Artificial Intelligence
in Anaesthesia
← Current Trends & Future Prospects →

Tushar

2020

2030

Anesthetist

Robot Anesthetist

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Vadodara

LECTURE
Outlines

- **Audience Poll**
- **Introduction and Definition of AI**
- **History and Evolution of AI**
- **Stages and Types of AI**
- **How AI works and Uses of AI**
- **History of AI in Healthcare**
- **History of AI in Anesthesiology**
- **Current status of AI in Anesthesiology**
- **Future of AI in Anesthesiology**
- **Will AI replace Anesthesiologist**
- **Journal Articles of AI in Anesthesia**
- **Conclusion**
- **Take home message**
- **My Verdict**
- **Cartoons & Thanks**

AUDIENCE POLL

- **Do you know you are already using AI in your practice ?**
- **How will AI affect or change clinical decision making in Anaesthesiology ?**
- **Will AI reduce errors in Anaesthesia practice ?**
- **Will you accept AI Anaesthesia practice in future ?**
- **Will AI replace Anaesthesiologist ?**

Which medical technologies and digital health innovations can expect the brightest future in the next decade of Anesthesiology ?

- Health Sensors and Telehealth
- Mixed Reality
- Surgical and Medical Robots
- Brain Computer Interfaces
- Nanotechnology
- 5G
- Direct to Consumer Genetic Testing
- 3D Printing
- Artificial Intelligence
- Quantum Computing
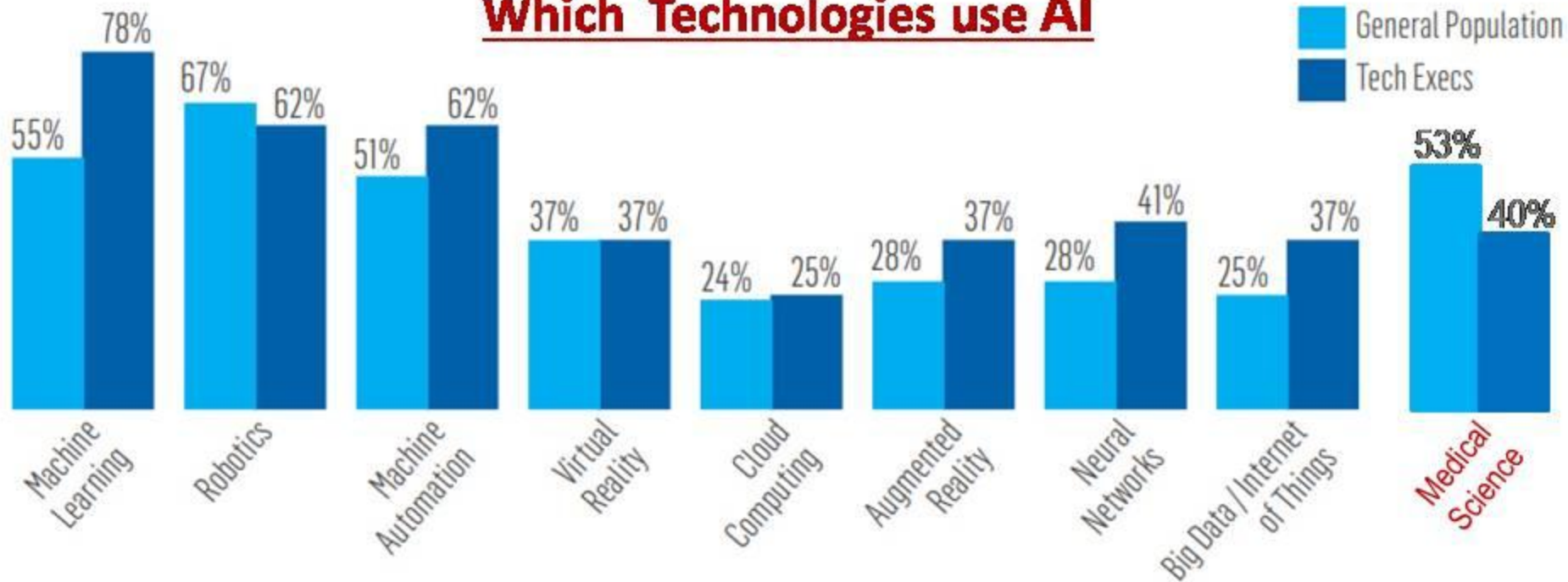
What is Artificial Intelligence?

Artificial intelligence is the capability of computers to respond in a manner resembling human intelligence

Dictionary Definition

AI can also be defined as:

Artificial Intelligence is the development of computer systems that are capable of performing tasks that normally require human intelligence, such as decision making, object detection, solving complex problems and so on.

Which Technologies use AI

General Population
Tech Execs

Machine Learning: 55% / 78%
Robotics: 67% / 62%
Machine Automation: 51% / 62%
Virtual Reality: 37% / 37%
Cloud Computing: 24% / 25%
Augmented Reality: 28% / 37%
Neural Networks: 28% / 41%
Big Data / Internet of Things: 25% / 37%
Medical Science: 53% / 40%

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AI is like Electricity

Without electricity we can't think this world Today
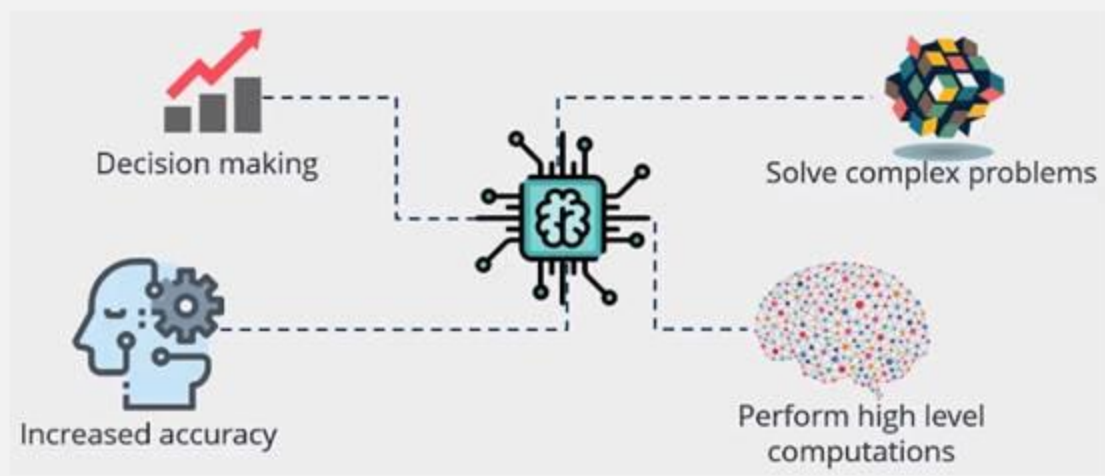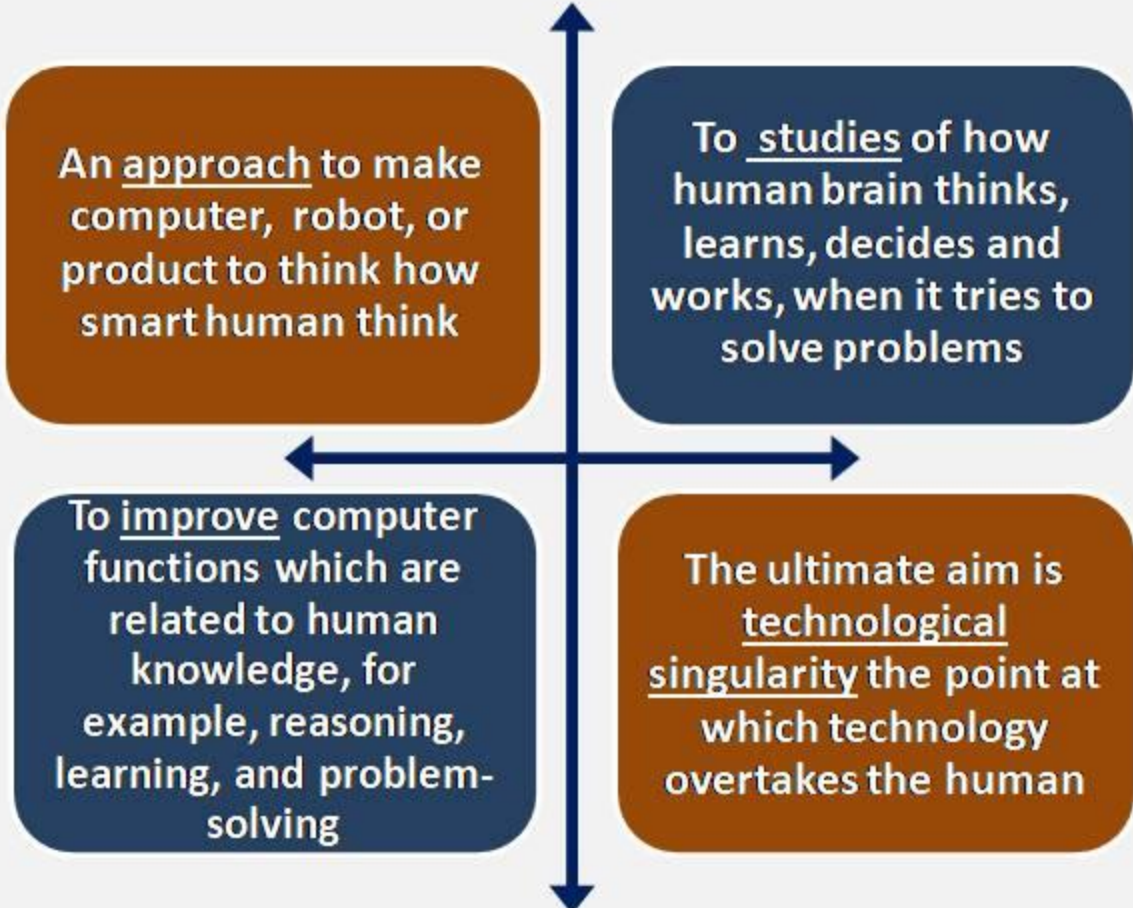**Like this**
Without AI we won't think this world in Future

Fathers of AI

Marvin Minsky ← → John McCarthy

In the 1956 they described
Artificial Intelligence
and gave the definition

AIM of A.I.

Decision making

Increased accuracy

Solve complex problems

Perform high level computations

An **approach** to make computer, robot, or product to think how smart human think

To **studies** of how human brain thinks, learns, decides and works, when it tries to solve problems

To **improve** computer functions which are related to human knowledge, for example, reasoning, learning, and problem-solving

The ultimate aim is **technological singularity** the point at which technology overtakes the human

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Terminology in AI

AI
1956

DS
Data Science
is a multi-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge (It applies all mathematical rules)

ML
1959

DL
1965

Artificial Intelligence (AI), (John McCarthy) Tashar

Is the capability of computers to respond in a manner resembling human intelligence (Machine to thinks without any human intervention) examples are Drones, Self driving cars, Search engines like Google and Medical diagnosis with procedures e.g. Robots in medicine

Machine Learning (ML), (Arthur Samuel)

Is a subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed (Provides statistical tools to explore data, so here machine learns automatically from past data without any confusion of any programme)

Deep Learning (DL), (Alexey Ivakhnenko)

