



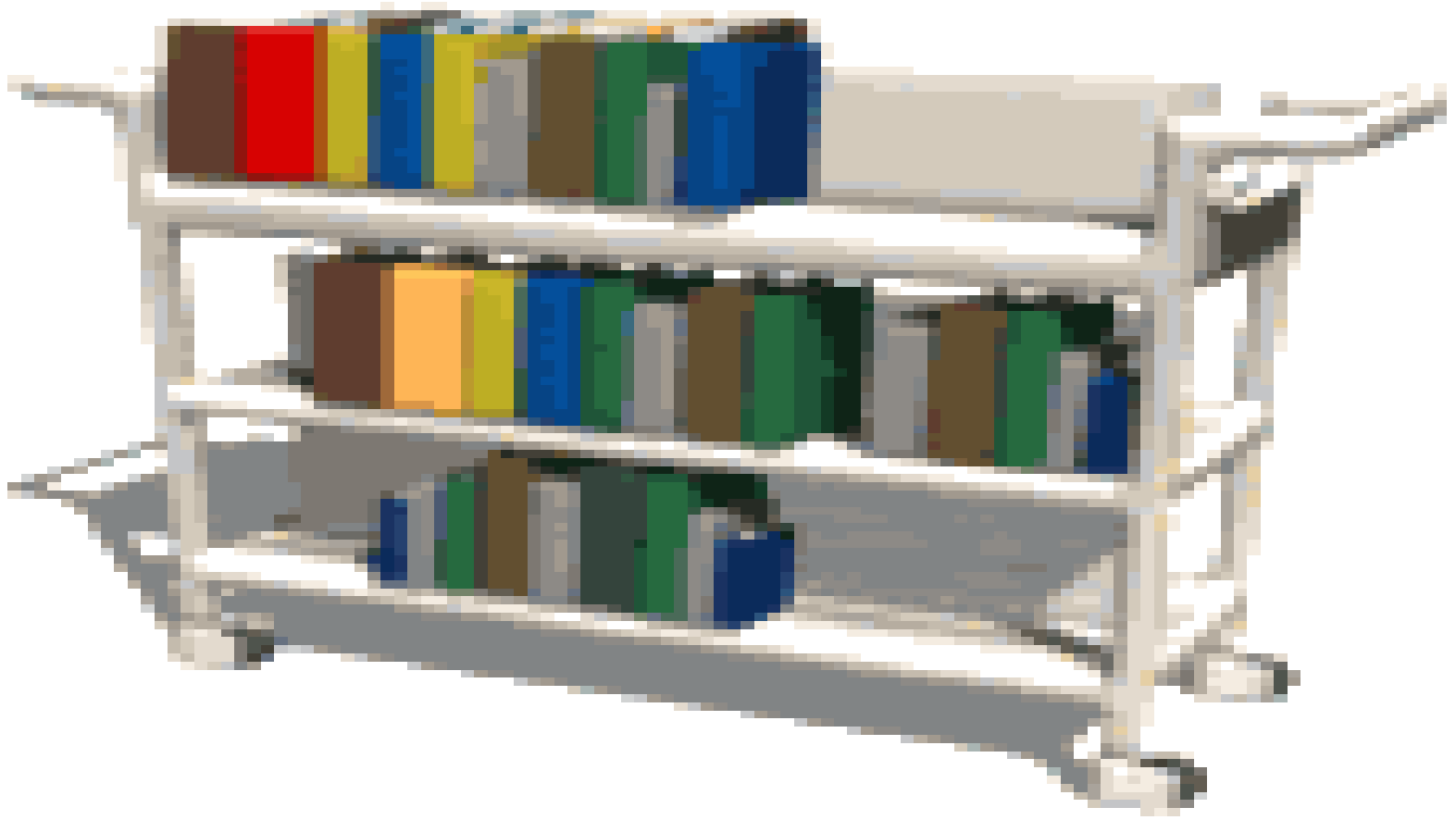
IN THE NAME OF GOD

Evidence – Based Medicine

**J . KOOHPAYEHZADEH
MD,MPH**

Professor of Community Medicine

What do you think about EBM?





Minimum reading to keep up-to-date with pediatrics

- **Pediatrics – 40 articles x 12 months**
- **New England Journal of Medicine – 5 articles x 52 weeks**
- **Lancet - 6 articles x 52 weeks**
- **Journal of Pediatrics – 18 articles x 12 months**
- **Pediatric Infectious Disease Journal - 15 articles x 12 months**
- **JAMA 8 articles x 12 months**
- **BMJ 10 articles x 52 months**
- **Archives of Pediatric and Adolescent Medicine – 10 articles x 12 months**
- **1694 article per year= 5 articles per day**



HISTORY

- MIDDEL 19 CENTURY IN FRANCE
MEDICAL SCHOOL
- EBM WAS CREATED M.C MASTER
UNIVERSITY 1980
- It was initially proposed by Dr. David Sackett and colleagues at McMasters University in Ontario, Canada.

What is Evidence-Based Medicine?

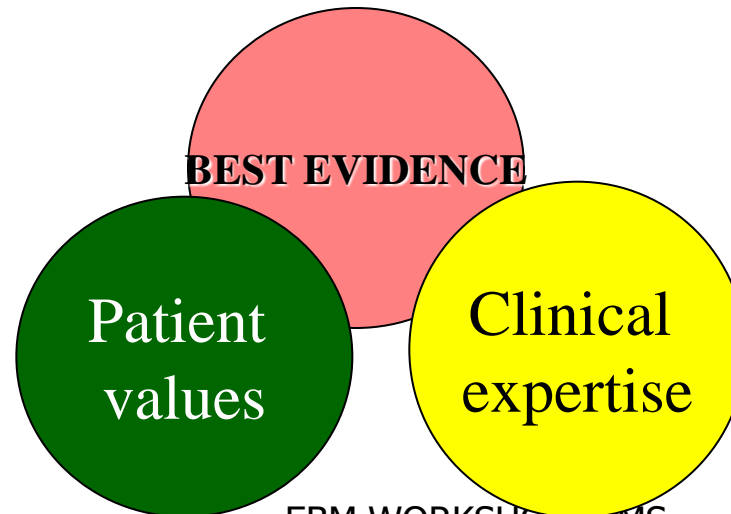


- Evidence-based medicine (EBM) is an important change in the way physicians practice, teach, and do research.

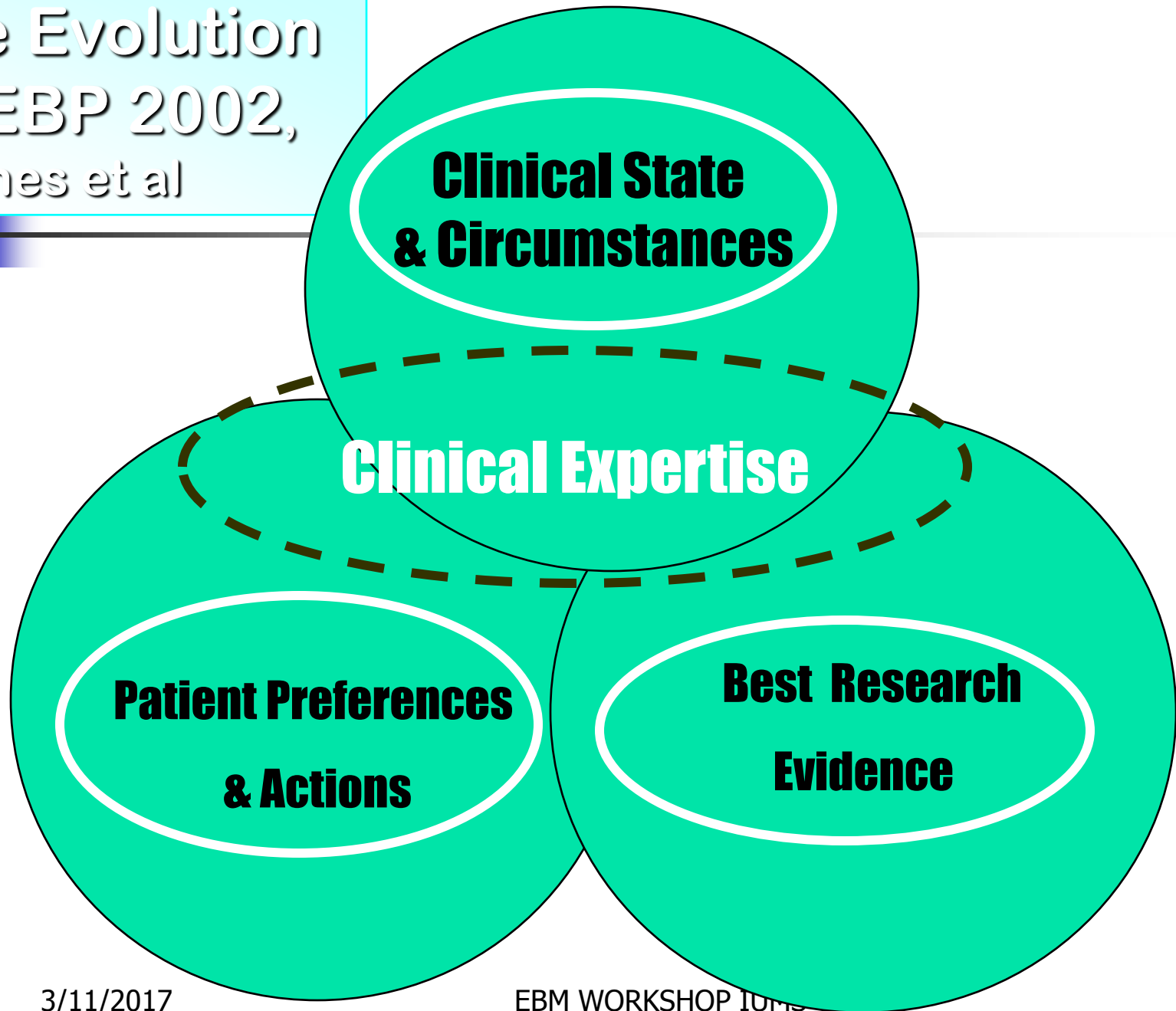
DEFINITION

■ INTEGRATION OF CLINICAL EXPERIENCE WITH THE BEST EVIDENCE PROVIDED BY SYSTEMATIC AND OBJECTIVE – ORIENTED RESEARCH

EBM MODEL



The Evolution
of EBP 2002,
Haynes et al





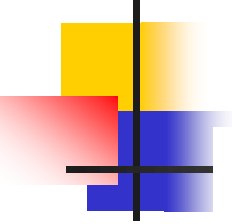
DEFINITION

- **CONSCIENTIOUS, EXPLICIT & JUDICIOUS USE OF CURRENT BEST EVIDENCE IN MAKING DECISIONS ABOUT CARE OF INDIVIDUAL PATIENTS OR THE DELIVERY OF HEALTH SERVICES** DAVID SACKETT.



