Cognitive Errors

-Although quantitative mathematical models can guide clinical decision making, clinicians can only rarely use formal computations to make patient care decisions in day-to-day practice. Rather, an intuitive (instinctive, innate) understanding of probabilities is combined with cognitive processes called heuristics to guide clinical judgment.

-Heuristics are often referred to as rules of thumb, educated guesses, or mental shortcuts. It is defined as is any approach to problem solving or self-discovery that employs a practical method that is not guaranteed to be optimal, perfect, or rational, but is nevertheless sufficient for reaching an immediate, short-term goal or approximation.
-Where finding an optimal solution is impossible or impractical, heuristic methods can be used to speed up the process of finding a satisfactory solution.
-Heuristics can be mental shortcuts that ease the cognitive load of making a decision. Examples that employ heuristics include using trial and error, a rule of thumb or an educated guess.

-Trial and error is a fundamental method of problem-solving. It is characterized by repeated, varied attempts which are continued until success, or until the practicer stops trying.
-In English, rule of thumb refers to an approximate method for doing something, based on practical experience rather than theory.

-This usage of the phrase can be traced back to the seventeenth century and has been associated with various trades where quantities were measured by comparison to the width or length of a thumb.
-Heuristics usually involve pattern recognition and rely on a subconscious integration (assimilation)of somewhat haphazardly gathered patient data with prior experience rather than on a conscious generation of a rigorous (hard)differential diagnosis that is formally evaluated using specific data from the literature.

-Such informal reasoning is fallible (weak and imperfect) because heuristics may cause several types of unconscious errors (cognitive errors).

-Studies suggest that more medical errors involve cognitive error than lack of knowledge or information.

-Types of Cognitive Errors

-There are many types of cognitive (reasoning) errors, and although it is obviously more important to avoid errors than to properly classify them once made, being aware of common types of cognitive errors can help clinicians recognize and avoid them.

-Cognitive errors may roughly be classified as those involving:-

1) Faulty assessment of pre-test probability (overestimating or underestimating disease likelihood)

2) Failure to seriously consider all relevant possibilities

-There are numerous named types of cognitive error, but they tend to fall into 2 groups: faulty assessment of pre-test probability and failure to seriously consider all relevant possibilities.

-Both types of error can easily lead to improper testing (too much or too little) and missed diagnoses

Availability error

-Availability error is when clinicians choose the first thing that comes to their mind. This often misestimates the actual pretest probability of a disease because a recent or memorable experience makes a given diagnosis more "available" to come to mind.

-Experience often leads to overestimation of probability when there is memory of a case that was dramatic, involved a patient who fared poorly, or a lawsuit.

-For example, a clinician who recently missed the diagnosis of pulmonary embolism in a healthy young woman who had vague chest discomfort but no other findings or apparent risk factors might then overestimate the risk of pulmonary embolism in similar patients and become more likely to order chest CT angiography for similar patients despite the low probability of disease.

-Experience can also lead to underestimation. For example, a junior resident who has seen only a few patients with chest pain, all of whom turned out to have benign causes, may do a cursory evaluation for cardiovascular or

thromboembolic disease even among patient populations in whom the disease prevalence is moderately high.

-Representation error

-Representation error is when clinicians focus on the presence or absence of classic manifestations of a disease without taking into account disease prevalence.
-For example, although several hours of vague chest discomfort in a thin, athletic, healthy-appearing 60-year-old man who has no known medical problems and who now looks and feels well does not match the typical profile of a myocardial infarction, it would be unwise to dismiss that possibility because myocardial infarction is common among men of that age and has highly variable manifestations.

-Conversely, a 20-year-old healthy man with sudden onset of severe, sharp chest pain and back pain may be suspected of having a dissecting thoracic aortic aneurysm because those clinical features are common in aortic dissection.
-The cognitive error is not taking into account the fact that aortic dissections are exceptionally rare in a 20-year-old, otherwise healthy patient without a family history of such events; that disorder can be dismissed and other, more likely causes (eg.pneumothorax, pleuritis) should be considered.

-Representation error also occurs when clinicians fail to recognize that positive test Results (for any test with a less than 100% specificity) in a population where the tested disease is rare are more likely to be false positive than true positive.

