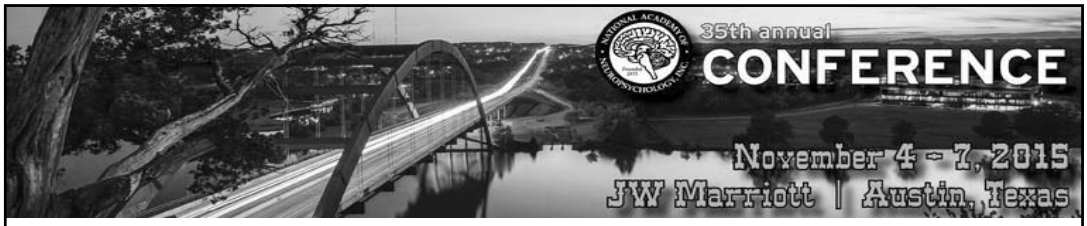
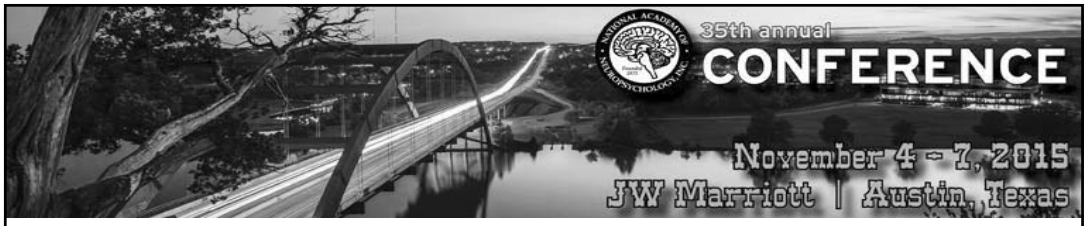


Reducing Uncertainty in Clinical Decision Making: The Role of the Evidence-based Practitioner

Gordon J. Chelune, Ph.D.
Professor, Department of Neurology
University of Utah School of Medicine



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b) Psychological Assessment Resources, INC

Reducing Uncertainty in Clinical Decision Making: The Role of the Evidence-based Practitioner

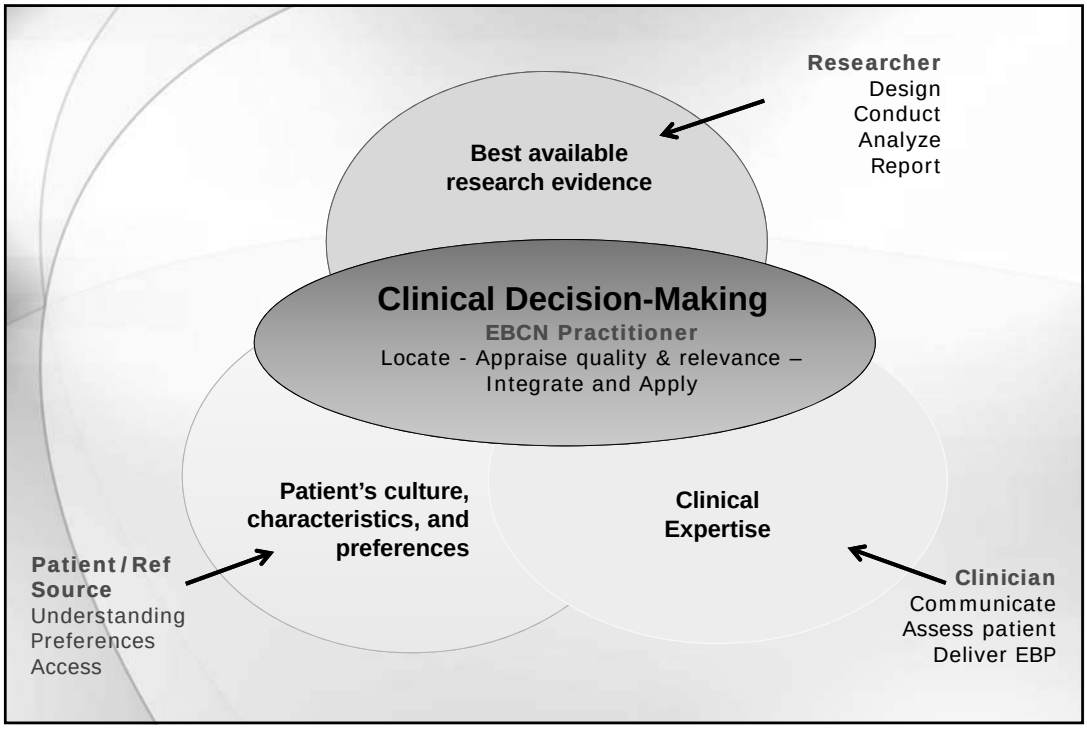
Learning Objectives:

As a result of attending this presentation, participants will be able to:

1. Assess the quality and applicability of published research in terms of the checklist criteria enumerated by the Standards for Reporting Diagnostic (STARD) accuracy studies initiative;
2. Extract base-rate information from published reports and apply this information to a patient's observed test scores to determine the Test Operating Characteristics (TOC) for those test scores; and
3. Apply Test Operating Characteristics information for a patient's specific scores to reduce uncertainty and inform clinical decision making in an evidence-based manner.

Evidence-Based Practice: General Components

- Integration of "best research"
- Clinical expertise
- Patient/Referral Source values



Who is the Evidence-Based Clinical Neuropsychological Practitioner (EBNP)?

A Clinical Neuropsychologist who uses …

A value-driven pattern of clinical practice that attempts to integrate "best research" derived from the study of populations to inform clinical decisions about individuals within the context of his/her expertise and individual patient values with the goal of maximizing clinical outcomes and quality of life for the patient in a cost-effective manner while addressing the concerns and needs of the provider's referral sources.

Adapted from Chelune, 2010

Clinical Significance of Tests

Patients "deserve decisions and recommendations that are founded increasingly upon empirical validation. The instruments chosen to produce data to resolve questions in a valid fashion should be selected for their power to reduce uncertainty with respect to those questions..."

Costa, JCN, 1983, p. 7.

Our ability "to reduce uncertainty" provides value to patient care

From Description to Outcomes

Every Patient Evaluation

- Represents a Clinical Outcome
- Every Test Score is part of the Outcome
- Can/Should be interpreted within context of Evidence-based Research

Clinical Outcomes

Clinical outcomes are individual events that are characterized by a change in status, performance, or other objectively defined endpoint.

To be useful in the care of patients, outcomes data must be analyzed and packaged in such a manner that they can be directly "used" by the end-user.

Outcomes data must be available to the end-user (clinician, policy-maker, insurance panel, etc.)