Is a subset of machine learning where artificial neural networks, algorithms inspired by the human brain, learn from large amounts of data (Human brain thinking, also called as Deep Neural Network or Deep Neural Learning)
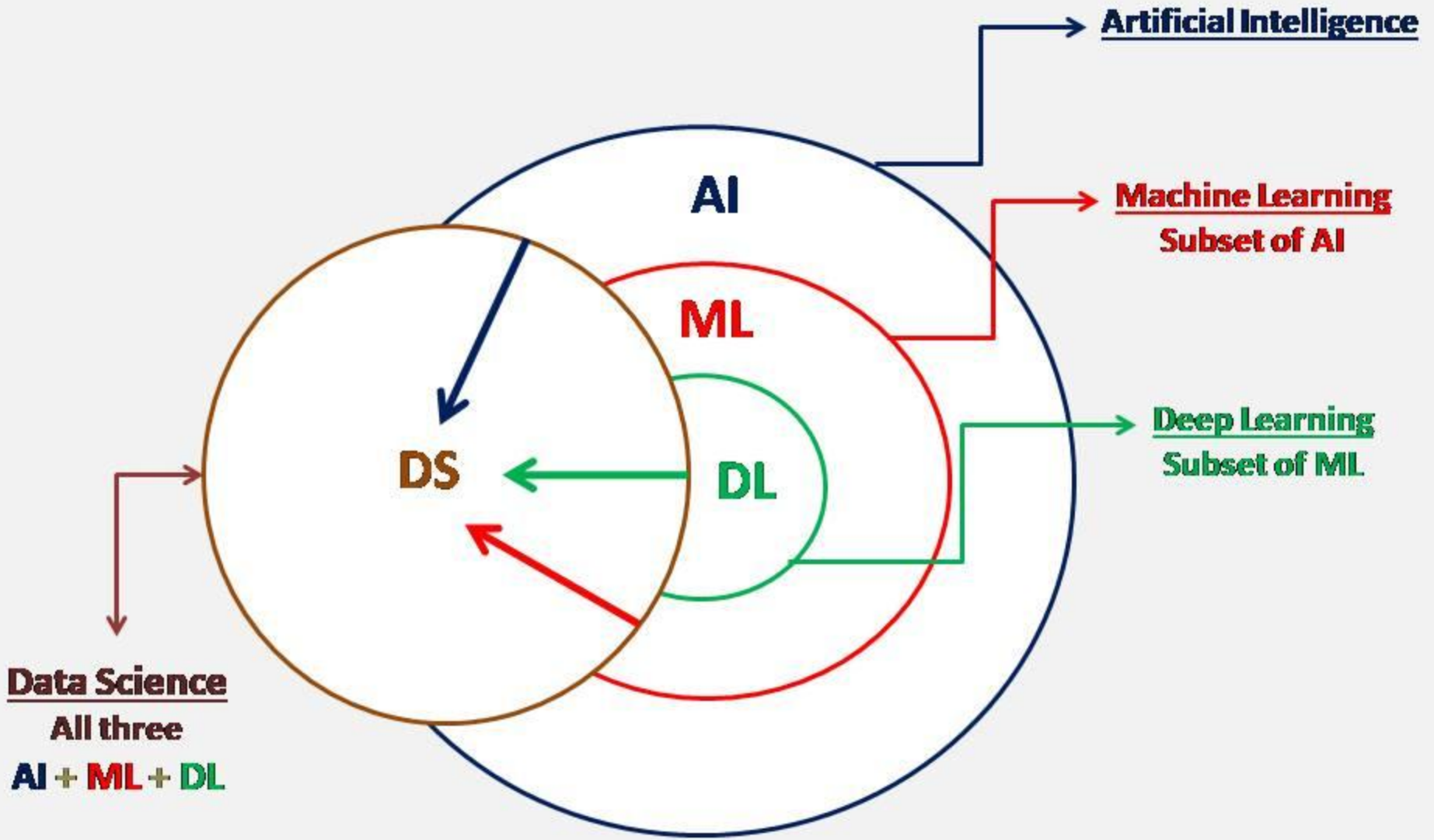
Basic Structure of Complete Artificial Intelligence

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H of AI
HISTORY

AI from 380 BC to 1900

Various mathematicians, theologians, philosophers, professors, and authors mused about mechanical techniques, calculating machines, and numeral systems

AI from 1900-1950

People took the "robot" idea and implemented it into their research, art, and discoveries and in 1929 the first robot was built in Japan

AI in the 1970s

gave way to accelerated advancements, particularly focusing on robots and automatons. WABOT-1, the first anthropomorphic robot, was built in Japan at Waseda University. Its features included moveable limbs, ability to see, and ability to converse

AI in the 1960s

Innovation in the field of artificial intelligence grew rapidly through the 1960s. Unimate, the first industrial robot was developed to work on a General Motors assembly

AI in the 1950s

Advances in the field of artificial intelligence came. Claude Shannon, "the father of information theory," published "Programming a Computer for Playing Chess. In 1956 John McCarthy gave the official birth of the word AI

AI in the 1980s

The rapid growth of artificial intelligence continued through the 1980s. Mercedes-Benz built and released a driverless van equipped with cameras and sensors

AI in the 1990s

The end of the millennium has helped artificial intelligence in its continued stages of advance growth. Deep Blue, a chess-playing computer developed by IBM became the first system to win a chess game and match against a reigning world champion Sony introduced AIBO (Artificial Intelligence RoBOt), a robotic pet dog

AI from 2000-2010

AI continued its trending upward. Professor Cynthia Breazeal developed Kismet, a robot that could recognize and simulate emotions with its face. Honda releases ASIMO, an artificially intelligent humanoid robot

AI 2010 to Present Day

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The current decade has been immensely important for AI innovation

In Smartphone having voice assistants and computers that have "intelligence" functions most are everything through advance AI

From 2010 onward, artificial intelligence has become embedded in our day-to-day existence

2010

Microsoft launched Kinect for Xbox 360, the first gaming device that tracked human body movement using a 3D camera and infrared detection

2011

Apple released Siri, a virtual assistant on Apple iOS operating systems. Siri uses a natural-language user interface to infer, observe, answer, and recommend things to its human user

2014

Microsoft released Cortana, their version of a virtual assistant similar to Siri on iOS

2015-2017

Google DeepMind's Alpha Go, a computer program that plays the board game *Go*, defeated various (human) champions

2015

Elon Musk, Stephen Hawking, and Steve Wozniak among 3,000 others started the development and use of autonomous weapons for wars

2014

Amazon created Amazon Alexa, a home assistant that developed into smart speakers that function as personal assistants

2016

Google released Google Home, a smart speaker that uses AI to act as a "personal assistant" to help users remember tasks, create appointments, and search for information by voice.

2017

The Face book Artificial Intelligence Research lab introduced chatbots to communicate with one another

2018

Samsung introduced Bixby, a virtual assistant. Bixby's functions include *Voice*, where the user can speak to and ask questions, recommendations, and suggestions

What to expect for AI in 2020 and beyond?

- Natural language processing (NLP)
- Machine Learning and Automated Machine Learning
- Autonomous vehicles
- Chatbot + Virtual assistants

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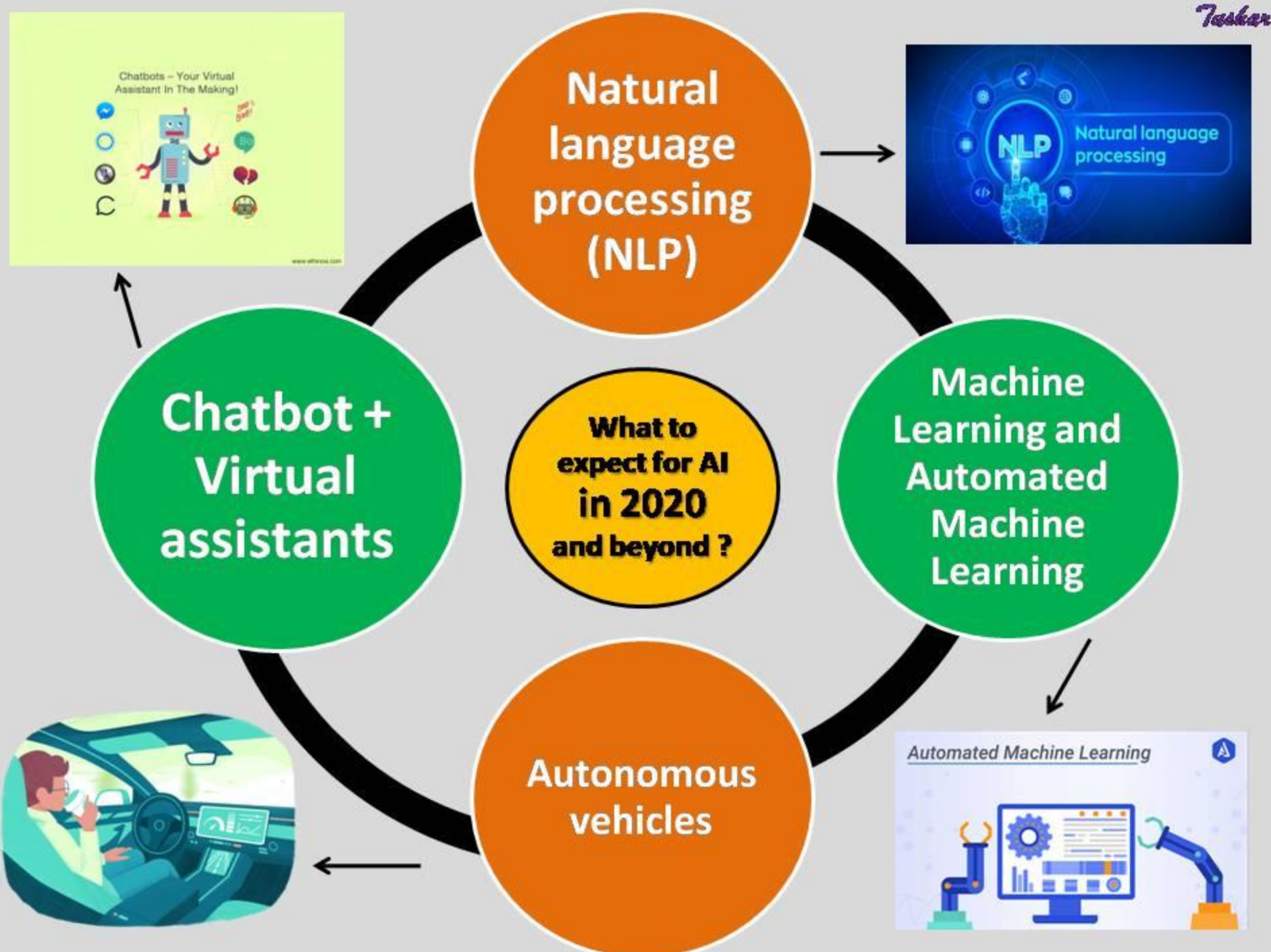
stages of AI

1) Artificial Narrow Intelligence (ANI)

Weak AI

- Machines has a narrow defined role of task
- e.g. SiRi, Alexa, Sophia, Self Driven Car

2) Artificial General Intelligence (AGI)

Strong AI

- Machine starts thinking just like humans
- Yet to create and developing all over world

3) Artificial Super Intelligence (ASI)

Super Strong AI

- Computers or Machines will surpass human beings
- Not exist and only seen in science fiction movies

Stage-3
Machine Consciousness

Stage-2
Machine Intelligence

Stage-1
Machine Learning
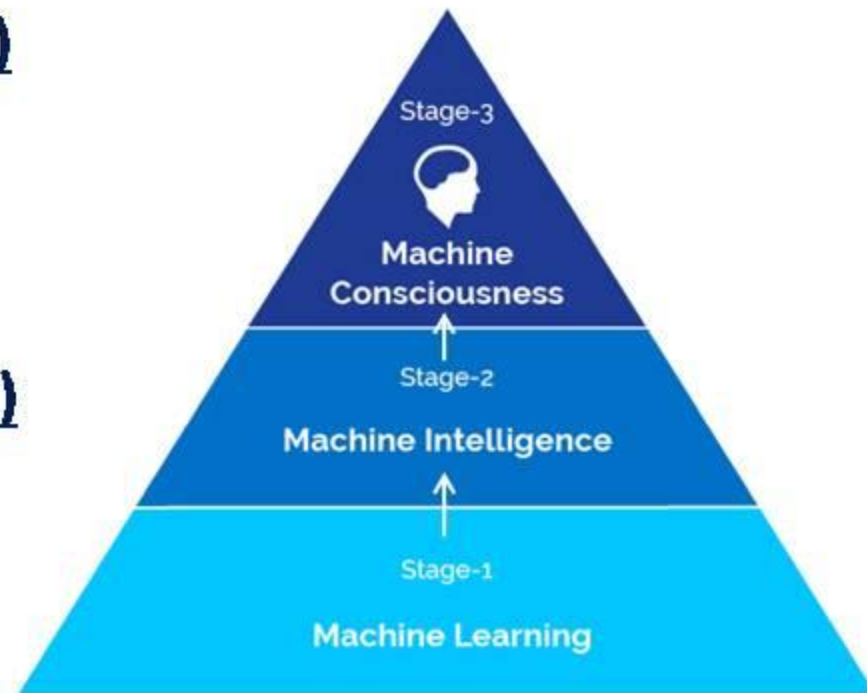
Reactive Machines AI

A basic type of AI system, they can only react to currently existing situations. e.g. <u>Deep Blue, a chess-playing supercomputer</u> created by IBM.