Premature closure

-Premature closure is jumping to conclusions. This is one of the most common errors; clinicians make a quick diagnosis (often based on pattern recognition), fail to consider other possible diagnoses, and prematurely stop collecting data.
-The suspected diagnosis is often not even confirmed by appropriate testing.
-Premature closure errors may occur in any case but are particularly common when patients seem to be having an exacerbation of a known disorder—eg, if a woman with a long history of migraine presents with a severe headache (and actually has a new subarachnoid hemorrhage), the headache may be mistakenly assumed to be another attack of migraine.

-A variation of premature closure occurs when subsequent clinicians (eg, consultants on a complicated case) unquestioningly accept a previous working diagnosis without independently collecting and reviewing relevant data.
-Electronic medical records may exacerbate premature closure errors because incorrect diagnoses may be propagated until they are removed.

-Anchoring errors

- Anchoring errors are when clinicians steadfastly, persistently cling (adhere or stick)to an initial impression even as conflicting and contradictory (inconsistent) data accumulate.
-For example, a working diagnosis of acute pancreatitis is quite reasonable in a 60-yearold man who has epigastric pain and nausea, who is sitting forward clutching his abdomen, and who has a history of several bouts of alcoholic pancreatitis that he states have felt similar to what he is currently feeling.

-However, if the patient states that he has had no alcohol in many years and has normal blood levels of pancreatic enzymes, clinicians who simply dismiss or excuse (e.g., the patient is lying, his pancreas is burned out, the laboratory made a mistake) these conflicting data are committing an anchoring error.

-Clinicians should regard conflicting data as evidence of the need to continue to seek the true diagnosis (acute myocardial infarction) rather than as anomalies to be disregarded.
-There may be no supporting evidence (ie, for the misdiagnosis) in some cases in which anchoring errors are committed.

Confirmation bias

-Confirmation bias is "cherry-picking," which means clinicians selectively accept clinical data that support a desired hypothesis and ignore data that do not.
-Confirmation bias often compounds an anchoring error when the clinician uses confirmatory data to support the anchored hypothesis even when clearly contradictory evidence is also available.

-For example, a clinician may steadfastly cling to patient history elements suggesting acute coronary syndrome (ACS) to confirm the original suspicion of ACS even when serial ECGs and cardiac enzymes are normal.

-Attribution errors

-Attribution errors involve making decisions based on negative stereotypes, which can lead clinicians to ignore or minimize the possibility of serious disease.
-For example, clinicians might assume that an unconscious patient with an odor of alcohol is "just another drunk" and miss hypoglycemia, ketosis, or intracranial injury, or they might assume that a known drug abuser with back pain is simply seeking drugs and miss an epidural abscess.
-Psychiatric patients who develop a physical disorder are particularly likely to be subject to attribution errors because not only may they be subject to negative stereotyping but they often describe their symptoms in unclear, inconsistent, or confusing ways, leading unwary (careless)clinicians to assume their complaints are functional in nature.

Affective error

-Affective error involves letting personal feelings (positive or negative) about a patient affect decisions.
-For example, avoiding unpleasant but necessary tests or examinations because of fondness or sympathy for the patient (eg, avoiding a pelvic examination and STD testing on a patient who is religious or a highly positioned executive or avoiding blood cultures on a seriously ill patient who has poor veins).
-Similarly, affective error includes failing to pursue a standard evaluation on an unlikeable patient (eg, minimizing the significance of dyspnea in a verbally abusive patient or someone with chronic obstructive pulmonary disease who continues to smoke).

-Risk Factors for Cognitive Error
-Internal and external factors can increase the risk of cognitive error.

1. Internal factors include Medical knowledge, training, and experience
-Fatigue/sleep deprivation Balance between being risk accepting/risk averse

2. External factors include
-Workload
-Distractions
-Team resource management and peer pressures

Minimizing cognitive errors

-Some specific strategies can help minimize cognitive errors.
-Typically, after history and physical examination are done, clinicians often form a working diagnosis based on heuristics.
-At this point, it is relatively easy to insert a formal pause for reflection, asking several questions:
1-If it is not the working diagnosis, what else could it be?
2-What are the most dangerous things it could be?
3-Is there any evidence that is at odds with the working diagnosis?
-These questions can help expand the differential diagnosis to include things that may have been left out because of cognitive errors and thus trigger clinicians to obtain further necessary information.