Chelune, 2002, 2010

Key Competencies in Evidence Based Practice

- Ask appropriate questions
- Acquire relevant data: Informatics skills in finding answers
- Appraisal skills in knowing what's good, bad, acceptable, etc.
- Applying results – skill in implementing assessment or intervention approach
- Assessing outcomes of practice – program evaluation

Asking: Well-Built Clinical Questions (PICO)

- Background: Do patients with AD and FTD have different patterns of semantic and phonemic fluency?
- Foreground: In patients with

Patient: Frontotemporal dementia

Intervention: patterns of phonemic and semantic fluency

Comparison: compared to Alzheimer's dementia

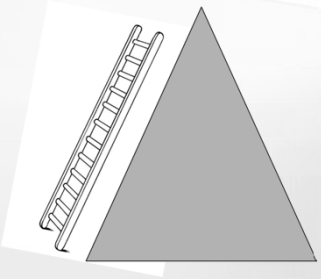
Outcome: are different (sensitive/specific)?

EBCNP: Individual Patient Application

- *Ask:* formulate the question
- *Acquire:* evidence - search for answers
- *Appraise:* the evidence for quality and relevance
- *Apply* the results
- *Assess* the outcome

Common "Types" of Evidence

- Editorials and Expert Opinions
- Case Series and Case Reports
- Case Controlled Studies
- Cohort Studies
- Randomized Cohort Studies
- Meta Analytic Studies



The Evidence Pyramid

Identifying "Best Research" is not easy

Incomplete and inadequate reporting of research hampers the assessment of the strengths and weaknesses of the studies reported in the medical and neuropsychological literature. Readers need to know what was planned (and what was not), what was done, what was found, and what the results mean.

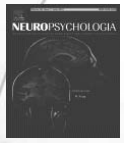
I fancy myself an EBCN…

I work in a Memory Disorders Clinic and am often faced with the question of differentiating AD from Frontotemporal Dementia (FTD). What tests or test signs might help me in making this differentiation?

I have read that differences between phonemic and semantic fluency can differentiate the two disorders.

I frame my question in the EBM PICO format and go to PubMed and do an advanced query under Clinical Queries to explore the Sensitivity and Specificity of Fluency Tests in differentiating AD from FTD

Meta Analysis



Neuropsychologia 42 (2004) 1212–1222

Verbal fluency performance in dementia of the Alzheimer's type: a meta-analysis

Julie D. Henry*, John R. Crawford, Louise H. Phillips

Abstract

A meta-analysis of 153 studies with 15,990 participants was conducted to compare the magnitude of deficits upon tests of phonemic and semantic fluency for patients with dementia of the Alzheimer's type (DAT) relative to healthy controls. As has been found for patients with focal temporal cortical lesions (but not for patients with focal frontal cortical lesions), DAT patients were significantly more impaired on tests of semantic relative to phonemic fluency ($r = 0.73$ and 0.57, respectively). Thus, since phonemic and semantic fluency are considered to impose comparable demands upon executive control processes such as effortful retrieval, but the latter is relatively more dependent upon the integrity of semantic memory, these results suggest that the semantic memory deficit in DAT reflects a degradation of the semantic store. Also supporting this conclusion, confrontation naming, a measure of semantic memory that imposes only minimal demands upon effortful retrieval, was significantly more impaired than phonemic fluency ($r = 0.60$ versus 0.55, respectively). However, since semantic fluency was also significantly more impaired than confrontation naming ($r = 0.73$ versus 0.61), deficits in semantic memory and effortful retrieval may be additive. Semantic, but not phonemic fluency, was significantly more impaired than measures of verbal intelligence and psychomotor speed. Thus, the semantic memory deficit in DAT qualifies as a differential deficit, but executive dysfunction as indexed by phonemic fluency does not constitute an additional isolated feature of the disorder. Dementia severity was not significantly related to the *relative* magnitude of deficits upon phonemic and semantic fluency.

Neuropsychology
2007, Vol. 21, No. 1, 20–30

Disparate Letter and Semantic Category Fluency Deficits in Autopsy-Confirmed Frontotemporal Dementia and Alzheimer's Disease

Katya Rascovsky, David P. Salmon, and Lawrence A. Hansen
University of California, San Diego

Leon J. Thal and Douglas Galasko
University of California, San Diego, and San Diego Veterans Affairs Medical Center

Patients with autopsy-confirmed frontotemporal dementia (FTD; $n = 16$) and Alzheimer's disease (AD; $n = 32$) were compared on first-letter and semantic category fluency tasks. Despite being matched on age, education, and dementia severity, FTD patients performed worse overall and showed similar impairment in letter and semantic category fluency, whereas AD patients showed greater impairment in semantic category than letter fluency. A measure of the disparity between letter and semantic category fluency (the semantic index) was effective in differentiating FTD from AD patients, and this disparity increased with increasing severity of dementia. These unique patterns of letter and semantic category fluency deficits may be indicative of differences in the relative contribution of frontal-lobe-mediated retrieval deficits and temporal-lobe-mediated semantic deficits in FTD and AD.

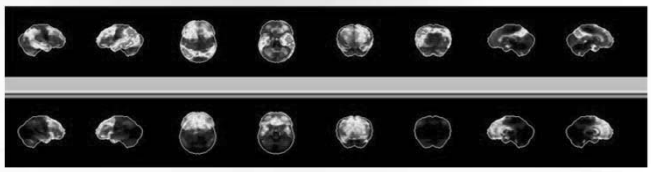
A study that specifically investigated disparities between phonemic and semantic fluency among patients with PET patterns of AD vs FTD

Background: Past research suggests that while both semantic and phonemic fluency deficits are common among patients with autopsy-confirmed AD and FTD, patients with AD have differentially greater semantic than phonemic fluency deficits. ^{18}FDG-PET is frequently used as an in vivo diagnostic test to discriminate AD vs FTD pathology.

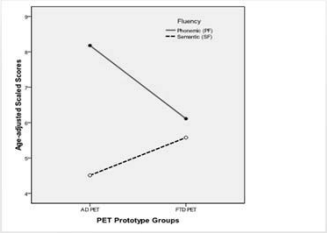
Objective: To determine if patients with AD vs FTD patterns of ^{18}FDG-PET pathology show differential patterns of semantic and phonemic fluency and whether these patterns can predict the pattern of PET abnormality.

