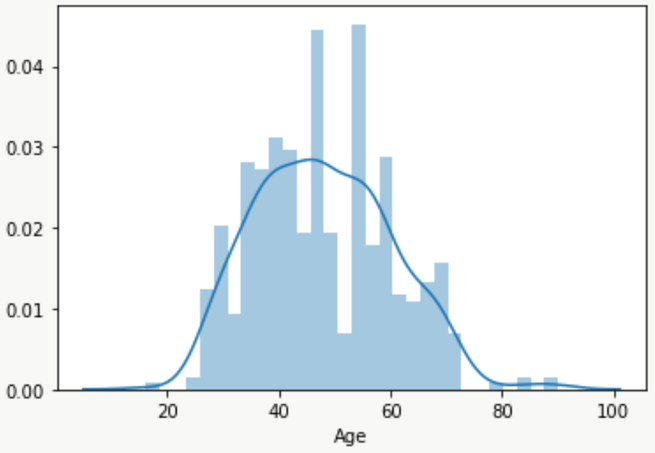
Relation of Partial Paresis for Diabetic and Non-Diabetic People.
Class 0- Absence
Class 1 - Presence

Age Plot of people with Diabtes. The plot is slightly positively skewed with mean around 50.









Why are experiments done on rats for human research?

01

Research by Baylor College of Medicine's Genome Sequencing Center & National Human Genome Research Institute

- genetic, biological and behavior characteristics closely resemble those of humans
- Many symptoms of human conditions can be replicated through rats
- experimental investigations in albino rats and estimated, in general, while considering their entire life span, that a human month resembles every-day life of a laboratory rat.
- the rat genome contains about the same number of genes as the human
- Furthermore, almost all human genes known to be associated with diseases have counterparts in the rat genome and appear highly conserved through mammalian evolution, confirming that the rat is an excellent model for human research.

THE ROLE OF RATS IN BIOMEDICAL RESEARCH

7 FACTS

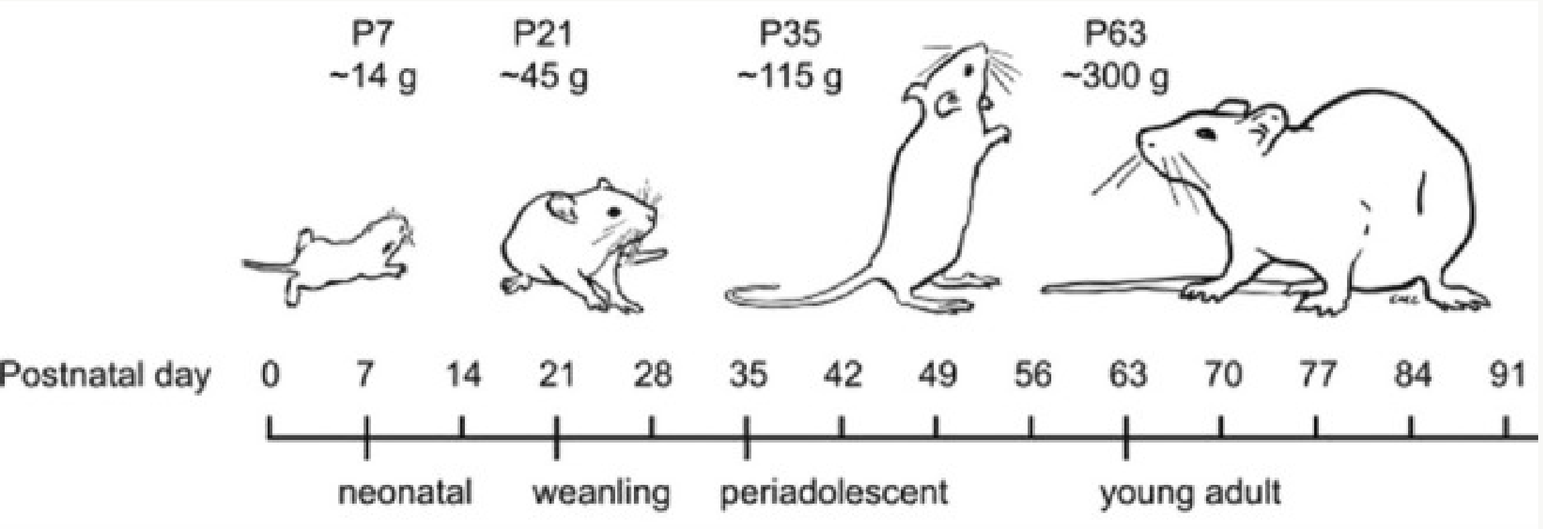
02

1. Rats were used in research for the first time more than 200 years ago to understand human physiology and medicine
2. Rats have been invaluable to cardiovascular medicine, neural regeneration, wound healing, diabetes, and transplantation
3. 30 Nobel Prizes were based on research with rats
4. The brown Norway rat genome was sequenced in April 2004
5. Almost all disease-linked human genes have genetic similarities in the rat
6. Rats were the first mammalian species specifically domesticated to be used in the laboratory
7. Rats share 90% of their genome with humans. Almost all disease-linked human genes we currently know of have equivalent genes within the rat genome