EBM OBJECTIVES

- KEEPING YOUR SKILLS UP TO DATE
 - MEMORY DECREASE
 - NEW TREATMENT METHODS
- SAVING TIME
- SAVING LIVES
- SUPPLEMENTING CLINICAL JUDGEMENT(EBM MODEL)

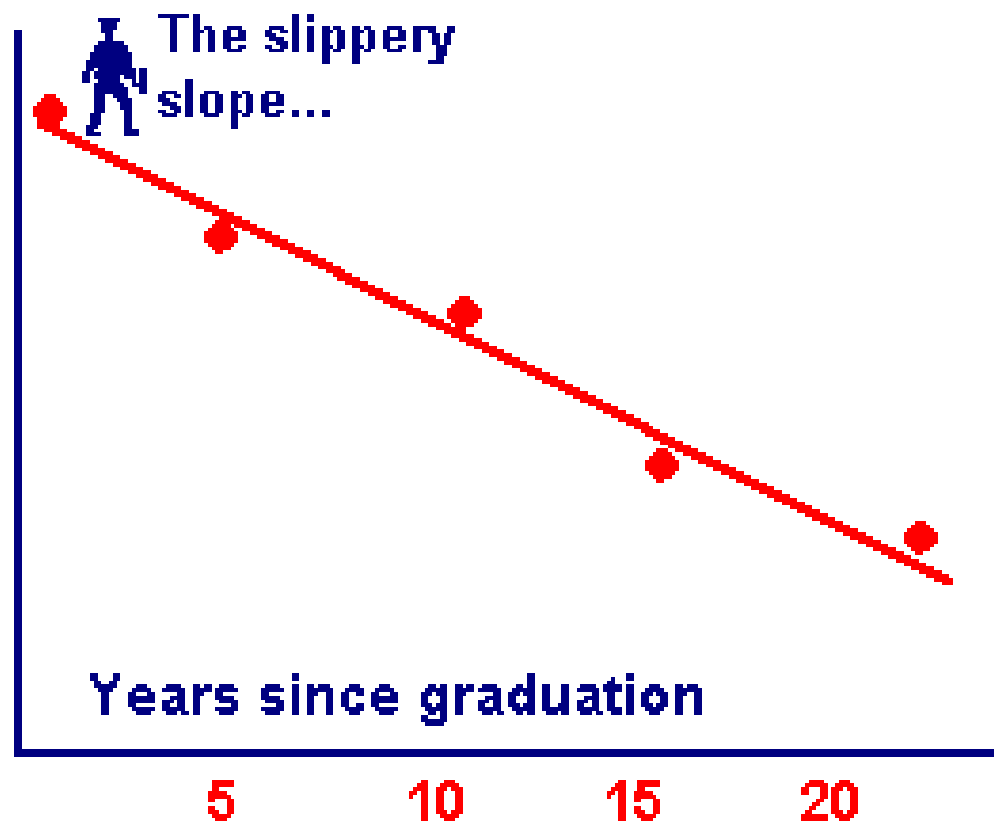


Knowledge
of best
hypertension
care

Shiri et al,
CMAJ, 1993

$r = -.54$

$p < 0.001$





مزایای EBM

- قابل آموزش به پزشکان در سطوح مختلف
- پر کردن شکاف بین تحقیقات بالینی و بکارگیری نتایج آنها
- تقویت آموزش مستقل و خود محور
- تقویت بحث گروهی
- روز آمد کردن اطلاعات پزشکان
- درک عمیق روش تحقیق توسط متخصصین بالینی

مزایای EBM

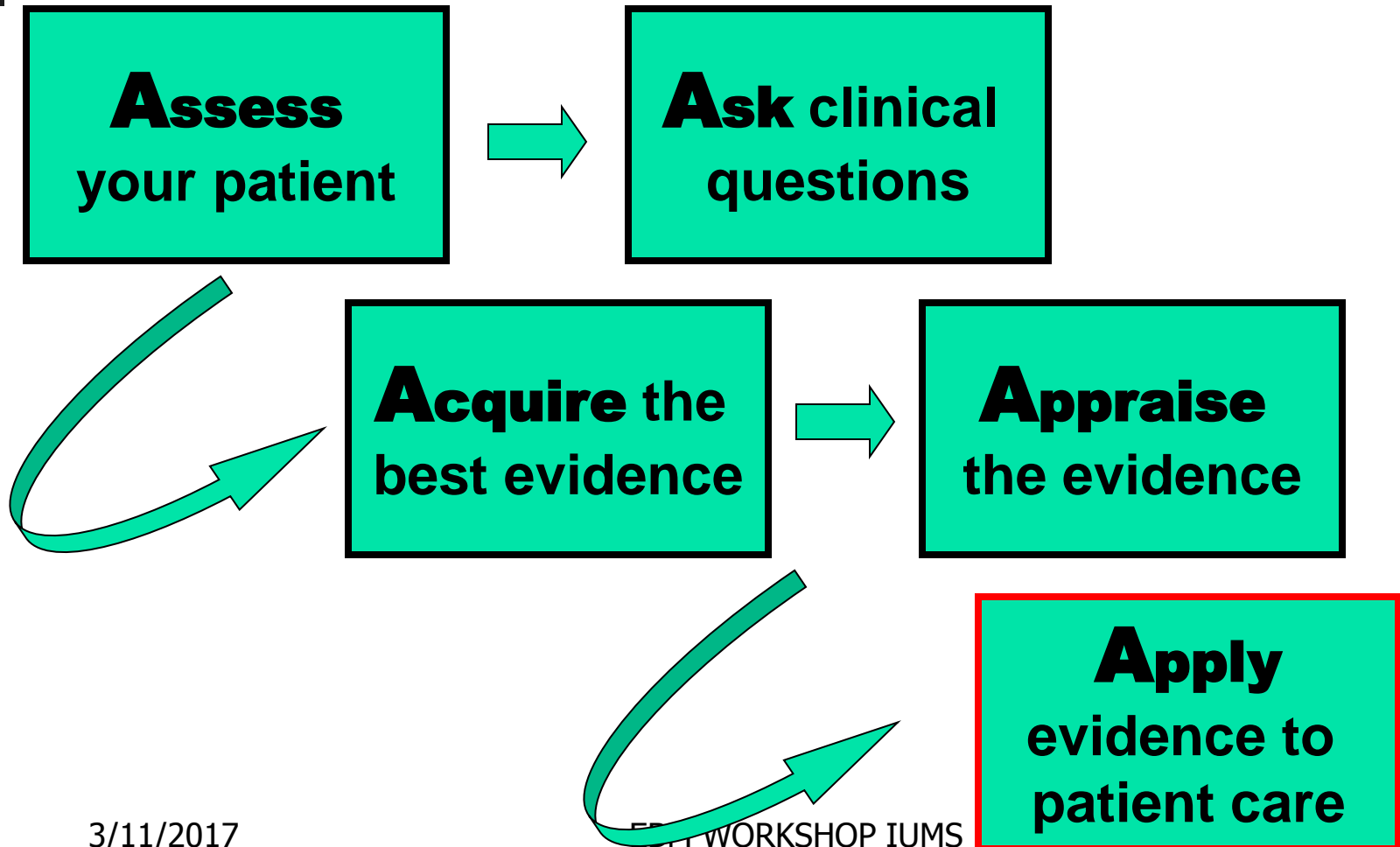
- افزایش اعتماد به نفس پزشکان بالینی در اخذ تصمیم بالینی
- افزایش توانائی پزشکان در جستجوی اطلاعات
- عادت به مطالعه را در پزشکان می افزاید
- امکان توجیه منطقی تصمیمات درمانی را برای بیماران فراهم می کند.
- طراحی دستور العمل مشترک برای تصمیمات بالینی توسط متخصصین محلی



مضرات EBM

- آموزش و بکارگیری EBM در بالین وقت گیر است
- هزینه فراهم سازی امکانات زیاد است
- کاهش اعتماد به نفس پزشکان در مقابل اطلاعات جدید و اقدامات فعلی آنها

EBM Method

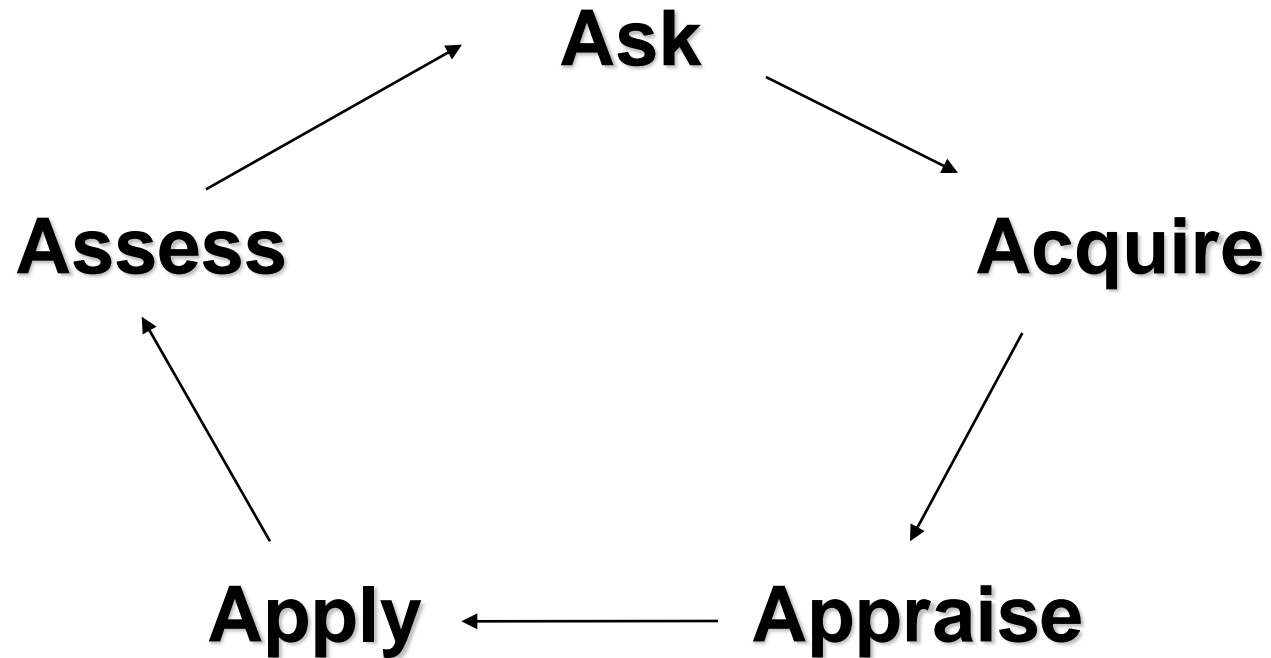


EBM PROCESS



1. PATIENT PROBLEM
2. CLINICAL QUESTION
3. SEARCH FOR EVIDENCE
4. CRITICAL APPRAISAL OF THE EVIDENCE
5. APPLYING THE RESULTS INTO PRACTICE (CURRENT PATIENT)

