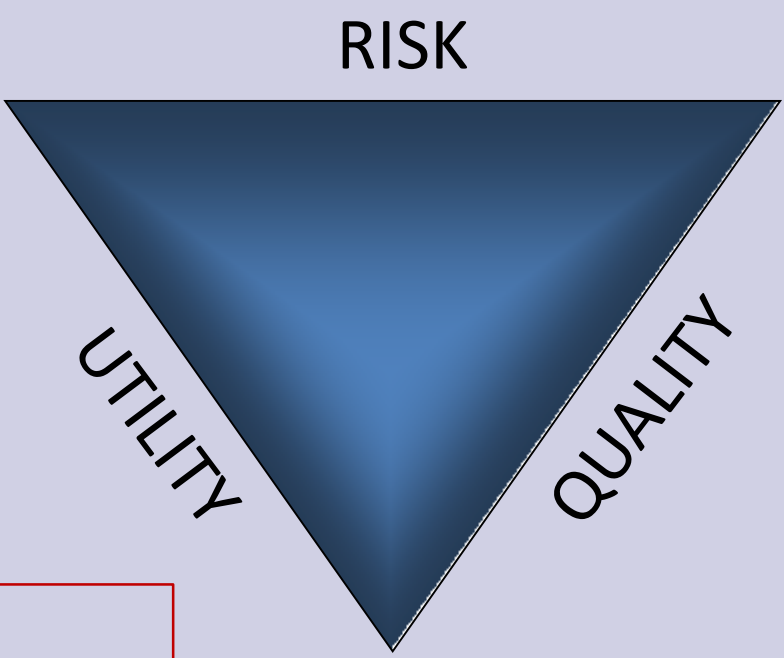


# CRITICAL JOURNAL ARTICLE REVIEW CAN

## REDUCE SYSTEMIC DIAGNOSTIC AND THERAPEUTIC ERROR IN MEDICINE

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1. Describe how growing complexity of medicine has made it difficult for the average physician to validate published journal articles in private practice
2. Recognize how authors can mislead the average reader into agreement with unfounded conclusions
3. Explain how misuse of complex statistical analysis and small changes in clinical criteria can lead to systemic diagnostic and therapeutic error

### SITUATION

In the past, limited therapeutic options made accurate and timely diagnosis less important than the succoring of the patient. Today, errors in diagnosis are much more evident than in the past. Why? Because, today, rapid advancements in diagnostic methods combined with more effective therapeutic modalities has made it less acceptable to fail to make a diagnosis, make the wrong diagnosis, or make a delayed diagnosis. The pressure this exerts on our profession has led to diagnosis based more on conclusions published by a growing, and, to a great degree, profligate journal literature and less upon judgment borne of careful validation of these conclusions tempered by experience. Furthermore, the complexity and obscurity of the statistical models used to validate academic and commercial inquiry have amplified the potential increased risk of establishing inherently flawed diagnostic criteria as standards of care.

### PROBLEM

How do we verify journal article conclusions prior to accepting them into our practice and how do we validate these conclusions in our daily practice of medicine to effectively reduce the potential for systematic flawed diagnostic criteria so as to:

- RISK:** → Maintain patient safety
- QUALITY:** → Minimize pain and discomfort
- UTILITY:** → Maximize efficiency and minimize cost

Through accurate, timely diagnosis?

### SOLUTION

In order to solve this systematic diagnostic problem we need to establish the following:

- ➔ Proper **Orientation** in our responsibilities to patient care, not diagnostic fads
- ➔ Appropriate **Education** in Logic, Statistics, and The Scientific Method
- ➔ **Training** in the use of these three tools in **critically evaluating** journal articles
- ➔ Establishing what is **Acceptable Risk** in applying specific diagnostic criteria
- ➔ **Monitoring outcomes** for accepted diagnostic criteria to **assure clinical validity**
- ➔ **Guarding** against the dissemination of inappropriate diagnostic criteria

These difficult goals are critical to **Reduce Diagnostic Error in Medicine**. Failure to achieve them leads to efforts to accurately apply faulty criteria – a waste of time.