Common physiological data	
Body temperature	37°C
Respiratory rate	75-115 breaths/min
Heart rate	260-400 beats/min
Daily water consumption	10-12 ml/100 g body weight
Daily food consumption	10 g/100 g body weight
Litter size	6-12
Birth weight	5 g
Weaning age	21 days
Sexual maturity	7 weeks (~P49)
Breeding duration	12-16 months
Male adult weight	450-550 g
Female adult weight	250-300 g
Life span	2.5-3.5 years

Rat age and human age: Revealing the relation

03



Correlating human year with rat days with different phases of life		
Entire life span	13.2 rat days	=1 human year
Weaning period	42.4 rat days	
Pre-pubertal period	3.3 rat days	
Adolescent period	10.5 rat days	
Adulthood	11.8 rat days	
Aged phase	17.1 rat days	
Average	16.4 rat days	

Rat age versus human age: Social maturity phase

Rat age (years)	Human age (years)
6 months (0.5)	18
12 months (1.0)	30
18 months (1.5)	45
24 months (2.0)	60
30 months (2.5)	75
36 months (3.0)	90
42 months (3.5)	105

Nanotechnology In Medicine

04

- Gold was used at Northwestern University use to make “nanostars”, star-shaped nanoparticles that can deliver drugs directly to the nuclei of cancer cells.
- In a recent paper, ACS Nano (American Chemical Society) have described how drug-loaded nanostars behave like tiny hitchhikers,
- that after being attracted to an over-expressed protein on the surface of human cervical and ovarian cancer cells, deposit their payload right into the nuclei of those cells.
- shape of a star helped in releasing the drugs precisely. The shape helps to concentrate the light pulses used to release the drugs precisely at the points of the star.
- The first generation of cancer drugs delivered via nanoparticles, for example, has already been approved by the US Food and Drug Administration (FDA).
- Scientists at Stanford University in the United States have used nanotechnology to devise a highly specific method of killing cancerous cells. They inserted carbon nanotubes into cancer cells and then exposed the tissue to near-infrared laser light, heating up the nanotubes and killing the cancer cells while leaving the healthy cells intact.
- The Central Scientific Instruments Organization of India has designed a nanotechnology-based TB diagnostic kit, currently undergoing clinical trials

An In Vivo Study in a Diabetic Animal Model

05

- Proteins undergo glycation resulting in the generation of advanced glycation end products.
- (AGEs) leads to onset and advancement of diabetes-associated secondary complications. Aminoguanidine (AG) acts as an antiglycating agent by inhibiting AGE generation.
- Research is aimed at glycation inhibition by conjugating gold nanoparticles (GnPs).
- The male Wistar rats (200–220 gm) were purchased from the Central Drug Research Institute, Lucknow, India.
- Type 1 diabetes in Wistar rats was induced by giving an intraperitoneal single dose of alloxan (100 mg/kg) after 24 hr. of fasting.
- The induction of hyperglycemia was confirmed one week after treatment. Rats with a blood glucose level of ≥11 mmol/L were considered diabetic.
- AG (10 mM/kg body weight) was used as control and administered intraperitoneally for 2 weeks on daily basis. The concentration of AG-GnPs was 0.5 mmol/L and 1.0 mmol/L per kg body weight.

Diabetic Animal Model Results :-

06

Department of Clinical Laboratory Sciences, College of Applied Medical Sciences, University of Hail, Saudi Arabia & Department of Biosciences, Integral University, Lucknow, India

Group	Glucose (mmol L^{-1})	Triglycerides (mmol L^{-1})	Insulin (mmol L^{-1})
Control	3.67 ± 0.26	1.48 ± 0.23	9.87 ± 0.76
Diabetic	16.8 ± 1.13	13.56 ± 0.83	3.23 ± 0.42
Diabetic+AG (10 mM kg^{-1})	10.13 ± 0.48	7.64 ± 0.65	4.55 ± 0.29
Diabetic+AG-Gnp (0.5 mM kg^{-1})	8.67 ± 0.86	5.88 ± 0.53	5.32 ± 0.68
Diabetic+AG-Gnp (1.0 mM kg^{-1})	7.32 ± 0.76	4.51 ± 0.36	7.45 ± 0.47

- **In the alloxan-induced (damaged pancreatic β-cells, like in humans) type 1 diabetic model, a significant increase in insulin and reduction in glucose levels were reported after AG-GnPs administration, along with an improved lipid profile.**
- **Moreover, the results also implied AG-GnPs mediated protecting effect on pancreatic tissues and β-cell functioning.**

01

Origin Story

- The use of Gold Nanoparticle started when Faraday found the Colloidal Gold particles behave differently from bulk Gold.
- AuNPs have unique properties, such as size- and shape-dependent optical and electronic features, a high surface area to volume ratio, and surfaces that can be readily modified with ligands containing functional groups such as thiols, phosphines, and amines, which exhibit affinity for gold surfaces.
- Gold nanoparticles present an excellent tendency to accumulate in tumor sites.
- Gold nanoparticles can use different mechanisms of killing tumor cells, such as drug delivery systems for anticancer agents, mechanical damage, or photothermal ablation.