Evidence-based Practice



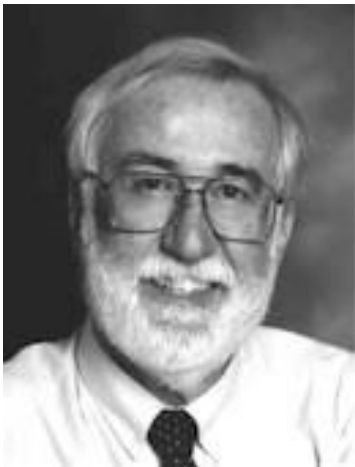
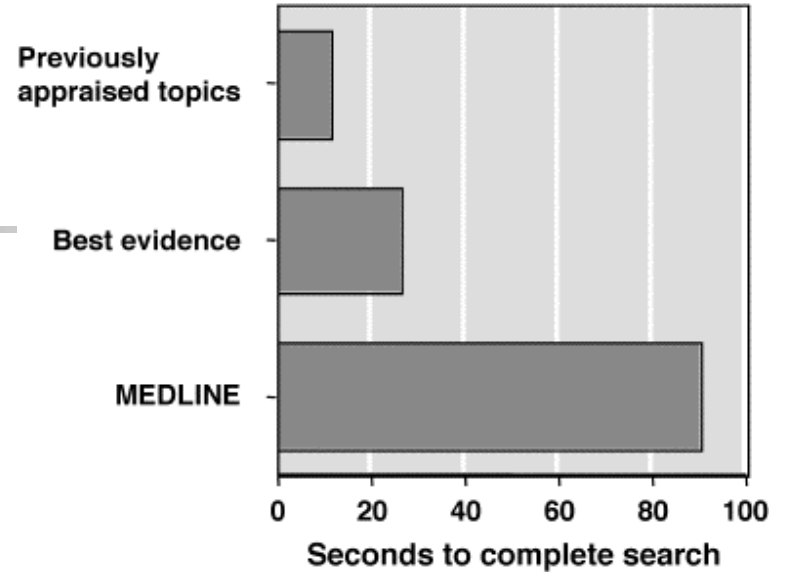


The Practice of EBM

- **Step 1:** Asking an answerable question
- **Step 2:** Tracking down the best evidence to answer that question
- **Step 3:** Critically appraise the evidence for validity, size of the effect, and utility of the findings
- **Step 4:** Incorporate the clinical appraisal into our clinical expertise and patient's individual issues
- **Step 5:** Evaluate and improve steps 1-4 with each new opportunity to apply these principles

Evidence Cart

Time to complete searches on the evidence cart



Dave Sackett

3/11/2017



EBM WORKSHOP IUMS



Domains of EBM

- TREATMENT
- PROGNOSIS
- DIAGNOSIS
- ETIOLOGY/CAUSATION/HARM



Types of Clinical Questions

By Content

- **Diagnosis**
- **Therapy**
- **Etiology**
- **Prognosis**

By Format

- **Background**
- **Foreground**



Good clinical questions

- **“Background” Questions**
 - General knowledge
 - Two components
 - Root (who, what, when, where, why)
 - A disorder or aspect of a disorder
 - E.g., “What is the typical age of onset of bipolar disorder?”
 - “How do I decide to use a typical vs. atypical antipsychotic for agitation?”



Good clinical questions

- **“Foreground” Questions**
 - These ask for specific information about managing a patient with a disorder
 - They have 3-4 essential components

COMPONENTS OF CLINICAL QUESTIONS



- o **P** - patient and problem(population)
- o **I** - intervention(treatment,test,prognosis...)
- o **C** - comparison
- o **O** - outcome



Diagnosis

“In patients with suspected pulmonary fibrosis, how does high-resolution CT compare with lung biopsy for establishing the diagnosis?”

P = Pulmonary fibrosis

I = High-resolution CT

C = Lung biopsy

O = Sensitivity/specificity/PVs/LRs



Etiology

“Do obstetrical complications during pregnancy increase the likelihood of schizophrenia in the child?”

P = Pregnant females

I = Obstetrical complications

C = No obstetrical complications

O = Childhood schizophrenia



Prognosis

“In patients with acute leukemia, is a normal white cell count at the time of diagnosis an independent predictor of disease-free survival?”

P = Acute leukemia

I = Normal white cell count

C = Abnormal white cell count

O = Disease-free survival

Ask Clinical Questions

Components of Clinical Questions

Patient/
Population

Intervention/
Exposure

Comparison

Outcome

In patients with
acute MI

In women with
suspected
coronary disease

In post-
menopausal
women

does early treat-
ment with a statin

what is the
accuracy of
exercise ECHO

does hormone
replacement
therapy

compared to
placebo

compared to
exercise
ECG

compared to no
HRaT

decrease cardio-
vascular mortality?

for diagnosing
significant
CAD?

increase the
risk of
breast cancer?

Clinical question(scenario) for treatment

- **P** –in a child with frequent febrile seizures
- **I** – would anticonvulsant therapy
- **C** – compared to no treatment
- **O** – results in seizure reduction



Question for diagnosis

- **P** – in an otherwise healthy 15 yrs old boy with sore throat
- **I**- how does the clinical exam
- **C**- compare to throat culture
- **O**- In diagnosing GAS infection ?



Question Prognosis

P- In children with Down syndrome

I - Is IQ an important prognostic factor

C

O - In predicting Alzheimer's later in life



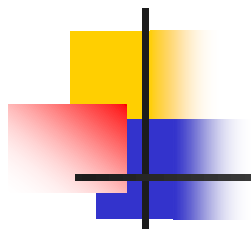
Etiology/Harm

- **P** -controlling for confounding factors, do otherwise healthy children
- **I** -exposed in utero to cocaine
- **C** - compared to children not exposed
- **O** - have increased incidence of learning disabilities at age six years?

Type of Question	Suggested best type of Study 
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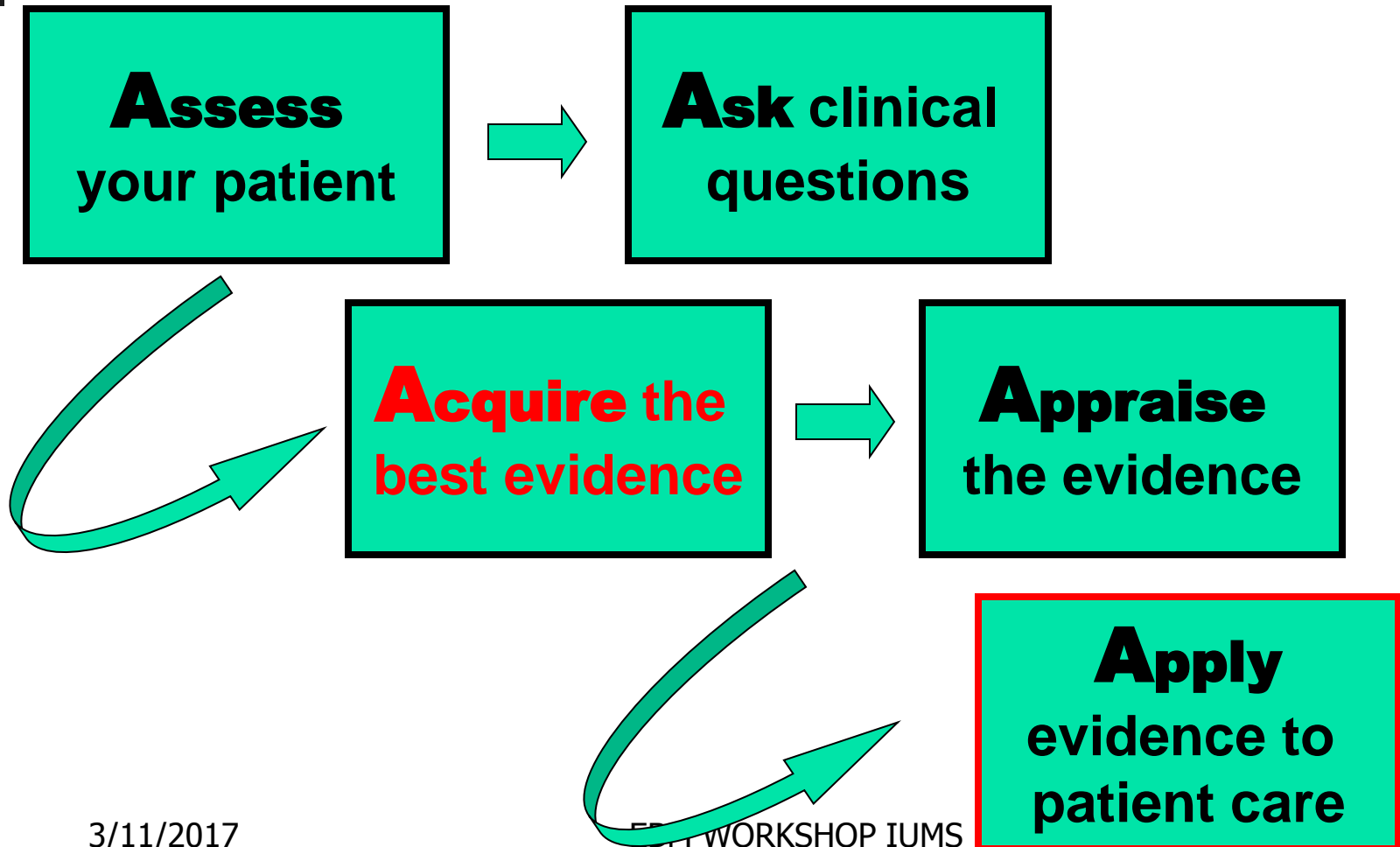
Therapy	RCT > cohort > case control > case series
Diagnosis	prospective, blind comparison to a gold standard
Etiology/Harm	RCT > cohort > case control > case series
Prognosis	cohort study > case control > case series
Prevention	RCT > cohort study > case control > case series





THANK YOU
ANY
QUESTIONS?

