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Review Article

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Health Informatics: Big Data, Artificial Intelligence, Machine Learning

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Abstract

Health Informatics can be defined as data and information used to support the decisions made by intelligent systems (whether human or artificial). Health informatics plays an important role in hospital decisions, especially in making the decisions made by doctors for patients more accurate. Health informatics brought together multiple fields and created a new discipline. This new field has created indispensable new opportunities in the field of health. These include; better diagnosis, better knowledge, better treatment, better security, better information, better impact, better decision, better wisdom, and better research. A good big dataset is characterized by its accuracy, completeness, relevance, reliability, security, and timeliness. Big data is defined by components that start with five "V". These are; volume, velocity, variety, verification, and value. Analytical thinking can be evaluated through words such as analytical solutions and usage. Key terms in analytics are; Epidemiology, Biostatistics, Artificial Intelligence, and Machine learning. Analytical thinking, logical thinking, and critical thinking take a significant role in analytical skills.

Participatory Approaches to Intelligent Patients in the Field of Medicine are important today. It illustrates four main approaches that enable smart patients to be included in disease and health management and medical research today. These are; Self-Assisting Intelligent Diagnosis, Treatment, and Disease Management Intelligent IT is undoubtedly a critical facilitator in the creation of intelligent patients.

Keywords: Health Informatics, Epidemiology, Biostatistics, Artificial Intelligence, and Machine learning.

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Health Informatics can be defined as data and information used to support the decisions made by intelligent systems (whether human or artificial). It is the systematic application of information and computer science and technology to more innovative and evidence-based diagnoses for human health, application, research, and learning to get more accurate conclusions in treatment.

Health informatics plays an important role in hospital decisions, especially in making the decisions made by doctors for patients more accurate. It enables the information to be used better and the patient to receive more accurate treatment. It helps researchers use big data by processing patient data. In this way, it enables the development of more accurate treatment methods and drugs. With the developing internet systems of the patients, access to information and shortening the treatment time has become more important (1,2).

Health informatics provides accurate communication between patient data and information and health care providers in order to minimize the mistakes made in the field of health today and to make the right health decisions. In a well-efficient hospital, all departments must work in sync to provide quality patient service. Traditionally, traditional paper-based medical service is full of errors and difficult to maintain. In modern hospitals, accessing and storing information is reliable (3,4).

Health informatics brought together multiple fields and created a new discipline. This new field has created indispensable new opportunities in the field of health. These include; better diagnosis, better knowledge, better treatment, better security, better information, better impact, better decision, better wisdom, and better research (Figure 1.1).

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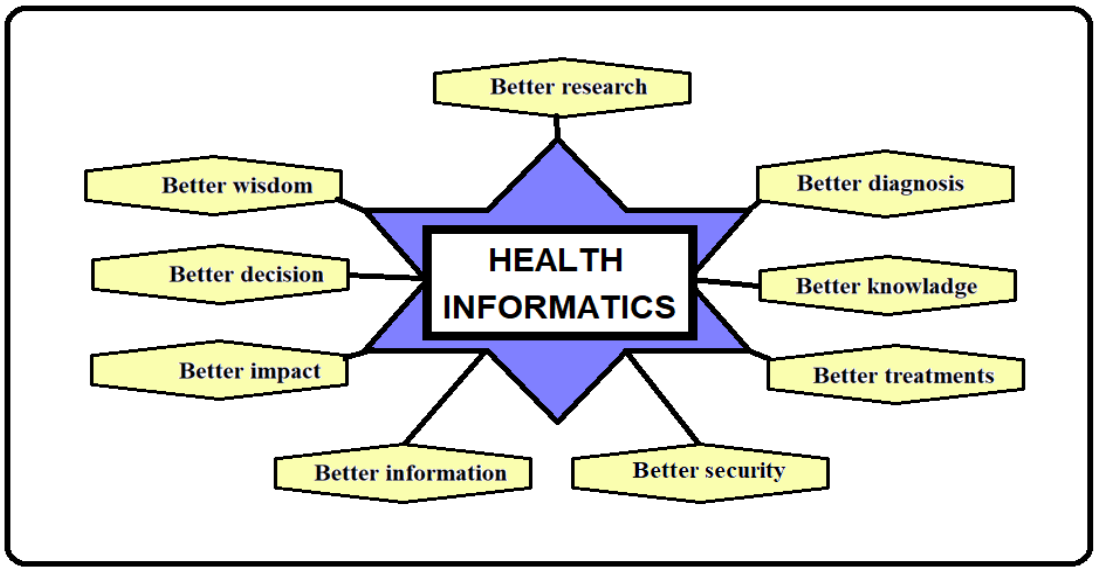

Figure 1.1 Health informatics

The internet age carries education to a digital environment. It creates an interdisciplinary collaborative space for patient care to achieve better patient outcomes and maximize the use of data and information in the following Figure 1.2.

