Learning Objectives:

1. To enhance skills in assessing diagnostic test articles for validity.
2. To learn to apply the results of a Diagnostic Test paper:
   - Estimating and understanding pre-test probabilities
   - Calculating a series of likelihood ratios directly from the data in the paper
   - Considering the importance of treatment thresholds in your application of a diagnostic test
   - Deciding whether the test will help you treat, understand or advise your patient

Problem-Based Educational Package

1. Read the attached clinical scenario.
2. Define the clinical question and outline a strategy to find the evidence
3. Read the attached JAMA articles about diagnostic tests.
4. Critically appraise the attached paper
5. Decide whether the diagnostic test will help you in your decision making for your patient.

Enclosed Materials

1. Wells PS, Hirsch, J et al. Accuracy of clinical assessment of deep-vein thrombosis. Lancet 1995;345: 1326-30.
2. Jaeschke, R et al. Users' Guides to the Medical Literature. III. How to use an article about a diagnostic test, A. Are the results of the study valid? JAMA 1994; 271 (5): 389-391.
3. Jaeschke, R et al. Users' Guides to the Medical Literature. III. How to use an article about a diagnostic test, B. What are the results and will they help me in caring for my patients? JAMA 1995; 274 (20): 1630-1632.
4. Critical Appraisal Worksheet
5. Worksheets for calculating likelihood ratios
6. Diagnostic test summary sheets

Clinical Scenario (A very real story)

It is your first experience as a general medicine ward attending. It is Saturday night and your team calls you because they are having trouble getting an ultrasound for one of the new admissions. The story unfolds as follows:

> The patient is a 69-year-old African American man who has coronary artery disease, diabetes mellitus and is s/p a remote stroke several years ago. His baseline function is that he can transfer from bed to wheelchair but he can not ambulate on his own. His wife brought him to the ER this evening because he was 'just not right' but she denies any particular precipitating events. In the ER, he is noted to be pleasant but unable to offer history. His physical exam is notable for left hemiplegia which is consistent with prior reports in his medical record from his primary care physician. He also is anemic (HCT 30; MCV 78). WBC is not elevated. In the ER it is reported that he has left leg swelling and he is admitted for "presumed DVT". Your resident calls radiology to arrange an ultrasound this evening to help establish the diagnosis. The radiologist refuses, remarking that "it won't change your management tonight anyway."
>
> Being a July attending, you come in to examine the patient with your team. Together, you measure his thigh and calf circumference. The left thigh is just under 2 cm larger than the right in both measurements. He has no erythema but has bilateral peripheral pitting edema. He moans when you examine his left leg, however he there is no focal tenderness and no cords. He is guaiac positive with brown stool on digital rectal exam. His Hct 2 months ago was 40.
>
> Your team is furious that the radiologist won't come in to do the ultrasound. By now, it is 11 p.m. Saturday night. You phone the on-call attending radiologist. As it happens, he is the chief of radiology and he tells you that he agrees that there is no reason to do the ultrasound tonight. You state that you uncertain as to whether there is clot. Furthermore, the patient appears to be bleeding, and you are concerned about anticoagulation in this setting. You would like to be more certain of the diagnosis to make the best possible decision. He holds his line and states that someone will be in tomorrow. In a final blow to your ego, he states "Call the chief of medicine and wake him up," if you are not happy with the answer. You look up the pager number of your chief and wonder what to do…

Prior to reading the paper, please answer the following:

1. What is the pre-test probability of DVT in this patient? (Write this estimate down and bring it with you to the teaching session!)
2. How good is a clinical assessment is at predicting DVT (i.e. how good a diagnostic test is it?)
3. How much do you think the ultrasound will change your assessment of DVT in this patient?
4. How sure will you have to be that he has clot before you will be willing to anticoagulate him? (or maybe you wouldn't anticoagulate him at all?)
5. What arguments can you make in favor of the 11 p.m. ultrasound? What arguments might be against the 11 p.m. ultrasound?

Diagnosis Teaching Package

Worksheets for Calculating Likelihood Ratios

Context:

In many instances, the papers you find will not describe the test properties in terms of likelihood ratios. You will need to calculate them or convert them yourself from the data given. The following pages are to help you do this. *These pages are optional, however they have helped some learners in the past.*

Contents:

Worksheet I
Calculating the Likelihood Ratio for the Clinical Model for Evaluation of DVT:

Table 2 Page 1328
First: you have to complete the 3x2 table below:
(Numbers taken from table 2 by adding up the numbers of outcomes and patients in each group)

Clinical Model	DVT Present by Venogram	DVT absent by Venogram
High prob		
Moderate prob		
Low prob		
Totals	135	394

You can get at the likelihood ratio for a high probability assessment by just asking two questions:
1. How likely is a high probability assessment in people who really have DVT? (proportion 1)
2. How likely is a high probability assessment in people who DON'T have DVT? (proportion 2)

