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Rational Mind and Heuristics in Medical Diagnostic Decision Making

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The medical diagnostic label is the most important process in patient management. The decision process involves the thinking process of the caregiver which operates differently in emergencies and outpatient clinic. The heuristics aspect of the mind is more efficient in dealing with emergencies and the slower analyzing mind in outpatient setting. The heuristic approach is useful in rapid decisions and management of emergencies whereas the slower stepwise approach in outpatient treatment will help in reducing investigations, medical errors and cost of care. The article also gives an evidence based template for predicting the disease process based on positive and negative likelihood ratios.

Keywords: Diagnostic decision; Emergency; Heurestics; Outpatient; Evidence based template.

1. INTRODUCTION

Diagnostic decisions are not easy but very crucial. The diagnosis is a vital part in patient care as it not only affects the patient but the society at large. Diagnostic errors appear to be the most common, most costly and most dangerous of medical mistakes [1]. The outpatient diagnostic errors are as high as 5.08% and half of this could be potentially harmful [2].

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The diagnosis is finally done by the caregiver and diagnostic label will guide the expensive investigations and management of the patient. The rapid escalation in the cost of medical care and a large number of patients still being treated in resource deprived settings makes it essential for the caregiver to utilize history and clinical examination as the most important tool in the diagnostic process. The statistical parameters of objectivity employed in lab parameters and therapeutics if applied to history taking and clinical examination will yield more value cost effectively which is called the practice of evidence based clinical examination. This practice needs effort from the caregiver. The article tries to explore this decision making process to make it more effective in the diagnosis. The technical definition of heuristics is a simple procedure that helps find adequate though often imperfect, but rapid answers to difficult questions. The technical definition of rational is consistent with or based on reason or logic. An unbiased appreciation of uncertainty is the cornerstone of rationality. The article is an attempt to look at the diagnostic decision making.

The decision making in medical disorders was analyzed to see the working of human mind from Evidence Based Medicine resources such as cochrane library, British medical journal updates and Journal of American medical association.

The decision making is an important aspect in the field of medicine. The diagnostic process involves the synthesis of data available from the patient and the evidence regarding the disease in medical literature. This synthesis determines the diagnosis and management of the patient.

The human mind works as 2 selves namely system 1 and system 2 [3].

Heuristics is system 1.

The characteristics of system 1 are:

1. Generates impressions and feelings,
2. Can be programmed by system 2 to mobilize attention when a particular pattern is detected,
3. Operates immediately,
4. Executes skilled responses and generates skilled intuitions when trained adequately,
5. Distinguishes surprise from normal,
6. Focuses on existing evidence-what you see is all there is(WYSIATI),
7. Represents sets by norms and prototype,
8. Computes more than intended (shot gun approach),
9. Frames decision problems narrowly, in isolation from one another and
10. Over weights low probabilities.

The review of diagnosis decision making revealed that system 1 is activated for emergencies where time is the crucial factor. This is the basic premise for protocols which are operational in casualties and emergency wards of well managed hospitals. This has created the need for intensive care unit protocol books. The same heuristic based approach has driven the Basic Life Support/Advanced Cardiac Life Support algorithms which are time bound. The ACLS/BLS guidelines are based on expert opinion, retrospective studies and animal research because no Randomized Controlled Trials can be done for resuscitative research and reflects heuristic thinking. The heuristic thinking has also reduced the mortality in medical emergencies like acute myocardial infarction, stroke and anaphylaxis where guidelines are formed by a combination of evidence and heuristic thinking by professional bodies.

The efficacy of system 1 is also reflected in the recent emergence of emergency medicine as a distinct course in the curricula of medical teaching.

The application of heuristics is also reflected in dedicated emergency and intensive care unit teams which manage only emergencies in organized health care settings.

The system 1 is prone for following type of heuristic errors namely 1) Representation, 2) Availability, 3) Association, 4) Illusion of validity and 5) Framing effect.

The system 2 has to operate overcoming the biases of system 1. The system 2 controls and guides system 1 when activated and reduces the errors. The system 2 operates more elaborately collecting all the facts pertaining to the situation. The system 2 also generates questions and operates leisurely. There is scope for rethinking, revising and contemplation.