(So it works on preset data)

Self-Awareness AI

Involves machines that have human-level consciousness. This form of AI is not currently in existence, but would be considered the most advanced form of artificial intelligence known to man and (Pray to GOD it will not exist)

Four Types
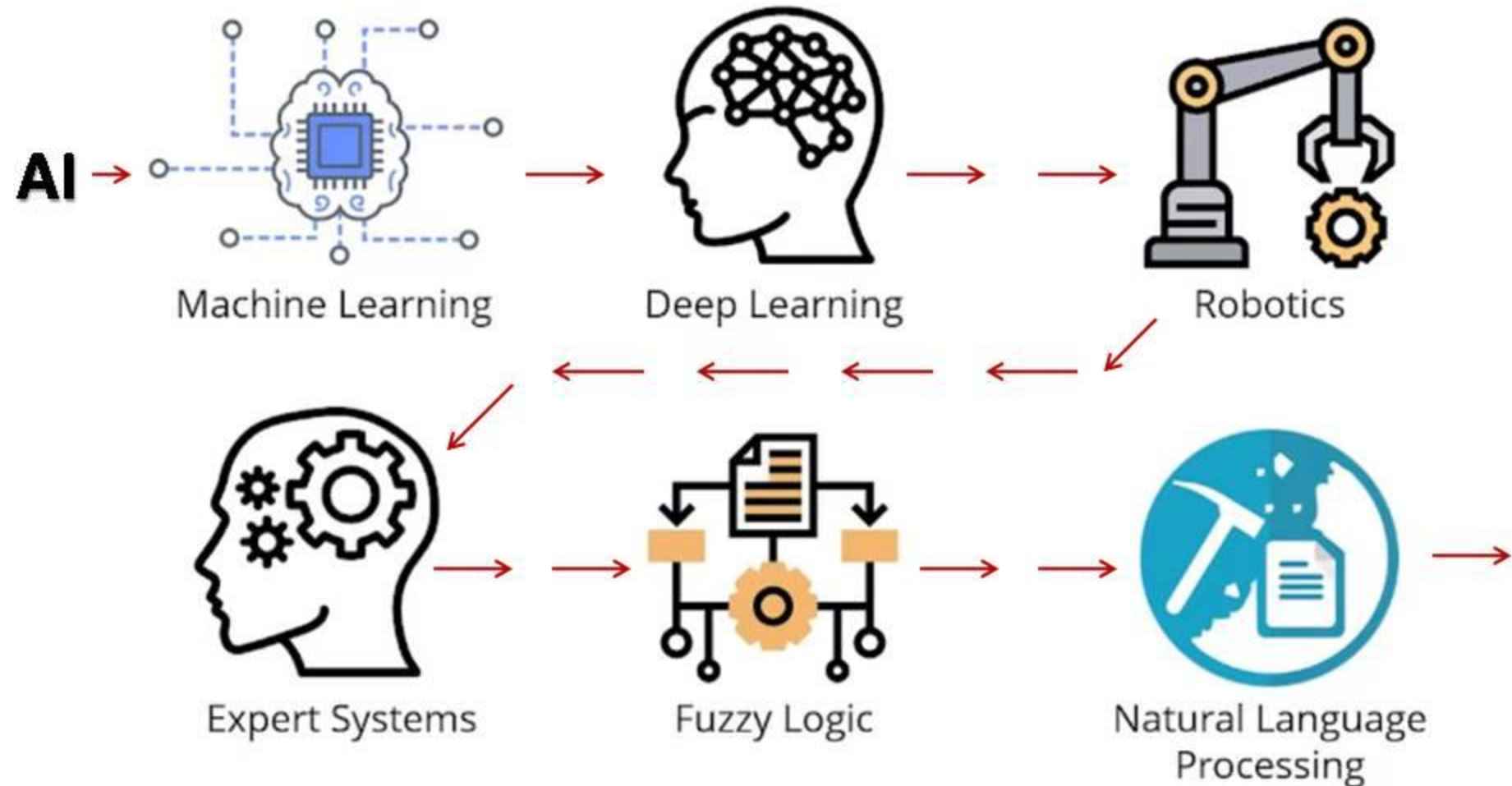## of Artificial Intelligence

Limited Memory AI

Comprises of machine learning models that derive knowledge from previously-learned information, stored data, or events. e.g. Autonomous vehicles, or <u>self-driving cars</u>.
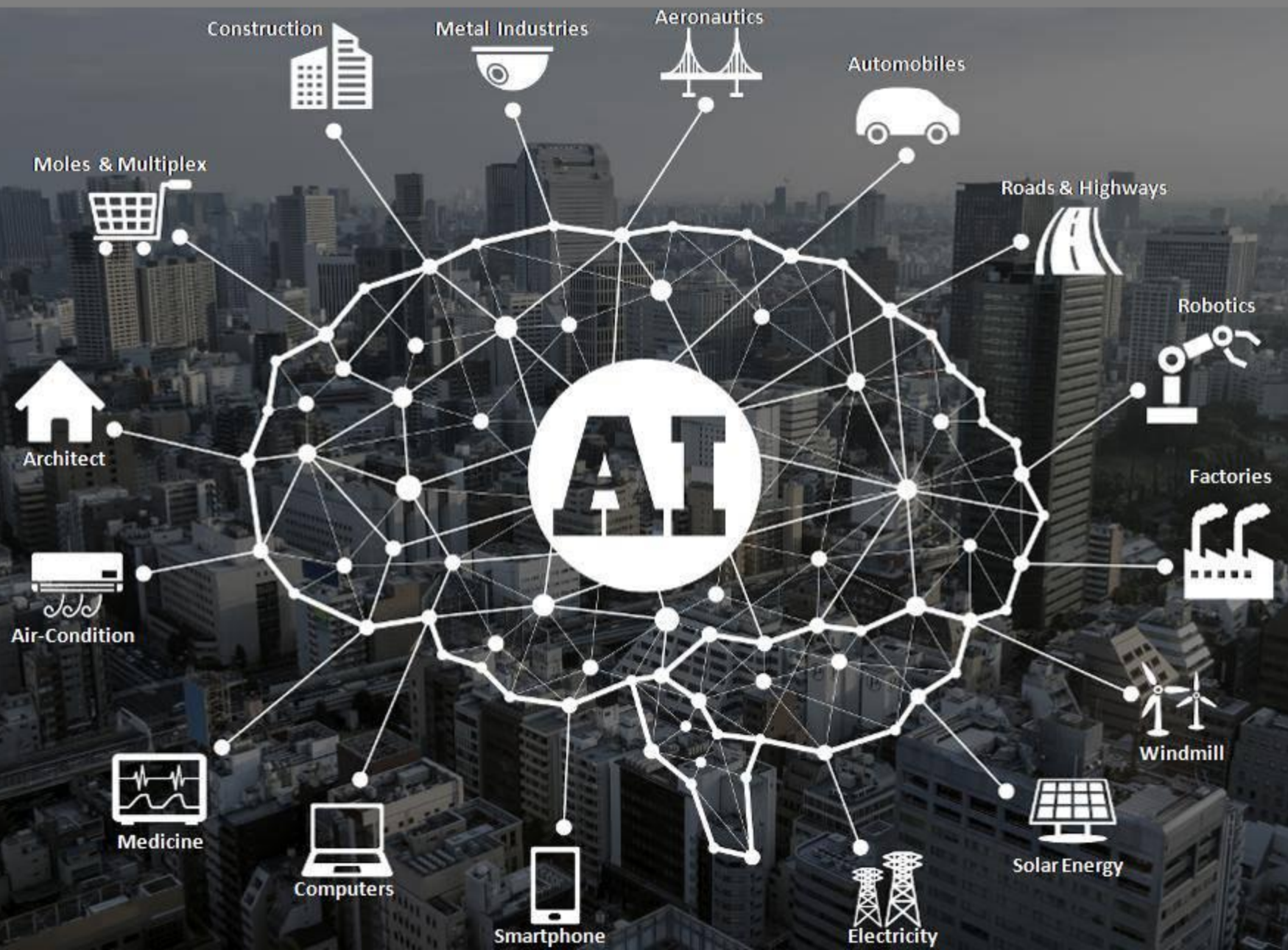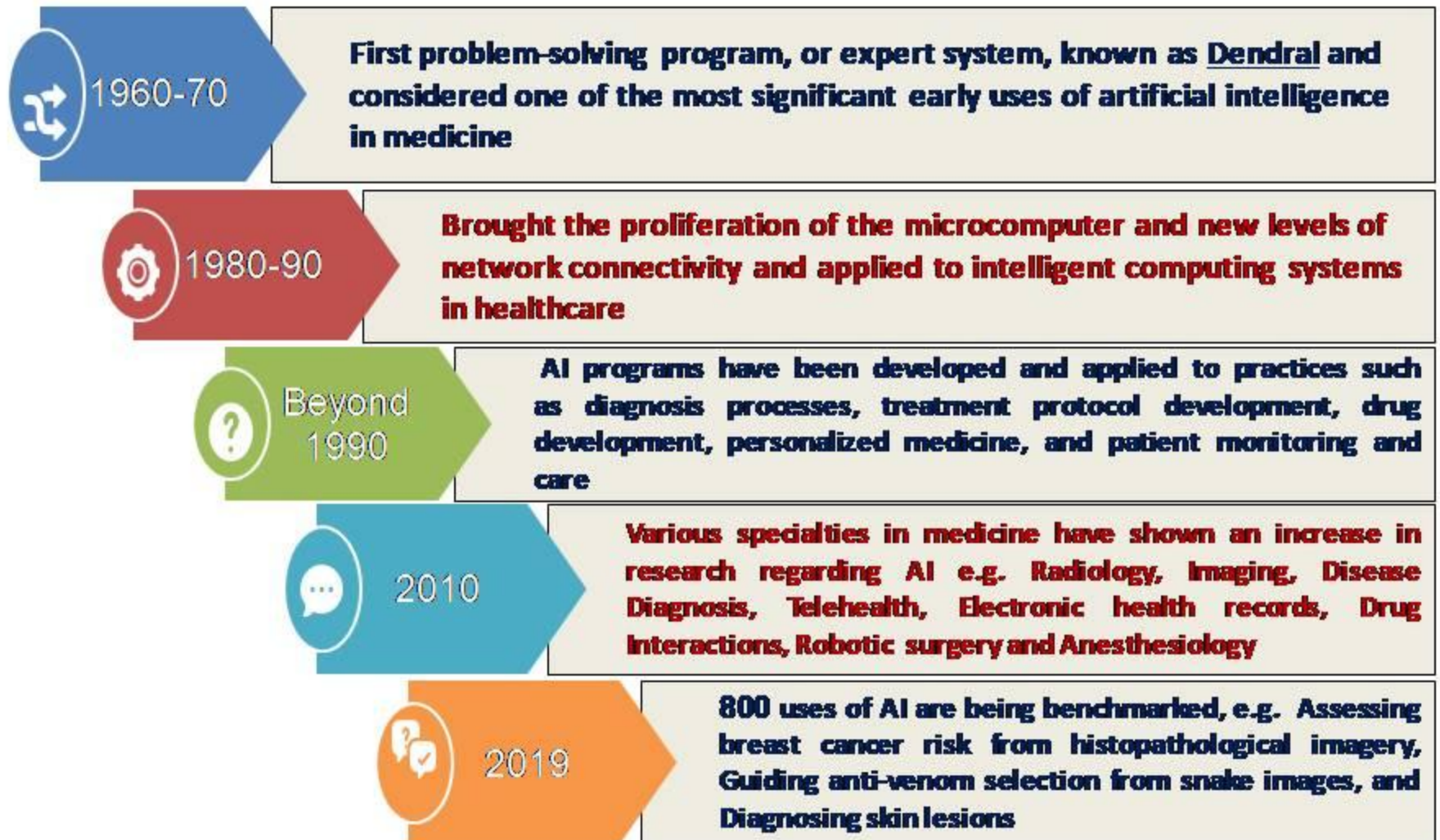
(So it works on past data)

Theory of Mind AI

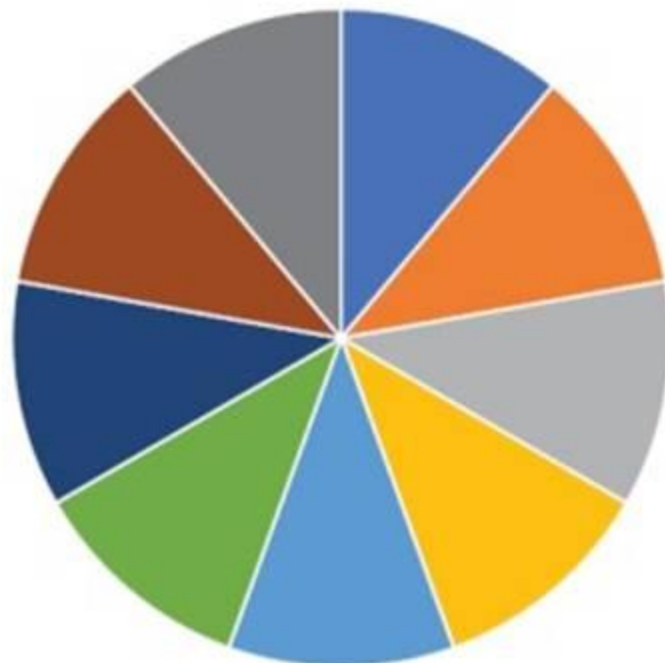Is the decision-making ability equal to the extent of a human mind, but by machines. Two notable examples are the <u>robots Kismet</u> and <u>Sophia</u>, created in 2000 and 2016.

