PRIMARY CARE
MED437

Clinical Reasoning and diagnosis

Objectives:

- Diagnostic Strategies in Clinical Practice
  - -Hospital vs family practice
  - -Hypothetico-deductive model
- Why Order a test? a diagnostic test?
- Sources of error in the diagnostic process
- Test characteristics: sensitivity, specificity, likelihood ratios.

Done by:

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References

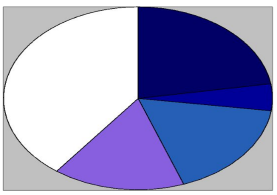
- Doctor's slides and notes

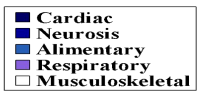
Important *Notes* *Extra* *Golden*

Editing file link

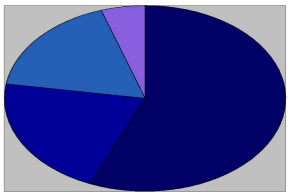
Contrasting Causes of Chest Pain

General practice
= Family medicine





Hospital

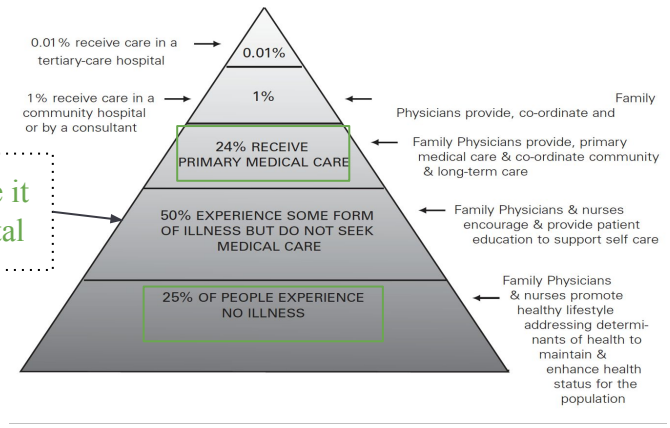


We see variety of causes of illnesses
We don't refer most of musculoskeletal cases to hospital because it's self limiting , mild , only need reassurance

We don't refer all patient with chest pain
Most chest pain managed within primary care

Describing Illness in the Community:

Illness for 1000 Persons During a One-Month Period (Rosser 1999)



They will try to manage it without going to hospital

Why?

- Pattern of illness: Community vs hospital
- Undifferentiated & unorganized illness
- No prior assumptions
- Information on which to base a precise diagnosis is lacking- early presentation
- Direct availability of physicians & unpredictable workload
- Doctor-patient relationship

✔ Use of time
✔ Patient-centredness

Problem-Solving styles

-Cookbook-Arborization التفرع > having algorithm " stepwise approach
-Dendritic arborization
-EUREKA " وجدتها " Pattern diagnosis" patient comes with typical picture > Eurica diagnosis
-Biomedical scientist
- Basket Collect as many information as you can then come up to a diagnosis

Inductiveالاستقراء Method of Problem-Solving

Full history:

Presenting complaint/ Systemic enquiry

Previous medical history/ Drugs/ Social/ family

PLUS Complete physical Examination

PLUS Investigations

Diagnosis

As outpatient or family medicine we can't do all this . we should have another way to reach quickly and effectively to the diagnosis

Hypothesis Matrix "Chest Pain"

Pathophysiologic process	Organ System		
	Cardio-vascular	***Pulmonary***	***Gastro-intestinal***
Mechanical	MI Dissecting aneurysm	Embolism	Achalasia
Inflammatory	Pericarditis	Pleuritis	Ulcer
Infectious	Endocarditis Myocarditis	Pneumonia	GE

3 Stages of Problem Solving

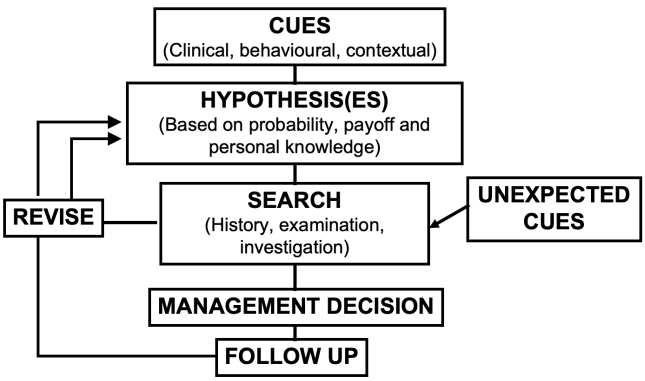
1.Identify the problem clearly.
2.Generate as many solutions as possible:
- *do not reject a solution at this stage, however preposterous it sounds.*

3.Take **STEP**s toward solving the problem:
a)**S**elect a solution.
b)**T**ry it out.
c)**E**valuate what happens.
d)**P**ersist until you feel better.