Gold Nanoparticles

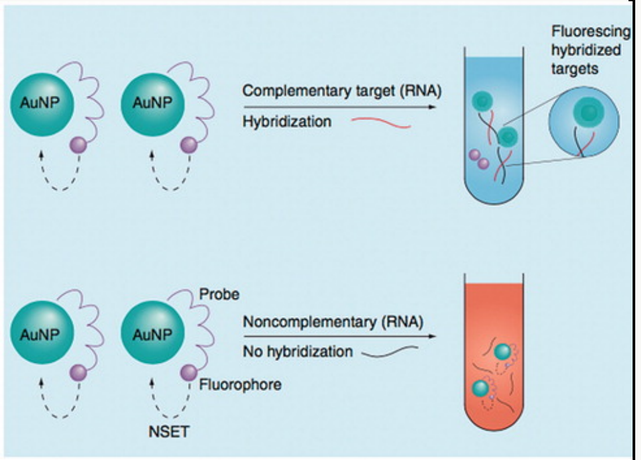
02

Disease	Experiments / Tests	Results	Features
• SARS-CoV-2 virus (COVID-19)	• lateral flow immunoassay strip (LFIAs) - SARS-CoV-2 nucleocapsid protein and coupling anti-human IgG with gold nanoparticles	• LFIAs provide a preliminary test result to make the correct diagnosis of SARS-CoV-2, especially in low-resource countries.	• used in detection • high false negative rates were reported hence it was developed.
• Alzheimer's Disease Amyloid aggregation is a hallmark of several degenerative diseases affecting the brain	• immobilization of specific antibody fragments on gold nanoparticles	• detection using scanning tunneling microscope (STM). • prevents several degenerative diseases affecting the brain.	• used in detection
	• Gold nanoparticles in weak microwave fields dissolve amyloid aggregates and prevents from further aggregations.	• serves as transport vehicles for drugs across the BBB (Blood Brain Boundary) and delivers them to the amyloid ridden tissue.	• to increase the efficacy of therapeutic drugs

Gold Nanoparticles

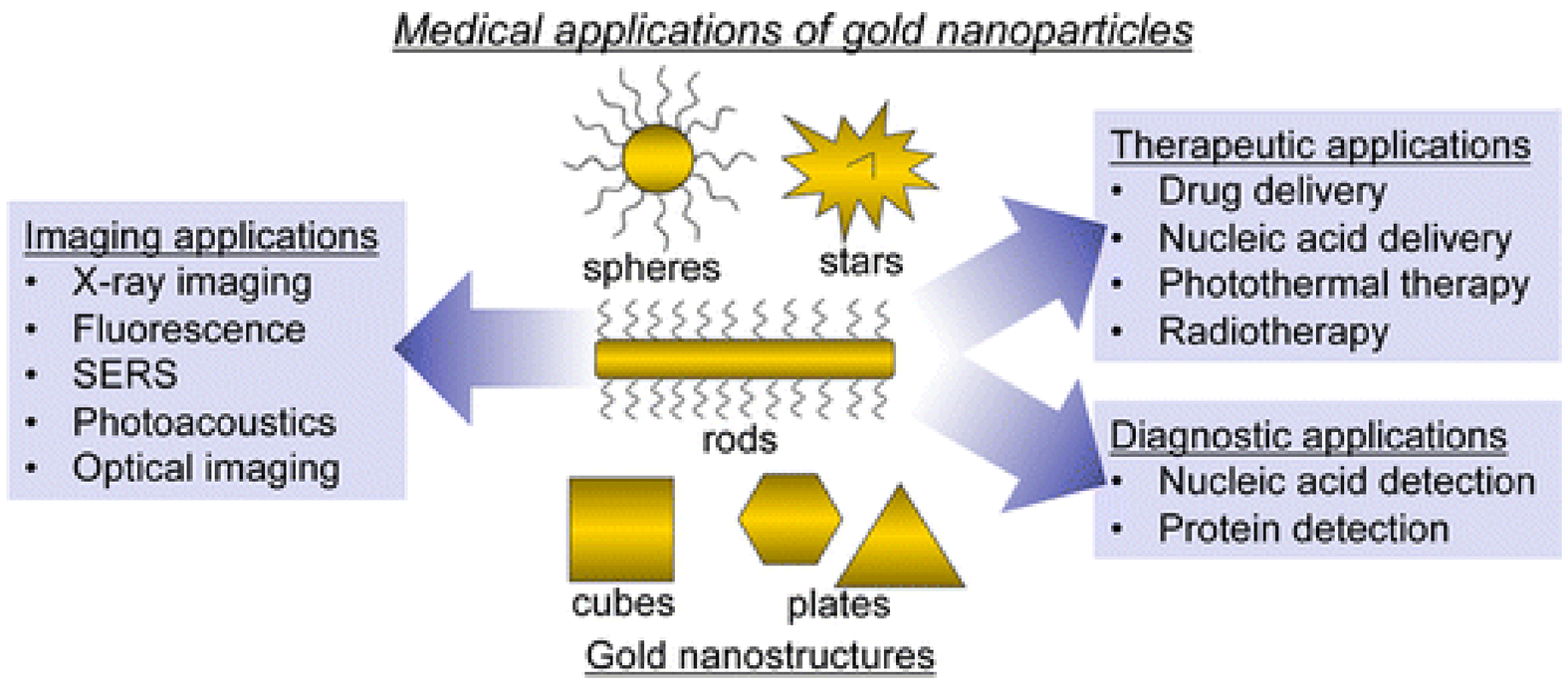
Disease	Experiments / Tests	Results	Features
• Human Breast Cancer Human Clinical trials Done!	• When an energy source producing non-ionizing electromagnetic radiation is applied, conversion to heat energy occurs in gold nanoparticles owing to electron excitation and relaxation.	• Hyperthermia • induces cell death • has been shown to increase local control and overall survival.	• gold nanoshells • efficient enough to convert absorbed radiations into heat
• Tumors of the Head and Neck • Prostrate Cancer	• Through plasmon resonance, • gold nanoparticles can induce hyperthermia with NIR laser.	• induces destruction of cancer cells with lethal levels of heat,	• gold metal shell and a non-conducting silica core
• Prostrate Cancer	• Prostate cancer cells have high levels of (PSMA). • Aptamer–Gold Conjugate binds to PSMA	• PSMA is a protein in prostate cells - cancer's development. • Imaging of cancer cells done using X-Ray CT.	• gold nanospheres • used in detection