(So it works on emotional intelligence)

DOMAINS OF AI

How AI Works

AI → Machine Learning → Deep Learning → Robotics

Expert Systems → Fuzzy Logic → Natural Language Processing →

Artificial Intelligence In Healthcare

History of AI in Healthcare

1960-70
First problem-solving program, or expert system, known as <u>Dendral</u> and considered one of the most significant early uses of artificial intelligence in medicine

1980-90
Brought the proliferation of the microcomputer and new levels of network connectivity and applied to intelligent computing systems in healthcare

Beyond 1990
AI programs have been developed and applied to practices such as diagnosis processes, treatment protocol development, drug development, personalized medicine, and patient monitoring and care

2010
Various specialties in medicine have shown an increase in research regarding AI e.g. Radiology, Imaging, Disease Diagnosis, Telehealth, Electronic health records, Drug Interactions, Robotic surgery and Anesthesiology

2019
800 uses of AI are being benchmarked, e.g. Assessing breast cancer risk from histopathological imagery, Guiding anti-venom selection from snake images, and Diagnosing skin lesions

Uses of AI in Healthcare

- ■ Drug development
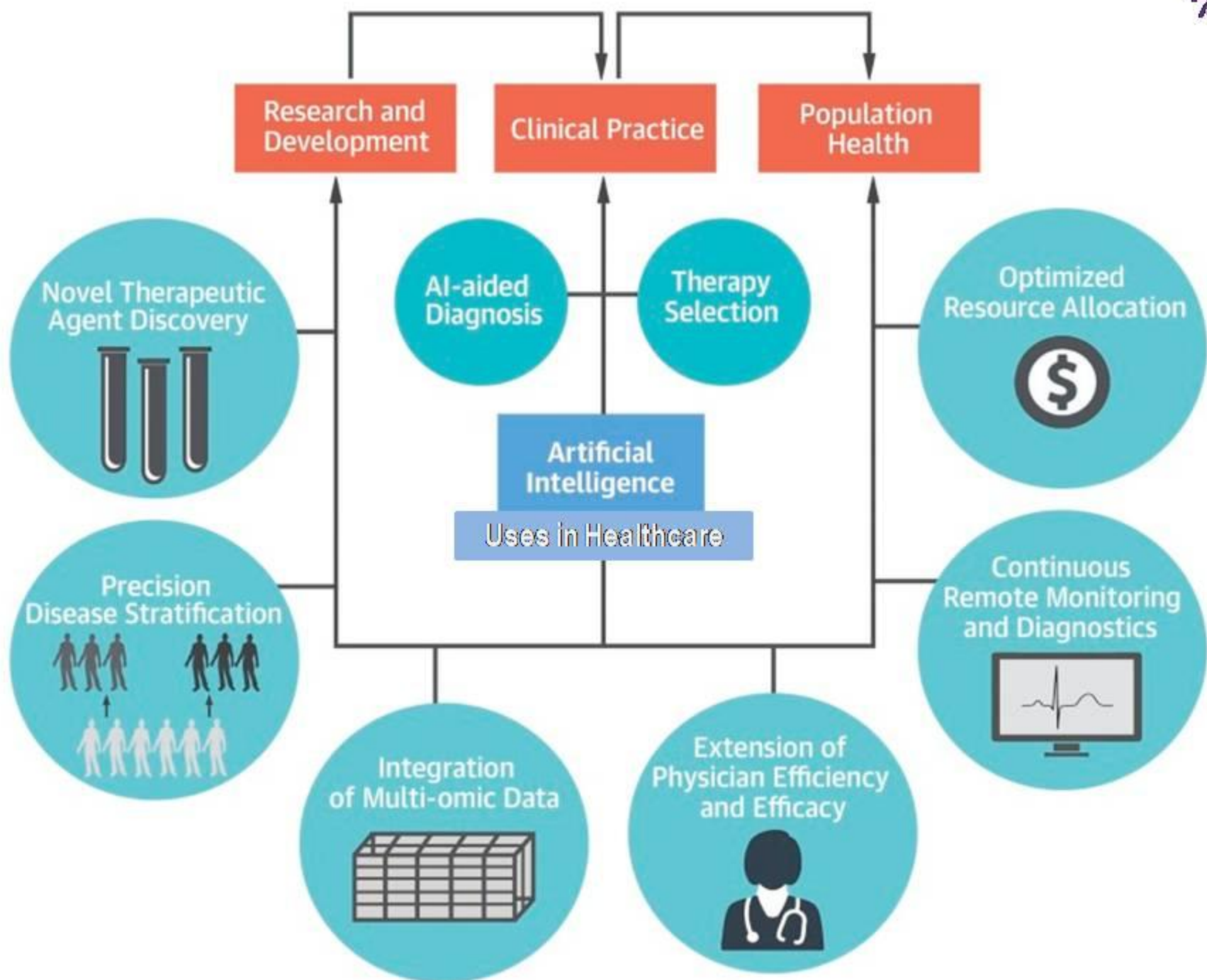- ■ Health montoring
- ■ Managing medical data
- ■ Disease diagnostics
- ■ Digital consultation
- ■ Personalized treatment
- ■ Analysis of health plans
- ■ Surgical treatment
- ■ Medical teratment

Research and Development

Clinical Practice

Population Health

Novel Therapeutic Agent Discovery

AI-aided Diagnosis

Therapy Selection

Optimized Resource Allocation

Artificial Intelligence

Uses in Healthcare

Precision Disease Stratification

Continuous Remote Monitoring and Diagnostics

Integration of Multi-omic Data

Extension of Physician Efficiency and Efficacy

Artificial Intelligence

[Pros vs. Cons]

Pros	Cons
Better data-driven decisions	Concerns regarding privacy & security
Increased disease diagnosis efficiency	Lack of curated healthcare data
Treatment time cut in half	High initial capital investment
Integration of information	Lack of interoperability
Reduce unnecessary hospital visits	Reluctance from staff to embrace AI
Create time-saving administrative duties	Potential for increased unemployment

Artificial Intelligence
In
Anesthesiology

History
Of AI in Anaesthesiology

In historical development, anesthesia was the earliest subject to implement artificial intelligence

Anesthesiology first established the concept and model of pharmacokinetics-pharmacodynamics of clinical drugs PK/PD model (Pharmacological Robots)

In the 1980s, Servo anesthesia theory system was formed, this was embryonic form of automated anesthesia and robotic anesthesia

In 1990s, intravenous anesthesia Target-Controlled drug Infusion (TCI) has been applied in clinical practice

With the gradual improvement of anesthesia monitoring, especially anesthesia depth EEG monitoring system, the open-loop and closed-loop automatic anesthesia system established

In recent years, anesthetic robots, technology robots, diagnosis robots developed rapidly

Since 2011
AI in anaesthesiology
is developing
tremendously

Current Status
of
AI in Anaesthesiology

(from 2011 to 2020)

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Anaesthesia Robots are developed two types

1) Manual Robots

2) Pharmacological Robots

The <u>iControl-RP machine</u> <u>closed-loop system</u> <u>intravenous anesthetic</u> <u>delivery system</u> which makes its own decisions regarding the IV administration of remifentanil and propofol

<u>Manual robots</u> include the <u>Kepler</u> <u>Intubation System (KIS)</u> intubating robot, designed to utilized video laryngoscopy and a robotic arm to place an endotracheal tube

2011 to 2020

<u>Pharmacological robots</u> include the <u>McSleepy intravenous sedation</u> <u>machine</u>, designed to administer propofol, narcotic, and muscle relaxant

The use of the **<u>DaVinci</u>** **<u>surgical robot</u>** to perform regional anesthetic blockade

The use of the **<u>Magellan</u>** **<u>robot</u>** to perform peripheral nerve blocks

Currently AI involved in all Anesthetizing patient, who requires

- Preoperative assessment of all past medical problems from the history
- Physical examination
- Laboratory evaluation
- Mask ventilation of an unconscious patient
- The diagnosis and treatment of any complication during or following the anesthetic
- Observation of all vital monitors during surgery
- Removal of the ET tube at the conclusion of most surgeries
- Placement of an ET tube

AI in Pre Anaesthesia Checkups

- **Google Translate will be very useful in PAC**

- **We can talk and do PAC in patient's mother tongue language by AI interface**

- **e.g. English Voice ---> English Text ---> Local text ---> Local Speech**

   So communication with patient through AI in their language will be routine and already established

AI in Operation Theatres in Future

In future anaesthesiologist will command all gadgets and lights in OT by AI which will be connected with different AI systems

- **Ok Google – Increase the height of OT table**

- **Alexa – Brighten and adjust the OT head lights**

- **Siri – Increase the AC cooling to 20 degree**

Contd.

- **Our future Anaesthesia work station will be operated by AI with just voice command with data entry**

- **Monitors will be controlled and self checked by AI**

- **Switch On and Switch Off Anaesthesia will become reality through AI in near future**

And, some AI enabled functions are already in some OT machines and monitors

AI in Tele Anaesthesia

- **With AI you will be virtually present with patient and colleague anaesthesiologists to guide them in their Peri operative period and in all procedures**

- **Even you can control all OT gadgets with your Smartphone AI Apps**

- **Tele anaesthesia is not a new concept but combined with AI it is very useful for teaching, in CMEs and Conferences (e. g. my webinar talk)**

- **Combined with Augmented Reality(AR) and AI will change the concept of Tele Anaesthesia, and you will be giving virtual anaesthesia to distant OT patients (and it's a reality e.g. Tele anaesthesia from Canada to Italy by Dr Hammerling and colleagues)**

In Future
from 2025 Onwards
We will witness

2025 Onwards

- **Smartphone Anesthesia** practice
- **Tele Anesthesia** in any part of world
- **Artificial Intelligence and Augmented Reality in Anaesthesia (AI & AR Anesthesia)**
- **Robotic Anesthesia**
- Nano-Medicine in Anaesthesia **(Nano Anesthesia)**
- Genetically Targeted medicine **(Genome Anesthesia)**
- **Auto Anesthesia** or **Auto TIVA**
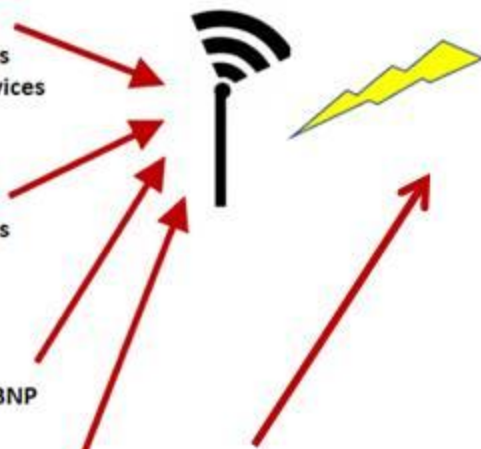
AI will work in Anaesthesiology as a Specialty
(AI Anaesthesiology)

- **Anaesthesiologists need a good <u>mix of cognitive and dexterity based labour</u>**

- **<u>AI will primarily result in the automation of cognitive work, it may be that our hands prevent full automation of the specialty</u>**

- **<u>The general dexterity</u> that humans possess allows for a wide range of functional interaction with our environment**

- **<u>As AI-based automation</u> systems gain further capability, they may be able to perform semiautonomous anesthesia maintenance, where the <u>AI-enabled machine</u> takes over specified domains of anesthesia maintenance**
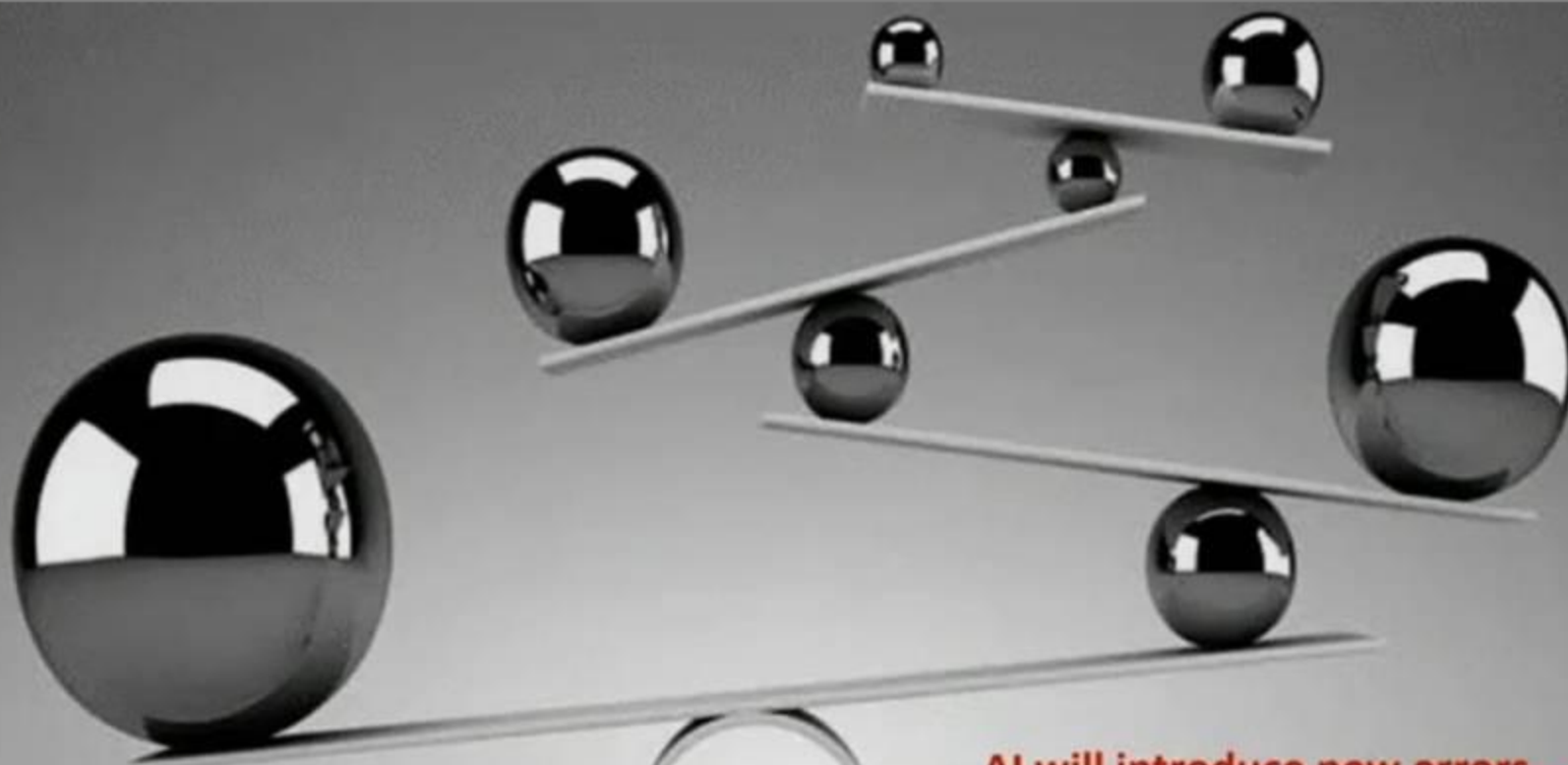
Contd.

