Screening and Diagnosis

Screening and diagnosis

NO SYMPTOMS
screening - identify the possible presence of an as-yet-undiagnosed disease in a person without signs or symptoms

SYMPTOMS
diagnosis - determining which disease or condition explains a person's signs or symptoms

Answering questions

does a person have cancer?

does a person have HIV?

does a person have depression?

does a person with abdominal pain have appendicitis?

does a person with a sore throat have strep throat?

Clinical Context

Each question and physical examination is a diagnostic test in itself, each with a sensitivity and specificity

The probability that is ‘sufficient’ to reach a ‘diagnosis’ varies with the seriousness, treatability or novelty of the diagnosis being considered

Bayes theorem

Commonly used measures for evaluating the clinical performance of diagnostic and screening tests

Sensitivity=the probability that an individual with the disease has a positive test result

Specificity=the probability that an individual without the disease has a negative test result

Positive predictive value=the probability that an individual with a positive test result has the disease

Negative predictive value=the probability that an individual with a negative test result does not have the disease

Positive likelihood ratio=the probability that an individual with the disease has a positive test result, divided by the probability that an individual without the disease has a positive test result (that is, sensitivity/(1−specificity))

Negative likelihood ratio=the probability that an individual with the disease has a negative test result, divided by the probability that an individual without the disease has a negative test result (that is, (1−sensitivity)/specificity)

Area under the receiver operating characteristic curve (AUROC)=the probability that a classifier will correctly rank a randomly chosen person with the disease higher than a randomly chosen person without the disease (that is, the area under a plot of sensitivity against (1−specificity))

BMJ 2016;353:i3139

Sensitivity and Specificity

Sensitivity - ranges from 0% to 100%

Specificity - ranges from 0% to 100%

these do NOT take prevalence into account

Prevalence = the proportion of individuals in a population having a disease at a particular time point = pre-test probability - ranges from 0% to 100%

Predictive value varies with the prevalence of the condition - ranges from 0 to 100%

Likelihood ratios can take into account different prevalences

less than 1 = a negative likelihood ratio

greater than 1 = a positive likelihood ratio

Diagnosis in primary care: probabilistic reasoning

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Box 1. Terminology and definitions

Pre-test probability = prevalence

Post-test probability of a positive test = positive predictive value

Post-test probability of a negative test = 1 – negative predictive value

Likelihood ratio (LR) = $\frac{\text{probability of test result in patients with disease}}{\text{probability of test result in patients without disease}}$

Likelihood ratio positive sensitivity/(1-specificity) (raises probabilities)

Likelihood ratio negative (1-sensitivity)/specificity (lowers probabilities)

Likelihood ratios

LR+ = probability that a test is **positive** in the people with the disease/the probability that the test is **positive** in people without the disease

LR+ = sensitivity/1-specificity

LR- = probability that a test is **negative** in the people with the disease/the probability that the test is **negative** in people without the disease

LR- = 1-sensitivity/specificity

greater than 1 = a positive likelihood ratio
less than 1 = a negative likelihood ratio