### IMPLEMENTATION

Over the past six years I have developed a Laboratory Tour for second Year Medical students that introduces them to the underlying logic and statistical aspects of the generation of laboratory test results related to uncertainty. This includes an actual physical tour combined with a series of questions and demonstrations along with a brief introduction to problems they will face when reading the professional literature as they progress in their profession.

This is followed up with a presentation to fourth year Medical Students and Internal Medicine residents focusing on the theoretical and operational approach to critical journal reading with specific examples taken from the literature extending back over a 100 year period that shows how pervasive and persistent errors in diagnostic criteria or underlying test modalities can adversely affect our patients.

### EXAMPLE LECTURE SLIDES

**JOURNAL ARTICLES RELY HEAVILY ON STATISTICAL ANALYSIS. THIS MEANS OUR PRACTICE OF MEDICINE DOES LIKE WISE. THEREFOR IT'S CRITICAL WE UNDERSTAND THE PITFALLS.**

#### UNINTENTIONAL DUE TO LACK OF UNDERSTANDING:

- ➔ Doing the study prior to choosing which statistics to use.
- ➔ Applying the wrong statistical test to the particular population distribution.
- ➔ Not understanding the meaning of the statistical outcome.
- ➔ Trying to prove their hypothesis instead of the null hypothesis.
- ➔ Unknowingly introducing various bias' or making implicit assumptions.
- ➔ Not properly controlling variables that affect the outcome of their experiments.

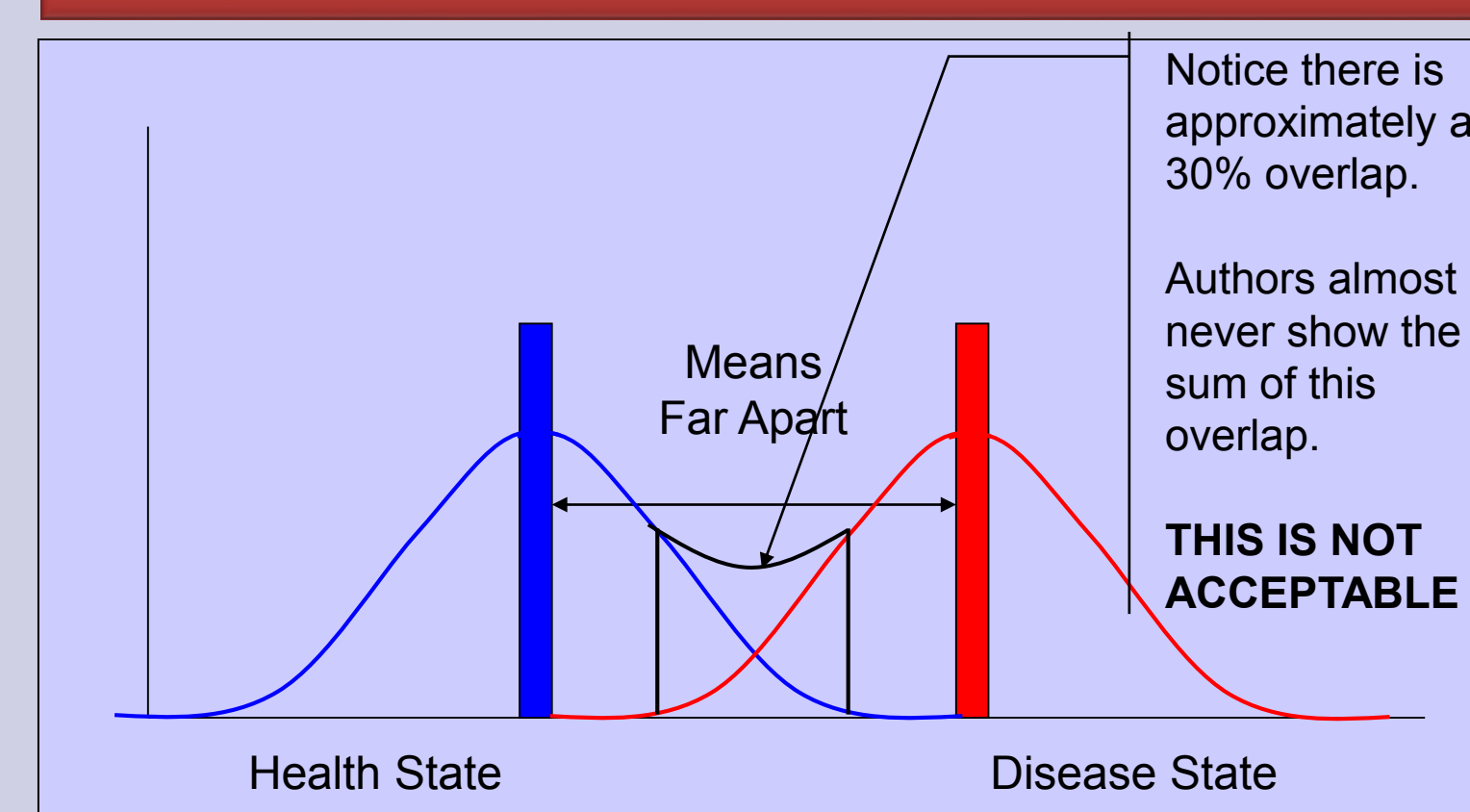
#### INTENTIONAL TO HIDE LACK OF EVIDENCE THROUGH:

- ➔ Concealment of the real implications of the data presented.
- ➔ Misinterpretation of the significance of the statistical outcome.
- ➔ Obfuscation through distortion of data presentation.
- ➔ Dropping data that supports the null hypothesis.
- ➔ Leaving out critical stratification and/or control information.

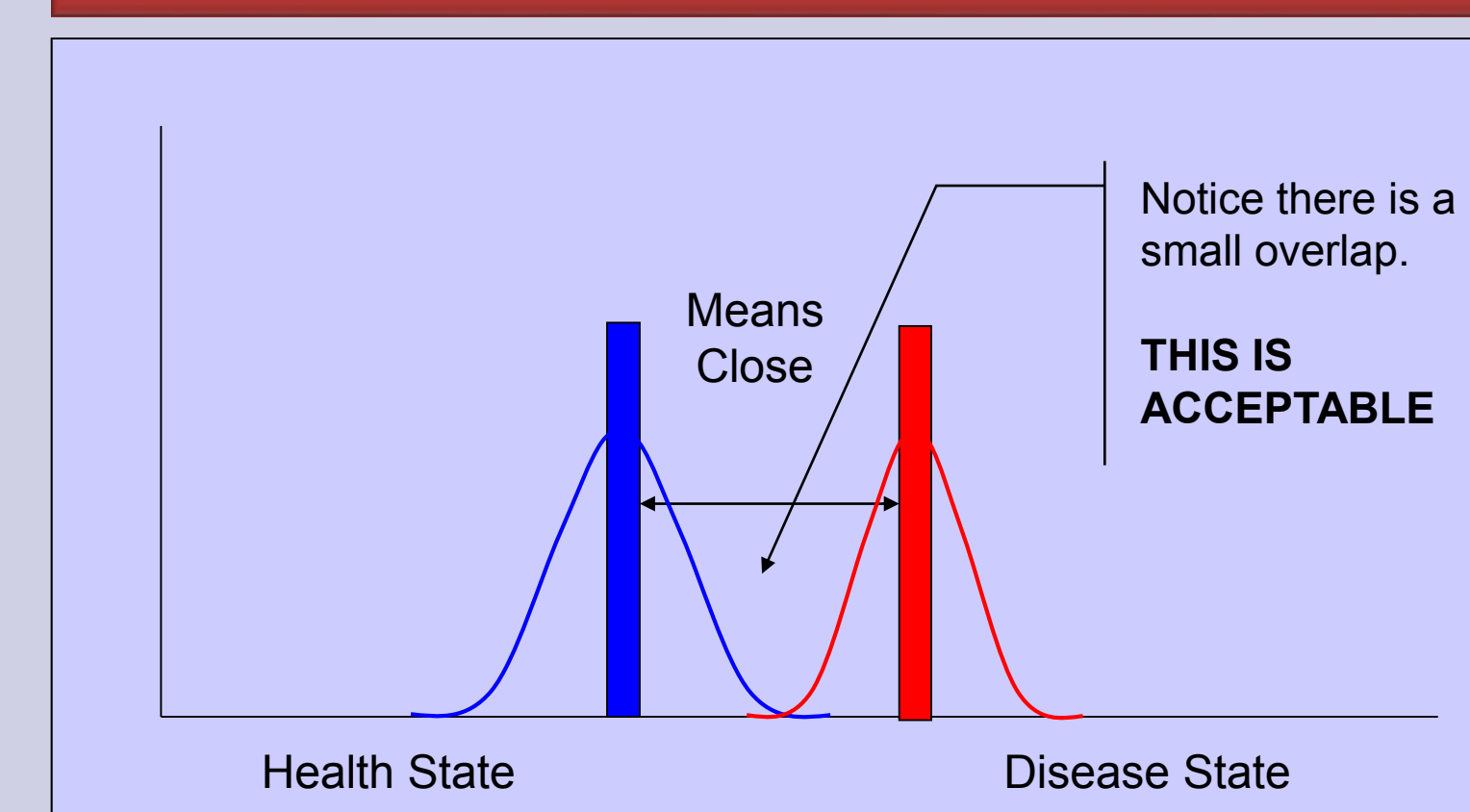
**HOW ARE THE POPULATION AND SAMPLE POPULATION CHOSEN? BELOW ARE JUST A FEW QUESTIONS YOU SHOULD ASK WHEN READING AN ARTICLE:**