- **Anaesthesia might never be fully automated because it involves dexterity-based labour**

- **Current robotic devices don't have exact dexterity required for tasks**

- **However, AI could be used in anesthesia to develop more advanced clinical decision support tools based on machine learning**

- **Ultimately, AI and machine learning could enable anesthesia to become a true perioperative medicine specialty rather than just an intraoperative specialty**

- **AI could assume some of anaesthesiologists' cognitive workload and support "a renewed emphasis on the doctor-patient relationship,"**

Will AI reduce
Errors in Anesthesiology ?

- **Safety Vs. Complexity (Complication)**

- **Human dexterity (skill hands) works will not be replaced by AI Anaesthesia or Robotic Anaesthesia**

- **AI can control the gadgets, monitors but anaesthesiologist will require all the time to do dexterity works like to fill the syringes, to put chest electrodes or to take clinical decision in odd situations**

AI will catch stupid mistakes and optimize patient care

But

AI will introduce new errors that humans would never make

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Will AI replace Anesthesiologist ?
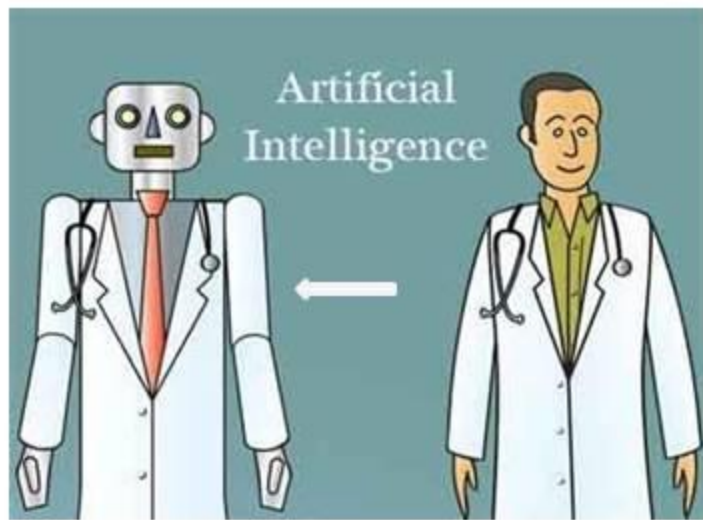
There are dearly cognitive tasks that AI will eventually assume from human anesthesiologists, but AI is not able to deal with many areas of decision making that anesthesiologists routinely perform

Like when the patient's well being deteriorates in the OT, almost all surgeons want an anesthesiologist being to discuss what it will take to get the patient stable again.

Talking to a robot or machine (no matter how smart it is) just isn't the same as addressing the guy who's been doing anesthesia for your patients for long time

>>   I do not think that AI will replace anaesthesiologist anytime soon

>>   Artificial intelligence is still at the very beginning of prototyping, fixing and testing all errors in anaesthesia

>>   On the flip side, we should start actively using and testing AI that is available in order to experience it and learn to corroborate it in our anaesthesia practice

>>   The AI of today will help anaesthesiologists to skip the boring stuff and hopefully make them more focused and smarter. If you have a talented team and the resources to play with intelligent monitors and anaesthesia machines, you will get the best results

>>   However, in the future we might see particular roles being replaced. The first people to be let go will likely be those roles that are very task-based and lack creativity

>>   The future of artificial intelligence in anaesthesia is unpredictable

>>   What is predictable is the intention for AI development. Five years from now, we might see amazing game-changing inventions as well as continuous steady progress towards more intelligent, self-thinking monitors, anaesthesia machines and TCI pumps

Intelligent control in Anaesthesia
(super super speciality)

- Intelligent control is a new and interdisciplinary subject developed on multiple directions, such as artificial intelligence and automatic control

- In 1967, Leonde and Mendel first used the concept of "intelligent control" to apply techniques of memory and goal decomposition to improve their ability to deal with uncertainty

- The intelligent control summarized as the combination of automatic control and artificial intelligence

- Closed loop TCI with anaesthesia depth monitor is intelligent control system (Auto Anaesthesia)

- It is widely used in clinical applications, including cardiac surgery, pheochromocytoma surgery, gastrointestinal surgery and has had good clinical results

Intelligent control In Auto Anaesthesia
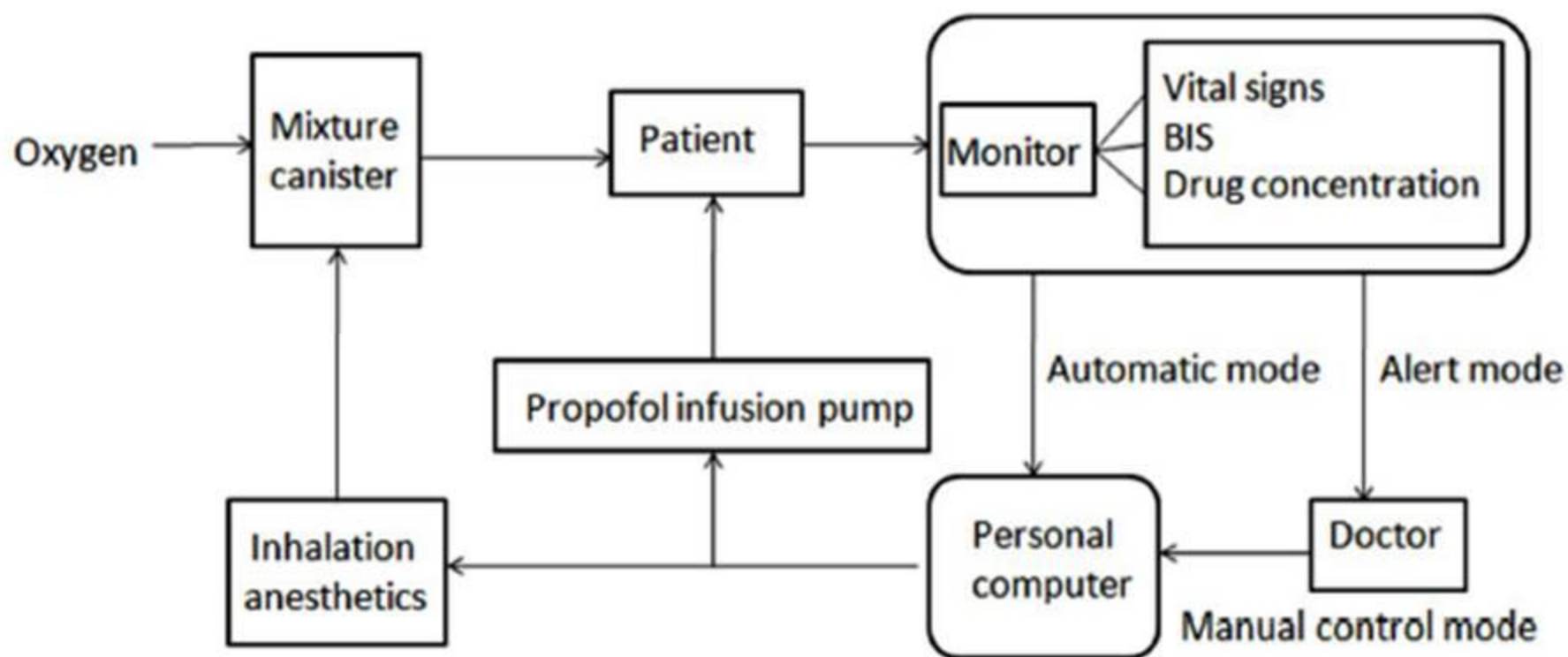
Apparatus for closed-loop anesthetics administration.

Close Loop Anesthesia Delivery System (CLADS)
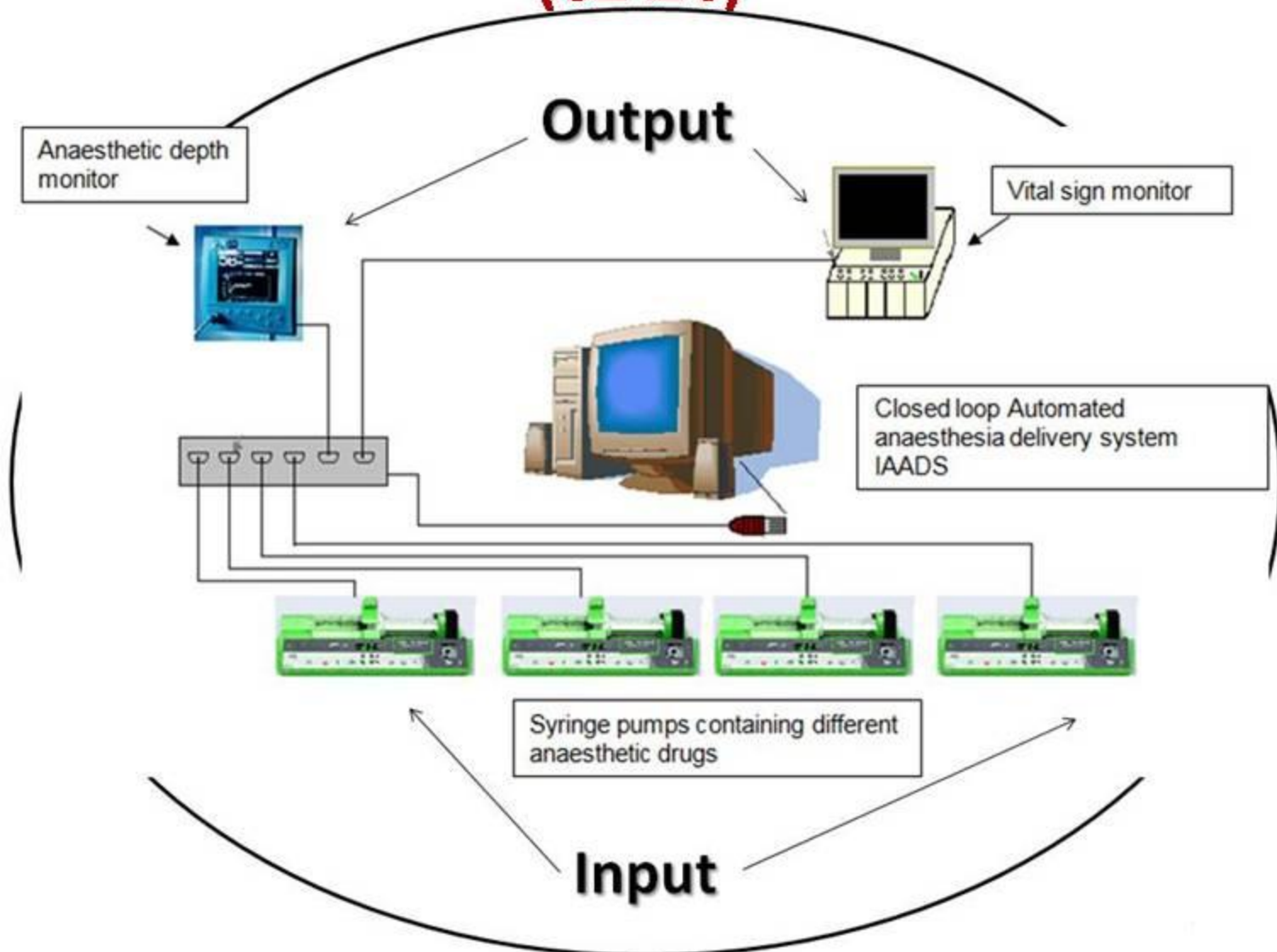
Determines Right Drug with Right Dose at Right Time by AI

Tasker

BJA
British Journal of Anaesthesia

Canadian Journal
of Anesthesia

World Journal of
Anesthesiology

Update in
Anaesthesia

ANESTHESIA &
ANALGESIA®

Articles

from

AJA
Asian Journal of Anesthesiology

JOURNAL

ISA
IJA
Indian Journal
of Anaesthesia
An official journal of the Indian Society of Anaesthesiologists

*Anaesthesia
and Intensive Care*

kja KOREAN JOURNAL of ANESTHESIOLOGY
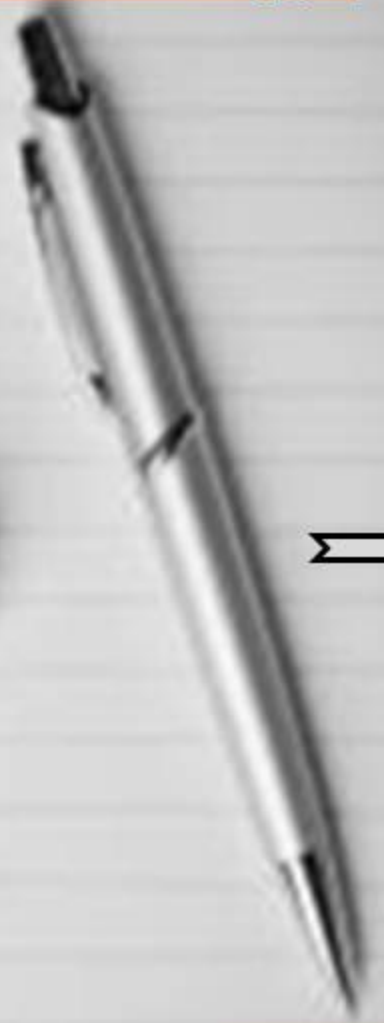
ANESTHESIOLOGY

Pub Med Research

- **Artificial Intelligence and Anesthesiology – 516**

- **Computerized Analysis and Anesthesiology – 282**

- **Machine Learning and Anesthesiology – 222**

- **Deep Learning and Anesthesiology – 49**

More than 1000 articles in journals
(In Last 10 years)

Artificial Intelligence in Anesthesiology: Current Techniques, Clinical Applications, and Limitations

Hashimoto DA, Witkowski E, Gao L, Meireles O, Rosman G.