How to calculate post-test probability using prevalence and LRs

Likelihood/ Fagan nomogram

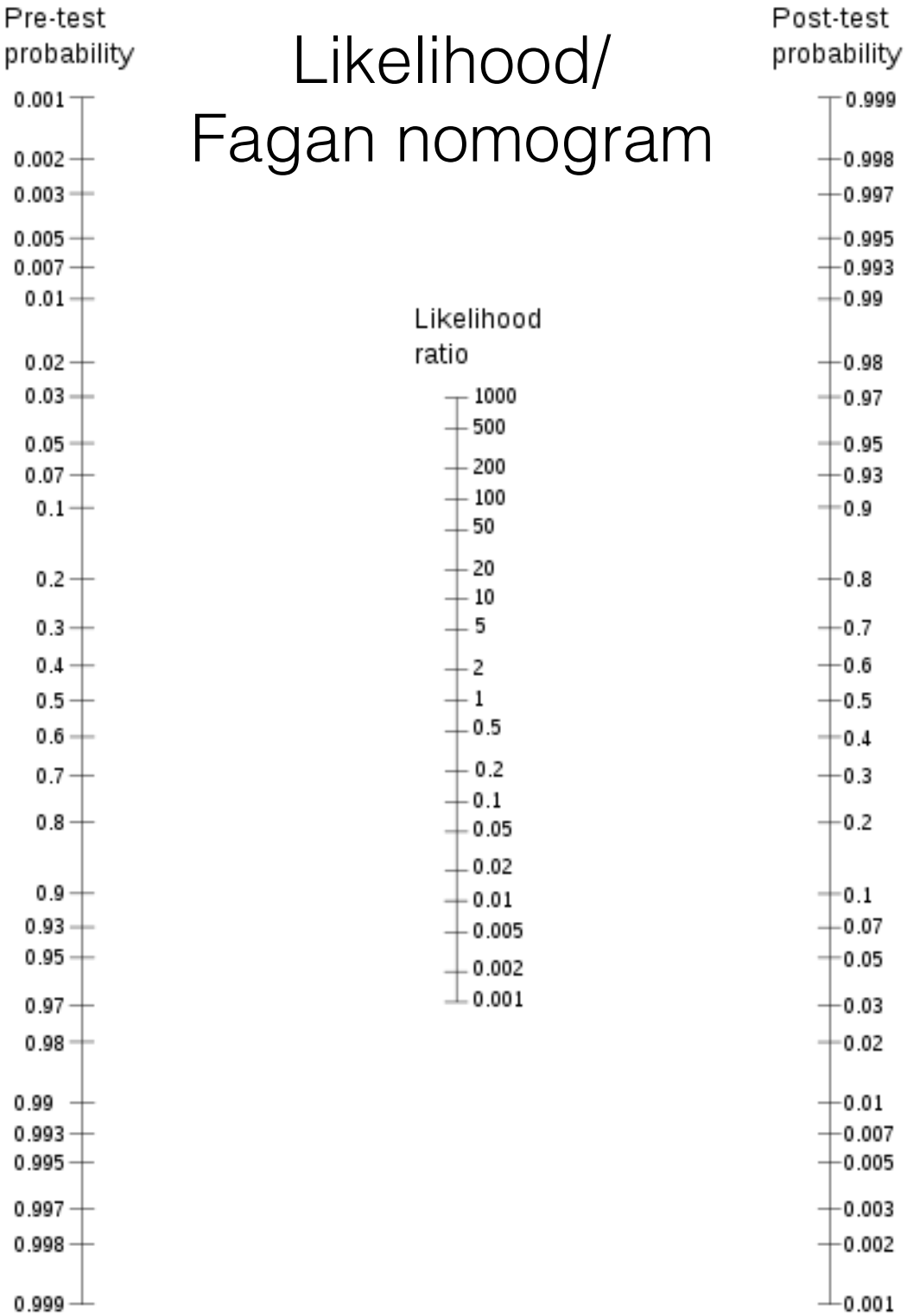
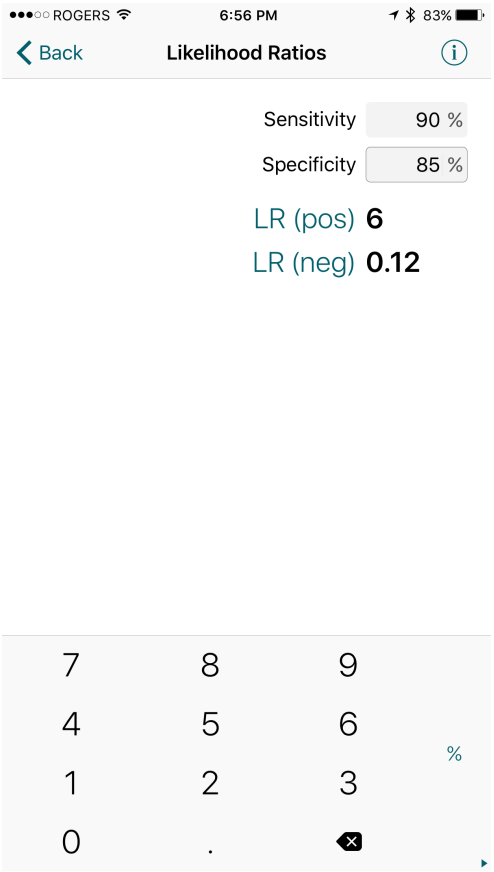


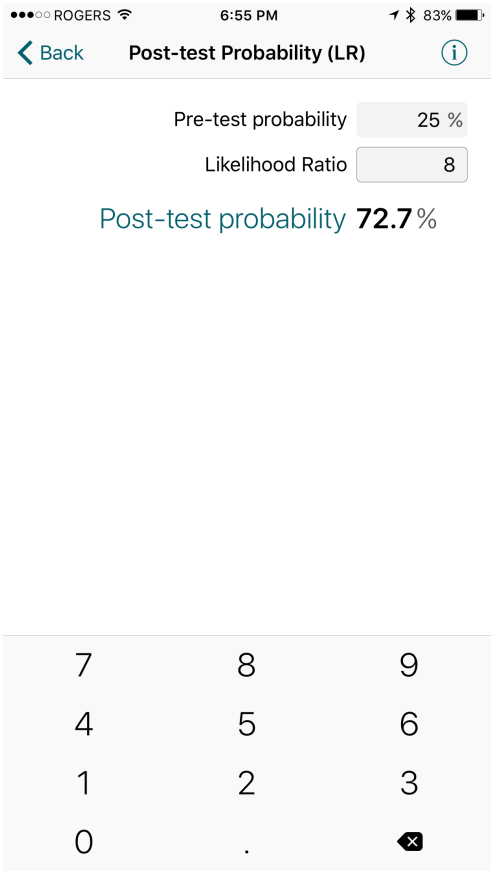
Table 4. Likelihood ratios and their approximate post test probabilities (modified by McGee 2002)[8]

Likelihood ratios			Approximate changes in post-test probabilities
Values between 0 and 1 decrease the probability of disease			
0.1	**Strong evidence**	**Large**	-45%
0.2		**Moderate**	-30%
0.3			-25%
0.4			-20%
0.5	**Weak evidence**	**Slight**	-15%
Likelihood ratio = 1		**None**	0%
Values greater than 1 increase the probability of disease			
2	**Weak evidence**	**Slight**	+15%
3			+20%
4			+25%
5		**Moderate**	+30%
6			+35%
8			+40%
10	**Strong evidence**	**Large**	+45%