Hypothetico-Deductive Model

Identification of **Errors** (at any step you could go wrong so you have to be careful)

Hypothetico: Derived from hypothesis
Deductive: الاستنتاج = أسلوب الاستنتاج باستخدام الفرضيات



Patient comes to you with cues
Cues= Pieces of info
And based on this cues you start to generate hypothesis
3-5 hypothesis
And then we search by using tests (History and examination is kind of a test not only investigation)
Which means it's not necessary to ask about everything , I will ask about about what discriminate between hypothesis. , while i'm doing this other cues will show , then I will manage based on the strongest hypothesis, and with follow up maybe I discover that the hypothesis i thought of wasn't the strongest , maybe something else is more likely and so on .. andI I will keep revising.

Cues could be clinical (signs and symptoms) , Behavioral (ex ; patient is avoiding eye contact , Contextual (Discrepancy between verbal and non verbal)

Hypothesis:
Based on probability > by knowing epidemiology
Pay off > قد أيش المكسب اني افكر في diagnosis
Ex; postmenopausal bleedinng
Most common is vaginal atrophy but other serious causes like endometrial cancer so we might consider some diagnosis because they are serious
So the pay off is because they are serious and shouldn't be missed not because they are common

In management we are managing based on probability , we are not 100% sure that this patient does/doesn't have the diagnosis

Case 1 :

A 61-year-old widow presents with a history of ‘wetting herself’ for the previous 5 days because she ‘can’t get to the toilet on time’. She had felt ‘perfectly well’ prior to the onset of her present symptomatology. Her medical records reveal she has no history of significant illness and that she is an infrequent attender.

Hypothesis: UTI,Urinary Incontinence, Uterine prolapse, diabetes

Case 2:

A 32-year-old divorcee with 2 children who has been ‘well’ until 2 months previously. She presented with:

Presentation 1

Tiredness
Irritability
Weight loss
Dislike of hot weather
Increased sweating
Palpitations
Trembling of hands
Increased appetite
(rule out thyrotoxicosis)

Presentation 2

Tiredness
Irritability
Increased sweating
Weight loss
Palpitations
Diminished appetite

Not typical for hyperthyroidism

Presentation 3

Tiredness
Weight loss?
Normal appetite

Not enough info , I will use inductive method
الاسلوب التقليدي في جمع المعلومات

Diagnostic Strategies in Clinical Practice:

- Pattern recognition : 20% we reach dx
- Arborization (multiple branching)
- Inductive: Exhaustive exploration of data.
- Hypothetico-deductive
- Computer-assisted

Why order a test?

- To rule in or out a diagnosis
- To screen for disease among asymptomatic patients
- To provide prognostic information on patients with established disease
- To monitor ongoing therapy, maximize effectiveness, and minimize side effects.
- To reassure a patient

The diagnostic process is probabilistic

Prior probability

⇩

Post-history probability

⇩

Post-exam probability

⇩

Post-test probability
(posterior probability)

When Order a *diagnostic* Test?

■When the characteristics of that test give it ***validity*** in the clinical setting.

■When the test result will **change the probability** of the disease leading to a change in clinical strategy.

Table 3.3 Results of a systematic review of serum ferritin as a diagnostic test for iron deficiency anemia

		Target disorder (iron deficiency anemia)		
		Present	Absent	Totals
Diagnostic test result (serum ferritin)	Positive (<65 mmol/L)	731 a	270 b	1001 a+b
	Negative (≥65 mmol/L)	c 78	d 1500	c+d 1578
Totals		a+c 809	b+d 1770	a+b+c+d 2579

Data from: Guyatt GH, Oxman AD, Ali M, et al. J Gen Intern Med 1992; 7: 145–53.

Prevalence = (a + c)/(a + b + c + d) = 809/2579 = 31%.

Positive predictive value = a/(a + b) = 731/1001 = 73%.