Six themes of applications of artificial intelligence in anesthesiology:

(1) Depth of anesthesia monitoring,
(2) Control of anesthesia,
(3) Event and risk prediction,
(4) Ultrasound guidance,
(5) Pain management, and
(6) Operating room logistics

Based on papers identified in the review, several topics within artificial intelligence were described and summarized:

(1) Machine learning (including supervised, unsupervised, and reinforcement learning),
(2) Techniques in artificial intelligence (e.g., classical machine learning, neural networks and deep learning, Bayesian methods),
(3) Major applied fields in artificial intelligence

CONCLUSIONS

Artificial intelligence has the potential to impact the practice of anesthesiology in aspects ranging from perioperative support to critical care delivery to outpatient pain management

https://www.ncbi.nlm.nih.gov/pubmed/31939856

A Novel Artificial Intelligence System for Endotracheal Intubation

Carlson JN, Das S, De la Torre F, Frisch A, Guyette FX, Hodgins JK, Yealy DM

CONCLUSIONS

Initial efforts at computer algorithms using artificial intelligence are able to identify the glottic opening with over 80% accuracy. With further refinements, video laryngoscopy has the potential to provide real-time, direction feedback to the provider to help guide successful ETI

https://www.ncbi.nlm.nih.gov/pubmed/26986814

Machine Learning Models of Post-Intubation Hypoxia During General Anesthesia

Sippl P , Ganslandt T , Prokosch HU , Muenster T , Toddenroth D

CONCLUSIONS

We interpret that our machine learning models could be instrumental for computerized observational studies of the clinical determinants of post-intubation oxygen deficiency. Future research might also investigate potential benefits of more advanced preprocessing approaches such as automated feature learning

Machine Learning Approach for Preoperative Anaesthetic Risk Prediction

Karpagavalli S , Jamuna KS , and Vijaya MS

Risk is ubiquitous in medicine but anesthesia is an unusual specialty as it routinely involves deliberately placing the patient in a situation that is intrinsically full of risk. Patient safety depends on management of those risks; consequently, anesthetist has been at the forefront of clinical risk management. Anaesthetic risk classification is of prime importance not only in carrying out the day-to-day anesthetic practice but coincides with surgical risks and morbidity condition. The preoperative assessment is made to identify the patients risk level based on American Society of Anesthesiologists (ASA) score that is widely used in anesthetic practice. This helps the anesthetist to make timely clinical decision.

CONCLUSIONS

In the research work, three supervised machine learning schemes were applied on the preoperative assessment data to predict the anaesthetic risk of the patients and the performance of the learning methods were evaluated based on their predictive accuracy and ease of learning

Prediction of Bispectral Index during Target-controlled Infusion of Propofol and Remifentanil: (A Deep Learning Approach)

Hyung-Chul Lee, M.D.; Ho-Geol Ryu, M.D., Ph.D.; Eun-Jin Chung, M.D.; Chul-Woo Jung, M.D., Ph.D.

Conclusion

Our study demonstrated that the deep learning model is superior to traditional PK–PD model in predicting BIS during Propofol and Remifentanil target-controlled infusions in surgical patients. The major advantage of the deep learning approach is its performance and extensibility. We expect that the accumulation of clinical big data will make the deep learning model more powerful and extend its application to a variety of clinical situations in the future.

https://anesthesiology.pubs.asahq.org/article.aspx?articleid=2656314

Automated anesthesia carts reduce drug recording errors in medication administrations - A single centre study in the largest tertiary referral hospital in China

Wang Y, Du Y, Zhao , Ren Y, Zhang W.

The total error rate was 7.3% with the automated anesthesia carts (1 in 14 administrations) and 11.9% with conventional manual carts (1 in 8 administrations)

CONCLUSIONS

The utilization of automated anesthesia carts reduced the drug recording errors in medication administrations of anesthesia

https://www.ncbi.nlm.nih.gov/pubmed/28625429

First robotic tracheal intubations in humans using the Kepler intubation system (KIS)

T. M. Hemmerling R. Taddei M. Wehbe C. Zaouter S. Cyr J. Morse

Conclusions

We present the first human testing of a robotic intubation system for oral tracheal intubation. The success rate was high at 91%. Future studies are needed to assess the performance and safety of such a system

1. Robotic Arm

2. Joy stick

3. Pentax AWS video-laryngoscope

4. Software control system

Technical communication:
First robotic ultrasound-guided nerve blocks in humans using the Magellan system

Hemmerling TM, Taddei R, Wehbe M, Cyr S, Zaouter C, Morse J.

Conclusions

Ultrasound-guided nerve blocks are becoming a standard of modern anesthesia. We developed a robotic system, Magellan, to perform nerve blocks using a remote control center.

We present the first human testing of a robotic ultrasound-guided nerve block system. The success rate was 100%. The total performance time was approximately 3 minutes to 4 minutes

https://www.ncbi.nlm.nih.gov/pubmed/23302984

"We have been working on closed-loop systems, where drugs are administered, their effects continuously monitored, and the doses are adjusted accordingly, for the last five years," said <u>Dr. Thomas M. Hemmerling</u> of McGill's Department of Aesthesia and the Montreal General Hospital, who heads ITAG (Intelligent Technology in Aesthesia research group), a team of anesthesiologists, biomedical scientists and engineers.

World's first totally automated administration of an anaesthetic in May 2008

McSleepy: Automated Anaesthesia System

- Controlling parameter: BIS+ ANALGOSCORE+ TOF

- 3 phases (induction/maintenance/emergence)

- 3 infusion pumps connected to a controlling unit

- Safety measures
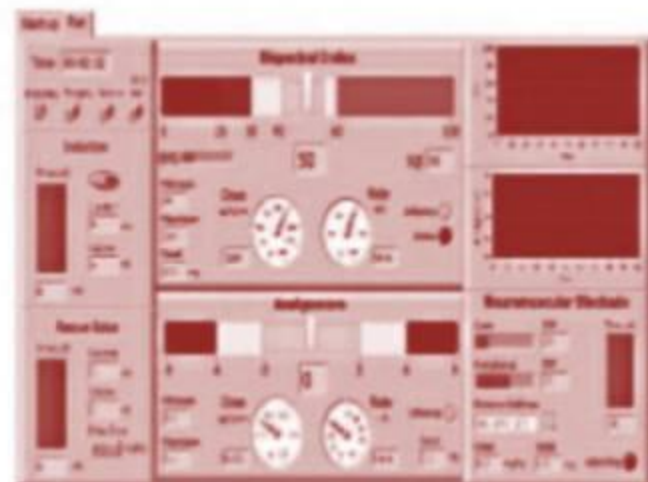
Father of Robotic Anesthesia

Dr. Thomas M. Hemmerling, MSc, MD, DEAA

Associate Professor - Department of Anesthesia, Division of Experimental Surgery, McGill University, Montreal, Canada

Robotic Anesthesia – A Vision for the Future of Anesthesia

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It offers a first classification of robotic anesthesia by separating it into pharmacological robots and robots for aiding or replacing manual gestures. Developments in closed loop anesthesia. First attempts to perform manual tasks using robots

From airway control to anesthesia control

Pharmacologic Robots

Closed loop for hypnosis

Closed loop of Anaesthesia

Closed loop of Analgesia

Anesthesia robots to aid or replace manual gestures

Teleanesthesia

Regional anaesthesia procedure

Placing a perineural catheter for continuous nerve block

Robotic Intubation

Patient Hypnosis

Infusion pump

Closed loop system

Hypnosis monitor

User interface and 'brain' of the system

Artificial intelligence
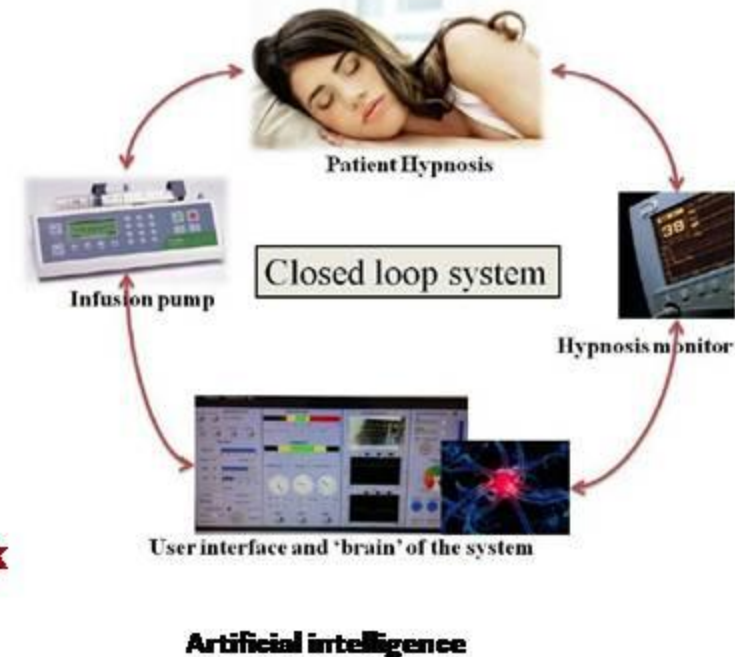
Automated Assessment of Difficult Airway With Facial Recognition Techniques (PeScho)

https://clinicaltrials.gov/ct2/show/NCT02022397

Responsible Party:	Patrick Schoettker,MD PD, Associate Professor, University of Lausanne Hospitals
ClinicalTrials.gov Identifier:	NCT02022397
Other Study ID Numbers:	183/09 CTI (Other Grant/Funding Number: Swiss Commission Technology and Innovation 12636.1)
First Posted:	December 27, 2013
Last Update Posted:	September 26, 2019
Last Verified:	September 2019

Study Type :	Observational [Patient Registry]
Estimated Enrolment :	6000 participants
Observational Model:	Cohort
Time Perspective:	Prospective
Target Follow-Up Duration:	1 Day
Official Title:	Automatic Assessment of Difficult Ventilation and Intubation From Automatic Face Analysis and Artificial Intelligence
Study Start Date :	March 2012
Estimated Primary Completion Date :	December 23, 2020
Study Completion Date :	December 23, 2020

Artificial Intelligence and Machine Learning in Anesthesiology

Christopher W. Connor, M.D., Ph.D

Advances in technology and monitoring can change the impetus for machine learning. For example, a neural network developed to detect esophageal intubation from flow-loop parameters and will be obviated by continuous capnography

Uses a very highly augmented data set in conjunction with logistic regression to produce an algorithmic model that can, in *post hoc* analysis, detect the incipient onset of hypotension up to 15 min before hypotension actually occurs

Neural network approach to predicting the Bispectral Index (BIS) based upon the infusion history of propofol and remifentanil

The most plausible route to the introduction of artificial intelligence and machine learning into anesthetic practice is that the routine intraoperative management of patients will begin to be handed off to closed-loop control algorithms

SEDASYS

Ethicon Endo-Surgery, a Johnson & Johnson subsidiary, created SEDASYS, a computer-assisted device that administers the prescription drug propofol into the bloodstream via intravenous IV infusion (approved in 2013)

The device can detect signs associated with over sedation and can automatically modify or stop infusion

But it was withdrawn from market

Artificial intelligence, machine learning and the pediatric airway

Matava C, et al. Paediatr Anaesth. 2019.