Useful apps and on-line tools

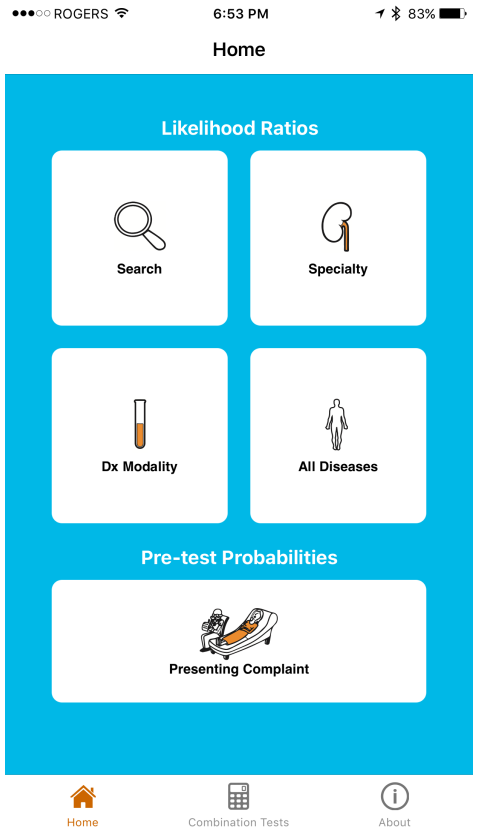
MedCalX - calculate likelihood ratios from sensitivity and specificity AND post-test probability calculator

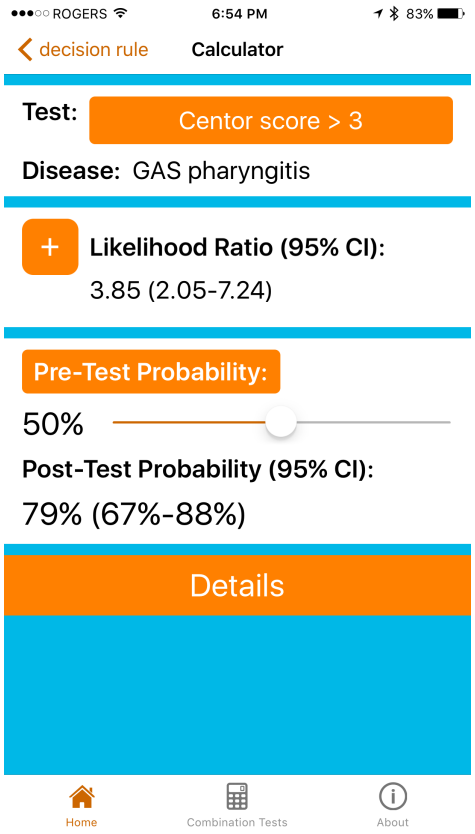


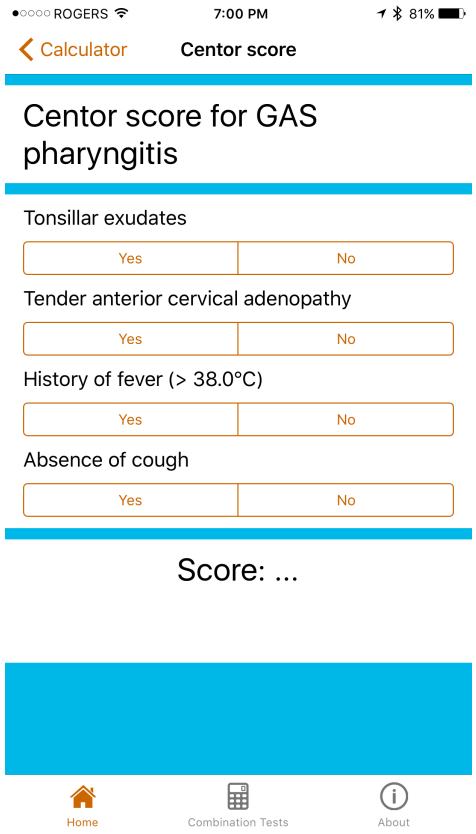


Useful apps and on-line tools

DxLogic - listing of LR and pre-test probabilities and a post-test calculator







lrdatabase.com - home of DxLogic

Oct. 12th, 2016: Check out my newest project: InvestLogic, an evidence-based guide and iOS app to help you save for retirement.