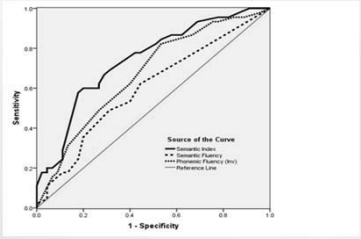
Methods: Two groups of N=45 with differential left hemisphere PET patterns of hypometabolism based on SSP images warped to Telairach space had been administered standard measures of semantic and phonemic fluency. Using age corrected fluency scores a composite Semantic Index (SI = SF/(SF+PF) was calculated for each subject. Group comparisons were conducted for the fluency measures and for SI, and ROC curves calculated to assess the sensitivity and specificity of the fluency measures in classifying the two PET patterns

Composite of the two PET groups



Results: The SI ratio was significantly different between PET groups (p< .000), with patients with AD PET patterns showing lower SI scores. A 2x2 Group x Fluency repeated measures ANOVA was calculated and there was a significant non-orthogonal interaction (p < .000) showing a marked difference between fluency measures among the AD PET group. ROC analysis of SI yielded an AUC of .742 (p < .000).





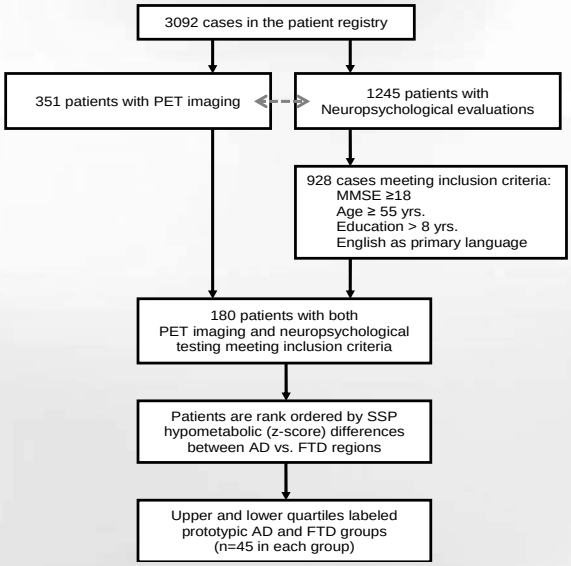
Your Challenge:

As an evidence-based practitioner, and based on these results, are your ready to begin using semantic and phonemic fluency tests as a marker for differentiating AD vs FTD?

If not, why?
or
What is wrong with this picture?

Flowchart of Data Selection:

Data collected from January 2006 – June 15, 2011



To be a good EBCN

You need to be a good Consumer

You are what you eat…

Jean Brillat-Savarin
Renown 18th century epicure and gastronome

Pleasures of the Table
The Physiology of Taste

"Tell me what you eat and I will tell you who you are"

Reporting Guidelines:
Moving toward greater transparency

- STROBE
- CONSORT
- STARD

STROBE : An international, collaborative initiative of epidemiologists, methodologists, statisticians, researchers and journal editors involved in the conduct and dissemination of observational studies, with the common aim of **STrengthening the Reporting of OBservational studies in Epidemiology.**

Website: http://www.strobe-statement.org/

Policy and practice Bulletin of the World Health Organization 2007;85:867–872.

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies*

Erik von Elm,[a] Douglas G Altman,[b] Matthias Egger,[a,c] Stuart J Pocock,[d] Peter C Gøtzsche [e] & Jan P Vandenbroucke[f] for the STROBE Initiative

The STROBE Statement and Neuropsychology: Lighting the Way Toward Evidence-Based Practice

David W. Loring & Stephen C. Bowden

To cite this article: David W. Loring & Stephen C. Bowden (2014) The STROBE Statement and Neuropsychology: Lighting the Way Toward Evidence-Based Practice, The Clinical Neuropsychologist, 28:4, 556-574, DOI: 10.1080/13854046.2012.762552

CONSORT

CONSORT: Stands for **Consolidated Standards of Reporting Trials** and encompasses various initiatives developed by the CONSORT Group to alleviate the problems arising from inadequate reporting of randomized controlled trials. The CONSORT statement is an evidence-based, minimum set of recommendations for reporting randomized trials. It offers a standard way for authors to prepare reports of trial findings, facilitating their complete and transparent reporting, and aiding their critical appraisal and interpretation.

Website: http://www.consort-statement.org/

CONSORT 2010

The CONSORT (CONsolidated Standards of Reporting Trials) 2010 guideline is intended to improve the reporting of parallel-group randomized controlled trial (RCT), enabling readers to understand a trial's design, conduct, analysis and interpretation, and to assess the validity of its results. This can only be achieved through complete adherence and transparency by authors.

CONSORT 2010 was developed through collaboration and consensus between clinical trial methodologists, guideline developers, knowledge translation specialists, and journal editors (see CONSORT group). CONSORT 2010 is the current version of the guideline and supersedes the 2001 and 1996 versions . It contains a 25-item checklist and flow diagram, freely available for viewing and downloading through this website.

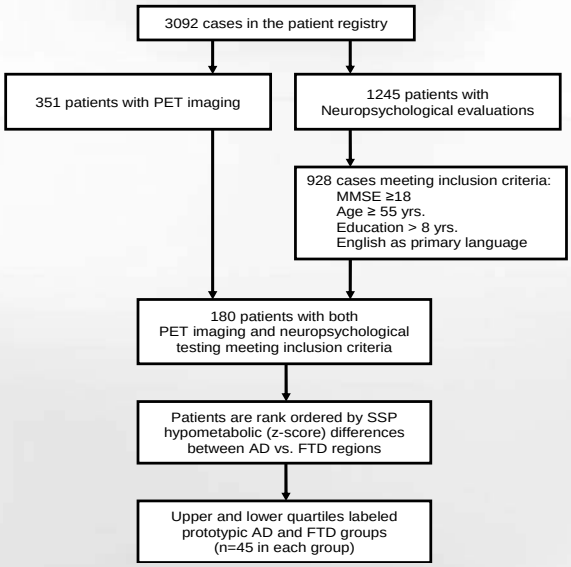
STARD: STAndards for the Reporting of Diagnostic accuracy studies.

The objective of the STARD initiative is to improve the accuracy and completeness of reporting of studies of diagnostic accuracy, to allow readers to assess the potential for bias in the study (internal validity) and to evaluate its generalisability (external validity).

The STARD statement consist of a checklist of 25 items and recommends the use of a flow diagram which describe the design of the study and the flow of patients.

Website: http://www.stard-statement.org/

Flowchart of Data Selection:
Data collected from January 2006 – June 15, 2011



STARD checklist for the reporting of studies of diagnostic accuracy.
First official version, January 2003.