EBM Method





How to Learn About Best Information Resources?

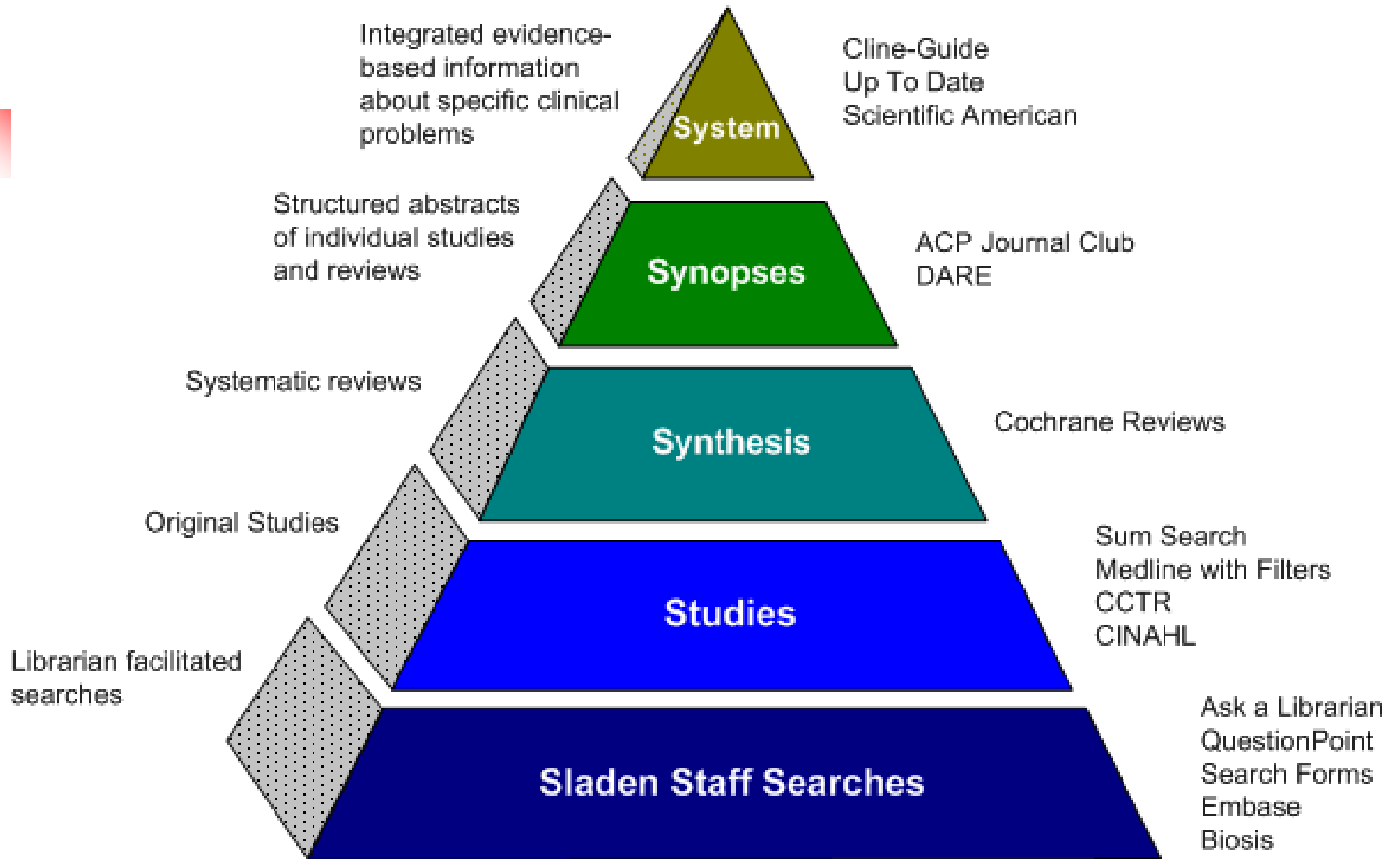
- From librarians (hands-on training)
- From experts in medical informatics
- Courses/ Tutorials

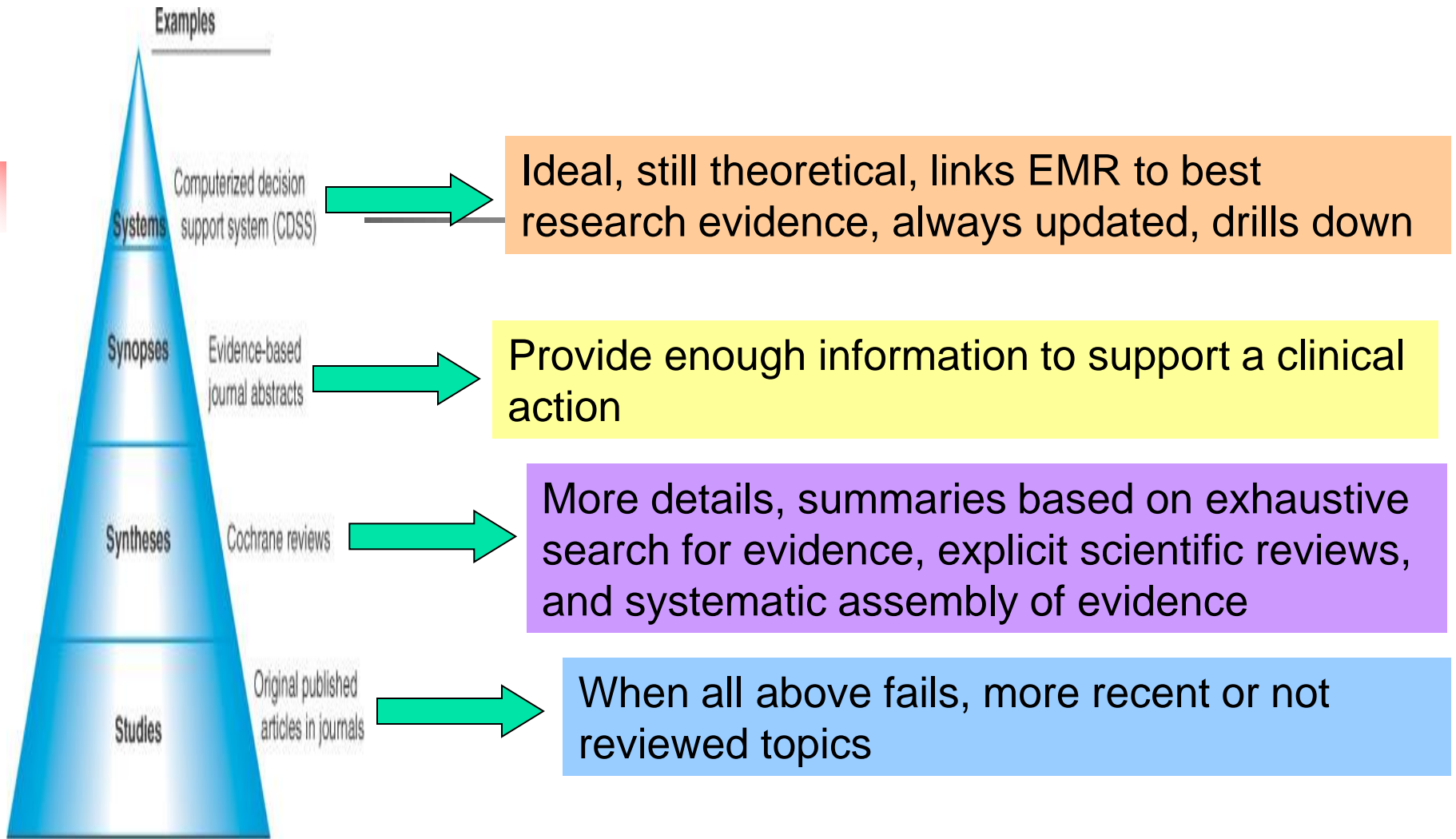
Searching for Answers:

The “4S” Approach of Haynes

Haynes RB: EBMH 2001;4:47 and ACP Journal Club 2001;134:A11

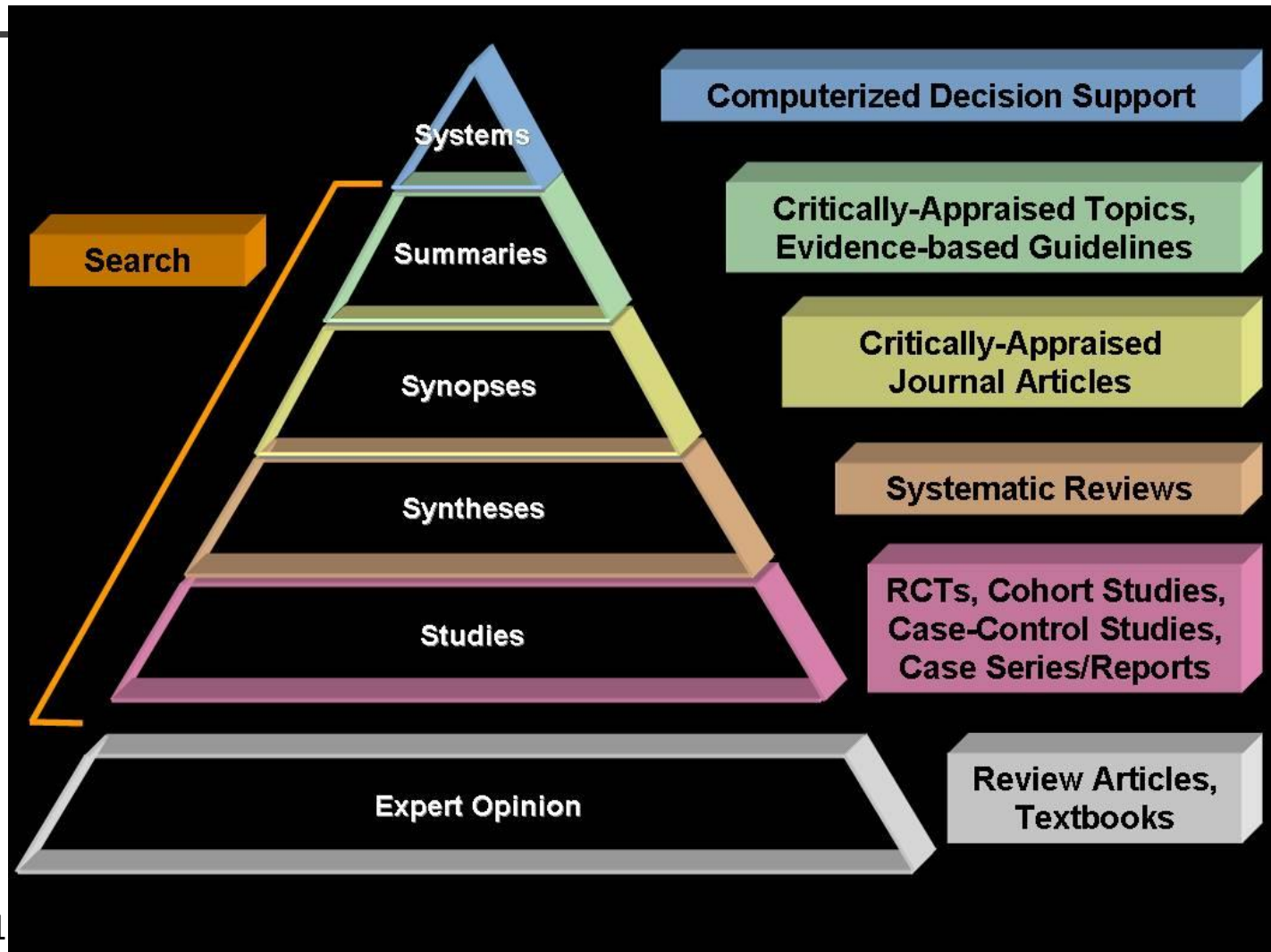
- **Systems** (comprehensive resources)
 - Clinical Evidence (www.clinicalevidence.com)
 - Collection of evidence-based guidelines
- **Synopses** (structured abstracts)
 - Evidence-Based Mental Health (<http://ebmh.bmjournals.com/>)
 - ACP Journal Club (www.acpjc.org)
- **Syntheses** (systematic reviews)
 - Cochrane Database (OVID)
 - DARE (<http://agatha.york.ac.uk/darehp.htm>)
- **Studies** (original research)





© Elsevier Ltd 2005. Straus et al.: Evidence-based medicine

EBM hierarchy Haynes 5S pyramid





Systems

- **Clinical Evidence (BMJ)**
 - URL: <http://www.clinicalevidence.com>
 - Contains limited range of clinical questions
- **PIER** (the Physician's Information and Education Resource) by ACP
 - URL: <http://pier.acponline.org>
 - Only for members
- **UpToDate®**
 - URL: <http://www.uptodate.com>
 - Updated quarterly
 - Extensively referenced
- **ACP Medicine** (Formerly Scientific American Medicine)
 - URL: <http://www.acpmedicine.com>

Systems (Cont'ed)

■ **Harrison's Principles of Internal Medicine**

- URL: <http://www.harrisonsmed.com>
- Only updated every 3 years

■ **Evidence Based on Call**

- URL: <http://www.eboncall.org/content.jsp.htm>

■ **Evidence-Based Pediatrics and Child Health**

- URL: <http://www.evidbasedpediatrics.com>

■ **Evidence Based Cardiology**

- URL: <http://www.evidencebasedcardiology.com/>

OVID includes and links EBMR (Cochrane, ACP Journal Club, the Database of Abstracts of Reviews of Evidence (DARE), and Medline



Criteria to evaluate systems

Look for Systems that:

- Are revised at least once a year: Date of revision should be listed
- Select and appraise the evidence in an explicit way (Introduction)
- Site evidence to support clinical care declarations



Synopses

- Published in secondary journals
 - Select only high-quality original research and review articles
 - Use explicit quality criteria for selection
 - Appraise for validity
 - Prepare structured, “value-added” abstract
 - Accompanying commentary
 - Declarative title that gives “bottom line”



Synopses

- ACP Journal Club <http://www.acpjc.org/>
- Give you the summary and links you to the evidence
- Ex: “Low Molecular Weight Heparin is Effective and Safe in the Acute Coronary Syndromes”



Syntheses: Systematic Reviews

- What makes a review systematic?
 - Comprehensive search
 - Use only high-quality studies
 - Summarize results
- Sources of systematic reviews
 - Cochrane Library (available through OVID)
 - Database of Abstracts of Systematic Reviews (DARE): <http://agatha.york.ac.uk/darehp.htm>



Syntheses

- **Cochrane Library**

- URL: <http://www.cochranelibrary.com/>

- **OVID's EBMR**

- (Includes ACP Journal Club, Cochrane Database of Systematic Reviews (CDSR), and DARE)

Studies

Specialized

- **ACP Journal Club:**

www.acpjc.org

- **Evidence Based Medicine:**

www.ebm.bmjournals.com

- **Evidence Based Nursing:**

www.ebn.bmjournals.com

- **Evidence Based Mental Health:**

www.ebmh.bmjournals.com

General

- **Cochrane Central Register of Controlled Trials (Therapy)**

- **MEDLINE:**

<http://www.ncbi.nlm.nih.gov/PubMed/>

- Using the Clinical Queries Search

- **ASK MEDLINE**

<http://askmedline.nlm.nih.gov/ask/ask.php>

Make use of your Library and Institutional subscriptions



Textbooks are only useful for “background questions”

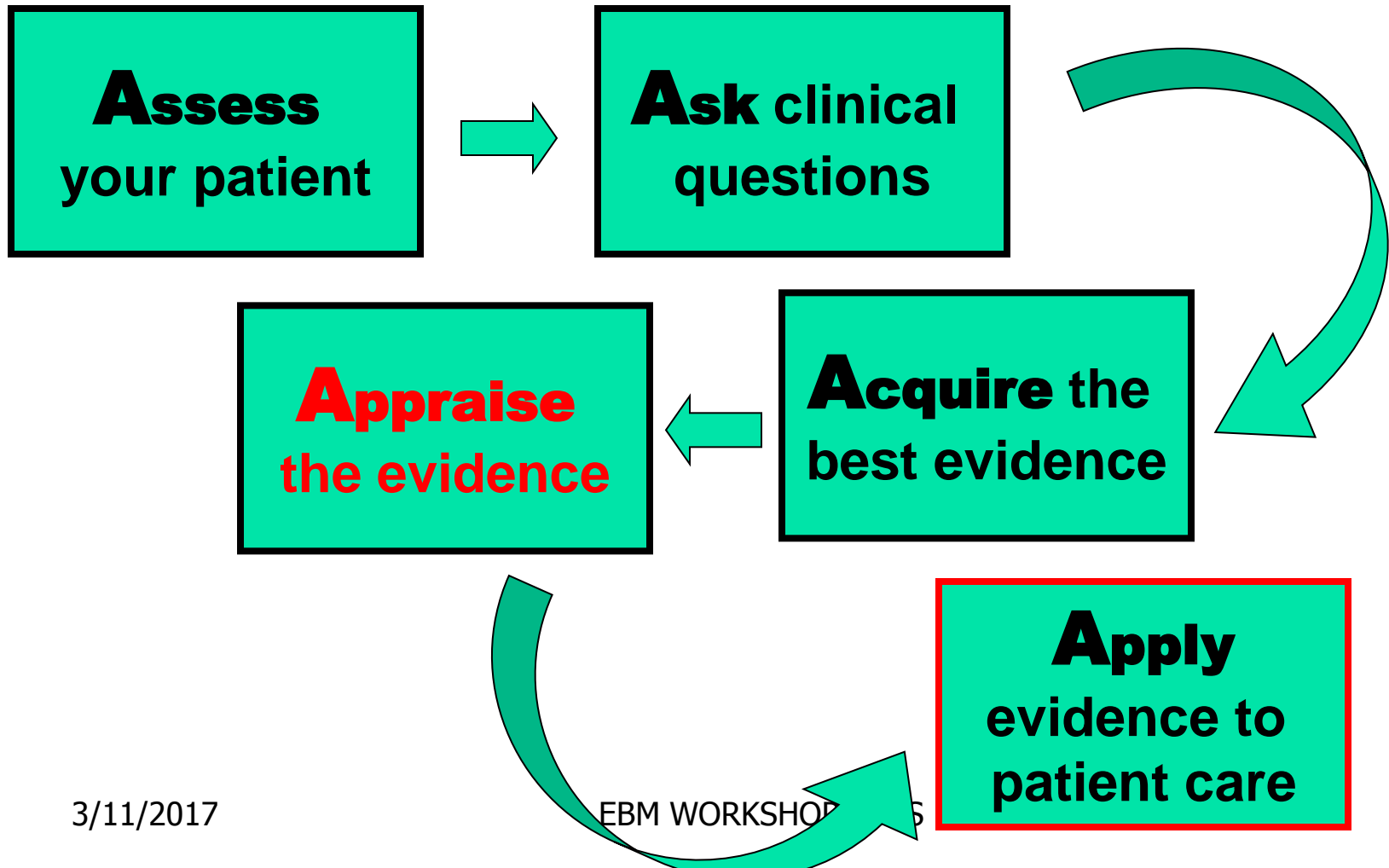
(Pathophysiology of clinical
problems)

Alternatives to the “4S” Search Approach



- TRIP database (www.tripdatabase.com)
 - Searches Cochrane, DARE, collections of systematic reviews and guidelines, and some on-line journals
 - Links to PubMed clinical queries
- SUMSearch (<http://sumsearch.uthsca.edu>)
 - Searches MEDLINE, DARE, National Guidelines Clearinghouse
 - Takes longer than TRIP

EBM Method



CRITICAL APPRAISAL



Dr. J. Koohpayehzadeh
***Associate professor of Social
Medicine***

EDC, Iran University of Medical Sciences

3/11/2017

EBM WORKSHOP IUMS



What is Critical Appraisal?