Search the Database

Likelihood Ratios

Specialty
- cardiology
- critical care
- dermatology
- endocrinology
- gastroenterology
- general surgery
- gynecology
- haematology
- infectious diseases
- nephrology
- neurology
- oncology
- orthopedics
- respirology
- rheumatology
- urology
- vascular surgery

Diagnostic Modality
- decision rule
- EKG
- history
- laboratory
- physical exam
- imaging

All Diseases
- list

Pre-test Probabilties

Presenting Complaint

abdomen
- abdominal pain
- acute liver failure
- suspected cauda equina syndrome
- suspected lower GI bleed
- suspected upper GI bleed

extremities
- ankle injury
- monoarthritis
- suspected deep vein thrombosis

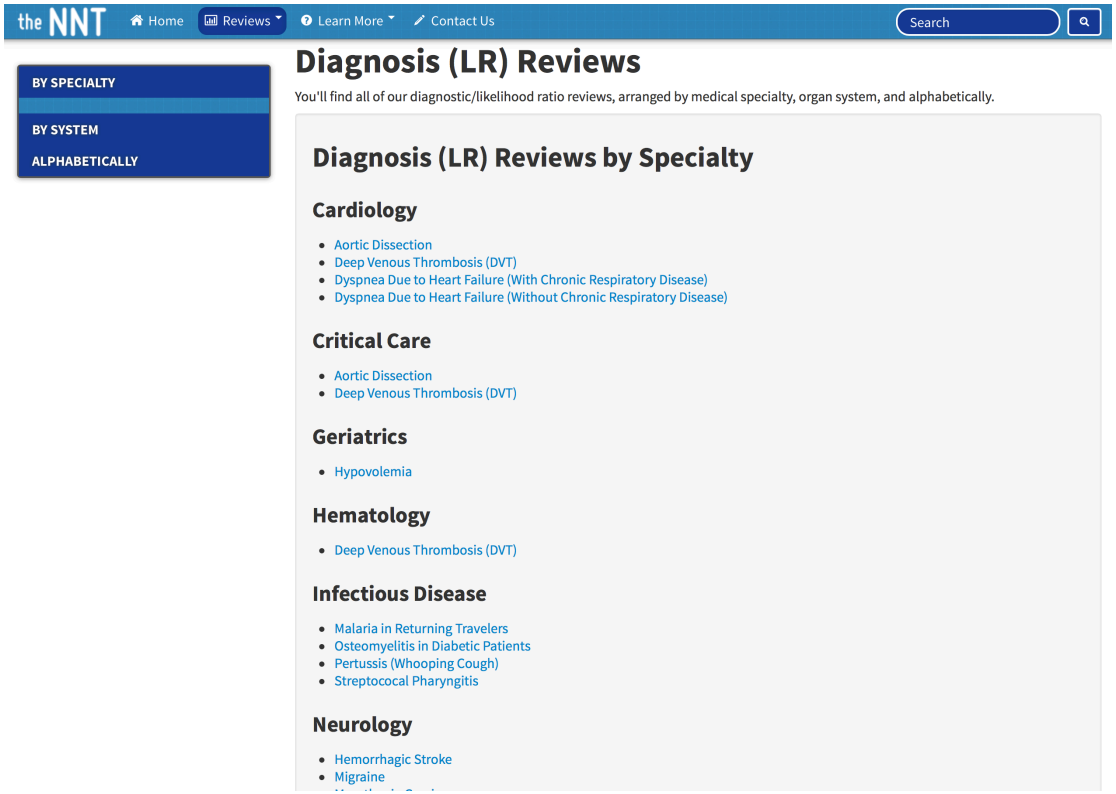
genitourinary
- acute renal failure
- hematuria (isolated and persistant)
- nephrotic syndrome
- proteinuria in patient with diabetes
- suspected ureteral stone
- vaginal complaint
- women presenting with 1 or more symptoms of UTI

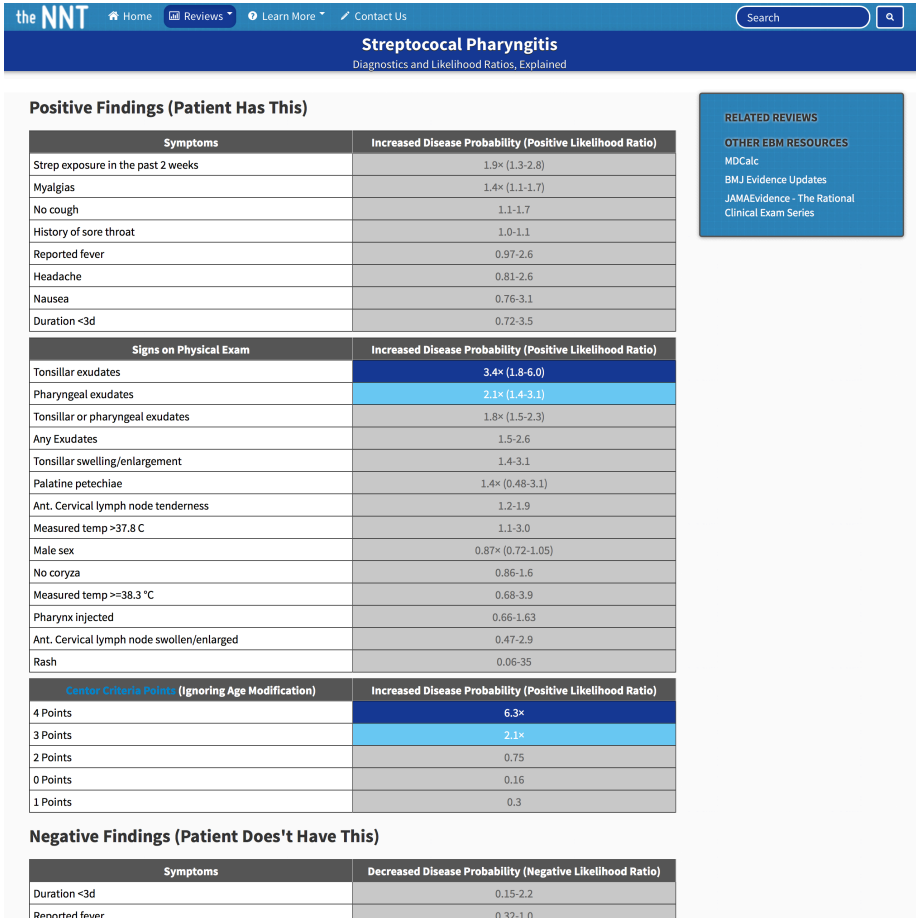
head and neck
- head injury
- neck injury
- sore throat