-Clinical decision support system (CDSS):

-is an interactive decision support system (DSS) Computer Software, which is designed to assist physicians and other health professionals with decision asking tasks, such as determining diagnosis of patient data.
OR:
-"Clinical Decision Support systems link health observations with health knowledge to influence health choices by clinicians for improved health care".
-A clinical decision-support system is any computer program designed to help health professionals make clinical decisions. ϖ In a sense, any computer system that deals with clinical data or medical knowledge is intended to provide decision support.
-It is a major topic of artificial intelligence in medicine and as a functional concept.

Alternative (more specific) Definition

-Clinical decision support systems are active knowledge systems which use two or more items of patient data to generate case-specific advice.

-Main components:

1-Medical knowledge

2-Patient data

3-Case-specific advice

-need for clinical decision support:

1. Medical error

-Evidence for unacceptable frequency of avoidable mistakes in hospitals has been referred to. Some hospital admissions led to adverse events, disabilities were permanent, contributed to death; half of which were considered preventable.

2. Service failures

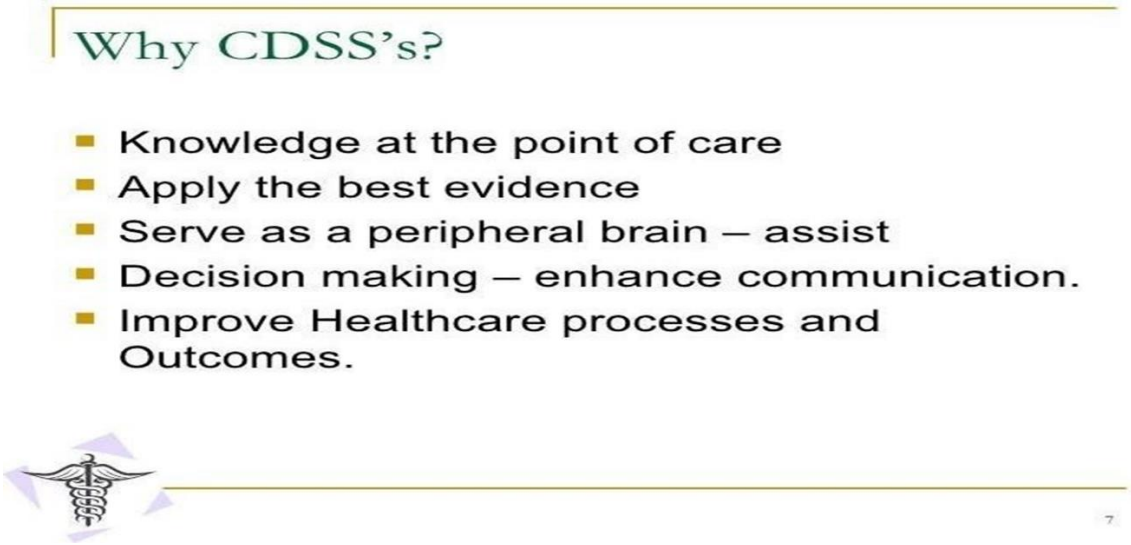
-Routine clinical practice can deviate from the best quality standard

3. The knowledge crisis

-medical knowledge is expanding also medical technologies and capabilities have progressed over the last few decades, whilst the practices and skills within the medical profession have struggled to keep up.

-The disparity between human capabilities and knowledge, be possible to achieve has led to the undesirable situation in which patients receive varying levels of care.

-The challenge is to integrate the vast pool of existing knowledge relevant to the care of any specific patient and deliver it in an effective and patient-specific manner at the point of care.



-Role & Characteristics

-A clinical decision support system has been coined as an "active knowledge systems, which use two or more itemsof patient data to generate case-specific advice."