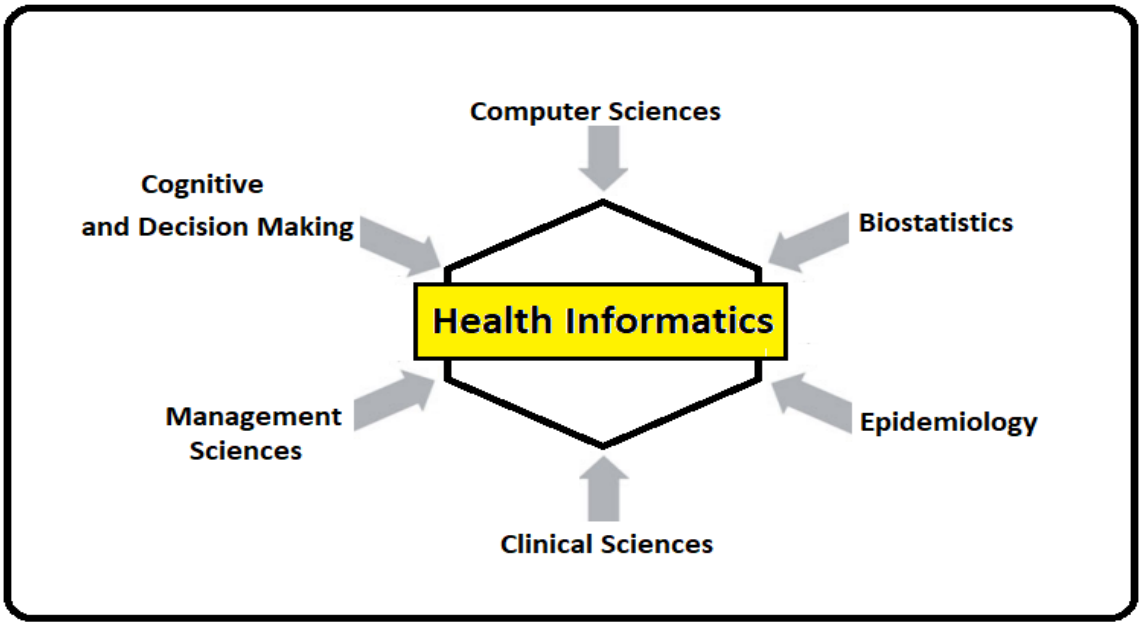

Figure 1.2. Health informatics with other disciplines

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Health informatics is the multidisciplinary area of identifying, implementing, incorporating, and integrating knowledge and technology-based advances in the delivery, management, and preparation of public health and healthcare services. (5).

The multidisciplinary nature of health informatics brings together different aspects of computer science, biostatistics, epidemiology, clinical sciences, management science, cognitive and decision-making, etc.

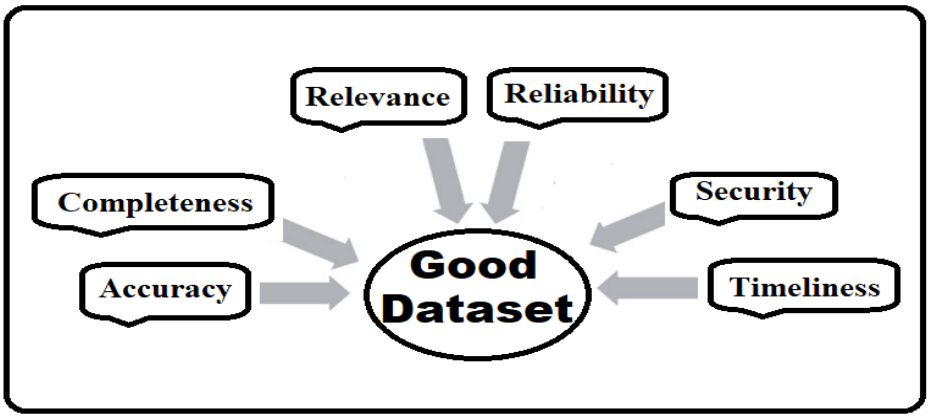

Figure 1.3 Good dataset

Health Data, Clinical Information

A good dataset is characterized by its accuracy, completeness, relevance, reliability, security, and timeliness (Figure 1.3). Accuracy is achieved when recorded health data is accurate, precise, and valid about a patient's condition; for example, a height of 165 cm recorded as 164 cm is approximate but still inaccurate. Completeness indicates that all necessary health data should be recorded (and recorded); for example, a unique identifier must be found in the patient master index (PMI) for each patient registered in a database to distinguish between individual patients. Compliance ensures that appropriate and necessary data is made available to authorized clinical personnel when and where necessary; for example, the internist should be able to view reports of their patient's blood values to monitor the progress of their patient's conditions. Reliability requires that recorded health data be reliable and consistent; for example,

if a patient's allergy list is available in a hospital food services system, the same list can also be accessed from the pharmacy system and should appear there. To ensure the confidentiality of patient data is not compromised and to guard against potential data misuse, security and privacy regulations require that only designated individuals with valid access rights can view or make authorized changes to recorded data. Finally, timeliness ensures that current health data is up-to-date and accessible for decisions and tasks at hand, especially when they are critical, such as life and death situations (6).

Hospital data is rapidly stored and protected electronically, and processes such as health management, legal requirements, and patient care generate huge amounts of data. Big data is a large amount of information. It is used to describe an evolving product range of enormous size and growing exponentially over time. Big data is processed using the database to analyze information. With the big data created, it becomes easier to obtain analyzes and important research results. Big data usefully aid clinical decision support and public health management. It has a wide variety of sources, including medical data, clinical records, biobanks, the internet, and patient self-reports. Thus, big data architecture can easily manage data from multiple sources.

The Clinical Information System (CIS) is a system that enables the collection, storage, and exchange of clinical data about patients. In the clinic, the doctor needs to manage the data about the patients for diagnosis and treatment. These data are integrated and stored. They are reached when necessary and accurate results are obtained from them.