<b>POPULATION CHOSEN</b>	Does it match the population we will treat or is it a population with much higher incidence of the disease?
<b>SAMPLING TECHNIQUES</b>	Is the sample truly representative or affected by unstated or unknown factors?
<b>SMALL SAMPLE SIZE</b>	Is it too small to be representative and capable of testing the null hypothesis?
<b>LARGE SAMPLE SIZE</b>	Is it so large it increases sensitivity to changes that are not clinically significant.
<b>RESPONSE BIAS</b>	Are patients self chosen or are they stratified by such factors as being referred to the study by some method?
<b>OVERT BIAS</b>	Have the researchers eliminated certain patients that would invalidate the hypothesis by inappropriate criteria?
<b>MISSING DATA</b>	How many patients have dropped out, for what reason, and has this been examined for its impact on the results?

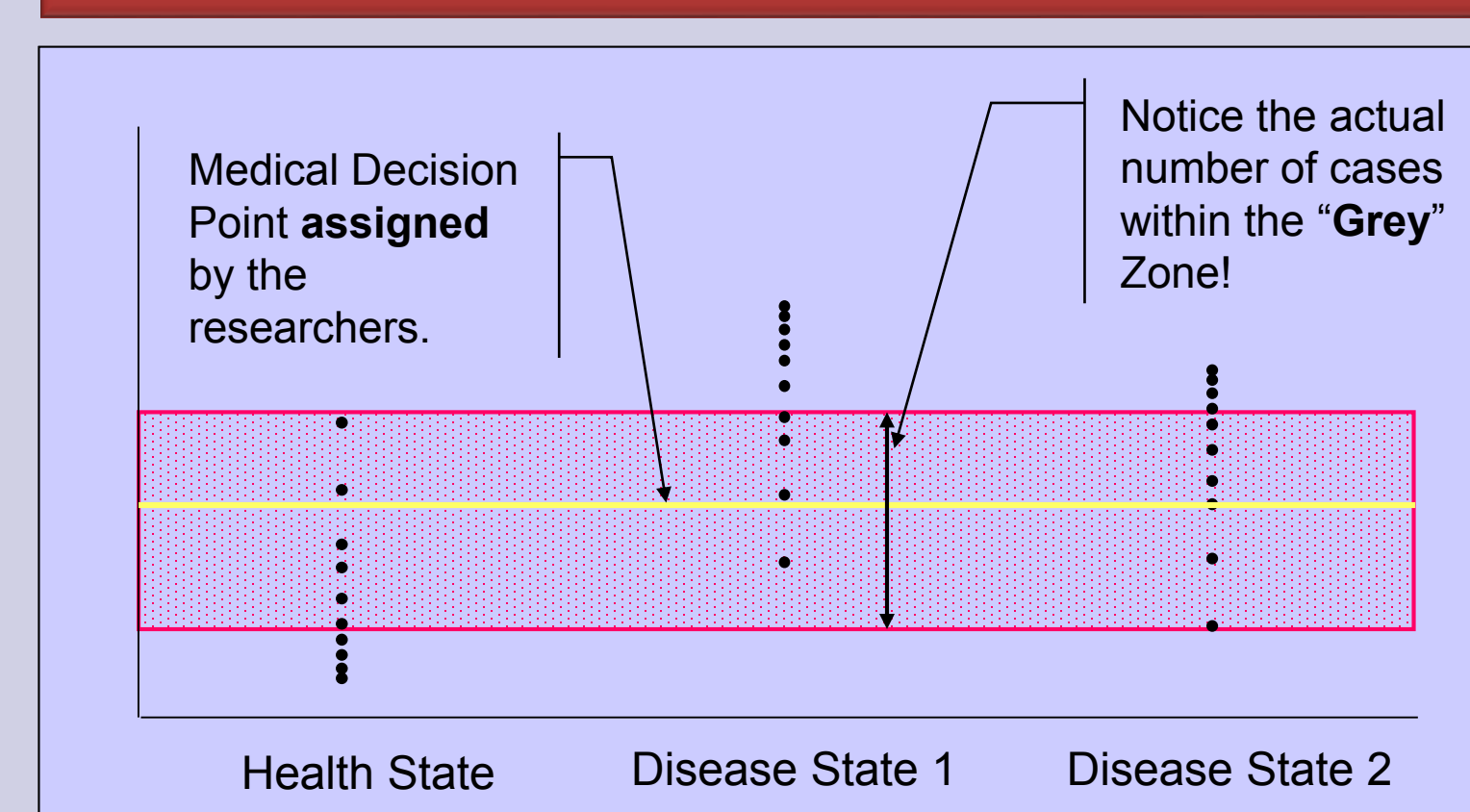