Artificial intelligence and machine learning are rapidly expanding fields with increasing relevance in anesthesia and, in particular, airway management. The ability of artificial intelligence and machine learning algorithms to recognize patterns from large volumes of complex data *makes them attractive for use in pediatric anesthesia airway management*

They critically assess the current evidence on the use of artificial intelligence and machine learning in the assessment, diagnosis, monitoring, procedure assistance, and predicting outcomes during pediatric airway management

The Feasibility of a Completely Automated Total IV Anesthesia Drug Delivery System for Cardiac Surgery

Cedrick Zaouter, MD, MSc, Thomas M. Hemmerling, MD, Romain Lanchon, MD, Emanuela Valoti, MD, Alain Remy, MD, Sébastien Leuillet, MSc, and Alexandre Ouattara, MD, PhD

In this pilot study, we tested a novel automatic anesthesia system for closed loop administration of IV anesthesia drugs for cardiac surgical procedures with cardiopulmonary bypass. This anesthesia drug delivery robot integrates all 3 components of general anesthesia: hypnosis, analgesia, and muscle relaxation

CONCLUSIONS:

The completely automated closed-loop system tested in this investigation could be used successfully and safely for cardiac surgery necessitating cardiopulmonary bypass. The results of the present trial showed satisfactory clinical performance of anesthesia control

Current Robotic and Artificial Intelligence Theatre

Robot

Robotic wrist 7 degrees of freedom - dexterity of human hand

Anesthesiologist

Nurse

Assistant

Surgeon at console with 3D view
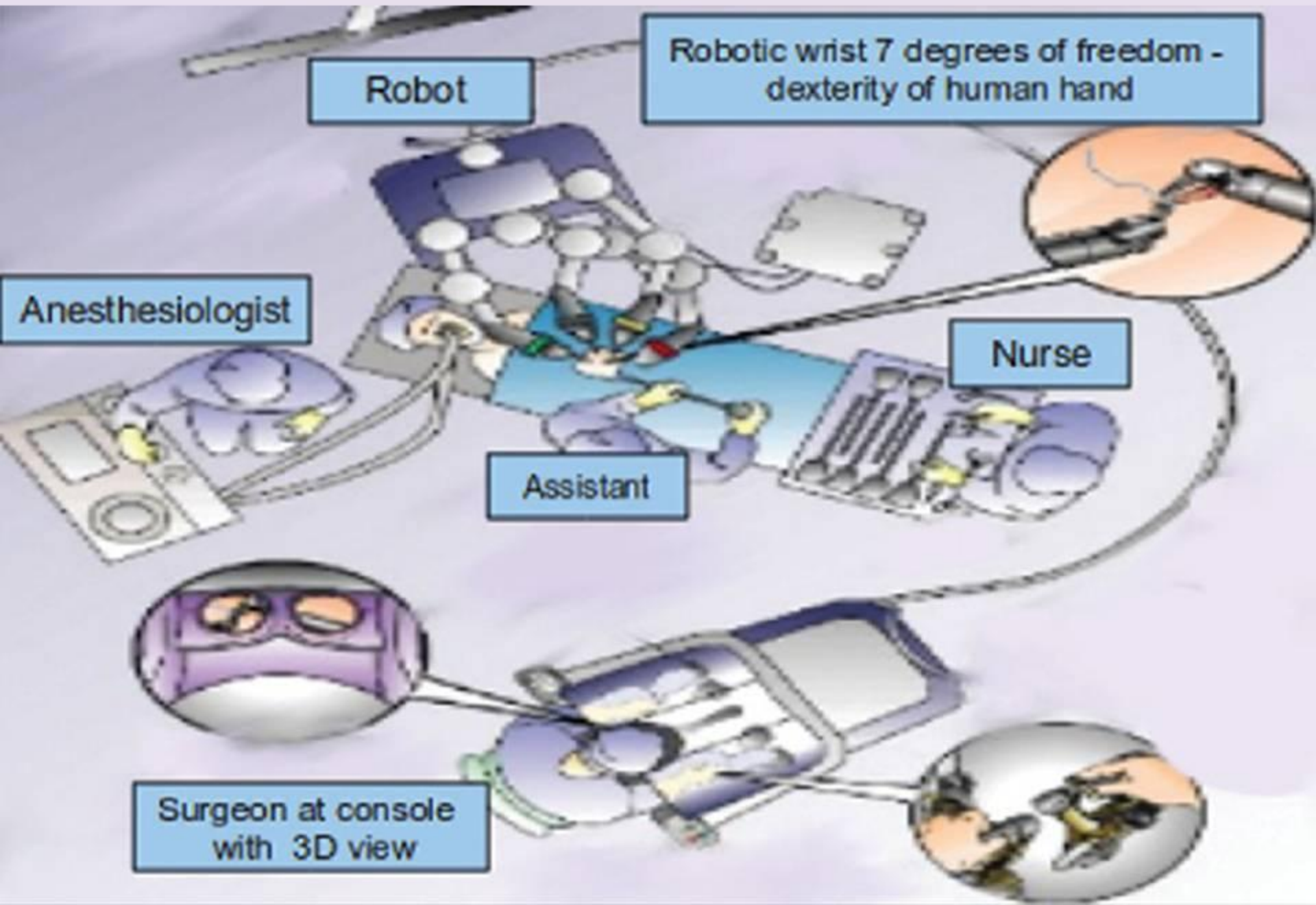
Existing AI enabled Monitors and Anaesthesia Work Station (Very Complex)
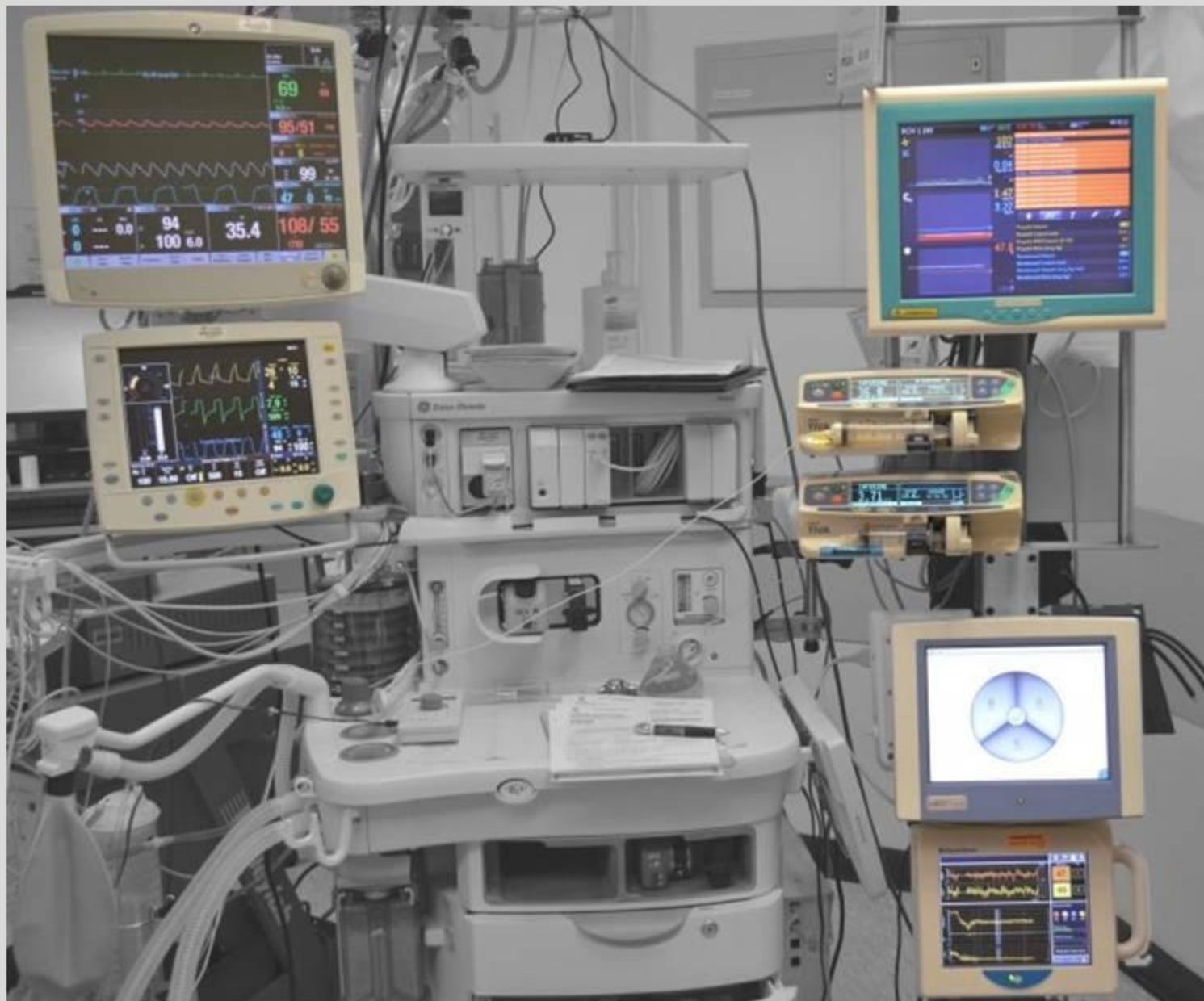
But
My vision in 2030 AI will replace this type
of complex anaesthesia monitors and machine
into
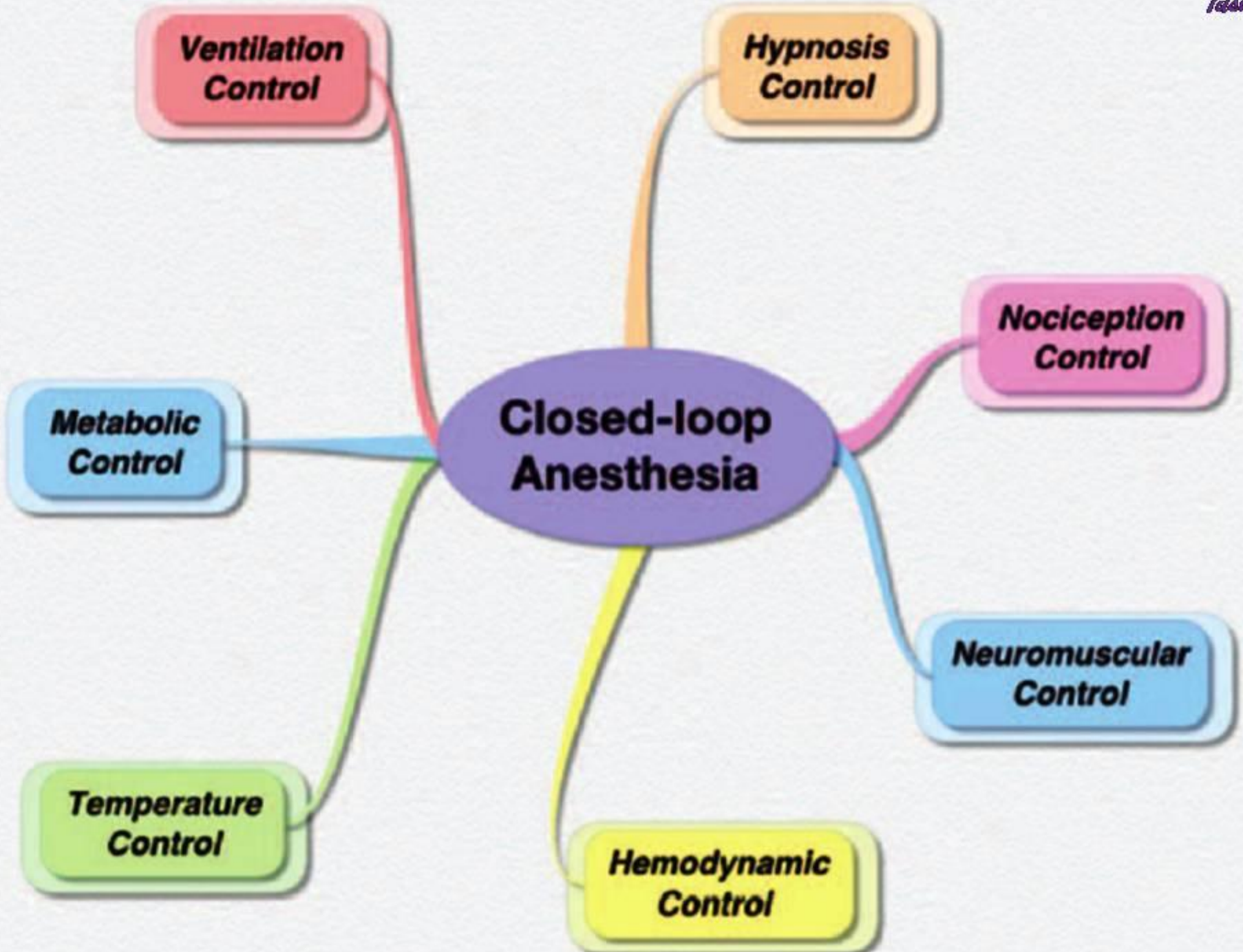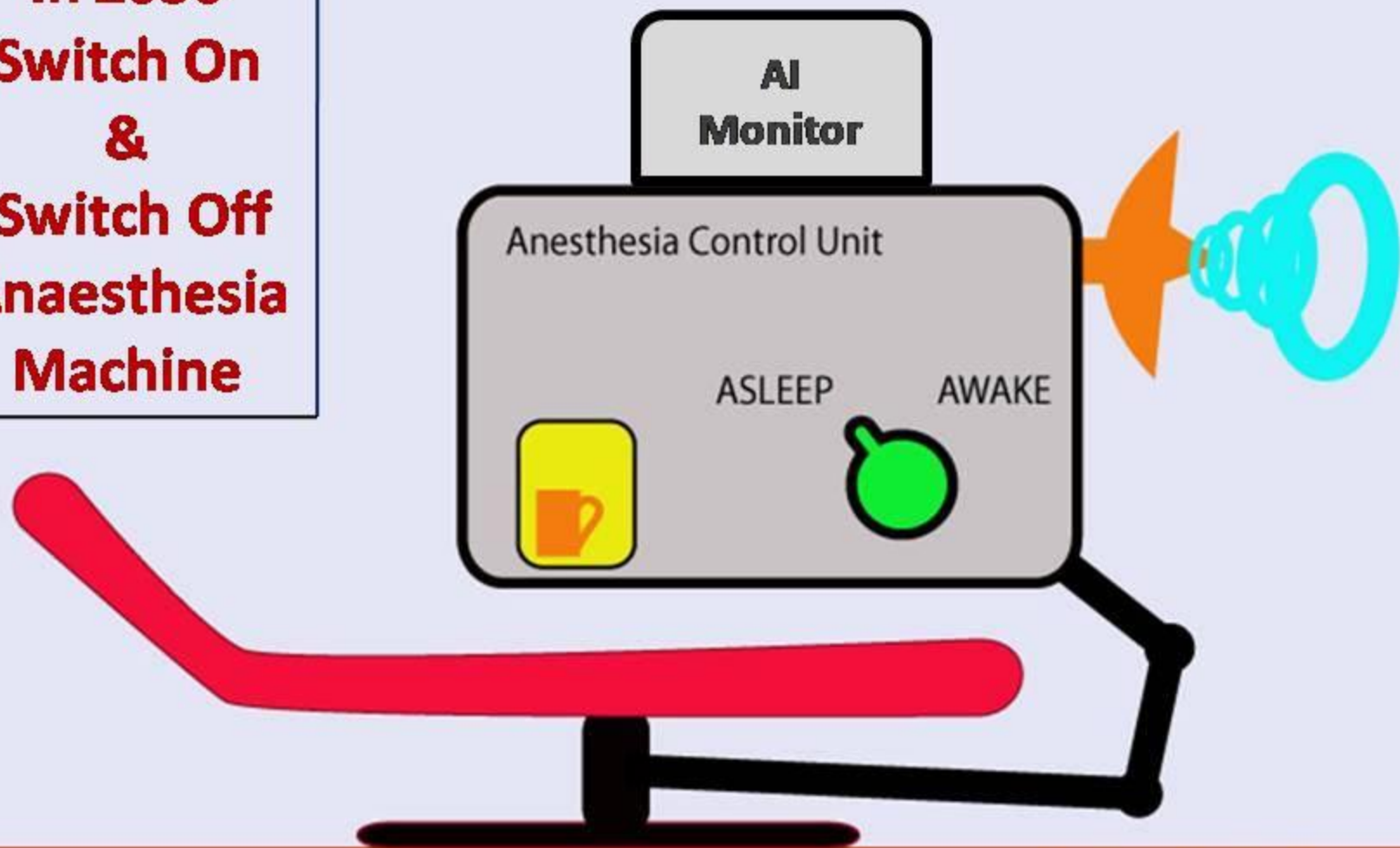
CONCLUSION