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Big Data

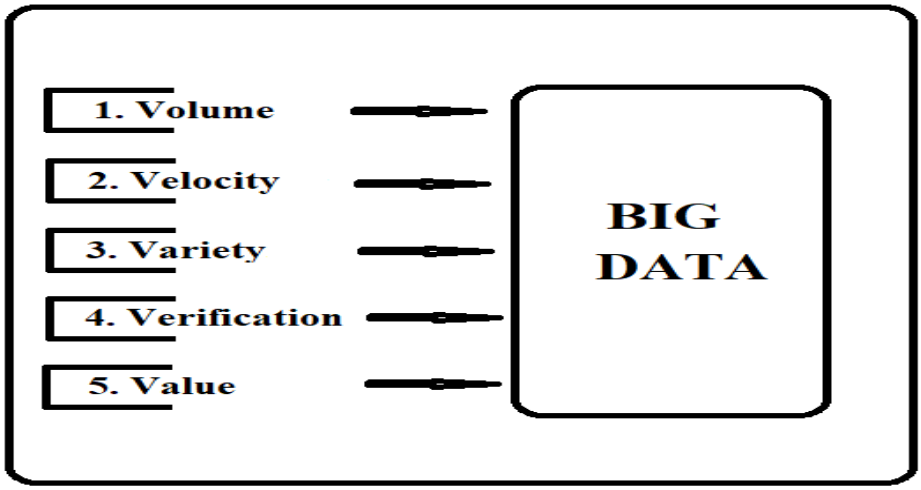

Figure 1.4 Big data components

Big data is defined by components that start with five "V". These are;

1. **Volume,**
2. **Velocity,**
3. **Variety,**
4. **Verification and**
5. **Value**

Volume: Many hospitals have large amounts of archived data. It uses large volume devices to store them. Some hospitals apply thousands of patients a day and the data increases geometrically and occupies a large volume.

Velocity: In big data, speed refers to the increasing rate of data flow. Today, high-capacity computerized devices detect and broadcast data at an unprecedented rate.

Variety: There are different formats and different content on the data. The content of the data is quite diverse. In addition, there are data types such as image, text, video, audio.

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Verification: The quality, level, and value of data is of the utmost importance in a hospital system. Because the patient's life depends on the quality of their data and the accuracy of their health information, big data must be error-free and highly accurate.

Value: Data retrieved in its original form often has a lower value relative to its volume. However, a high value can be obtained by performing large-volume analyzes of such data.

All these components of big data should be applied carefully. In this case, more accurate predictions can be made in health services.

Data play an important role in modern medicine. Data is a repository of information. However, as the availability of data sources and information systems continues to increase, extracting value from data requires higher knowledge. Analytical methods are developing models to solve this problem (7,8).

There are strong correlations among data, information, knowledge, and wisdom, together with relationships between them, an introduction to other analytical terms, and the categorization of various analytical methods. Data, Information, Knowledge, and Wisdom To learn about public health analytics and the use of big data, one needs to better understand several key terms—data, information, knowledge, and wisdom—as well as the hierarchical relationships between them. These relationships are described as the DIKW (Data, Information, Knowledge, Wisdom) pyramid.

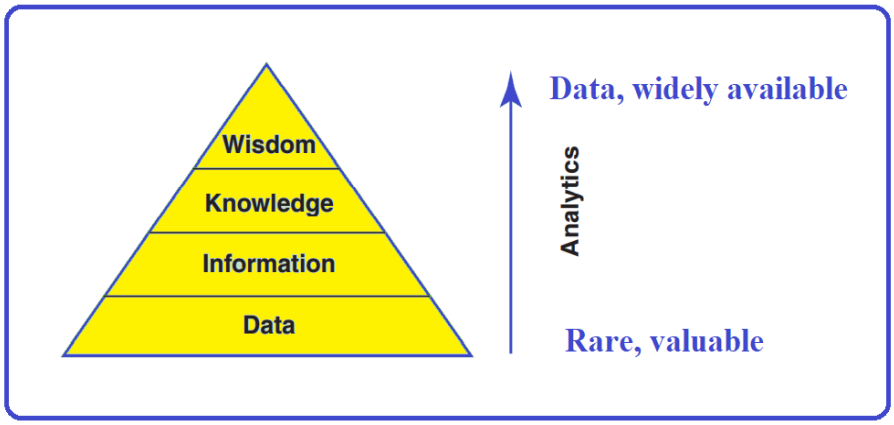

Figure 1.5 Data, Information, Knowledge, Wisdom pyramid.

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•Data (the base of the pyramid) is a discrete, objective collection of facts or observations that are represented in a raw and unorganized form and without context. Therefore, they are of little value.

• Information is data that has been prepared for a specific need and therefore organized or structured to be useful, relevant, and valuable.

• Knowledge is a stream of framed experiences, contextual information, values, expert opinion, and grounded intuition. Understanding how to apply knowledge to achieve specific goals transforms it into knowledge.

• Wisdom is the ability to increase efficiency. It adds value that requires the use of judgment. Wisdom is often personal and inherent in the individual. Wisdom; intelligence is more than knowledge of science and philosophy or knowledge of any other subject (9).