The bias or weakness of system 1 is as follows:

1. Association heuristics; Statistics gives objectivity to opinions because it considers what is known as chance occurrence. Events happen randomly. There is no

causative factor for events and there need not be a coherent pattern for the occurrence. Statistics trumps causes. System 2 needs to tame the intuitions. The information supporting the hypothesis should be given more validity rather than the coherence of the concept.

2. Availability heuristics; the process of judgment based on the ease which instances come to the mind. This process is a big contributor for bias and was defined by Norbert Schwarz [4]. Baseline predictions based on medical statistics to be relied upon rather than uniqueness of cases.
3. Judging probabilities based on representativeness neglecting base-rate information. Bayes rule [5] specifies how prior beliefs should be combined with the diagnosticity of the evidence the degree to which it favors the hypothesis over the alternative.
4. Overconfidence: Halo effect, illusion of validity. Mechanical combinations of few variables can outperform the subtle complexity of human judgment. Algorithms need to be respected rather than intuitions [6].
5. Combined evaluation of facts before decisions rather than considering a single parameter to get over the anchoring effect. Openness for reversal or reconsideration is a important attribute. Reality bound decisions rather than frame bound decisions are arrived at by a broader and all inclusive approach.

The traditional teaching in clinical medicine was focused on the history and clinical examination for a list of differential diagnosis. The review of diagnostic decisions based on evidence based approach model revealed that the system 2 is activated in a programmed manner and gives rational management decisions in tune with the latest available evidence [7]. The evidence based approach in management not only overcomes the bias of heuristic approach but also combines the heuristic mind with the rational mind in diagnostic decisions.

The association availability and representative bias is overcome by the use of statistics in the decision making model.

The statistical parameters employed are [8].

2. PATIENT RELATED

1. Prevalence-proportion of all individuals who have the disease.

2.1 Symptom or a Group of Symptoms and Physical Sign Related

1. Sensitivity-the proportion of true positives who are test positive.
2. Specificity-the proportion of true negatives who are test negative.
3. Positive predictive value-proportion of test positives who are true positive.
4. Negative predictive value-proportion of true negatives who are true negative.
5. Kappa-it is a statistical parameter that measures the agreement between 2 raters where response can fall into any of a number of categories.

Interpreting kappa
<.00-poor
.00-.20-slight
.21-.40-fair
.41-.60-moderate
.61-.80-good
.81-1.00-very good

2.2 Disease Related

1. Likelihood ratio(LR)-+LR tells us how likely is that a result is a true positive rather than a false positive.

A +LR >10 causes a large shift in disease probability and are very useful for ruling in disease ,+LR 5-10 cause a moderate shift in probability.

A -LR tells us how likely a result is false negative rather than a true negative. A-LR less than 0.1 causes a large shift in disease probability and are very useful in ruling out a disease. An -LR between 0.1 and 0.5 cause a moderate shift in probability.

The LRs are not dependent on the prevalence of the disease. They give a strong idea regarding the probability of the disease and are available in evidence based clinical diagnosis manuals.

2. Odds-the odds of having the disease is defined as follows-

   Pretest odds=prevalence/1-prevalence
   Post test odds=pretest oddsxLR

3. Pretest and Post test probability

   The pretest probability is arrived at by taking the prevalence, bhistory and physical examination. The posttest probability is calculated from the posttest odds or normograms. The test refers to historical features and clinical signs.

The difference between odds and probability is that the odds give the ratio between the diseased and non- diseased group. The probability gives the proportion of diseased to the combined group of those with disease and those without disease.

In the evidence based approach, the diagnostic process involves estimating the pretest probability [3]. The parameters to consider in fixing the prior probability are

a) Prevalence in the area from available literature, experience.
b) Clinical setting which may be outpatient, emergency ward and co morbid conditions.
c) Individual patient profile which includes age, gender, habits and occupation.

The emphasis is on reducing the differential by pausing at this time and looking at the *overall scenario* based on a broader perspective. The history and clinical examination which are more objective will help in arriving at a stronger probability and establishing the testing and treatment thresholds.