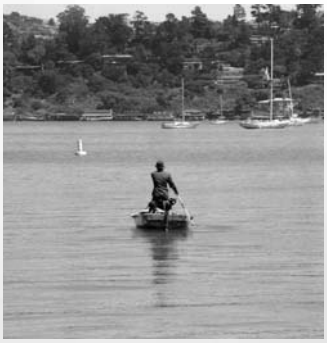
Section and Topic	Item #		On page #
TITLE/ABSTRACT/ KEYWORDS	1	Identify the article as a study of diagnostic accuracy (recommend MeSH heading 'sensitivity and specificity').	
INTRODUCTION	2	State the research questions or study aims, such as estimating diagnostic accuracy or comparing accuracy between tests or across participant groups.	
METHODS			
Participants	3	Describe the study population: The inclusion and exclusion criteria, setting and locations where the data were collected.	
	4	Describe participant recruitment: Was recruitment based on presenting symptoms, results from previous tests, or the fact that the participants had received the index tests or the reference standard?	
	5	Describe participant sampling: Was the study population a consecutive series of participants defined by the selection criteria in items 3 and 4? If not, specify how participants were further selected.	
	6	Describe data collection: Was data collection planned before the index test and reference standard were performed (prospective study) or after (retrospective study)?	
Test methods	7	Describe the reference standard and its rationale.	
	8	Describe technical specifications of material and methods involved including how and when measurements were taken, and/or cite references for index tests and reference standard.	
	9	Describe definition of and rationale for the units, cutoffs and/or categories of the results of the index tests and the reference standard.	
	10	Describe the number, training and expertise of the persons executing and reading the index tests and the reference standard.	
	11	Describe whether or not the readers of the index tests and reference standard were blind (masked) to the results of the other test and describe any other clinical information available to the readers.	

Statistical methods	12	Describe methods for calculating or comparing measures of diagnostic accuracy, and the statistical methods used to quantify uncertainty (e.g. 95% confidence intervals).	
	13	Describe methods for calculating test reproducibility, if done.	
RESULTS			
Participants	14	Report when study was done, including beginning and ending dates of recruitment.	
	15	Report clinical and demographic characteristics of the study population (e.g. age, sex, spectrum of presenting symptoms, comorbidity, current treatments, recruitment centers).	
	16	Report the number of participants satisfying the criteria for inclusion that did or did not undergo the index tests and/or the reference standard; describe why participants failed to receive either test (a flow diagram is strongly recommended).	
Test results	17	Report time interval from the index tests to the reference standard, and any treatment administered between.	
	18	Report distribution of severity of disease (define criteria) in those with the target condition; other diagnoses in participants without the target condition.	
	19	Report a cross tabulation of the results of the index tests (including indeterminate and missing results) by the results of the reference standard; for continuous results, the distribution of the test results by the results of the reference standard.	
	20	Report any adverse events from performing the index tests or the reference standard.	
Estimates	21	Report estimates of diagnostic accuracy and measures of statistical uncertainty (e.g. 95% confidence intervals).	
	22	Report how indeterminate results, missing responses and outliers of the index tests were handled.	
	23	Report estimates of variability of diagnostic accuracy between subgroups of participants, readers or centers, if done.	
	24	Report estimates of test reproducibility, if done.	
DISCUSSION	25	Discuss the clinical applicability of the study findings.	

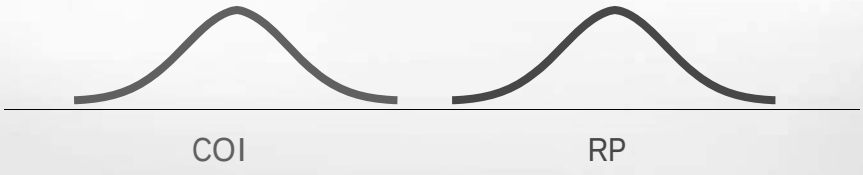
Evidence-based Practice and Research

One of the defining features of evidence-based practice is the use of data derived from research based on ***populations*** to inform clinical decisions about ***individuals….***

*…how do we move from **group** data to data that is applicable at the level of the **individual**?*

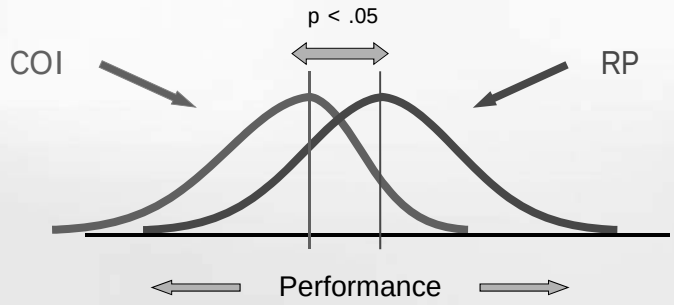


Do Patients with a Condition of Interest Differ from Reference Population?

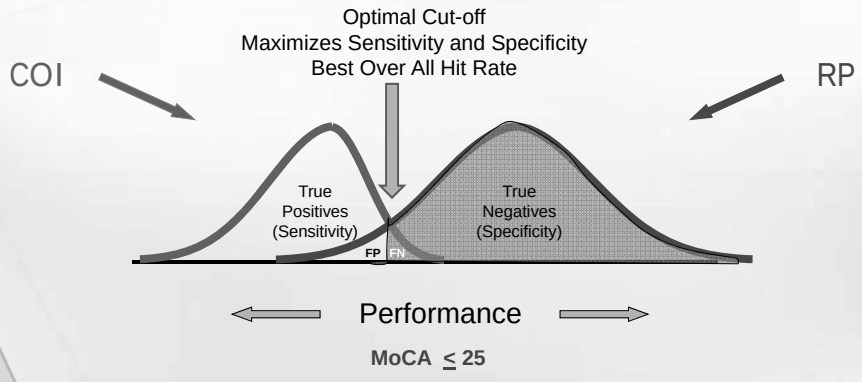


Are there Between Group Differences?

Is the difference between groups statistically reliable?