Analytics

The word analytics is referred to as ' Resolved'. It can be said as the solution to any situation or event and problem in life. The word analytic, which has a philosophical origin, is also used in the name of a department in geometry today. Here, it stands out as the ways considered to resolve any problem. Analytical thinking can be evaluated through words such as analytical solutions and usage.

Key Terms in Analytics

1. Epidemiology, Biostatistics - Data analysis

What are Epidemiology and Statistics?

Epidemiology is the study and analysis of the distribution, patterns, and determinants of health and disease conditions. Epidemiology, whose subject is human health and preventive medicine, is the cornerstone of public health and shapes policy decisions and evidence-based practice by identifying risk factors for diseases.

The science of statistics was born before the 18th century. The questions that statistical experts are interested in are; "What could it be?" or "What is likely?" As a statistical definition;

statistics is concerned with the scientific method for collecting, organizing, summarizing, presenting, and analyzing data as well as drawing valid conclusions and making reasonable decisions based on such analysis. As the science of statistics developed over time, it has become used in almost every subject in our daily life. Statistics is a branch of science that is used in many fields of sciences.

The goal of biostatistics is to make valid inferences that can be used to solve problems in public health. Biostatistics develops statistical methods based on evidence to conduct research in the fields of public health, and medicine. Many times, experts in biostatistics study with other scientists and researchers.

In a sense, Biostatistics constitutes the intersection of research methodology with the field of medicine. Biostatistics is a science developed for the field of health. It is not the application of another branch of science. Because it has its laws. It includes many original methods for problems and hypotheses that require evidence-based solutions in different fields of health sciences. Biostatistics has a working environment in all fields of health sciences and is multidisciplinary. The biostatistician ensures that the results are presented appropriately in articles and publications by using statistical methods and analyzing for hypotheses appropriate to the data.

The quality of medical research depends on the specific statistical planning of the study, the analysis of the data using evidence-based methods, and the reporting of results, usually verified by a biostatistician. Nowadays, with the introduction of "evidence-based medicine", more emphasis has been placed on biostatistics and research methodology. The doctor tries to provide his patients in the clinic with the strongest evidence in the decision-making process for the best treatment options. The biostatistician should choose and use the correct and powerful statistical method to obtain the most accurate result for the clinician (10).

Epidemiology and Biostatistics in Decision Making

Statistics are largely the basic thought processes they use in estimation, inference, control, and experimental design, and are the cornerstones of management. Statistical thinking

is therefore in the public domain. Biostatistical thinking can create new solutions for clinicians. In the short term, it can improve the quality of decisions. To minimize variability, sources of variation must be identified and eliminated.

The stages in Decision Making are;

There are main eight stages in the decision-making process are as follows;

1. Framing the problem

2. Hypothesis development

3. Data collection

4. Choosing the statistical method that provides the best evidence

5. Data analysis

6. Interpretation

7. Decision making

8. Implementation

Statistical thinking in decision making, statistical inferences, suggests and provides important solutions in problem formulation, hypothesis development, data collection, data analysis, evidence-based method selection, interpretation, decision making, and application of results.

Objectives of the Biostatistics

The objectives of the biostatistics are determined as follows:

OBJECTIVE 1. To gain the ability to interpret simply by solving complex problems in research.

To grasp the existence of variation, to learn to describe the population with data, to learn to reduce data with statistical representations, to reach generalizable results from the sample, to learn the logic of sampling methods, to identify and control errors in interpretation and measurements, to identify causal processes or factors, to determine the logic behind the methods (as an example) experiments) to learn.

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OBJECTIVE 2. To reveal the mysterious information in the observations made in the field of health by using methods.

Formulate the problem, plan the research, collect and organize data, view, explain and analyze data, discuss results, and define further research.

OBJECTIVE 3. Analytical skills, gaining procedural skills

What is Analytical Thinking?, Analytical thinking means having a systematic mindset to solve problems. To be able to reveal the comments in the data with statistical methods with the help of technology and computer.

OBJECTIVE 4. To reveal the pattern among the health field data

Knowing how the mean value changes with the extreme values or how the change in the data changes the mean and median. Also to reveal the correlation between the data.

OBJECTIVE 5. Understanding probability and dependence on chance

To understand the dependence of daily events on chance, to understand probabilistic processes to better understand the events in our daily life, to understand probability, which is a measure of uncertainty, to learn to develop a model, and to learn that sometimes our intuitions will cause erroneous results and interpretations with a certain probability.

OBJECTIVE 6. To comprehend statistical thinking and develop interpretive skills

Learning to be aware of possible biases or limitations to gain the ability to interpret research findings and reach generalizable conclusions based on the data.

OBJECTIVE 7. To develop skills in terminology to provide statistically communication.

To learn to speak and write effectively about statistical investigations and probable phenomena (probabilistic phenomena) or methods (processes). To understand the concept of validity and to be able to criticize and discuss statistically effectively. Gain the ability to ask debatable questions in single or small case studies

OBJECTIVE 8. Excellent communication skills and gaining a useful statistical character.

A statistician needs to be able to communicate their results with others who may not have the same level of understanding of statistics. Therefore, he should have excellent communication skills to make the unknown known.

People should have a statistical character that can plan, make the right decision, and develop useful scientific tools in the social and research world. Teaching common terms, concepts, and scientific methods used in research is an important issue. The idea of "understanding is to unite" should be acted upon. The new concepts described must be meaningfully combined with the objects in the mind. If this situation is provided, the lesson becomes more meaningful rather than artificial. Biostatistics provides students with synthesis skills. The concept of synthesis, which is one of the most important objectives of the course, should always be at the forefront.