Gold Nanoparticles

Disease	Experiments / Tests	Results	Features
• hepatitis C virus (HCV RNA)	• purpose of HCV RNA sensing and detection • RNA probe is with fluorophores • absorbed onto AuNPs • the probe binds to the targeted RNA, • then dsRNA complex is released into the solution	• resultant solution undergo a color change from red to blue due to aggregation of AuNPs. • fluorescence intensity is directly proportional to the concentration of the target HCV RNA	
• Pregnancy Tests	• Biosynthesized gold nanoparticles were used to qualitatively determine the hCG hormone in pregnancy women urine sample. • hCG above 25 mIU/mL - positive	• The mixture of gold nanoparticles in the urine sample • changed color into pink that confirmed pregnancy. • Otherwise it turned into gray.	• 100% accurate in diagnosis of pregnancy • used in detection • good alternative method for urine pregnancy test

Gold Nanoparticles

Summary



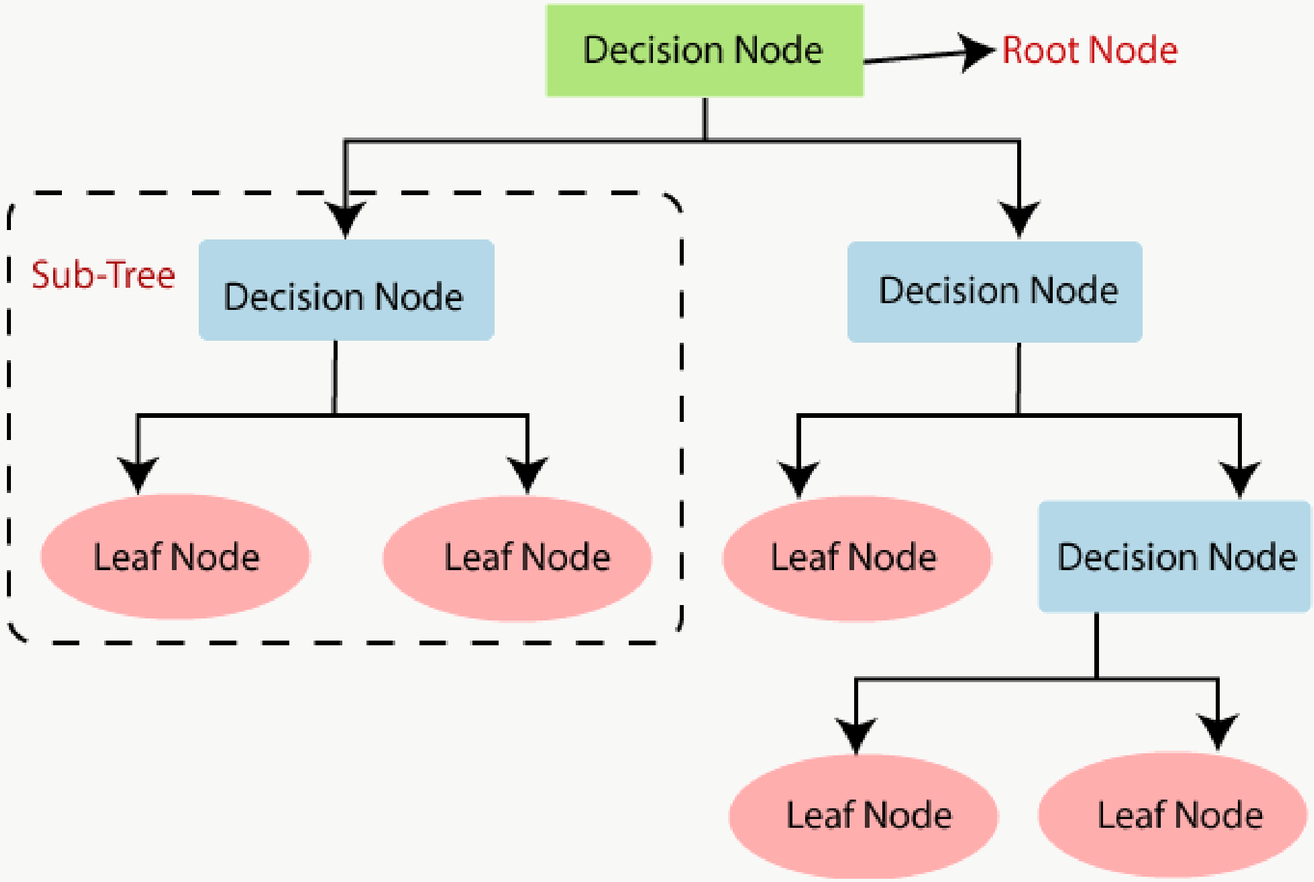
MACHINE LEARNING MODELS

Early Prediction of Diabetes

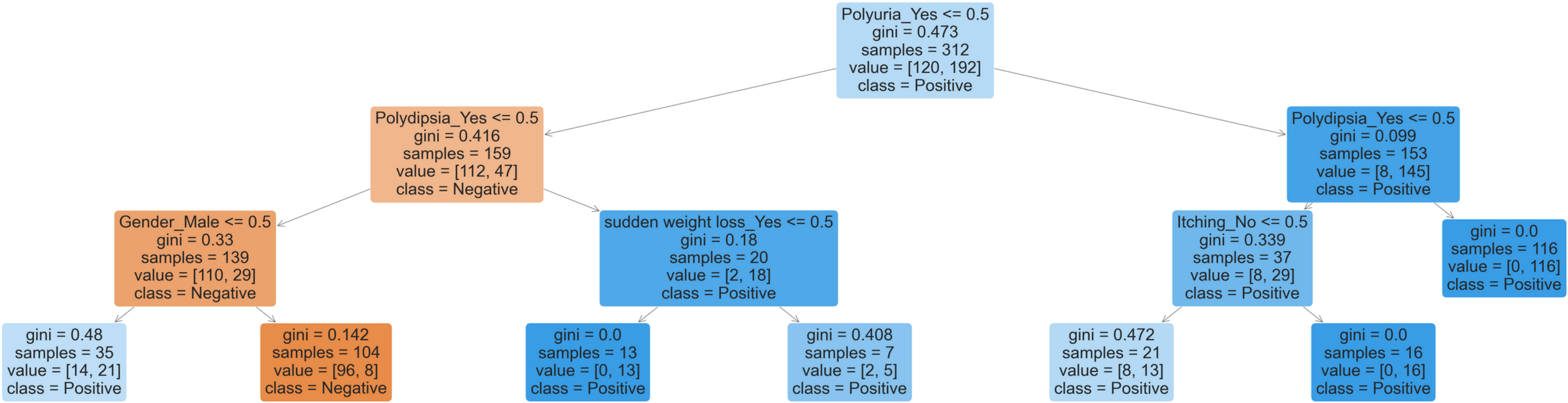
• Algorithm Types	• Accuracy of Test Set
• Decision Tree	91 % Accuracy
• Naïve Bayes	88 % Accuracy
• Random Forest Tree	96 % Accuracy

Decision Tree

- **The decision tree is a supervised ML Model in which the data points are classified based on a certain parameter.**