lrdatabase.com - home of DxLogic

Useful apps and on-line tools

http://www.thennt.com/home-lr/





Useful apps and on-line tools

http://getthediagnosis.org/

GetTheDiagnosis.org: A Database of Sensitivity and Specificity

Search: Go

Browse By Diagnosis Finding Category Random Entry Newest Entries

- About Us
- Explanation of Sensitivity and Specificity
- Explanation of ROC Curves
- Sensitivity and Specificity Calculator
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GetTheDiagnosis is a collaborative database for health professionals to share knowledge on the **sensitivity** and **specificity** of history questions, physical exam findings, and lab and imaging tests. You can use it to look up sensitivity and specificity, or submit an entry of your own from the literature!

We are currently up to **300** diagnoses and **1102** findings, for a total of **1624** entries! Follow our newest entries with our RSS feed.

Helicobacter pylori: Sensitivity and Specificity

Introduction: From UpToDate (http://www.utdol.com/online/content/topic.do?topicKey=acidpep/4732):

The ACG guidelines made the following conclusions:

- Testing for H. pylori should be performed only if the clinician plans to offer treatment for positive results.

* Testing is indicated in patients with active peptic ulcer disease, a past history of documented peptic ulcer or gastric MALT lymphoma.

- The test-and-treat strategy for H. pylori (ie, test and treat if positive) is a proven management strategy for patients with uninvestigated dyspepsia who are under the age of 55 years and have no "alarm features" (bleeding, anemia, early satiety, unexplained weight loss, progressive dysphagia, odynophagia, recurrent vomiting, family history of GI cancer, previous esophagogastric malignancy).

* Deciding which test to use in which situation relies heavily upon whether a patient requires evaluation with upper endoscopy and an understanding of the strengths, weaknesses, and costs of the individual test.

[Edit Diagnosis] [Merge dx] [Add prevalence]

Tags: Gastrointestinal Problem Infection *Tag this Diagnosis.*

The sensitivity and specificity of findings for Helicobacter pylori are listed below. See the left navigation bar to change the display.

Sensitive and Specific Findings

Finding	*Sensitivity*	*Specificity*	*Comments, Study*
Antral biopsy urease test	90%	95%	[sens/spec is per UpToDate] One reason for lack of specificity: If specifmen contains less common non-pylori gastric helicobacters, which give only weakly positive results in the biopsy urease test. Positive identification of these bacteria requires visualization of the characteristic long, tight spirals in histologic sections. • Adapted from Harrison's Online Chapter 144: Helicobactor pylori infections **Study:** Am J Gastroenterol. 2007 Aug;102(8):1808-25. PMID 17608775
Urea breath test	93%	92%	in patients with an UGIB. **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583

Specific Findings

Finding	*Sensitivity*	*Specificity*	*Comments, Study*
Biopsy culture	45%	98%	In addition to diagnosis, biopsy culture allows for determination of antibiotic sensitivity **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583
Rapid urease test	67%	93%	in patients with UGIB. **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583
Biopsy histology	70%	90%	in patients with UGIB. **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583

Sensitive Findings

Finding	*Sensitivity*	*Specificity*	*Comments, Study*
Serology	88%	69%	in patients with UGIB **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583
Stool antigen test	87%	70%	in patients with UGIB **Study:** Am J Gastroenterol. 2006 Apr;101(4):848-63. PMID 16494583

SCREENING EXAMPLE

6 rapid human immunodeficiency virus (HIV) antibody tests

Sensitivity was >95% and specificity was >99% for all rapid tests

Clin Infect Dis 2011;52:257-63

2% prevalence	HIV	No HIV	
Test +	19	10	29
Test -	1	970	971
	20	980	1000

LR+
= sensitivity/1-specificity
=
LR-
= 1-sensitivity/specificity
=

If prevalence	If test positive Post test probability	If test negative Post test probability
0.1%		
1%		
2%		
10%		
40%		

http://bit.ly/2fd9sjf

DIAGNOSIS EXAMPLE

GABHS (strep) rapid antigen detection test kit, in comparison with oropharynx swab culture

Table 4 - Comparison between oropharynx swab culture and latex particle agglutination test for detecting GABHS*