One of the aims of statistics education is to teach the concept that there is a small amount of error in every right. This concept can be explained with relevant possibilities and it gives the candidates who will become physicians a good habit of not ignoring the thought of making mistakes in clinical diagnosis and decision-making in the future (10).

2. Artificial intelligence (AI):

A subdomain of computer science that focuses on the simulation of human intelligence (or brain function) by a machine. Artificial intelligence is a wide domain that encompasses machine learning as well as other topics, such as logic, problem-solving, and reasoning which are out of the scope of this chapter.

Every day, Artificial intelligence does what humans do more efficiently, faster, and at a lower cost. The need and potential for both AI and robotics in healthcare are huge. Just like in our daily lives, Artificial intelligence and robots are becoming more and more used (11).

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Use of Artificial Intelligence (AI) and Robotics in the field of health;

• Keeping Well:

One of the biggest potential benefits of AI is minimizing the need for hospitals and doctors. Already the use of AI and the Internet of Medical Devices is to help human health. Technology applications are to teach healthy behaviors to patients or individuals. Thus, it controls the health and well-being of consumers. AI is to deliver the warnings of health authorities to individuals.

• Diagnosis:

It is the use of AI for disease diagnosis. Artificial intelligence and robotics play important roles in the fields of early diagnosis, diagnosis, decision-making, treatment, research, education, and health protection.

Artificial intelligence today; provides important services to doctors, patients, hospitals, and all health-related fields. Artificial intelligence methods are currently used in areas such as computed tomography, diabetic retinopathy analysis, and heart attack risk determination by EKG. Since there is a lot of data in these fields, algorithms can be as successful as expert doctors in diagnosing.

• Treatment:

Artificial Intelligence strengthens the power of doctors to treat, with applications aimed at determining the patient's disease risks and realizing personalized prevention and treatment methods. Artificial intelligence uses complex computation and inferences to generate insights and enable the system to learn and reason. Research shows that precision medicine, genomics and non-genomic markers, combined with information from clinical history and lifestyles, facilitate personalized treatment and predict the course and duration of disease.

Robots have been used in medicine for more than 30 years. They range from simple laboratory robots to highly complex surgical robots that assist human surgeons or perform operations on their own. In addition to surgery, it is used in hospitals and laboratories to support those with repetitive work, rehabilitation, physical therapy, and long-term conditions.

• Research:

The field of health is full of research in the laboratory, clinical or other fields. The drug development process from the research lab to the patient is long and expensive. Drug research and discovery is one of the newest applications for AI in healthcare. By driving the latest advances in AI to streamline drug discovery and drug reprocessing, there is the potential to significantly reduce both times to market and costs for new drugs. Artificial intelligence is used in every step of the research.

• Early Detection:

AI provided the ability to detect many diseases at an early stage. Techniques based on artificial intelligence have been developed that can detect changes in the brains of people at high risk of Alzheimer's disease ten years before the disease is diagnosed.

Scientists; developed AI technology for the early detection of common cancer types such as prostate, colon, and breast cancer. The artificially developed self works like an alarm system.

Thanks to this developed biotechnological method, the gene network integrated into human body cells are placed under the skin. When the amount of calcium, one of the cancer indicators, exceeds the limit value for a long time, it appears as a mole at a certain point in the body. If this study, which has not yet been successfully carried out in animal experiments, gives successful results on humans, it will have made significant progress in the early and rapid diagnosis of cancer.

• Decision Making:

It is known that artificial intelligence applications have strategic importance in the decision-making process. Artificial intelligence applications eliminate the problem of simultaneous access to information and accelerate the decision-making process.

As a result of the examinations made within this framework, it is predicted that artificial intelligence applications and technologies will develop further in the future and their use in decision-making processes will increase significantly. Artificial intelligence applications, which imitate the work of the human brain without the risk factors affecting decision making,

and enable us to save time and costs, which are the most important resources, gain importance. Scientific disciplines that form the basis of artificial intelligence include disciplines such as logic, statistics, cognitive psychology, decision theory, neuroscience, linguistics, cybernetics, and computer engineering. Major artificial intelligence applications; expert systems, fuzzy logic, genetic algorithms, and artificial neural networks.

• End-of-life care:

Life expectancy is increasing. As a result, we die differently and slowly from conditions such as dementia, heart failure, and osteoporosis as we approach the end of life. Robots have the potential to revolutionize lifelong care, helping people stay independent longer, and reducing the need for hospitalizations and nursing homes. AI, along with advances in humanoid design, is enabling robots to go even further and engage in other social interactions with humans to keep aging brains sharp.

A helper robot was developed; It was designed to address the problem of caregiver shortages predicted for the elderly with dementia, depression, and Alzheimer's.

The AI-programmed robot chats with patients to remind them to take their medication and guide them through light physical activity and cognitive play. The robot uses speech detection to respond to patients with appropriate facial expressions, using a special projection design.

• Training:

The education system in the world is now constantly renewing itself in line with the use of artificial intelligence applications. The studies carried out are important in terms of providing information about the uses and benefits of artificial intelligence in education, keeping educators up-to-date on the subject, and adapting themselves to new technologies. Artificial intelligence

The biggest advantage of these applications is that the applications provide the opportunity to learn according to the student's own level and learning speed. In addition, flexible working hours for some applications. It can be said that maximum efficiency is obtained from the teaching outputs because it provides students with the opportunity to teach when they feel motivated.