CRITICAL APPRAISAL is the process of assessing and interpreting *evidence*, by systematically considering its **validity, results** and **relevance to your own work**

Critical Appraisal of Literature

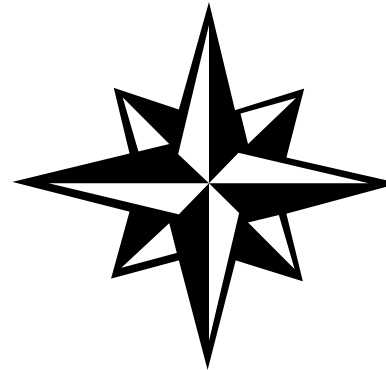
Intended to enhance the clinician's skill to determine whether the results reported in an article were likely to be



- . . . true
- . . . important
- . . . applicable to their patients!

KEY QUALITY PARAMETERS

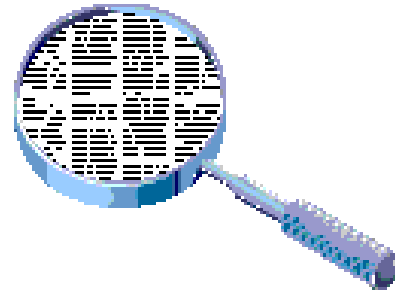
- VALIDITY
- RELIABILITY
- IMPORTANCE



Tools for Critical Appraisal

EBM “simplified” approach:

- What are the results?
- Are the results valid?
- Will the results help me in patient care?





3 Important Questions

- **Are the results of the study valid?**
- **What are the results?**
- **Will the result help locally?**



COMMON PROBLEMS

INTRODUCTION

- In concise statement of the problem
- Inadequate review of the literature
- Weak study rationale



COMMON PROBLEMS

METHODS

- **Inadequate sample size, non-representative sample, or biases in subject selection or recruitment**
- **Inadequate controls (random assignment, or well-matched controls?)**
- **Measurement biases (valid tools? blinded? timing appropriate? follow-up?)**



COMMON PROBLEMS

RESULTS

- **Selection and/or number of statistical tests performed**
- **Selection of variables for inclusion**



COMMON PROBLEMS

DISCUSSION

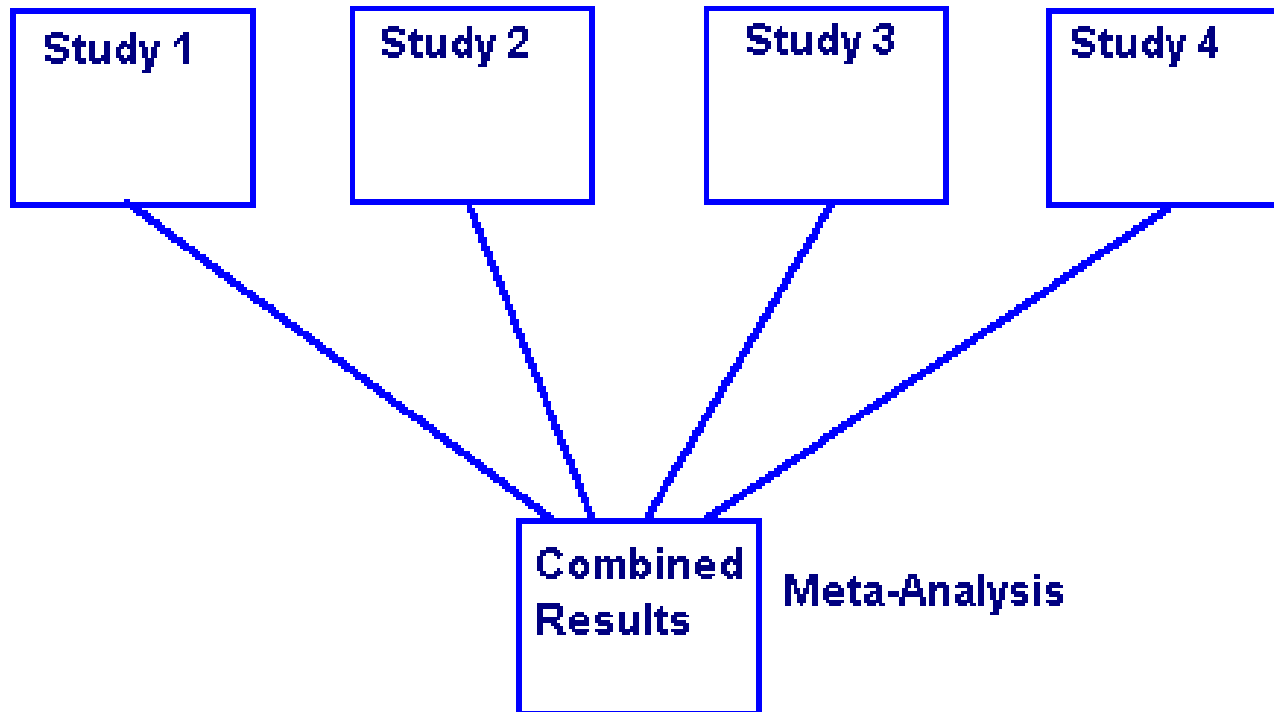
- **Failure to link findings to current literature**
- **Inappropriate inferences**
- **Failure to critique own work**
- **Little insight or direction provided**