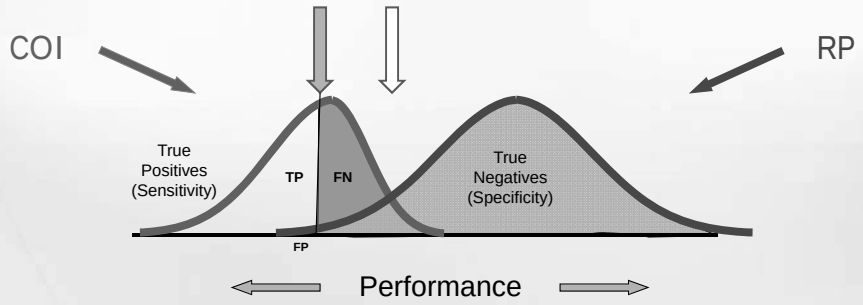
Clinical Significance



Diagnostic vs Screening Tests

Its All About the Cutoff

SpPin: High Specificity + Positive Result = Rules the COI **IN**



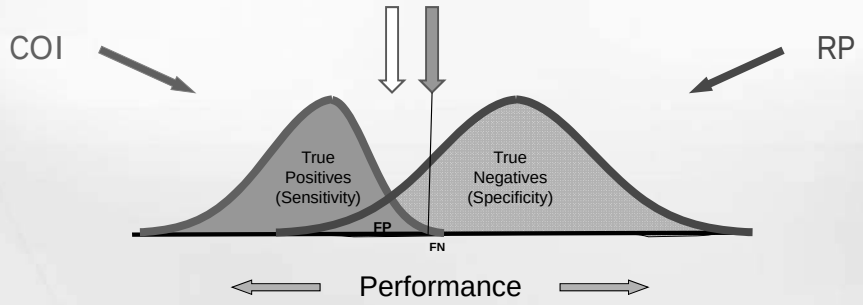
A Good **Diagnostic** Test

Diagnostic vs Screening Tests

Its All About the Cutoff

TOC: Test Operating Characteristics

SnNout: High Sensitivity + Negative Result = Rules the COI **OUT**



A Good **Screening** Test

Bayesian approach: Analyses of Changes in Base Rates

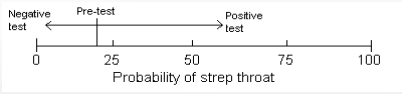
Bayes' Theorem: What we know after giving a test in equal to what we knew before doing the test times a modifier (based on the test results). Test results are used to adjust a *prior distribution* to form a new *posterior distribution* of scores.

Value Driven Pattern of Practice

http://omerad.msu.edu/ebm/Diagnosis/Diagnosis4.html

Michigan State University: Evidence-based Medicine Course

In the language of clinical epidemiology, we take our initial assessment of the likelihood of disease ("pre-test probability"), do a test to help us shift our suspicion one way or the other, and then determine a final assessment of the likelihood of disease ("post-test probability").



The Test Result guides the Rx (the "Front Door")

The Basic 2x2 Table

		Condition of Interest: Yes	Condition of Interest: No
Factor (event): Yes +		True Positive **A**	False Positive **B**
Factor (event): No -		False Negative **C**	True Negative **D**

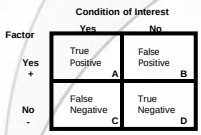
Bayesian Test Operating Characteristics	
% Prevalence	Odds
% Overall Correct Hit Rate	Odds Ratio
Sensitivity	Relative Risk Ratio
Specificity	Likelihood Ratio
Positive Predictive Power	Pre – Post Test Odds
Negative Predictive Power	Pre – Post Test Probabilities

Odds and Probabilities

The chances or likelihood of an event can be expressed as either a Probability or as Odds

Probability is the fraction or percentage of times an event will occur in a specific number of trials. Range: 0 to 1.0. E.g., 1 of 5 = .20

Odds are defined as the probability that an event will occur divided by the probability that the event will not occur or the ratio of events to non-events. E.g., (1/5)/(4/5) = 1:4 = .25



TOC Characteristics of a Diagnostic Test

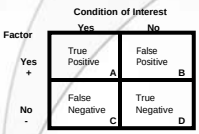
Odds having COI w. Pos. Test: (A/N)/(B/N) or simply A/B
Odds having COI w. Neg. Test: (C/N)/(D/N) or simply C/D

Odds Ratio: Compares the relative odds of having the COI when the Test Factor is Positive vs. odds when it is Negative
(A/B)/(C/D) or AD/BC Used in Case-Controlled studies

Interpretation: The odds of having the COI are X-times higher when the test is Positive than when it is Negative

(Relative) Risk Ratio: The ratio of the proportion of having the COI when the Test Factor is Positive vs when it is Negative
(A/(A+B))/(C/C+D)) Used in Cohort studies

Interpretation: The Relative Risk of having the COI is X-times higher when the test result is Positive than when the test result is Negative



TOC Characteristics of a Diagnostic Test

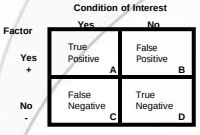
Likelihood Ratio: **A measure of how reliably a diagnostic test actually detects the COI. It represents the likelihood that a test result would be expected in patients with the COI divided by the likelihood that the same result would be expected in patients without the COI. It compares the proportion of TP to proportion of FP**

LR+: Likelihood of COI if Test is Positive = Sensitivity/(1-Specificity)

LR-: Likelihood of COI if Test is Negative = (1-Sensitivity)/Specificity

Interpretation of LR+: ***If a test result is positive in a patient, the patient is X-times more likely to have the COI than not to have it.***

- **More stable than PPP and NPP**
- **Does not vary with prevalence**
- **Can be calculated for several levels of a test result.**



TOC Characteristics of a Diagnostic Test

Informing the Diagnostic Process: Does Testing Matter

Pre-test Odds: **The odds of a patient having the COI before a test is given –**
Pre-test probability/(1- Pre-test Probability)

Pre-test Probability: **This is the prevalence or base rate of the COI without knowledge of any test findings –**
(A+C)/N

Post-test Odds: **The Odds that the patient has the target disorder after the test is given –**
Pre-test odds X the Likelihood Ratio (LR)

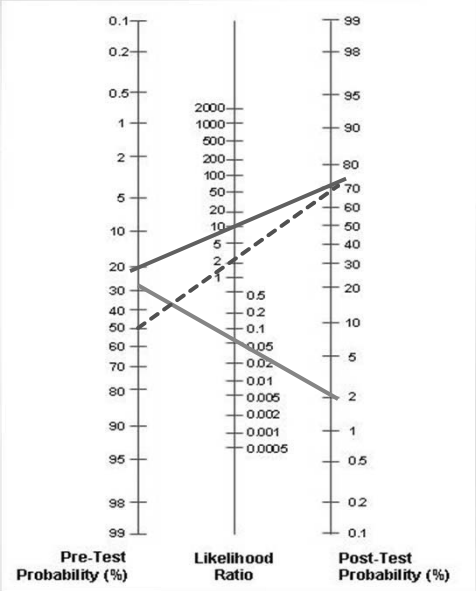
Post-test Probability: **The proportion of patients with a particular test result that have the COI –**
Post-test Odds/(1+Post-test Odds)

Does Testing Matter

Nomogram for using Likelihood Ratios (LR) to determine Post-test Probabalities of a COI *if the Pre-test Probability and LR are known*