Artificial intelligence technologies are observed to increase the learning interactions of all students globally and the opportunities available for the teaching and design of educational experiences. Accordingly, it can be stated that artificial intelligence in education aims to provide inclusive, equitable, and quality education and to promote lifelong learning opportunities for everyone (12).

3. Machine Learning

Machine learning: It can be defined as the ability of a computer system to learn to perform a task. These approaches allow various algorithms to learn from data without the need for explicit programming. Machine learning is a subset of artificial intelligence.

Machine Learning generally refers to any type of computer program that can "learn" by itself, without having to install a program by the programmer. The origins of this definition go back decades. Today, machine learning encompasses many of the types of programs you'll encounter in big data analytics and data mining.

Machine learning and artificial intelligence are confused with each other. Artificial intelligence and machine learning are different processes. In artificial intelligence, machines make their own decisions, learn new skills from them, and try to solve problems the way humans do.

Machine learning, on the other hand, is a system of learning new things by feeding on data. Label data samples can be fed by automatically identifying patterns instead of programming algorithms. If we teach machines to label "White or Black", they will start to label white or black on their own, without any help in the next process.

In supervised machine learning, the user trains the program to generate a response based on a known and labeled dataset. Classification and regression algorithms, including random forests, decision trees, and support vector machines, are commonly used for supervised learning tasks. In unsupervised machine learning, algorithms generate answers on unknown and unlabeled data. Data scientists often use unsupervised techniques to discover patterns in new datasets. Clustering algorithms such as “k-means” are often used in unsupervised machine

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learning. Data scientists can program machine learning algorithms using a range of technologies and languages, including Java, Python, Scala, and others (13).

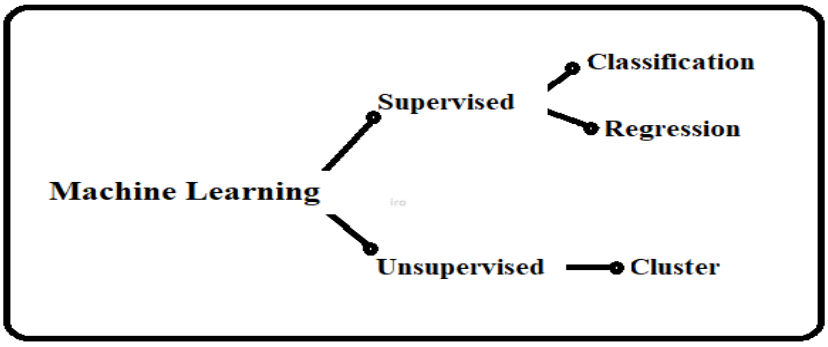

Figure 1.6 Machine learning groups

Supervised Learning is the most used and most popular method in machine learning. The system is trained with labeled data. It is ensured that the system learns the problems through training. The training given is fed with manual labels. While making estimations, regression or classification method is used.