**IT APPEARS THIS TEST HAS GOOD DISCRIMINATORY CHARACTERISTICS BASED ON THE DISTANCE BETWEEN TEST RESULT MEANS.**



**IT APPEARS THIS TEST HAS POOR DISCRIMINATORY CHARACTERISTICS BASED ON THE DISTANCE BETWEEN TEST RESULT MEANS.**



**IT APPEARS THIS TEST HAS GOOD DISCRIMINATORY CHARACTERISTICS BASED ON THE DISTANCE BETWEEN APPARENT TEST RESULT MEANS.**



**THE ACTUAL OVERLAP IN TEST RESULTS FOR ONE OR A VARIETY OF DISEASE STATES MAKES THIS LESS VALUABLE THAN IT FIRST APPEARED**

**OUR GREATEST CHALLENGE IS TO LIVE UP TO THE CAPABILITIES THAT MODERN SCIENCE HAS PLACED IN OUR HANDS AND THIS MEANS ACTING RATIONALLY.**

"Modern man needs a relation to facts, a self-justification to convince him [or her] self that by acting in a certain way, he [or she] is obeying reason and proved experience."  
Jacques Ellul

In other words, in a world that is so much based on the miraculous technology born of **rational scientific inquiry** we, the inhabitants of this world, have a deep seated need to act out that rationality to support our naturally irrational behavior.