Negative predictive value = d/(c + d) = 1500/1578 = 95%.

Sensitivity = a/(a + c) = 731/809 = 90%.

Specificity = d/(b + d) = 1500/1770 = 85%.

LR+ = sensitivity/(1 – specificity) = 90%/15% = 6.

LR – = (1 – sensitivity)/specificity = 10%/85% = 0.12.

Study pre-test odds=prevalence/(1 – prevalence) = 31%/69% = 0.45.

Post-test odds = pre-test odds × likelihood ratio.

Post-test probability = post-test odds/(post-test odds + 1).

What Is A **VALID** Test?

(high Sensitivity and high specificity)

Sensitivity: A/(A+C)

Specificity: D/(D+B)

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The 2 x 2 table

Spin and *Snout*

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Sn***N***out: A highly se***N***sitive test, if ***N***egative, helps to rule the disease **out**.

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Sp***P***in: A highly s***P***ecific test, if ***P***ositive, helps to rule the disease **in**.

What do diagnostic tests do?

Patient presentation (e.g. with symptoms) (prior probability)

LRs from history ↓

Post-history probability

LRs from examination ↓

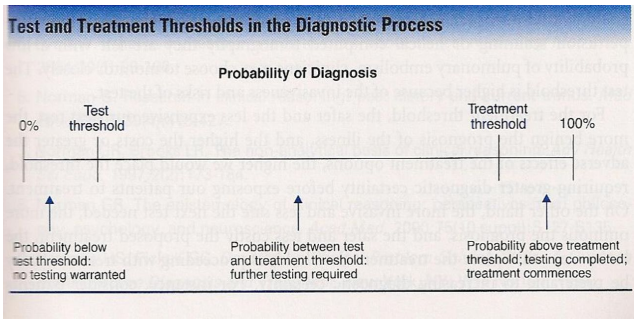
Post-examination probability

LRs from testing ↓

Post-test probability (posterior probability)

Test threshold :
The chances of patient having chest pain and the probability of him or her to have coronary artery disease
- Probability range = 0 - 100

Test and Treatment Thresholds



Treatment threshold :
Threshold when probability is very strong; even when the probability become more , there is no need to waste time and i'm going to treat right away

Chest Pain *and* Coronary Artery Disease (CAD)

■Test Threshold? 10% If we think that the probability for this patient to have coronary artery disease 10% or less , then i'm going to consider other diagnosis

■Treatment threshold? 80% 80% is high , I'm going to treat the patient as he have CAD

If the probability is 70% , I'm not sure I need to test - even 20%- but 10% is very unlikely for the patient to have CAS

Chest Pain and ECG

■How helpful is the stress ECG in diagnosing coronary artery disease (CAD) among patients presenting with chest pain?

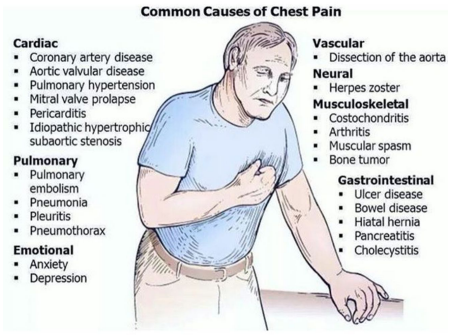
■**Sensitivity: 45%**

■**Specificity: 85%**

■**Likelihood ratios:**

■**+ve: 3.0**

■**-ve: 0.7**



Chest Pain and stress ECG- *Scenario 1*

- Middle aged man
- Typical history of angina
- Tight substernal pain
- ↑ by exercise
- ↓ by rest- within 5 min

Probability of CAD: **90%**

Stress ECG?

Post-test probability of CAD:
+ve = **96.4%**
-ve =**85.3%**

Higher than treatment threshold -80%-
If negative still the probability 85%; so the idea telling if the test is negative then we rule out the disease is not correct!
We should start treatment

Chest Pain and stress ECG- *Scenario 2*

- 40-year-old
- No risk factors
- Vague (L) Sided chest pain
- Unrelated to exercise
- ↑ by moving the chest wall

Probability of CAD: **3%**

Stress ECG?