The Likelihood Ratio is simply a comparison of proportion 1 to proportion 2.
high probability assessment in disease/ high probability assessment in health

Next from each possible test result (High, Moderate, or Low prob) calculate the Likelihood Ratio below

Clinical Model	proportion 1 (patients with DVT)	Proportion 2 (patients without DVT)	Likelihood Ratio Proportion1/proportion 2
High prob	__ /135 =	__ /394=	__ /__=
Moderate prob	__ /135=	__ /394=	__ /__=
Low prob	__ /135=	__ /394=	__ /__=

Worksheet II
Calculating the Likelihood Ratio for Ultrasound for Evaluation of DVT:

For the following exercise, we will use **Table 3 pg 1328 for All Groups Combined**

Combined Groups: **Proximal DVT**			Combined Groups: **ALL DVT**		
	(+) DVT	(-) DVT		(+) DVT	(-) DVT
(+) US			(+) US		
(-) US			(-) US		
	103	353		121	353

For Combined Groups, calculate the likelihood ratio for Ultrasound for **Proximal DVT**:

Ultrasound Result	Proportion 1 (DVT present)	Proportion 2 (DVT absent)	Likelihood Ratio (L1/L2)
(+) US	____ /103 =	____ /353 =	LR(+) =____ /____ =
(-) US	____ /103 =	____ /353 =	LR (-)=____ /____ =

For Combined Groups calculate the likelihood ratio for Ultrasound for **All DVT**:

Ultrasound Result	Proportion 1 (DVT present)	Proportion 2 (DVT absent)	Likelihood Ratio (L1/L2)
(+) US	____ /121 =	____ /353 =	LR(+) =____ /____ =
(-) US	____ /121 =	____ /353 =	LR (-)=____ /____ =

Formulas and Definitions
Diagnostic Testing: Summary Sheet

Definitions and the 2x2 table

	"Gold Standard" Result: Condition Present	Condition Absent		
Positive Test	**a** True Positive	**b** False Positive	a+b	**PPV*** = a/(a+b) portion of (+) test results that are correct
Negative Test	**c** False Negative	**d** True Negative	c+d	**NPV *=** d/(c+d) portion of (-) test results that are correct
	a+c	**b+d**	a+b+c+d	**Prevalence** = (a+c)/(a+b+c+d)

Sensitivity = a/(a+c) portion of people with disease who correctly test (+)

Specificity = d/(b+d) portion of people without disease who correctly test (-)

Accuracy = (a+d)/(a+b+c+d)

(*denotes test is affected by disease prevalence)

Sensitivity
PID positivity in disease
test low sensitivity-> miss cases (false negative results)
SnN(-)OUT- negative rules out disease

Specificity
NIH negativity in health
test low specificity-> incorrectly labels healthy people as having condition (false positives)
SpP(+)IN- positive rules in disease

2X2 table example:
Population size = 100,000
Sensitivity =90%
Specificity =90%

disease prevalence = 1%	(+) disease	(-) disease	
(+) test	900	9,900	PPV= 8.3%
(-) test	100	89,100	
	1,000	99,000	100,000
11 false (+) for every true (+)			

disease prevalence = 0.1%	(+) disease	(-) disease	
(+) test	90	9,990	PPV= 0.9%
(-) test	10	89,910	
	100	99,900	100,000
111 false (+) for every true (+)			

Formulas and Definitions
Diagnostic Testing: Summary Sheet (cont.)

Likelihood ratios
translates pre-test probability to post-test probability for individual patients

Conceptual framework: we are trying to determine the discriminating ability of the test in people with disease and without disease

Definitions of likelihood ratio
Before you do any calculations, consider what a likelihood ratio means (e.g. LR+ =10):

- odds of disease given a test result
- if the test is positive than the odds of disease is increased 10-fold
- a coefficient that modifies your pretest probability to generate post-test probability
- likelihood ratio of 10 means that that result is ten times more likely to occur in patients with disease than without
- a ratio which compares the likelihood of a particular test result for patients with disease to the likelihood of that same result for patients without
- a likelihood ratio is a ratio of likelihoods

test	disease (+)	Likelihood 1	disease (-)	Likelihood 2	Likelihood Ratio (L1/L2)
(+)	a	(a/a+c)	b	(b/b+d)	(a/a+c)/(b/b+d)
(-)	c	(c/a+c)	d	(d/b+d)	(c/a+c)/(d/b+d)

Relating LR to Sensitivity and Specificity: sometimes you will want to convert sensitivity and specificity directly into LR(+) or LR (-).

positive likelihood ratio (a/a+c)/(b/b+d)= sensitivity/(1-specificity)
negative likelihood ratio (c/a+c)/(d/b+d)= (1-sensitivity)/ specificity