E.g. Prevalence of COI = 20%
LR = 10

AD vs FTD
SI ≤ .40000



Enter data into Yellow areas

AD ≤ .4000
FTD > .4000

Calculators for Computing Test Operating Characteristics

Tools for Evaluating Diagnostic Studies

Cells Definitions:

A: Subjects in which Condition of Interest (COI) is Present (+) AND Test Result is Positive (+) -- True Positives
B: Subjects in which Condition of Interest (COI) is Absent (-) BUT Test Result is Positive (+) -- False Positives
C: Subjects in which Condition of Interest (COI) is Present (+) BUT Test Result is Positive (+) -- False Negatives
D: Subjects in which Condition of Interest (COI) is Absent (-) AND Test Result is Negative (-) -- True Negatives

Fill In the Number of Subjects in Each Cell:

A:	31
B:	14
C:	14
D:	31

Condition of Interest (COI)

Test Result	AD	FTD	Totals	
≤ .4000	31 (A)	14 (B)	45	A+B
> .4000	14 (C)	31 (D)	45	C+D
Totals	*45* *A+C*	*45* *B+D*	*90*	*A+B+C+D*

Test Operating Characteristics		Formulas
% **Prevalence** (**Baserate**) of COI	50.00 %	((A+C)/N)*100
% Positive Test Result	50.00 %	((A+B)/N)*100
% Negative Test Result	50.00 %	((C+D)/N)*100
% Overall Correct Hit Rate	68.89 %	((A+D)/N)*100
Sensitivity (% True Positives)	0.6889	A/(A+C)
Specificity (% True Negatives)	0.6889	D/(B+D)
Positive Predictive Power	0.689	A/(A+B)
Negative Predictive Power	0.689	D/(C+D)
Odds having COI w. Pos. Test	2.214	(A/B)
Odds having COI w. Neg. Test	0.452	(C/D)
Odds Ratio	4.9031	(A*D)/(B*C)
Likelihood Ratio (LR+)	2.2143	Sensitivity/(1-Specificity)
Likelihood Ratio (LR-)	0.4516	(1-Sensitivity)/Specificity
Pre-Test Odds	1.0000	Prevalence/(1-Prevalence)
Post-Test Odds	2.2143	Pre-Test Odds*LR
Pre-test Probabality	0.5000	(A+C)/N
Post-Test Probabality	0.6889	Post-test Odds/(Post-test Odds+1)
Risk Ratio (cohort studies)	2.2143	(A/(A+B))/(C/(C+D))
Enter Confidence Level (1-α)	0.95	
Z-score Interval ($Z_{1-\alpha/2}$)	1.960	
Standard Error of OR	0.4554	
Odds Ratio Lower CI	2.008	
Odds Ratio Upper CI	11.970	

AD ≤ .4000
FTD > .4000

Test Operating Characteristics		Formulas
% **Prevalence** (**Baserate**) of COI	50.00 %	((A+C)/N)*100
% Positive Test Result	50.00 %	((A+B)/N)*100
% Negative Test Result	50.00 %	((C+D)/N)*100
% Overall Correct Hit Rate	68.89 %	((A+D)/N)*100
Sensitivity (% True Positives)	0.6889	A/(A+C)
Specificity (% True Negatives)	0.6889	D/(B+D)
Positive Predictive Power	0.689	A/(A+B)
Negative Predictive Power	0.689	D/(C+D)
Odds having COI w. Pos. Test	2.214	(A/B)
Odds having COI w. Neg. Test	0.452	(C/D)
Odds Ratio	4.9031	(A*D)/(B*C)
Likelihood Ratio (LR+)	2.2143	Sensitivity/(1-Specificity)
Likelihood Ratio (LR-)	0.4516	(1-Sensitivity)/Specificity
Pre-Test Odds	1.0000	Prevalence/(1-Prevalence)
Post-Test Odds	2.2143	Pre-Test Odds*LR
Pre-test Probability	0.5000	(A+C)/N
Post-Test Probability	0.6889	Post-test Odds/(Post-test Odds+1)
Risk Ratio (cohort studies)	2.2143	(A/(A+B))/(C/(C+D))
Enter Confidence Level (1-α)	0.95	
Z-score Interval ($Z_{1-\alpha/2}$)	1.960	
Standard Error of OR	0.4554	
Odds Ratio Lower CI	2.008	
Odds Ratio Upper CI	11.970	

TOC
AD ≤ .3333
FTD > .3333

Fill In the Number of Subjects in Each Cell:		Condition of Interest (COI)				
A:	**21**		**AD**	**FTD**	*Totals*	
B:	**7**	**≤ .3333**	**21** A	**7** B	*28*	A+B
C:	**24**	**Test Result**				
D:	**38**	**> .3333**	**24** C	**38** D	*62*	C+D
		Totals	*45* *A+C*	*45* *B+D*	*90* *A+B+C+D*	

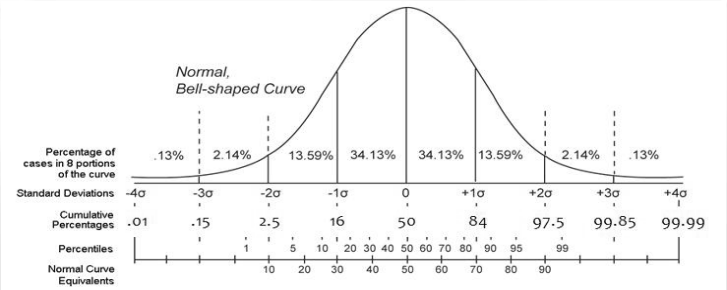
Test Operating Characteristics		Formulas
% **Prevalence** (**Baserate**) of COI	50.00 %	((A+C)/N)*100
% Positive Test Result	31.11 %	((A+B)/N)*100
% Negative Test Result	68.89 %	((C+D)/N)*100
% Overall Correct Hit Rate	65.56 %	((A+D)/N)*100
Sensitivity (% True Positives)	0.4667	A/(A+C)
Specificity (% True Negatives)	0.8444	D/(B+D)
Positive Predictive Power	0.750	A/(A+B)
Negative Predictive Power	0.613	D/(C+D)
Odds having COI w. Pos. Test	3.000	(A/B)
Odds having COI w. Neg. Test	0.632	(C/D)
Odds Ratio	4.7500	(A*D)/(B*C)
Likelihood Ratio (LR+)	3.0000	Sensitivity/(1-Specificity)
Likelihood Ratio (LR-)	0.6316	(1-Sensitivity)/Specificity
Pre-Test Odds	1.0000	Prevalence/(1-Prevalence)
Post-Test Odds	3.0000	Pre-Test Odds*LR
Pre-test Probability	0.5000	(A+C)/N
Post-Test Probability	0.7500	Post-test Odds/(Post-test Odds+1)
Risk Ratio (cohort studies)	1.9375	(A/(A+B))/(C/(C+D))