Finding the Evidence



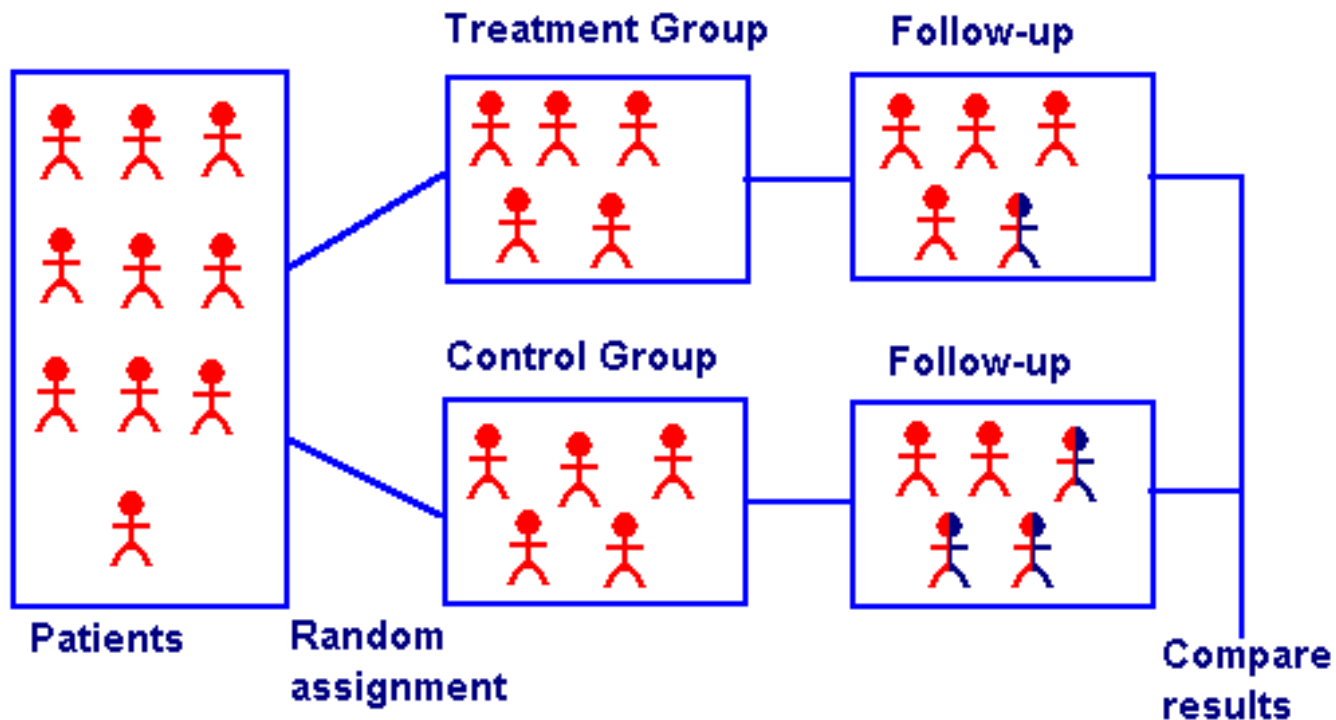
Finding the Evidence

Systematic Reviews and Meta-Analyses



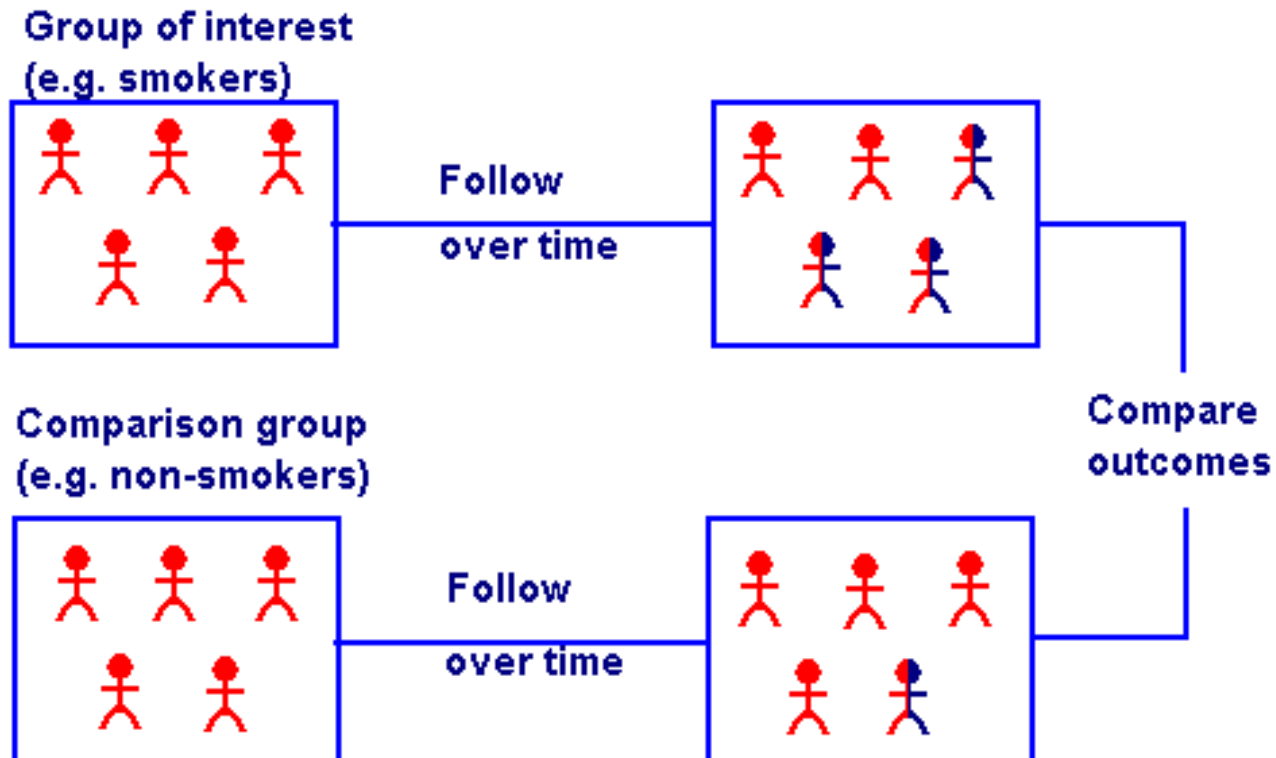
Finding the Evidence

Randomized Controlled Studies



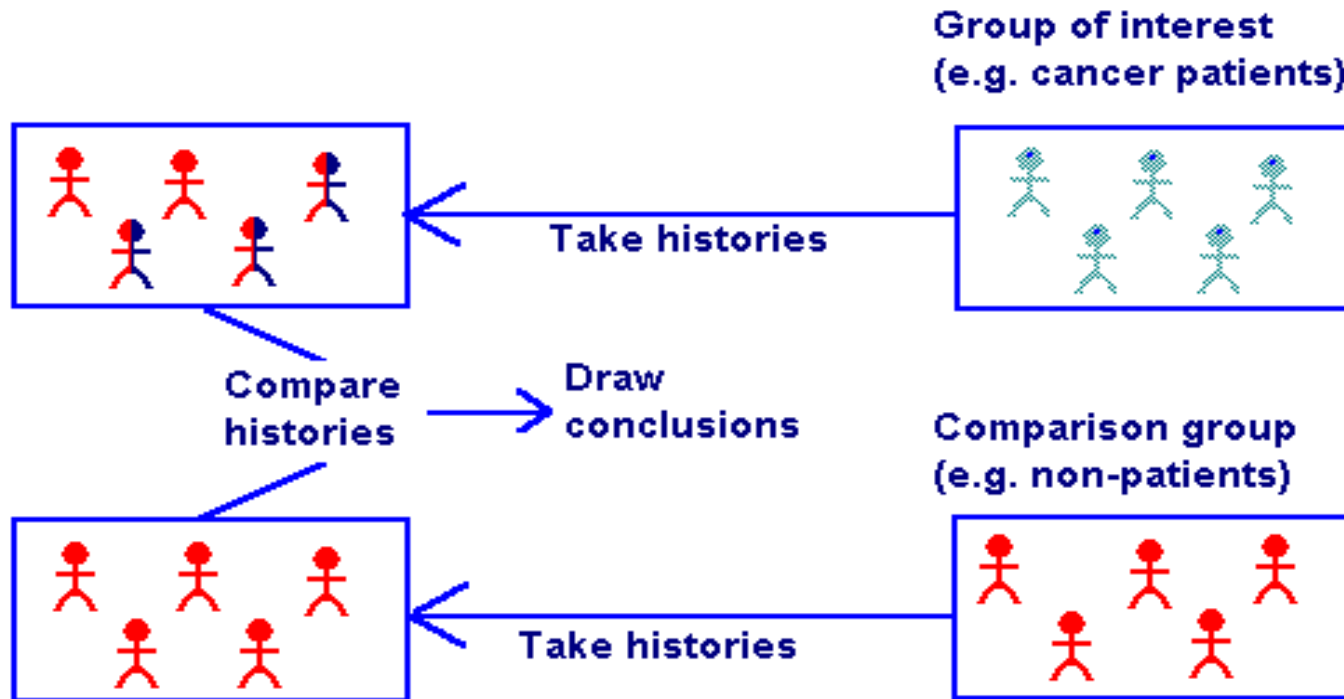
Finding the Evidence

Cohort Studies



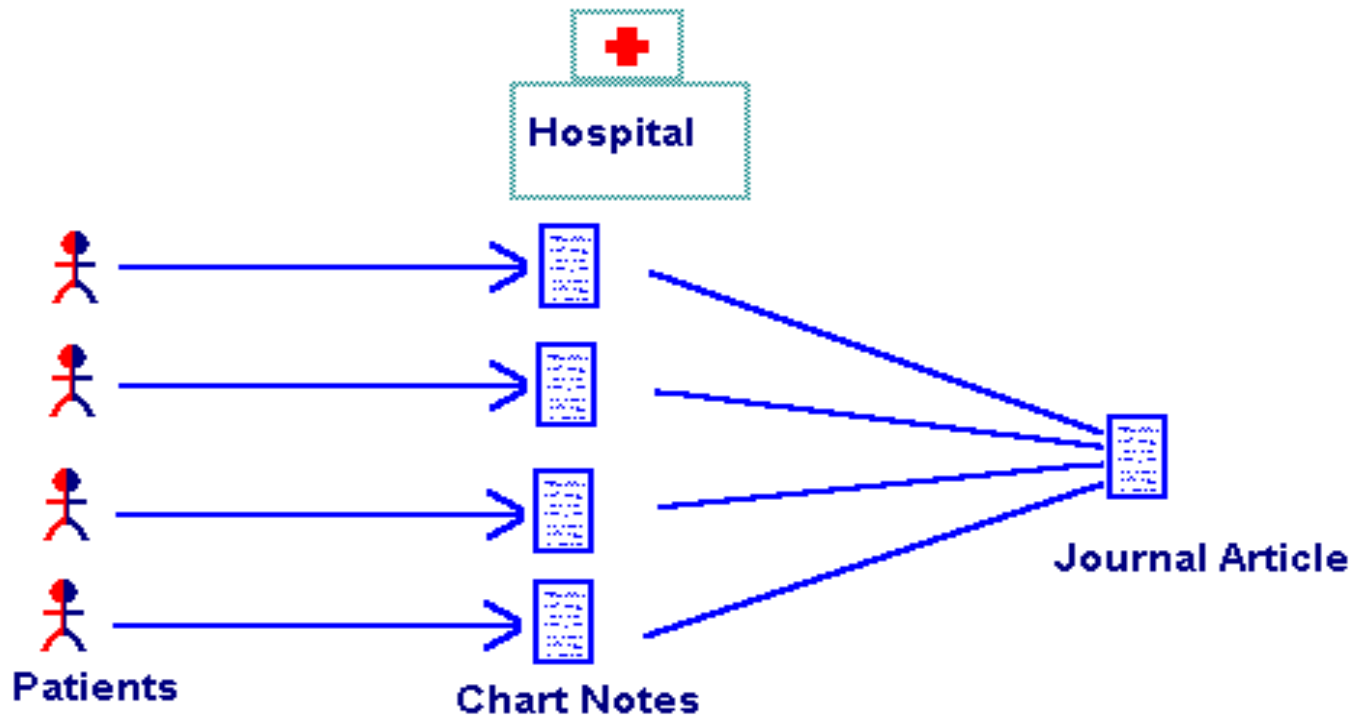
Finding the Evidence

Case Control Studies



Finding the Evidence

Case Series and Case Reports





Thank You!
Any Question?



statistics

- **DIAGNOSIS: SEN, SPE, PPV, NPV, LR**
- **PROGNOSIS: CI, SURVIVAL ANALYSIS**
- **THERAPY: CER, EER, RRR, ARR, NNT**
- **HARM: OR, RR, NNH**



statistics

DIAGNOSIS

- **Sensitivity and Specificity**
- **Positive and Negative Predictive Values**
- **Likelihood Ratios**



statistics

Sensitivity: the proportion of patients with the disease who have a positive test result

$$Se = P(T+ | D+)$$

Specificity: the proportion of patients without the disease who have a negative test result

$$Sp = P(T- | D-)$$

statistics

Information for a dichotomous test

		Disease	
		Present	Absent
Test Result	Positive	True positive A	False positive B
	Negative	False negative C	True negative D
		A+C	B+D

$$\text{Sensitivity} = A / (A+C)$$

$$\text{Specificity} = D / (B+D)$$



statistics

Information for a dichotomous test

		Disease	
		Present	Absent
Test Result	Positive	True positive A = 103	False positive B = 16
	Negative	False negative C = 12	True negative D = 211

$$\text{Sensitivity} = 103 / (103 + 12) = 89\%$$

$$\text{Specificity} = 211 / (16 + 211) = 93\%$$



statistics

Predictive values

PPV : the proportion of patients with a **positive** test result who **have** the disease ■

$$\text{PPV} = P(D+/T+)$$

NPV : the proportion of patients with a **negative** test result who do **not have** the disease ■

$$\text{NPV} = P(D-/T-)$$



statistics

		Disease		
		Present	Absent	
Test Result	Positive	True positive A	False positive B	A+B
	Negative	False negative C	True negative D	C+D

$$\text{PPV} = A / (A+B)$$

$$\text{NPV} = D / (C+D)$$



statistics

		Disease	
		Present	Absent
Test Result	Positive	True positive A = 103	False positive B = 16
	Negative	False negative C = 12	True negative D = 211