A Applications of artificial intelligence (AI) and machine learning (ML) have shown promising results in anesthesiology

B It is clear that AI will find many applications in anesthesia care, in delivering real-time results

C The contributions of AI to general anesthesia have got advancements in monitors, TCI machines & closed-loop systems

D The fields of postoperative pain management and chronic pain have also benefited from AI by developing software

E AI will also increase the training power of simulations thereby improving education in anesthesiology

F Much more work is required to understand exactly the scope that AI will play in anesthesiology

G But, in general AI will certainly continue enhancing the patient experience and Anesthesiologist expertise
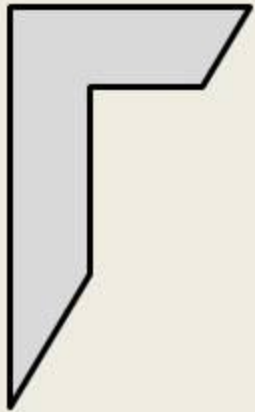
*Take home message
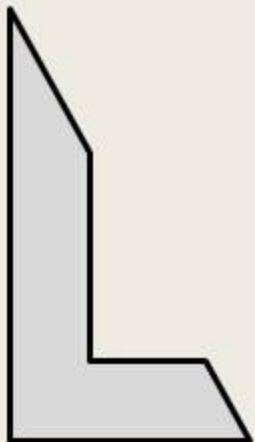
1) Artificial intelligence (AI) in anesthesia is the use of complex algorithms and software to estimate human cognition

2) It will never replace Anaesthesiologist

3) AI or Robot will be Pilot, but we will always be there as Co-Pilot

4) AI will definitely reduce the errors in anaesthesia practice

5) In near future we all will witness the changes of anaesthesia practice with AI

6) AI in anaesthesia will put zero complication rate in our practice, which we can't recognised

7) Ultimately you have to accept artificial intelligence in your practice which you are already practicing

The potential of Artificial Intelligence in anesthesiology, changing patient's lives beyond recognition is both exciting and challenging

MY VERDICT

The anaesthesiologist has to accept the use of AI in their future practice for learning the art of modern AI enabled Anaesthesia machines, monitors and gadgets

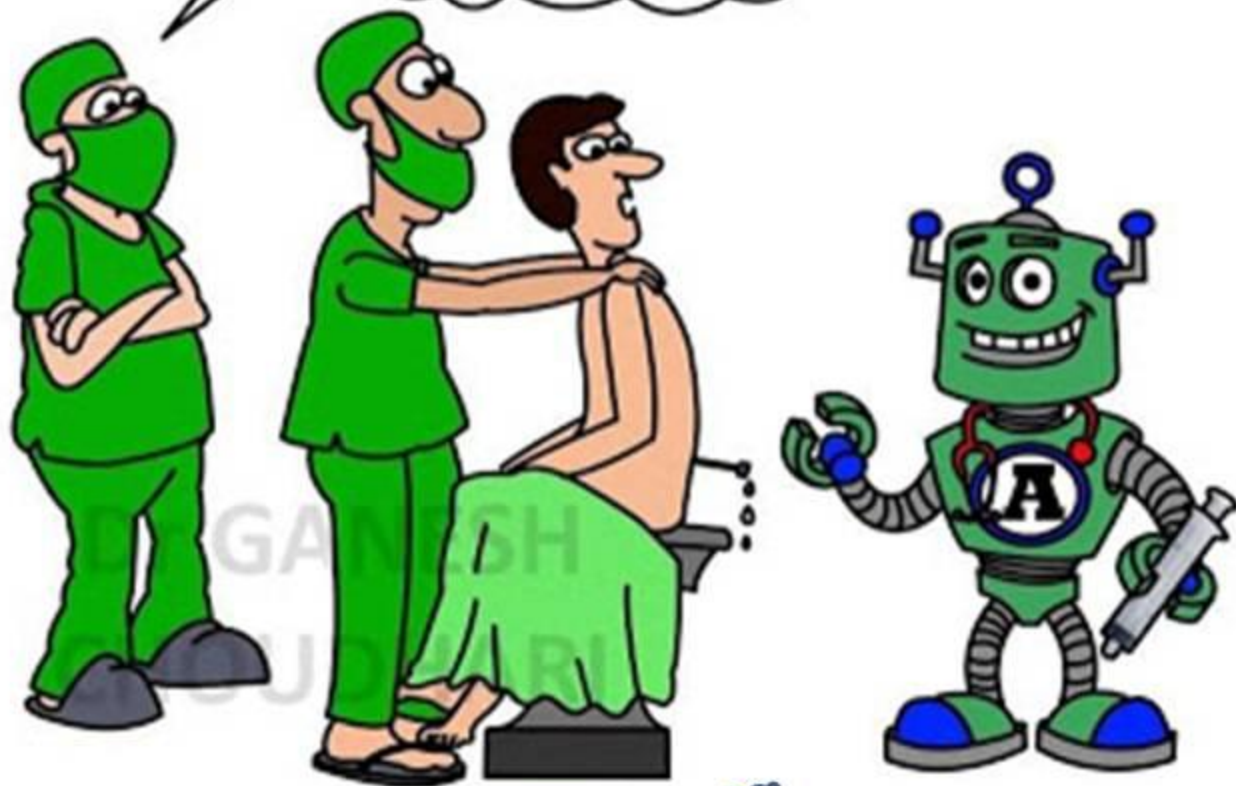2000 BC   1846   1950   2000   2014   2025   2030

ETHER

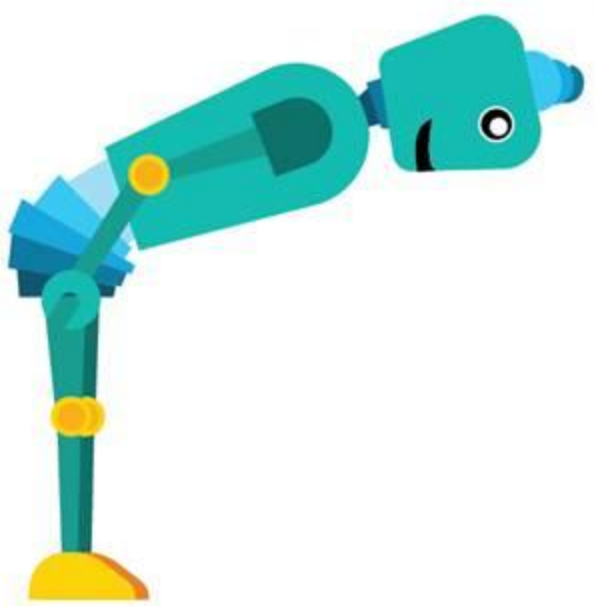ROBOT ANAESTHETISTS

Artificial Intelligence Under Litigation
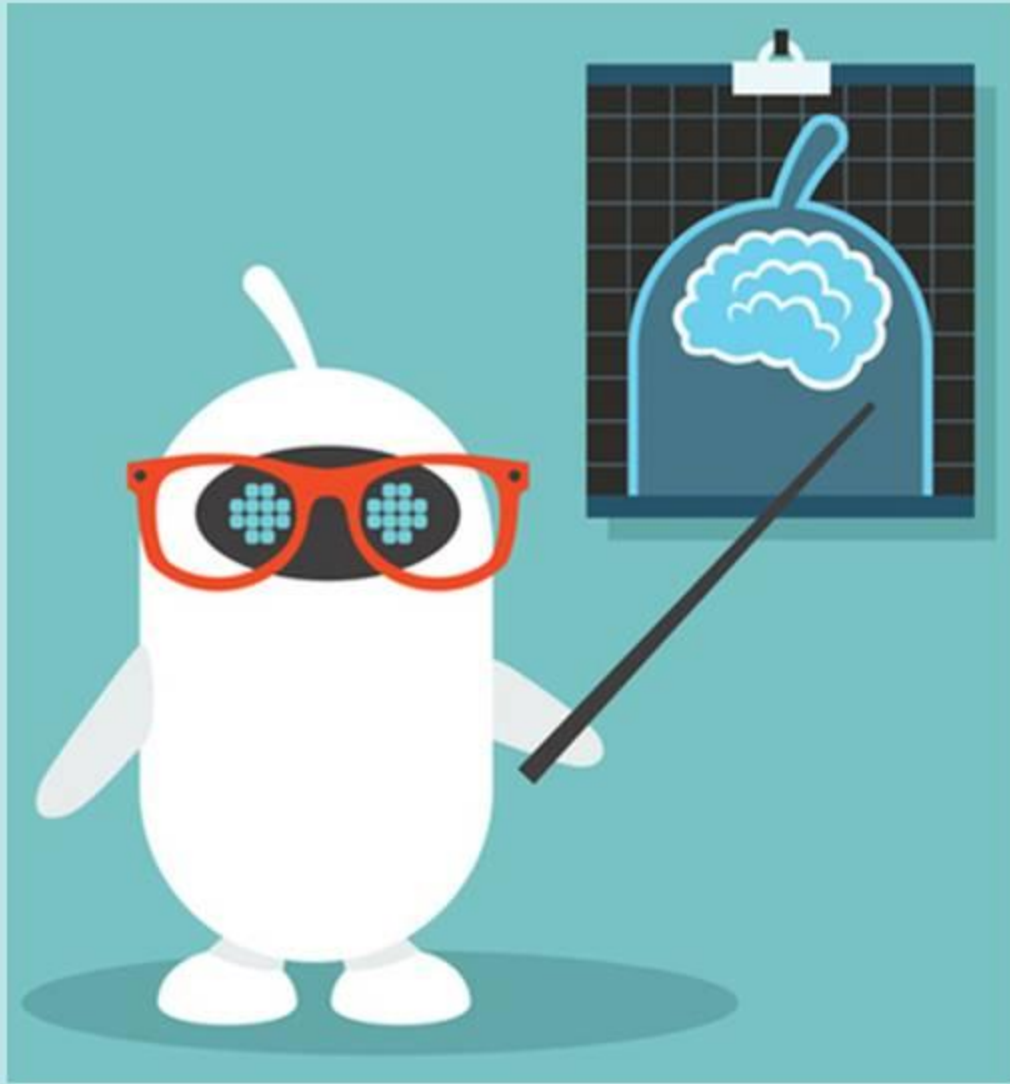
Finally We have to accept Robots and AI
Will be Our Pilots & Teachers in our practice

AI means
Artificial Intelligence
but
AI means
Anesthetist Intelligence
also

Thank You!