But what if the Author did not report the Baserates
You only have the Means and Standard Deviations

AD-PET Group
Mean = .3519
SD = .1301

FTD-PET Group
Mean = .4681
SD = .1242

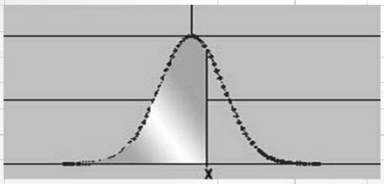
Of all things “Normal”



Z-Score to Percentile Conversions

****IMPORTANT**** Calculations assume normal distribution of scores
Use only within the scope of this assumption

Enter Mean, SD and Target Score Below	
Mean	100
SD	15
Target Score	105
z-score	0.333
Percentile Above	0.37
Percentile Below	0.63



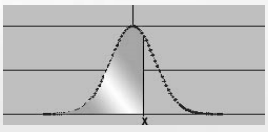
If you know the Mean and Standard Deviation for any group of individuals, you can transform any patient's observed score to a z-score (assuming the scores are normally distributed).

Z-score = (X – M)/ SD

Z-score = (X – M)/ SD

Standard Scores:	*M=100, SD=15*	(105 – 100)/15	= +0.33
Scaled Scores:	*M = 10, SD=3*	(11 – 10)/3	= +0.33
T-scores:	*M = 50, SD=10*	(53.33 – 50/10	= +0.33
A unique scale:	*M=28.3, SD=5.1*	(30 – 28.3)/5.1	= +0.33

The distribution of z-scores have a Mean=0 and SD=1

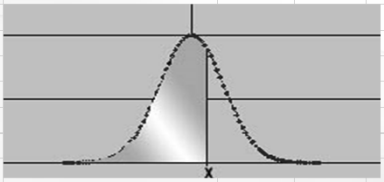


Under the Unit Curve, the z-score tells us what % of cases with be above and below that z-score

Z-Score to Percentile Conversions

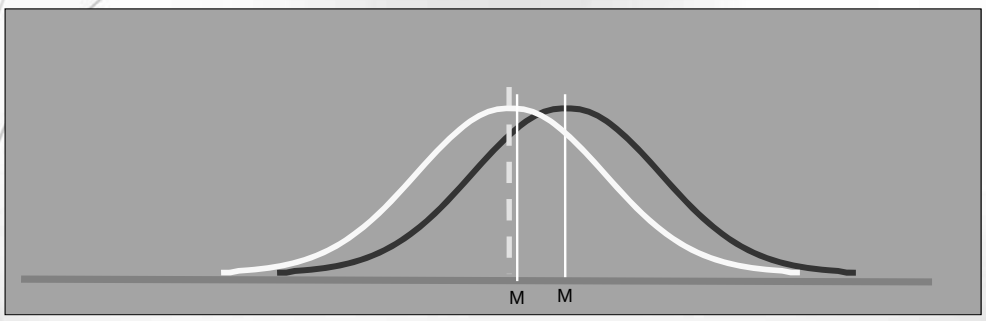
****IMPORTANT**** Calculations assume normal distribution of scores
Use only within the scope of this assumption

Enter Mean, SD and Target Score Below	
Mean	100
SD	15
Target Score	105
z-score	0.333
Percentile Above	0.37
Percentile Below	0.63



If you know the sample size (N), you can estimate the actual number of cases above and below that z-score.

Given N=1105 and a z-score of +0.33
Cases Above = 1105 * .37 = 409
Cases Below = 1105 * .63 = 696



Pt's Score = .3333

COI Group
Mean = .3519
SD = .1301
z = -0.145
% Above = .56
% Below = .44
N = 45
Above = 25
Below = 20

Reference Group
Mean = .4681
SD = .1242
z = -1.088
% Above = .86
% Below = .14
N = 45
Above = 39
Below = 6

Reference Group	
Enter Mean, SD and Target Score	
Mean	0.47
SD	0.1242
Target Score	0.333
z-score	-1.08776
Percentile Above	0.86
Percentile Below	0.14
Enter N for Ref Group	45
Est. N Above Target score	39
Est N Below Target score	6

COI Group	
Enter Mean, SD and Target Score	
Mean	0.3519
SD	0.1301
Target Score	0.333
z-score	-0.145
Percentile Above	0.56
Percentile Below	0.44
Enter N for COI Group	45
Est. N Above Target score	25
Est. N Below Target score	20

Fill In the Number of Subjects in Each Cell:	
A:	20
B:	6
C:	25
D:	39

Enter Confidence Level (1-α)	0.95
Z-score of Interval ($Z_{1-\alpha/2}$)	1.960
Standard Error of OR	0.5258

Estimated Test Operating Chara	
% Prevalence of COI	50.00 %
% Overall Correct	65.19 %
Sensitivity	0.4422
Specificity	0.8616
PPP	0.762
NPP	0.607
Odds Ratio	4.938
Odds Ratio Lower CI	1.762
Odds Ratio Upper CI	13.841
Likelihood Ratio (LR+)	3.197
Likelihood Ratio (LR-)	0.6473
Pre-Test Odds	1.0000
Post-Test Odds	3.1966
Pre-Test Probability	0.5
Post-Test Probability	0.7617
Risk Ratio*	1.9384 * For col

Condition of Interest (COI)			
	AD	FTD	*Totals*
≤ .3333	21 (A)	7 (B)	*28*
> .3333	24 (C)	38 (D)	*62*
Totals	*45*	*45*	*90*

Test Result

	COI Present	COI Absent
Positive	20 (A)	6 (B)
Negative	25 (C)	39 (D)

Relevance

A pharmaceutical company has developed a new drug that they hope will reduce the Beta-amyloid burden in patients with early AD. The drug company is powering the study with N=50 and will be getting Amyloid PET scans on participants at a cost of $5000 each and asks if you can help them enrich their sample by eliminating potential cases with FTD.