Post-test probability of CAD:
+ve = ***8.5%***
-ve = ***2.0 %***

Probability is low
If i order the test and it's positive the probability will increase to 8.5% , if negative will decrease to 2%
The test is not useful

Chest Pain and stress ECG- *Scenario 3*

- Middle aged man
- Attacks substernal pain several months
- Occurs at rest few min – ½ hr
- Worsened since onset
- ↑ By exertion
- **X** relieved by rest

Probability of CAD: **65%**

Stress ECG?

Post-test probability of CAD:
+ve = ***84.8%***
-ve = ***54.7%***

Probability of CAD is 65% , I'm not sure in this case , not very high probability to say definitely he has CAD , and not very low probability to say he is unlikely to have CAD
It is in the range between treatment and test threshold > This is where the test would be useful
If +>above my treatment threshold
If - > doesn't rule out
So it is useful if it's positive

Likelihood Ratios

■ 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").

■ Likelihood ratios (LRs) tell us how much we should shift our suspicion for a particular test result.

■ The "positive likelihood ratio" (LR+) tells us how much to increase the probability of disease if the test is positive, while the "negative likelihood ratio"

(LR-) tells us how much to decrease it if the test is negative.

$$LR+ = \frac{\text{Probability of an individual } \textbf{\textit{with}} \textit{ the condition having a } \textit{positive test}}{\text{Probability of an individual } \textbf{\textit{without}} \textit{ the condition having a } \textit{positive test}}$$

$$LR- = \frac{\text{Probability of an individual } \textbf{\textit{with}} \textit{ the condition having a negative } \textit{test}}{\text{Probability of an individual } \textbf{\textit{without}} \textit{ the condition having a } \textit{negative test}}$$

$$LR+ = \frac{\text{Sensitivity}}{\text{1-specificity}}$$

$$LR- = \frac{\text{1-sensitivity}}{\text{specificity}}$$

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LR Interpretation

>10	Large & often conclusive increase in the likelihood of disease
5-10	Moderate increase in the likelihood of disease
2-5	Small increase in the likelihood of disease
1-2	Minimal increase in the likelihood of disease
1	No change in the likelihood of disease
0.5-1.0	Minimal decrease in the likelihood of disease
0.2-0.5	Small decrease in the likelihood of disease
0.1-0.2	Moderate decrease in the likelihood of disease
<0.1	Large & often conclusive decrease in likelihood of disease

Strength of Test by Likelihood Ratio

Qualitative Strength	LR+	LR-
Excellent	10	0.1
Very Good	5	0.2
Fair	2	0.5
Useless	1	1

Symptom: Chest pain (all)
Disease: coronary artery disease

Test Name	LR+	LR-	Sens	Spec
Transesoph dobutamine stress echo (women)	41	0.2	82%	98%
CT coronary angio (64 slice, mod pretest prob)	14	0.01	99%	93%
CT coronary angio (64 slice, all pts)	9.0	0.01	99%	89%
CT coronary angio (64 slice, low pretest prob)	9.0	0.01	100%	89%
Stress thal (visual read)	5.9	0.2	83%	86%
QT dispersion >= 60 msec after exercise test	4.9	0.3	74%	85%
Women: thallium scintigraphy	4.3	0.2	86%	80%
Stress echocardiogram (women)	4.1	0.2	86%	79%
CTA >= 50% + CTP SSS >= 4 (pts without known CAD)	4.1	0.3	77%	81%
Exercise echocardiography	3.7	0.2	85%	77%
Radionuclide angiocardiography	3.6	0.04	97%	73%
CTA >= 50% + CTP SSS >= 4 (pts with no prior MI)	3.5	0.3	80%	77%
CT coronary angio (64 slice, high pretest prob)	3.5	0.01	99%	72%
Dipyridamole stress thal	3.3	0.2	87%	74%
CTA >= 50% + CTP SSS >= 4 (all patients)	3.1	0.3	80%	74%
Graded exercise test (men)	3.0	0.7	45%	85%
CTA >= 50% + CTP SSS >= 2 (pts without known CAD)	2.8	0.2	84%	70%
CT (16 slice hi res) by artery segment	2.5	0.2	89%	65%
Exercise SPECT imaging	2.4	0.2	87%	64%
CTA >= 50% + CTP SSS >= 2 (pts with no prior MI)	2.3	0.2	88%	62%
Stress thallium (women)	2.2	0.3	78%	64%
CT (16 slice hi res) by patient	2.1	0.04	98%	54%
CTA >= 50% + CTP SSS >= 2 (all patients)	2.1	0.2	90%	57%
Magnetic resonance angiography	2.0	0.2	88%	56%
Graded exercise test (women)	2.0	0.6	61%	70%
Fractional flow reserve CT	2.0	0.2	90%	54%
Electron beam CT	1.9	0.1	93%	50%