-This implies that a CDSS is simply a Diagnostic Support System that is focused on using knowledge management in such a way to achieve clinical advice for patient care based on some number of items of patient data.

-Categories:

1-Diagnostic

2-assistance

3-Therapy planning

4-Image recognition and interpretation

5-Lab investigation interpretation

-Tools for Patient-Specific Consultation

-Provide modified assessments or advice based on sets of patient-specific data:

1-Suggest differential diagnoses

2-Advice about additional tests and examinations

3-Treatment advice (therapy, surgery, …)

-Characterizing Decision-Support Systems

1-System function

-Determining what is true about a patient (e.g.correct diagnosis)
-Determining what to do (what test to order, to treat or not, what therapy plan …)

2-The mode for giving advice

-Passive role (physician uses the system when advice needed)
-Active role (the system gives advice automatically under certain conditions

-Functions

-Four key functions of electronic clinical decision support systems are outlined:

1."Administrative: Supporting clinical coding and documentation, authorization of procedures, and referrals.

2 "Managing clinical complexity and details: Keeping patients on chemotherapy protocols; referrals follow-up, and preventive care.

3."Cost control: Monitoring medication orders; avoiding duplicate or unnecessary tests.

4."Decision support: Supporting clinical diagnosis and treatment plan processes; and promoting use of best practices, condition-specific guidelines, and population-based management

-Purpose/Goal

-The main purpose of modern CDSS is to assist clinicians at the point of care.
-This means that a clinician would interact with a CDSS to help determine diagnosis, analysis, etc. of patient data.
-use the CDSS to accurately make decisions for the clinician.
-The clinician would input the information and wait for the CDSS to output the "right" choice and the clinician would simply act on that output.

-Typically, the CDSS would make suggestions of outputs or a set of outputs for the clinician to look through and the clinician officially picks useful information and removes erroneous CDSS suggestions.

-computerized decision support systems (CDSSs) can improve clinical performance and patient outcomes
-CDSS, with the potential to minimize practice variation and improve patient care, CDSS provide clinicians, staff, patients, and other individuals with knowledge and person-specific information, intelligently filtered and presented at appropriate times, to enhance health and health care and to improve quality.
-promoted the importance of electronic medical records (EMRs), there has been a slow but increasing adoption of health intelligence technology (IT).
-Further, although EMRs with computerized provider order entry (authorized access) can improve accessibility and legibility of information, it is unlikely that there will be major improvements in the quality and cost of care from the use of health IT.

-There are two main types of CDSS:
1. Knowledge-Based
2. Non Knowledge-Based

-An example of how a CDSS might be used by a clinician comes from the subset of CDSS, DDSS (Diagnosis Decision Support Systems).
-A DDSS would take the patients data and propose a set of appropriate diagnoses. The doctor then takes the output of the DDSS and figures out which diagnoses are relevant and which are not.
-Another important classification of a CDSS is based on the timing of its use. Doctors use these systems at point of care to help them as they are dealing with a patient, with the timing of use as either pre- diagnoses, during diagnoses, or post diagnoses.

-Pre-diagnoses CDSS systems are used to help the physician prepare the diagnoses.
-CDSS used during diagnoses help review and filter the physician's preliminary diagnostic choices to improve their final results.

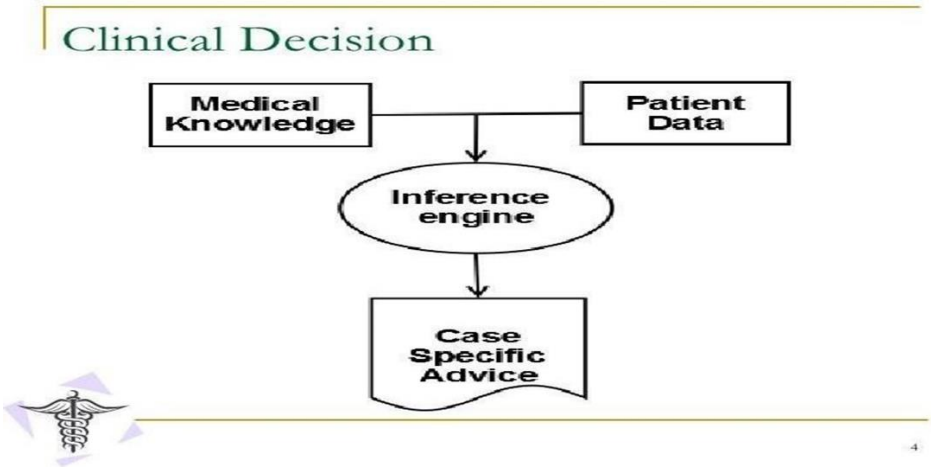
-And post-diagnoses CDSS systems are used to extract data to derive connections between patients and their past medical history and clinical research to predict future events