Prevalence of AD = 50.0% [FTD = 50.0%]
To arrive at 50 cases with AD, a sample of 100 is needed
Cost of 100 Amyloid scans = $500,000

Using a SI cut-score of .333 yields a post-test probability of .75
To arrive at 50 cases with AD, a sample of 67 is needed
Cost of 67 Amyloid scans = $335,000

Cost Savings = ($500,000 - $335,000) = $165,000

The Clinical Neuropsychologist, 2012, 26 (8), 1296–1311

Confronting Patients About Insufficient Effort: The Impact on Subsequent Symptom Validity and Memory Performance

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Table 1. Means, standard deviations, and ranges for demographic and clinical characteristics of the sample

					CONF vs N-CONF comparison	
	Valid ($n=451$)	Non-valid total ($n=56$)	Non-valid CONF ($n=28$)	Non-valid N-CONF ($n=28$)	*t* or *Chi-Square*	*p*
Age (years)	45.51 (9.40) 18–76	40.18 (8.65) 19–58	38.25 (8.40) 35–42	42.11 (8.62) 39–45	1.67	.096
Education (years)	14.14 (2.46) 7–20	12.80 (1.54) 9–18	13.07 (1.80) 12–14	12.54 (1.20) 12–13	1.31	.196
Age of illness onset (years)	35.00 (9.73) 13–64	31.61 (8.88) 14–53	29.63 (7.71) 27–33	33.57 (9.65) 30–37	1.68	.098
Illness duration (years)	5.35 (5.95) 2–37	4.89 (4.79) 0–22	5.75 (4.77) 4–8	4.04 (4.75) 2–6	1.35	.183
BDI-2 (total raw score)	16.30 (10.48) 0–54	22.77 (9.93) 4–44	22.11(9.80) 18–26	23.46 (10.21) 19–28	0.49	.625
% female	73%	66%	61%	71%	.717	.397
% left-handed	11.5%	12.5%	7%	18%	1.47	.225

Table 2. Victoria Symptom Validity Test scores and mean T-score across four WMS-III indices

		CONF ($n=28$)		
	Valid ($n=451$)	Time 1	Time 2	N-CONF ($n=28$)
VSVT Easy items	23.84 (.55)	21.96 (3.27) [2.36]	23.11 (2.13) [.99]	21.68 (3.15) [2.35]
VSVT Hard items	22.63 (1.81)	11.54 (3.77) [5.62]	17.29 (4.40) [2.62]	12.21 (3.91) [5.24]
Mean Memory	42.42 (9.25)	39.83 (9.54) [.28]		34.44 (7.88) [.86]

WMS-III Composite Memory Scores

Valid Group		**Confronted Group**		**Non-Confronted Group**	
Enter Mean, SD and Target Score		Enter Mean, SD and Target Score		Enter Mean, SD and Target Score	
Mean	42.42	Mean	39.83	Mean	34.44
SD	9.25	SD	7.88	SD	7.88
Target Score	39 ⇦	Target Score	39 ⇦	Target Score	39 ⇦
z-score	-0.36973	z-score	-0.1053	z-score	0.5787
Percentile Above	0.64	Percentile Above	0.54	Percentile Above	0.28
Percentile Below	0.36	Percentile Below	0.46	Percentile Below	0.72
Enter N for Ref Group	451	Enter N for COI Group	28	Enter N for COI Group	28
Est. N Above Target score	291	Est. N Above Target score	15	Est. N Above Target score	8
Est N Below Target score	160	Est. N Below Target score	13	Est. N Below Target score	20

Memory Deficit as COI

Valid vs Confronted

Fill In the Number of Subjects in Each Cell:		Condition of Interest (COI)		
A:	13		≤ 39	≥ 40	Totals
B:	15	Conf.	13	15	28
C:	160	Exposure	A	B	
D:	291	Valid	160	291	451
			C	D	
		Totals	173	306	479
			A+C	B+D	A+B+C+D

Test Operating Characteristics		Formulas
% **Prevalence** (**Baserate**) of COI	36.12 %	((A+C)/N)*100
% Positive Test Result	5.85 %	((A+B)/N)*100
% Negative Test Result	94.15 %	((C+D)/N)*100
% Overall Correct Hit Rate	63.47 %	((A+D)/N)*100
Sensitivity (% True Positives)	0.0751	A/(A+C)
Specificity (% True Negatives)	0.9510	D/(B+D)
Positive Predictive Power	0.464	A/(A+B)
Negative Predictive Power	0.645	D/(C+D)
Odds having COI w. Pos. Test	0.867	(A/B)
Odds having COI w. Neg. Test	0.550	(C/D)
Odds Ratio	1.5763	(A*D)/(B*C)
Likelihood Ratio (LR+)	1.5329	Sensitivity/(1-Specificity)
Likelihood Ratio (LR-)	0.9725	(1-Sensitivity)/Specificity
Pre-Test Odds	0.5654	Prevalence/(1-Prevalence)
Post-Test Odds	0.8667	Pre-Test Odds*LR
Pre-test Probability	0.3612	(A+C)/N
Post-Test Probability	0.4643	Post-test Odds/(Post-test Odds+1)
Risk Ratio (cohort studies)	1.3087	(A/(A+B))/(C/(C+D))

Valid vs Non-Confronted

ll In the Number of Subjects in Each Cell:		Condition of Interest (COI)		
	20		≤ 39	≥ 40
	8	Non-Conf.	20	8
	160	Exposure	A	B
	291	Valid	160	291
			C	D
		Totals	180	299
			A+C	B+D

Test Operating Characteristics		Formulas
% **Prevalence** (**Baserate**) of COI	37.58 %	((A+C)/N)*100
% Positive Test Result	5.85 %	((A+B)/N)*100
% Negative Test Result	94.15 %	((C+D)/N)*100
% Overall Correct Hit Rate	64.93 %	((A+D)/N)*100
Sensitivity (% True Positives)	0.1111	A/(A+C)
Specificity (% True Negatives)	0.9732	D/(B+D)
Positive Predictive Power	0.714	A/(A+B)
Negative Predictive Power	0.645	D/(C+D)
Odds having COI w. Pos. Test	2.500	(A/B)
Odds having COI w. Neg. Test	0.550	(C/D)
Odds Ratio	4.5469	(A*D)/(B*C)
Likelihood Ratio (LR+)	4.1528	Sensitivity/(1-Specificity)
Likelihood Ratio (LR-)	0.9133	(1-Sensitivity)/Specificity
Pre-Test Odds	0.6020	Prevalence/(1-Prevalence)
Post-Test Odds	2.5000	Pre-Test Odds*LR
Pre-test Probability	0.3758	(A+C)/N
Post-Test Probability	0.7143	Post-test Odds/(Post-test Odds
Risk Ratio (cohort studies)	2.0134	(A/(A+B))/(C/(C+D))

Conclusions

- Every patient's test data can be viewed as an individual outcome. It is possible to use published research to determine/estimate the specific TOC characteristics of a given patient's specific test scores.
- By using simple Bayesian methods it is possible to enhance evidence-base practice that is: a) value-driven; b) integrates research derived from the study of groups to inform clinical decisions about individuals; and c) addresses the concerns and needs of our referral sources.