The utilization of resources of evidence based clinical medicine. The review of literature for studies which are valid, accurate and precise is a exhaustive process which requires diligence and the ability to understand errors in the background of statistics. The Journal of American Medical Association has a continuing series of articles which have looked into the precision, accuracy and validity of studies dealing with clinical diagnosis and is a valuable source of Likelihood Ratio for the physical signs [9].The kappa statistics from evidence based resources will give the reliability of the physical signs. Articles where the errors are minimum and pass the scrutiny of validity are used for deriving the LR and pretest probability [10,11].

The Halo effect and anchoring bias are overcome by the following steps in the evidence based decision model:

The differential diagnosis will have a leading hypothesis, not to miss diagnosis (diseases which can cause loss of life or limb) and active alternates [12].

There is a focus on establishing a treatment threshold and test threshold for the effective and early management of the patient rather than arriving at an absolute diagnosis based on gold standard. The tests are done in a more logical manner based on evidence and at times treatment initiated without tests depending upon the clinical situation. The focus is on early treatment with minimum delay and optimal investigations supported by the available evidence in literature.

To make use of evidence based validated scales and algorithms (when available) in choosing tests and deciding treatment. Prediction scales are available for common diseases like strep throat, Irritable bowel syndrome and deep vein thrombosis. Screening guidelines are available for common diseases like hypertension, diabetes, colon and breast cancers.

The lab tests are ordered considering the operating characteristics of the test. The operating characteristics of a lab test are a) Sensitivity, b) Specificity, c) Reliability, d) accuracy and positive/ negative predictive values of the test. For diagnostic decisions the positive/negative predictive values of the test are of paramount importance and this operating characteristic is highly dependent upon the prior probability of the disease. The prior probability of the disease is to be calculated by the caregiver and enhances or reduces the predictive value of the test. Tests with high sensitivity are ordered for diagnosis and tests with high specificity are ordered for confirmation of the disease. A step wise approach for ordering tests is recommended rather than a battery of tests [13]. The tests are ordered when the testing threshold is reached in the diagnostic process.

Management decisions are based on post test probability of disease which is arrived at by either the Bayers theorem or easily available normograms.

The case in example for rational decision making is pulmonary embolism. Clinical scoring systems such a Wells and the revised Geneva score have outlined what to look for but not how to look for in medical decision making. Emerging evidence illustrates that the physician Getsalt may perform better than the sole reliance on scoring systems. The Getsalt theory is a German concept which in simple terms means that the whole is not the

sum of its parts but greater than the sum of its parts. The caregivers heuristic judgment in conjunction with evidence based validated scoring systems is very effective in deciding the most likely diagnosis [14,15].

The combined approach in decision making reduces medical errors, medico-legal issues and the cost of medical care if implemented effectively.

3. DISCUSSION

Decision making is an important process for every doctor. The decision making can be broadly categorized under 2 headings namely the Emergency setting and outpatient setting.

1. Emergency setting: The decision process needs to be rapid for obvious reasons. It is a matter of minutes for cardiac and neurological emergencies where time is muscle and brain. The system 1 is activated and needs to respond quickly. All the characteristics of system1 are useful for reaching quick decisions based on the evidence available at the time of presentation. The prior skill acquired and honed over time will give a good working diagnosis and timely interventions can be done. The key words are skill acquired and honed over time. A team dedicated to emergency work can achieve wonders in emergency patient management. The system1 which is adequately equipped in knowledge and experience will achieve good results in quick time as short term outcomes are more important.
2. Outpatient setting: The decision making process involves long term goals in this setting. Time is less important and the diagnosis needs to consider all the bias in the diagnostic process and a more comprehensive approach needs to be adopted. The proper selection and avoidance of unnecessary investigations can be done by utilizing system 2 which is more rational. There is a role for followup and stepwise approach for the diagnosis. There is also scope for reconsidering decisions and outside view in the diagnostic process. The activated system 2 will go a long way in the efficient management of the patient. The combination of both systems is most effective as illustrated in the case of pulmonary embolism.

4. CONCLUSION

There is a role of both the systems of the mind in evidence based decisions in the management of patients. A properly equipped and trained system1 needs to play a dominant role in the emergency setting. The activated and time consuming system2 needs to be more involved in the outpatient setting .The combination of system1 and system can probably give the most likely diagnosis in both outpatient and emergency setting.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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