As such, much of what we read and, therefore do as a result, is not rational by a long shot and it is this deep seated tendency toward irrational thought which has to be guarded against on a daily basis if we are to avoid harming our patients.

**REFERENCES – SELECTED:**

1. Stewart W, Feder N; **The Integrity of the Scientific Literature**; Nature Vol 325 p 207-214 Jan 1987
2. Ioannidis, J; **Why Most Published Research Findings are False**; PLoS Medicine Vol 2 No 8 p 0696-0701 Aug 2005.
3. Chan A, et al; **Empirical Evidence for Selective Reporting of Outcomes in Randomized Trials: Comparison of Protocols to Published Articles**; JAMA Vol 291 No 20 p 2457-2465 May 2004.
4. Ransohoff, D; **Bias as a Threat to the Validity of Cancer Molecular-Marker Research**; Nature Reviews | Cancer Vol 5 p 142-149 Feb 2005.
5. Smith, R; **The Science of Medicine: The Abuse of Logic**; American Clinical Laboratory p 28-29 Mar 1993.
6. Frankel C; **The Nature and Sources of Irrationalism**; Science Vol 180 p 927-931 Jun 1973.
7. Editorial; **Unreliable Research - Trouble at the Lab: Scientists Like to Think of Science as Self-Correcting. To an Alarming Degree, it is Not**; The Economist http://www.economist.com/node/21588057/print.

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### COST BENEFIT ANALYSIS

The up front cost of implementing such an endeavor is significant in terms of designing the course work, developing the presentation, and writing the course materials.

The ongoing cost of implementing such an endeavor is significant in terms of requiring the repeated presentation of these materials to small 6 – 7 person groups so as to directly challenge the students with questions and obtain feed back as to effectiveness of the presentation.

The long term benefits will take time to ascertain. However, students who have gone through this course often contact the educator with questions regarding appropriate utilization of clinical testing methodologies as promoted in the journal literature.

### EXAMPLE

To the left are a very small sampling of the contents of a 70 slide presentation given to the 4th year medical students and Internal Medicine residents. This is supplemented with a valuable tool set and flow chart for approaching article review in an open minded but skeptical, systematic, and logical way [Critical Thought!]. This includes:

Discerning what errors might have been committed or what bias' might have been at work that could have lead to inappropriate:

- ➔ Formulation of an hypothesis
- ➔ Overall design of the research or clinical trial
- ➔ Characteristics being measured or compared to test the hypothesis
- ➔ Presentation of the data making independent analysis difficult or impossible
- ➔ Analysis of this data leading to potentially wrong outcome in hypothesis testing
- ➔ Weighting of sensitivity and specificity ignoring the balance of clinical risk
- ➔ Interpretation of statistical results given actual incidence and prevalence data
- ➔ Reporting of the analytical results misleading the reader to the wrong conclusion
- ➔ Logic used to formulate conclusions regarding clinical applicability

By referring to this list of items during an article review, the reader begins to learn how to identify both strengths and weaknesses in an author's position and to assign a degree of trust in the validity of the conclusions put forth. This provides a means of deciding:

- ➔ Do the conclusions of the article arise from a well designed and executed methodology as well as appropriate and logical analysis?
- ➔ Is **Acceptable Risk** incurred by utilizing the article as the basis for clinical practice regarding patient safety, quality of service, and cost to the patient and society?

### CONCLUSION

Before we can even think about improving diagnostic medicine we must establish rigorous standards regarding:

- ➔ Establishment of **Scientific Fact** in the Medical Literature
- ➔ **Application of Logic** in Developing Diagnostic Criteria From These Facts
- ➔ **Validation** of Diagnostic Criteria in Routine Clinical Practice

Otherwise, our efforts to significantly **Reduce Diagnostic Error in Medicine** will yield paltry results in gaining control over an endeavor that consumes almost 20% of our entire economy – The Health Care Economy.