	Culture					
Latex	**Positive**		**Negative**		**Total**	
Positive	49	90.7%	19	10.9%	68	29.7%
Negative	5	9.3%	156	89.1%	161	70.3%
Total	54	100%	175	100%	229	100%

Sensitivity LR +

Specificity LR -

J Podiatry 2007;83:465-70

Pre-test probability

General practice clinic in Canada - people with a sore throat who have Strep ~10%

LR + =
= Post-test probability
LR - =
= Post-test probability

Prevalence	If positive Post test probability	If negative
1		
10		
40		

OPEN ACCESS Freely available online

PLOS | ONE

Rapid Antigen Group A Streptococcus Test to Diagnose Pharyngitis: A Systematic Review and Meta-Analysis

Enzyme immunoassay

CHILDREN - pooled sensitivity was 86% (95% CI, 79–92%) and the pooled specificity was 92% (95% CI, 88–95%)

LR + = 10.8 LR - = 0.15

ADULTS - the pooled sensitivity was 86% (95% CI, 81–91%) and the pooled specificity was 97% (95% CI, 96 to 99%)

LR + = 28.7 LR - = 0.14

PLOS 1 November 2014

SCREENING EXAMPLE

Thickening of the Nuchal Translucency - Ultrasound

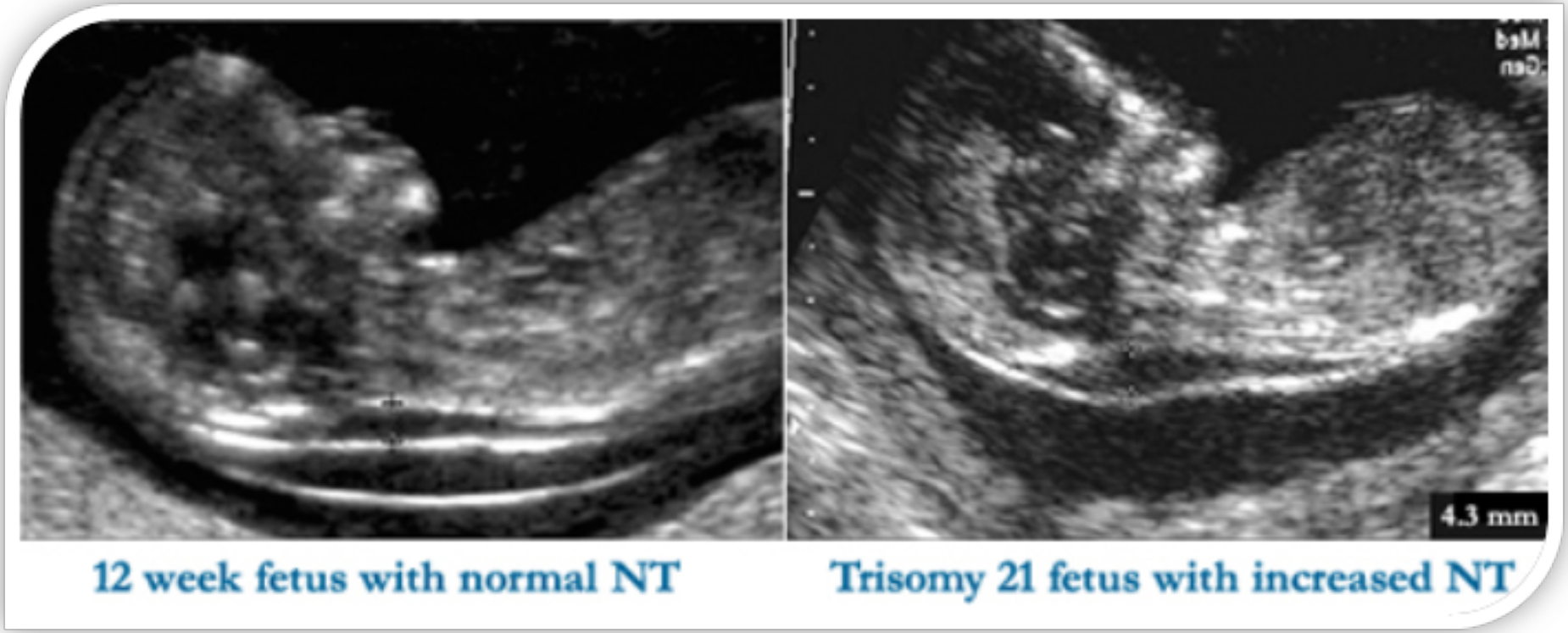


Table 5. Calculated LRs (Sensitivity/False-Positive Rate) of Sonographic Findings for Fetal Down Syndrome

Sonographic Marker	LR Overall*	LR as Isolated Marker†	95% CI
Nuchal thickening	61	11	5.5–22
Hyperechoic bowel	33.8	6.7	2.7–16.8
Short humerus	15.3	5.1	1.6–16.5
Short femur	6.1	1.5	0.8–2.8
EIF	6.3	1.8	1.0–3.2
Pyelectasis	5.2	1.5	0.6–3.6

*LR when a marker was present either as an isolated finding or in combination with other markers.
†LR when a marker was present as an isolated finding.