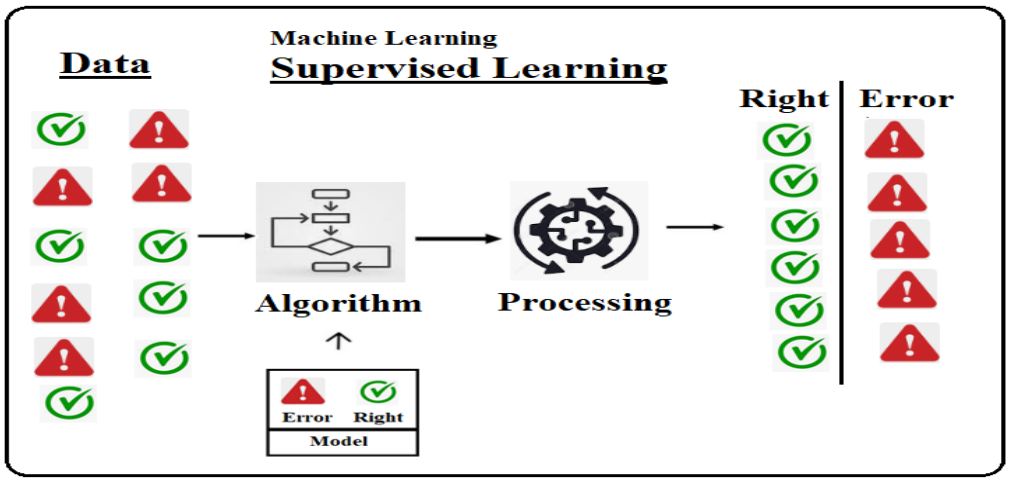

Figure 1.7 Supervised Learning

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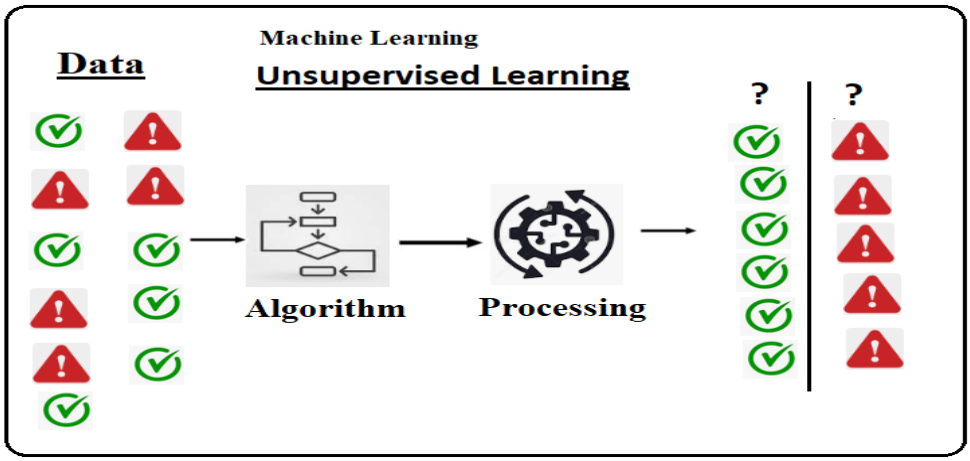

Figure 1.8 Unsupervised Learning

Unsupervised Learning; This system uncovers the insights and relationships found in unlabeled data. Unlabeled data is used while training. It is used to understand, recognize and explore unlabeled data. The desired results from the system are therefore unknown. He needs to find patterns on his own. In the unsupervised learning model, the system results in similarities or differences by grouping from the available data (14).

4. Analytics:

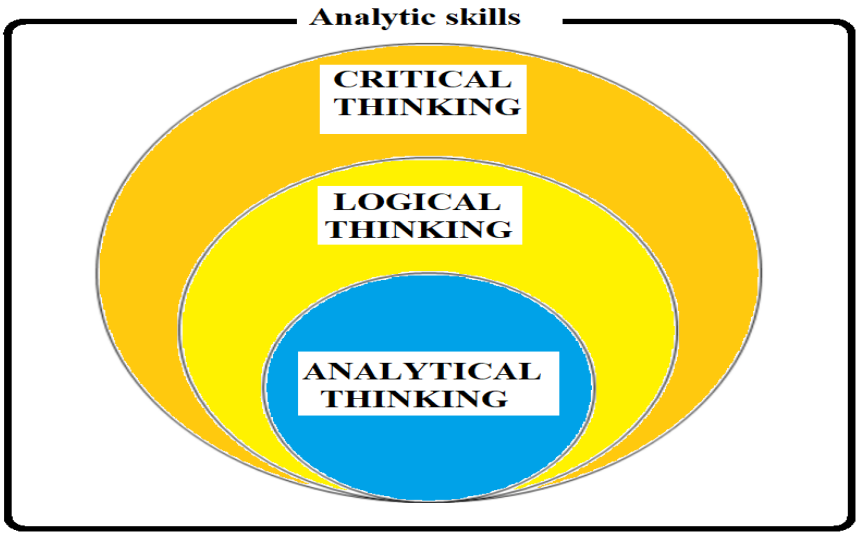

Figure 1.9 Analytic skills

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The discovery, interpretation, and communication of meaningful patterns found in data, as well as the application of data patterns for effective decision-making. Human intelligence and creativity have always produced new solutions in the face of negative situations and various problems experienced in every period. Science has made new discoveries by developing multiple solutions to solve complex problems. The source of these innovations is science. The structure that constitutes the systematic of science is analytical. Analytics is an indispensable part of the scientific process (15).

Analytical thinking;

Analytical thinking, on the other hand, means having a systematic mindset to solve problems. It can be defined as the ability to reach a solution by evaluating the factors causing the problem and combining it with the information obtained in order to solve a problem. Analytical thinking teaches us to be inquisitive, to make fewer mistakes, and to make rational decisions.

Analytical thinkers are those who can instantly divide a topic into parts and sort out the problem and solve it. Even if the individual does not have any problems, they are able to make the necessary innovation and development. There are two main elements of analytical thinking. The first of these is to be inquisitive, to check and find errors and mistakes. The second is to be aware of the benefits and effects of solving problems and to display attitudes and behaviors accordingly. In this way, it is possible to achieve a systematic and efficient result (16).

Individuals with analytical thinking skills have the ability to comprehend and make sense of what they read in a short time and make them functional. People who have this skill try to reach real data by criticizing how accurate any information is. They outline the problem they face. They reach the desired results by evaluating alternative solution options to eliminate the problems.

Logical thinking:

In order to talk about logical thinking, it is necessary to know what the underlying logic is. Logic is a field that shows the right ways of thinking and also takes the way of thinking called logic as its subject and makes a regular determination of logical thinking. As in every

discipline, there are rules for logic. Logical thinking is key to making sound decisions and solving complex problems. We can deduce that logical thinking is based on the necessity of being a good problem solver and thinker. Logical thinking includes a mental process. Logical thinking, which has a cognitive structure, requires effective decision-making in order to reach a conclusion. In other words, it can also be called the process of reaching the result by making a logical decision. Logical thinking, which is one of the higher-order thinking skills, is thinking that takes place above the knowledge and comprehension level in the cognitive knowledge level. The cognitive dimension of logical thinking is also effective in covering concepts, results, and high-level ideas about knowledge, experiments, and observations. This knowledge, which can be created in the mind, cannot be learned by simply observing or being told by someone else, it can only be structured in the mind of the person. There are basic items that will form logical thinking. These items are; 1. Recognizing abstract structures; is the power to discern patterns in our environment. 2. Reasoning by induction; is the logic used in the process of reaching the whole from the parts. 3. Deductive reasoning; is a skill used in the process of reaching parts from the whole, which is the opposite of deductive reasoning. 4. Distinguish context and relationships; It includes data sorting and classification behaviors that affect individuals in daily life. 5. Making complex calculations; using number relations in daily life. 6. Using the Scientific Method; In this process, there are observing, judging, weighing, deciding, and applying an event. As can be seen, logical thinking means solving problems, making conceptual analyzes, using ways of reasoning, and recognizing abstract structures (17,18).