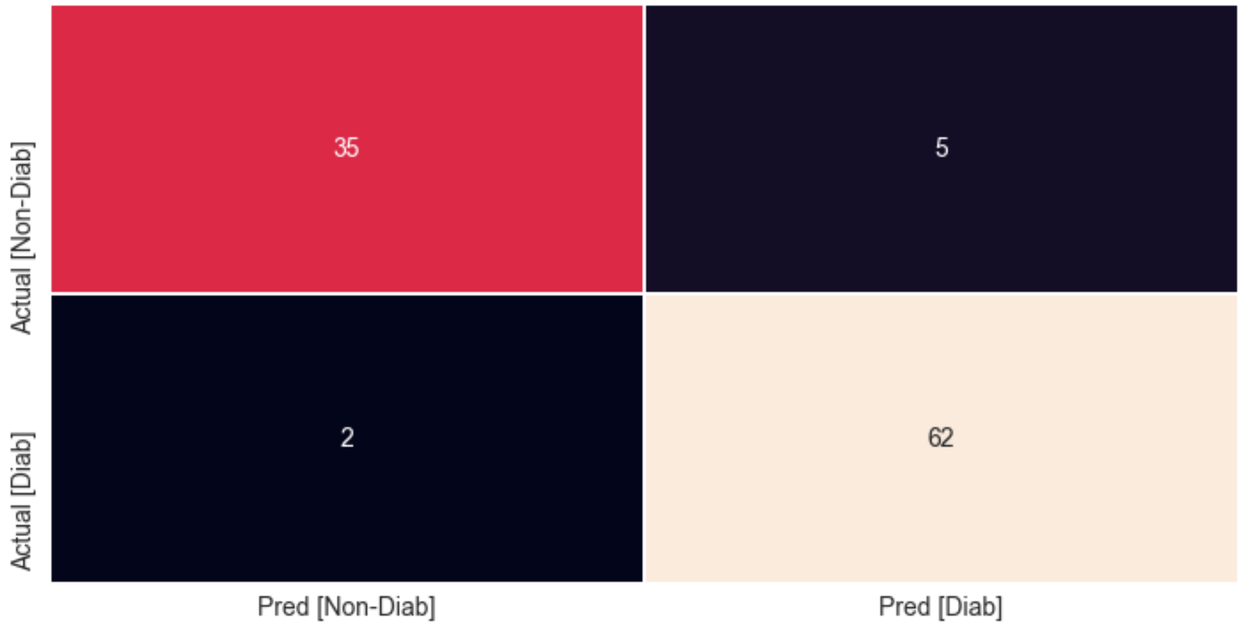
Decision Tree - Predicted Model



Confusion matrix

Decision Tree

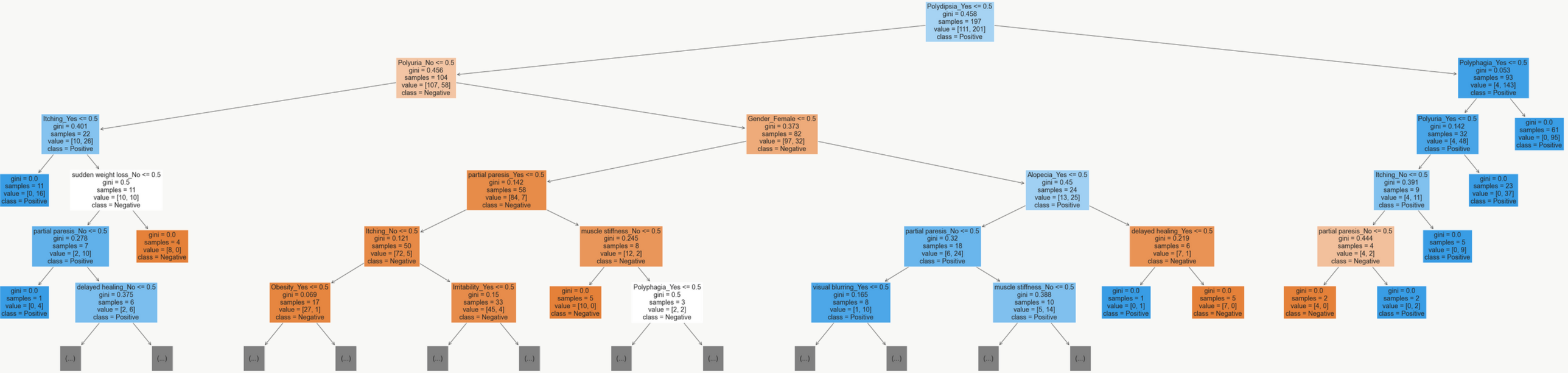
- A confusion matrix is a table that is often used to describe the performance of a classification model (or "classifier").
- The Confusion Matrix presents the prediction made by the Model.