-Features of a Knowledge-Based CDSS:

-Most CDSS consist of three parts, the knowledge base, inference engine, and mechanism to communicate.

-The knowledge base contains the rules and associations of compiled data which most often take the form of IF-THEN rules.
-If this was a system for determining drug interactions, then a rule might be that IF drug X is taken AND drug Y is taken THEN alert user.

-Using another interface, an advanced user could edit the knowledge base to keep it up to date with new drugs.
-The inference engine combines the rules from the knowledge base with the patient's data.
-The communication mechanism will allow the system to show the results to the user as well as have input into the system.



Features of a non-Knowledge-Based CDSS:

-CDSS's that do not use a knowledge base use a form of artificial intelligence called machine learning, which allow computers to learn from past experiences and/or find patterns in clinical data.
-Two types of non-knowledge-based systems are artificial neural networks and genetic algorithms.

1. Artificial neural networks or more generally neural networks use nodes and weighted connections between them to analyze the patterns found in the patient data to derive the associations between the symptoms and a diagnosis.

-This eliminates the need for writing rules and for expert input.

-However, since the system cannot explain the reason, it uses the data the way it does, most clinicians don't use them for reliability and accountability reasons.

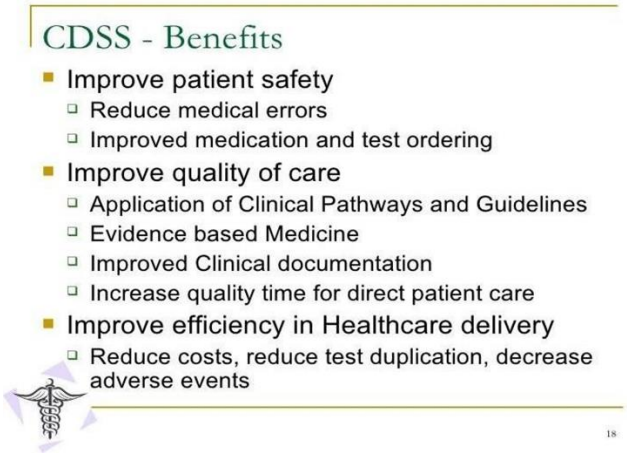
2. Genetic Algorithms are based on simplified evolutionary processes using directed selection to achieve optimal CDSS results.

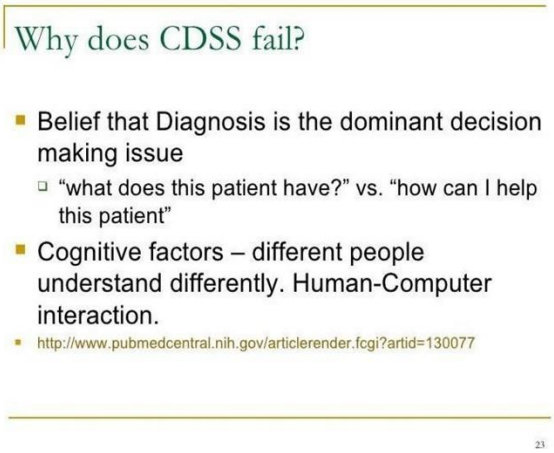
-The selection algorithms evaluate components of random sets of solutions to a problem. The solutions that come out on top are then recombined and mutated and run through the process again.