Critical thinking:

Critical thinkers are skeptical. They approach texts with the same skepticism and skepticism as they do with oral expressions. Critical thinkers are active, not passive. They ask questions and analyze. They consciously apply tactics and strategies to uncover meaning or confirm their understanding.

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Critical thinking allows us to recognize a wide array of subjective analyzes of normally objective data and to evaluate the extent to which each analysis will meet our needs. Facts may be real, but how we interpret them may differ.

Participatory Approaches to the Medical Field of Intelligent Patients Today

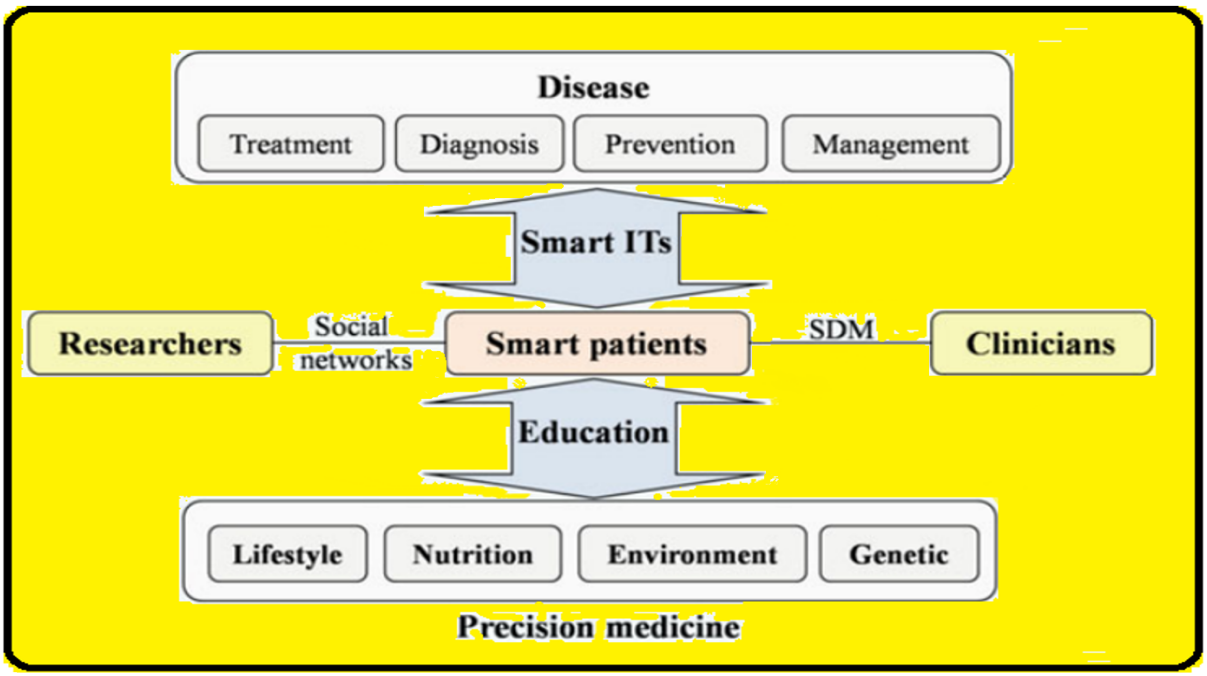

Figure 1.9 Participatory model of a smart patient.

SDM: shared decision-making Source (19): Bairong Shen Editor, Healthcare and Big Data Management. The registered company is Springer Nature Singapore Pte Ltd. 2017

Figure 1.9 illustrates four major approaches to engaging smart patients in disease and wellness management and medical research today. Self-Assisting Intelligent Diagnosis, Treatment, and Disease Management Intelligent IT is undoubtedly a critical facilitator in the creation of intelligent patients. With wearable devices, patients, hospitals, the Internet, robotics, and doctors will be compatible with each other under the name of new medical normality. Health workers' Internet, robots, sensing device, health Apps, etc. can provide better healthcare

to patients. With the help of predictive methods, patients can identify risk factors and whether it is due to genetics or lifestyle choices.

As healthcare apps measure, smart patients must be able to intelligently choose and use any smart tool to encourage behaviors that maintain health and assist in self-health management.

Through positive technologies, patients can participate in the delivery of health services as required by their own care. At this point, it is important to customize positive technologies according to the needs of patients. The use of positive technology in patient participation is generally used in areas such as the transmission of clinical questions, biometric data, patient questionnaires, and risk calculation.

Shared decision-making with healthcare providers and communication between patient and physician is at the heart of medical care. Effective communication not only improves patients' knowledge of their illness, but can also help them become partners in their care, improve adherence to treatment, and increase their satisfaction with care.

Engaging in medical research via social networks in the new age, more and more patients are going online to access information about their health and talk to other patients with a common condition Many patients share advice and details about their treatment and symptoms, both with each other and with researchers. Clinical trial researchers are increasingly using the internet to recruit subjects, communicate with participants, and even collect data (20,21).

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