- In a healthcare department-related model :
- False Negativity becomes the most important factor for analysis.



	Precision	Recall	f1 - score
Negative	0.95	0.88	0.91
Positive	0.93	0.97	0.95

Random Forest

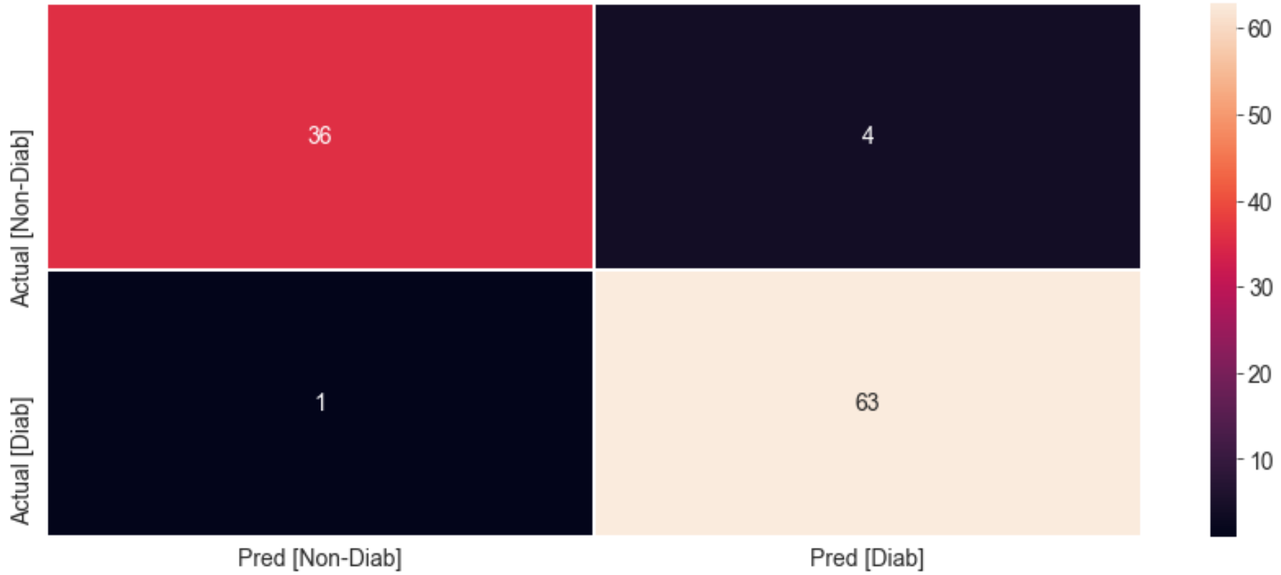
Random Forest is a classifier that contains several decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset.