J Ultrasound Med 20:1053–1063, 2001

Pre-screening probability

Nuchal thickening LR = 11

The risk of Down's syndrome (trisomy 21) varies with maternal age:

1:1,500 (0.07%) at 20 years

1:800 (0.1%) at 30 years

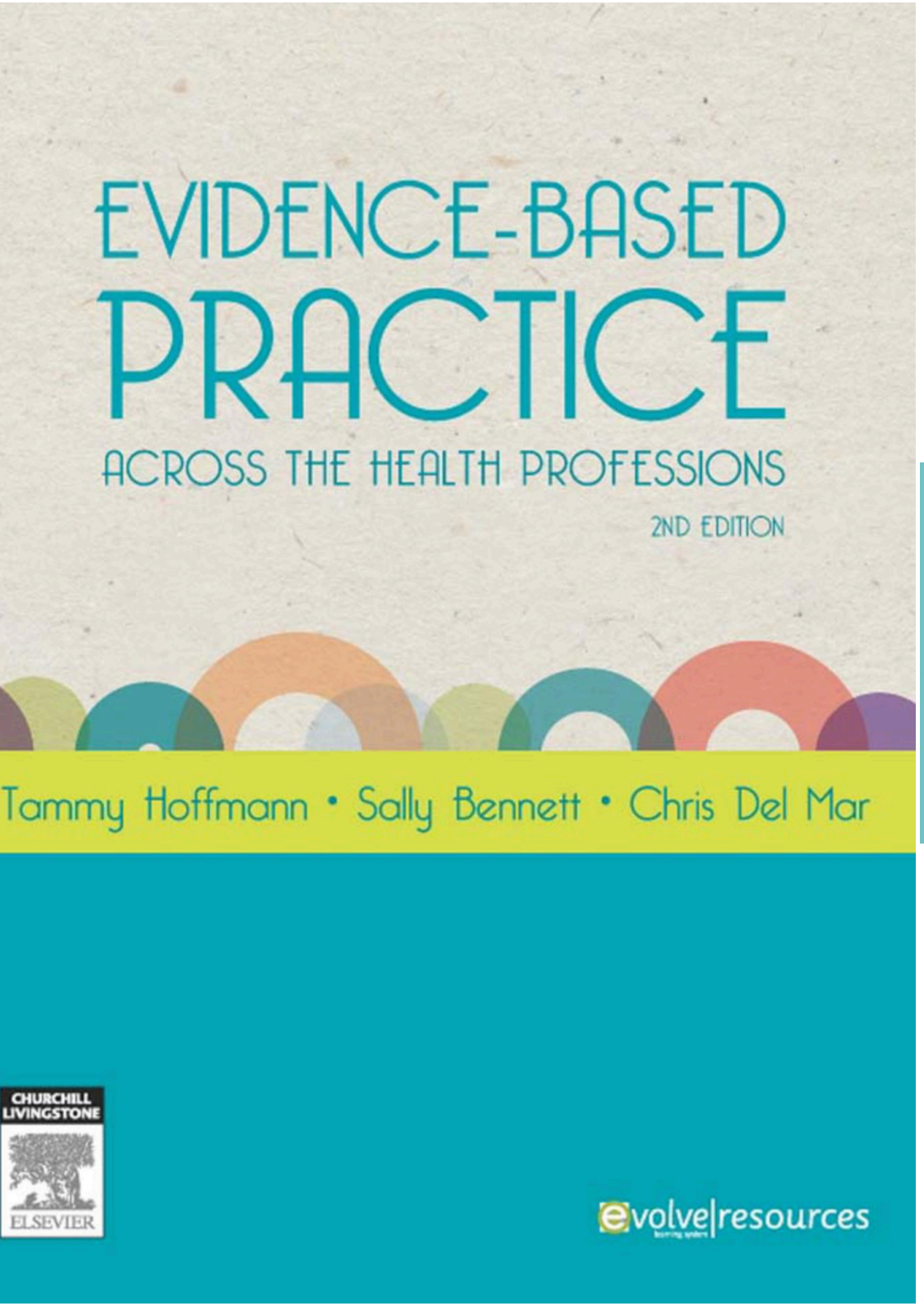
1:270 (0.4%) at 35 years

1:100 (1%) at 40 years

>1:50 (2%) at 45 years and over

Prevalence	Post test probability If nuchal thickening positive
0.07%	
0.1%	
0.4%	
1%	
2%	

DIAGNOSIS EXAMPLE



Chapter 6

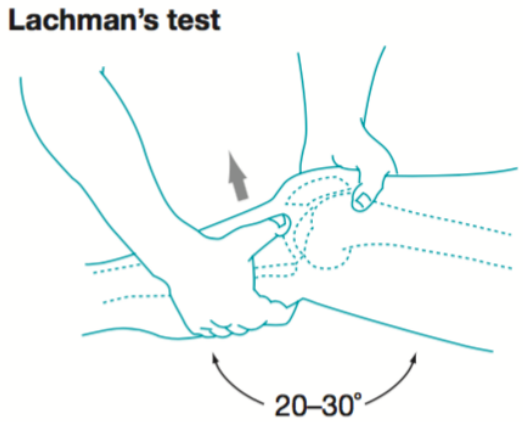
Evidence about diagnosis

Jenny Doust

24-year-old man who twisted his right knee while playing football the day before. He has been suffering with pain and swelling in the knee since the time of the injury, and is able to weight-bear but with difficulty.