Useful when it's positive

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Estimating Pre-Test Probability

- Research papers evaluating diagnostic tests
- Epidemiological studies and national surveys
- Audit data
- Clinical experience

Clinical Symptoms & Diagnosis of UTI

1. **P**atient population. Women in child bearing age
2. **I**ntervention. Symptoms (Dysuria, Frequency, etc)
3. **C**omparison intervention
4. **O**utcomes Probability of UTI

"In women in child bearing age suspected to have UTI, to what extent, would the presence or absence of certain symptoms relate to the probability of UTI?

Using a number of sx will help ; Dysuria and frequency = 23 which will predict UTI

Clinical Signs and Symptoms in the Prediction of Urinary Tract Infection

Symptom	LR+	LR-	Symptom	LR+	LR-
Dysuria	1.5	0.48	Vaginal Irritation	0.24	2.7
Frequency	1.8	0.59	Back Pain	1.6	0.83
Hematuria	2.0	0.92	Self-diagnosis	4.0	0
Fever	1.6	0.9	Vaginal Discharge on Physical Examination	0.69	1.1
Flank Pain	1.1	0.84	Costovertebral Angle Tenderness on PE	1.7	0.86
Lower Abdominal Pain	1.1	0.89	Dipstick Urinalysis	4.2	0.3
Vaginal Discharge	0.34	3.1			

Symptom Combination	LR+	Symptom Combination	LR-
Dysuria present	1.5	Dysuria absent	0.5
Frequency present	1.8	Vaginal discharge or irritation present	0.3 or 0.2
Vaginal discharge absent	3.1	**Overall**	**0.1 - 0.2**
Vaginal irritation absent	2.7	Dysuria or frequency present	1.5 or 1.8
Overall	**23**	Vaginal discharge or irritation present	0.3 or 0.2
		Overall	**0.3 - 0.5**

Questions

1.You note that in your practice, a large number of women with a family history of breast cancer in a first-degree relative develop breast cancer themselves. You evaluate a number of charts, and find that 5% of the women in your practice who have breast cancer have a family history, but only 2% of women without breast cancer have a family history. Given this information, what is the sensitivity of using family history as a predictor of breast cancer in your patient population?
a. 2%
b. 5%
c. 93%
d. 95%
e. 98%

2.You are reading a population study that reports 90% of people with lung cancer are smokers. Thirty percent of the people without lung cancer are also smokers. Given this information, what is the specificity using smoking as a predictor of lung cancer?
a. 10%
b. 30%
c. 40%
d. 70%
e. 90%

3.You are determining whether or not to use a rapid streptococcal antigen test to screen for streptococcal pharyngitis. You find that 2% of people with strep throat actually test negative using this test. Which of the following statements best describes this situation?
a. The sensitivity of the test is 2%.
b. The specificity of the test is 98%.
c. The test has a 2% false-negative rate.
d. The test has a 2% false-positive rate.
e. The test has a positive predictive value of 98%.

Questions

4.You are considering using a new influenza screening test. You find a study that evaluated 1000 patients with this new test. Of these 1000 patients, 400 had the disease. Three hundred of those had positive tests, and 100 of those had a negative test. Of the 600 that did not have the dis- ease, 200 had positive tests, and 400 had negative tests. What is the positive predictive value of this test?

a. 50%
b. 60%
c. 66%
d. 75%
e. 80%

5.You find that many of your patients that have gone to the emergency department with chest pain have a negative set of initial cardiac enzymes. Most of those with a negative set of initial enzymes did not have a heart attack. You decide to evaluate 100 of your patients who have gone to the emergency department with chest pain to find out if an initial set of negative enzymes by itself is a good predictor of those that are not having an MI. Of those 100 patients, 20 of them had acute MIs. Of those 20, 10 had a positive set of enzymes initially. Of the 80 that did not have an acute MI, none of them had a positive set of initial enzymes. Given this information, what is the negative predictive value of the initial set of cardiac enzymes in your patient population?

a. 20%
b. 22%
c. 50%
d. 89%
e. 100%

Answers:
1.b
2.d
3.c
4.b
5.d