Confusion Matrix

Random Forest

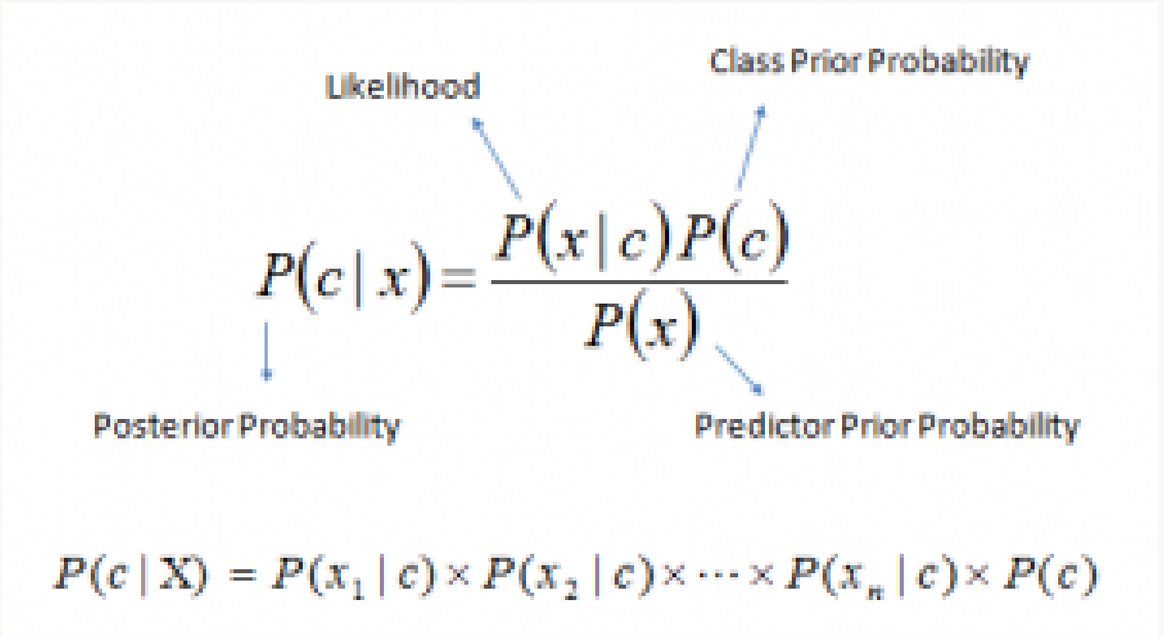
- **In the Random forest Model selected the False Negativity rate is very good compared to other models.**



	Precision	Recall	f1 - score
Negative	0.97	0.90	0.94
Positive	0.94	0.98	0.90

Naïve Bayes Classifier

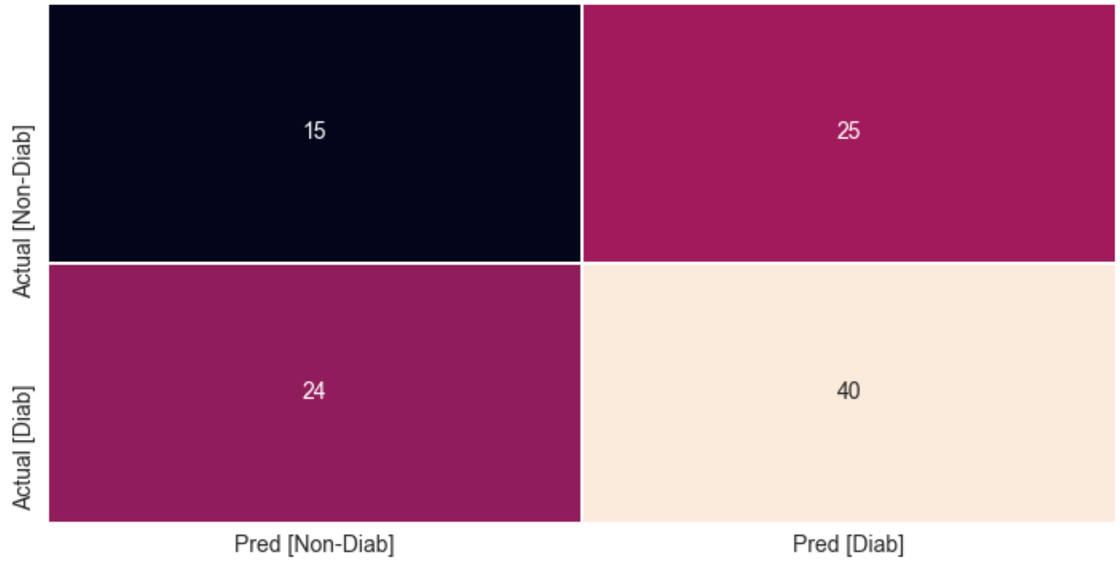
- **It is a classification technique based on Bayes' Theorem with an assumption of independence among predictors.**
- **In simple terms, a Naïve Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature.**



Confusion Matrix

Naïve Bayes

- Here the Confusion matrix of the Naive Bayes model is presented.
- The Comparison of this model with the Random forest model based on even False Negativity shows a clear upper hand.