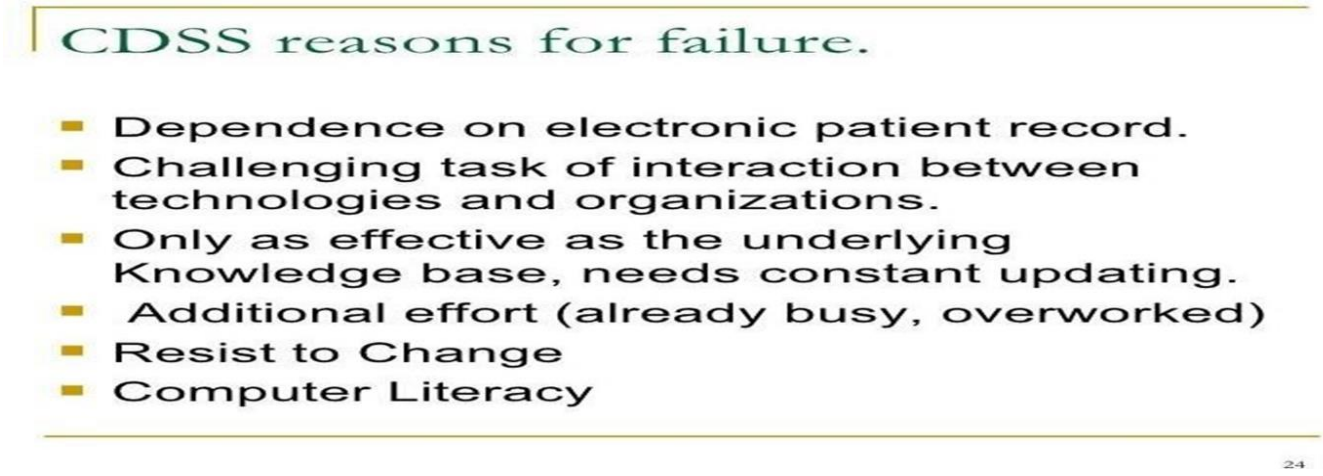
-This happens over and over until the proper solution is discovered.

-They are the same as neural networks in that they derive their knowledge from patient data.

-non-knowledge-based networks often focus on a narrow list of symptoms like ones for a single disease as opposed to the knowledge-based approach which cover many different diseases to diagnosis







-Target Area of Care: -

1. Preventive care: Immunization, screening, disease management guidelines for secondary prevention.

2. Diagnosis: Suggestions for possible diagnoses that match a patient's signs and symptoms

3. Planning or implementing treatment: Treatment guidelines for specific diagnoses, drug dosage recommendations, alerts for drug-drug interactions

4. Follow up management: Corollary orders, reminders for drug adverse event monitoring

5. Hospital, provider efficiency: Care plans to minimize length of stay, order sets

6. Cost reductions and improved patient convenience: Duplicate testing alerts, drug formulary guidelines

-Challenges to Adoption

-Clinical Challenges

-Much effort has been put forth by medical institutions and software companies to produce viable CDSSs to cover all aspects of clinical tasks.

-However, with the complexity of clinical workflows and the demands on staff time high, care must be taken by the institution deploying the support system to ensure that the system becomes a fluid and integral part of the workflow.

-Despite the wide range of efforts by institutions to produce and use these systems, widespread adoption and acceptance has still not yet been achieved for most offerings.

-Technical Challenges & Barriers to Implementation: -

-Clinical decision support systems face steep technical challenges in a number of areas.

-Biological systems are profoundly complicated, and a clinical decision may utilize an enormous range of potentially relevant data.

-Generally extra steps are required of the clinician which then causes a disruption in workflow affecting efficiency.

Potential drawbacks related to the use of CDSSs

1. Potential 'deskilling' effect

2. Can be perceived as a threat to clinical judgment

3. Can be considered too inflexible (can appear prescriptive, can appear to direct proceedings; can be difficult to depart from ordered, pre-prepared paths)
4. Promote over-reliance on software; limit clinicians' freedom to think?
5. Difficult to evaluate - lack of accepted evaluation standards
6. Can be time-consuming to use, possibly lead to longer clinical encounters and create extra work
7. Uncertain and untested ethical and legal status
8. Costs: maintenance, support and training required after initial outlay
9. A clinician's experience and imagination cannot be duplicated in a computer application