Question - meniscal injury, an injury to the anterior cruciate ligament or a soft-tissue injury

Best way to assess - arthroscopy
next best MRI - not 100% but…



A positive test result is movement of the knee with a soft or mushy endpoint

Lachman's test

	Ligament damage	No ligament damage	
Test +	37	14	51
Test -	22	130	152
	59	144	203

Prevalence in this example is

PPV

NPV

Sensitivity

LR+

Specificity

LR-

Prevalence effect on predictive value - total of 100 people

Prevalence = 15%
Sensitivity = 10/15 = 67%
Specificity = 45/85 = 53%

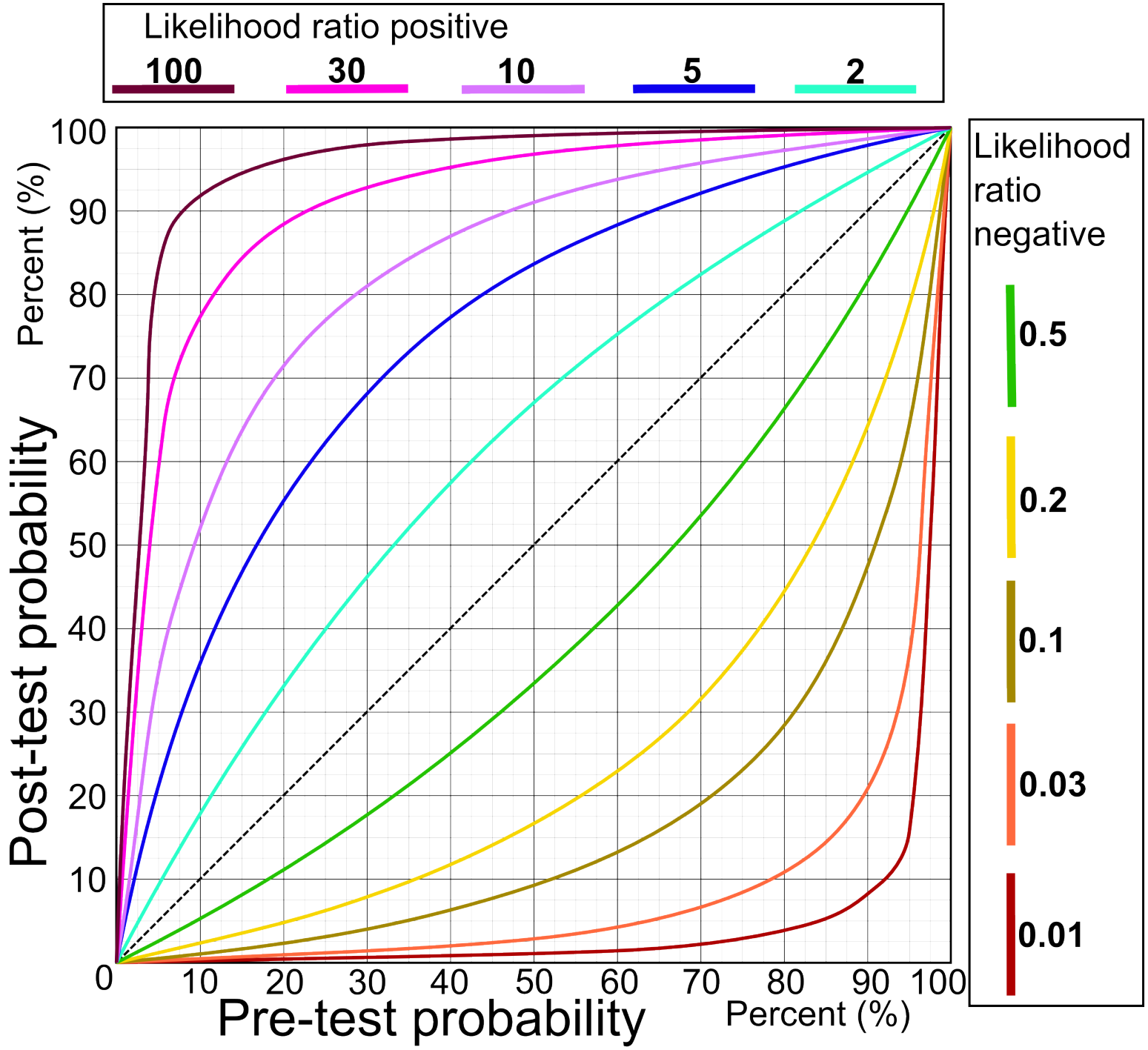
PPV = 10/50 = 20%
NPV = 45/50 = 90%

Prevalence = 30%
Sensitivity = 20/30 = 67%
Specificity = 37/70 = 53%

PPV = 20/53 = 38%
NPV = 37/47 = 79%

Prevalence = 60%
Sensitivity = 40/60 = 67%
Specificity = 21/40 = 53%

PPV = 40/59 = 68%
NPV = 21/41 = 51%



https://en.wikipedia.org/wiki/Pre-_and_post-test_probability