	Precision	Recall	f1 - score
Negative	0.38	0.38	0.38
Positive	0.62	0.62	0.62

Objectives of the Project

01

Diabetes & Gold Nanoparticles

To :-

- understand about diabetes (Type I) and its complications
- explore the field of nanotechnology in medicine
- understand about gold nanoparticles and their applications in biology and medicine.
- predict diabetes at an early stage to pave a path for better treatments
- learn and employ Machine Learning Algorithms for early prediction.
- use gold nanoparticles for detection and treatment of diabetes (Type I)
- optimize the diabetes management system
- develop a database for further enhancements in diagnosis and treatment of diabetes.

Addressing Objectives

Diabetes & Gold Nanoparticles

02

Stage - I (In-depth understanding of Diabetes and gold nanoparticles)

- from valuable experiences of researchers
- interviews with PhD scholars
- Extensive literature review of studies and clinical observations

Stage - II (Early Prediction of Diabetes)

- By selecting relevant major risk factors & variables (gender, Polyuria, Polydipsia, visual blurring loss, muscle stiffness, obesity, irritability, paresis, itching, alopecia) from the datasets (National Institute of Diabetes and Digestive and Kidney Diseases)
- Machine learning algorithms & models like decision tress, Random forest, and Naïve Bayes technique were employed and then the accuracy values were compared.

Addressing Objectives

Diabetes & Gold Nanoparticles

03

Stage - III (Utilizing Gold nanoparticles)

- for nanotechnology based glucose sensors (glucose detecting molecules)
- measured as a voltammetric or fluorescent output.
- for insulin delivery (glucose-responsive insulin-releasing system)
- to minimize diabetes complications (frequency of injections) and reduce the risks of fatal diseases.

Stage - IV (Database Development)

- Depended on the data provided by the glucose sensors
- Glucose levels, AuNP administered and
- others factors like age, gender, race, region.

Evolution of Ideas

Diabetes & Gold Nanoparticles

04

Stage - I (In-depth understanding of Diabetes and gold nanoparticles)

- Is Diabetes Becoming the Biggest Epidemic of the Twenty-first Century?
- increased understanding by literature review of research articles and
- from experience of PhD scholars and researcher

Stage - II (Early Prediction of Diabetes)

- Initially, we planned to use Decision Tree model
- respondents suggested to compare several models and find the best one
- Compared decision tress, Random forest, and Naïve Bayes technique and
- came to final conclusion that Random Tree model was the most accurate.

Evolution of Ideas

Diabetes & Gold Nanoparticles

05

Stage - III (Utilizing Gold nanoparticles)

- started with glucose oxidase-based (enzymatic) approach but
- shortcomings - can have considerable batch-to-batch variability in activity,
- It also requires a constant oxygen level, pH and temperature, as well as frequent recalibration for a reliable readout.
- To overcome inconsistent enzyme activity we switched to non-enzymatic nanosensors - no battery, improved precision and no coagulation.
- using gold nanoparticles clusters (high drug loading capacity)

Stage - IV (Database Development)

- Database contained only glucose and gold nanoparticle levels,
- later we added several other major factors that influence the process - (clinical obs.)

Is the Idea New ?

Diabetes & Gold Nanoparticles

06

- Yes,

- integrating Artificial Intelligence for efficient early prediction of Diabetes
- using several ML algorithms for accuracy comparison
- highly accurate model - 96% accuracy
- non-enzymatic approach - sensor to provide a fluorescent or voltammetric readout using gold nanoparticles (detection)
- utilizing gold nanoclusters for insulin administration
- (nanoclusters are collections of nanoparticles)
- database development - paving a path for future research

Database Devloment

Diabetes & Gold Nanoparticles

07

- **The Result presented is of an individual Case instance as per the database generated.**
- **Apart from the Data transmitted, Fluorescence results, age, region etc., can give an idea about the influence of AuNP. These also provide validation on any toxicity possible by the particle.**

AuNP Administration results

Age: 41

Gender: Male

Diabetic : Yes

Amount Of AuNP Administered: 20 mg

Glucose Level over Period of 120 mins: -, 150, 135, 120, 110, 100

Introduction to the Solution

Diabetes & Gold Nanoparticles

Part - I (Early Prediction of Diabetes)

- By selecting relevant major risk factors & variables (gender, Polyuria, Polydipsia, visual blurring loss, muscle stiffness, obesity, irritability, paresis, itching, alopecia) from the datasets.
- Machine learning algorithms & models like decision tress, Random forest, and Naïve Bayes technique were employed and then the Random Forest model was used.

Part - II (Utilizing Gold nanoparticles)

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- measured as a voltammetric or fluorescent output.
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Addressing Objectives

Diabetes & Gold Nanoparticles

03

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