$$\text{Sensitivity} = 103 / (103 + 12) = 89\%$$

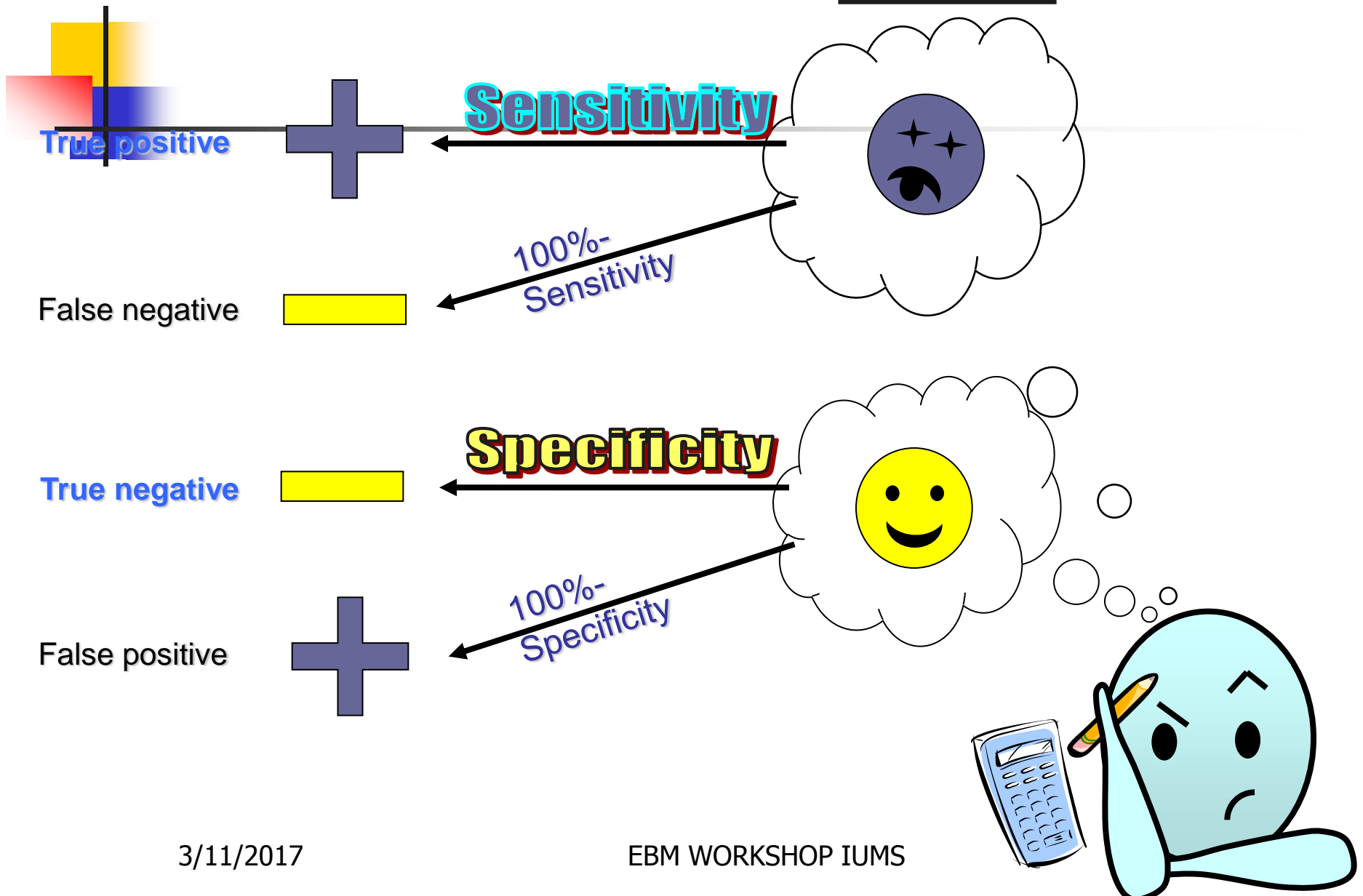
$$\text{Specificity} = 211 / (16 + 211) = 93\%$$

$$\text{PPV} = 103 / (103 + 16) = 86\%$$

$$\text{NPV} = 211 / (12 + 211) = 94\%$$

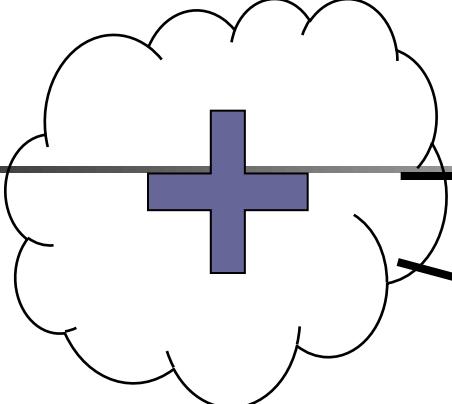
Test Result

Diagnosis



Test Result

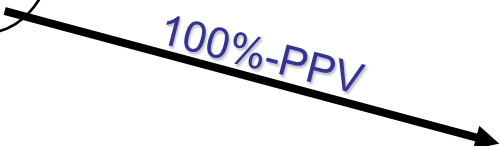
Diagnosis



PPV



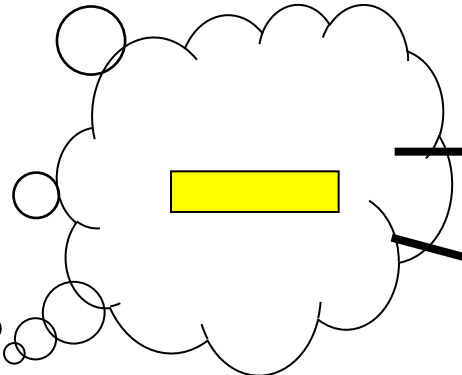
True positive



100%-PPV



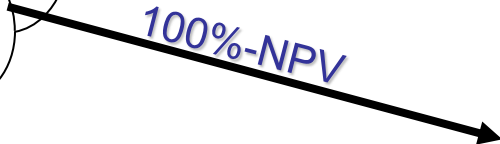
False positive



NPV



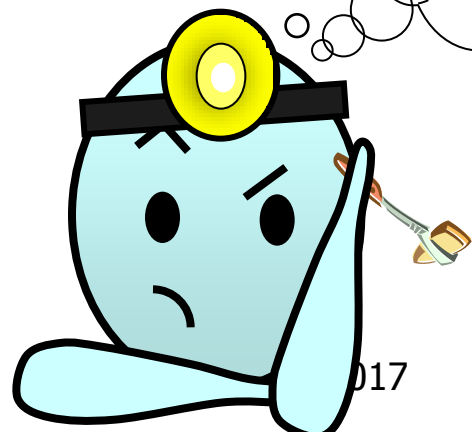
True negative



100%-NPV



False negative



Likelihood ratio

Likelihood ratio = the likelihood of a test result in patients *with* the disease / the likelihood of a test result in patients *without* the disease

- **$LR(+)$ = sensitivity/(1-specificity)**
- **$LR(-)$ = (1-sensitivity)/specificity**



Likelihood Ratio

- When ordering a test, which tests will best help us rule in or rule out disease?
- Initial assessment of likelihood of disease = pre-test probability
- Final assessment of likelihood of disease = post-test probability



Likelihood Ratio

Probability of patient **with** disease
having a given test result

Probability of patient **without** disease
having a given test result



Positive Likelihood Ratio (LR+)

Probability of patient **with** disease
having a **positive** test result

Probability of patient **without** disease
having a **positive** test result



Negative Likelihood Ratio (LR-)

Probability of patient **with** disease
having a **negative** test result

Probability of patient **without** disease
having a **negative** test result



Likelihood Ratios

- LR+

sensitivity

1 - specificity

- LR-

1-sensitivity

specificity

statistics

		Disease	
		Present	Absent
Test Result	Positive	True positive A	False positive B
	Negative	False negative C	True negative D

$$\text{Sensitivity} = A / (A+C)$$

$$\text{Specificity} = D / (B+D)$$

$$\text{PPV} = A / (A+B)$$

$$\text{NPV} = D / (C+D)$$

$$\text{LR}(+) = \frac{A / (A+C)}{B / (B+D)} = \text{sn} / (1-\text{sp})$$

$$\text{LR}(-) = \frac{C / (A+C)}{D / (B+D)} = (1-\text{sn}) / \text{sp}$$

statistics

Disease

Present

Absent

Test
Result

Positive

True positive
A = 103

False positive
B = 16

Negative

False negative
C = 12

True negative
D = 211

$$\text{Sensitivity} = 103 / (103 + 12) = 89\%$$

$$\text{Specificity} = 211 / (16 + 211) = 93\%$$

$$\text{PPV} = 103 / (103 + 16) = 86\%$$

$$\text{NPV} = 211 / (12 + 211) = 94\%$$

$$\text{LR}(+) = \frac{A / (A + C)}{B / (B + D)} = \text{sn} / (1 - \text{sp}) = 12.7$$

$$\text{LR}(-) = \frac{C / (A + C)}{D / (B + D)} = (1 - \text{sn}) / \text{sp} = 0.11$$



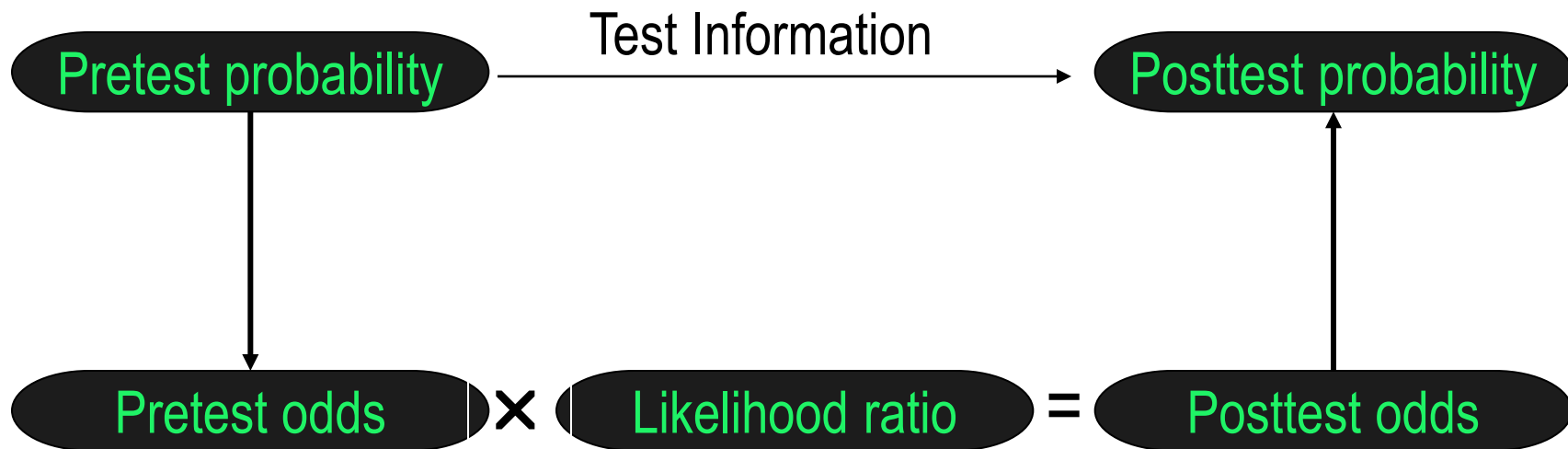
statistics

Likelihood ratio

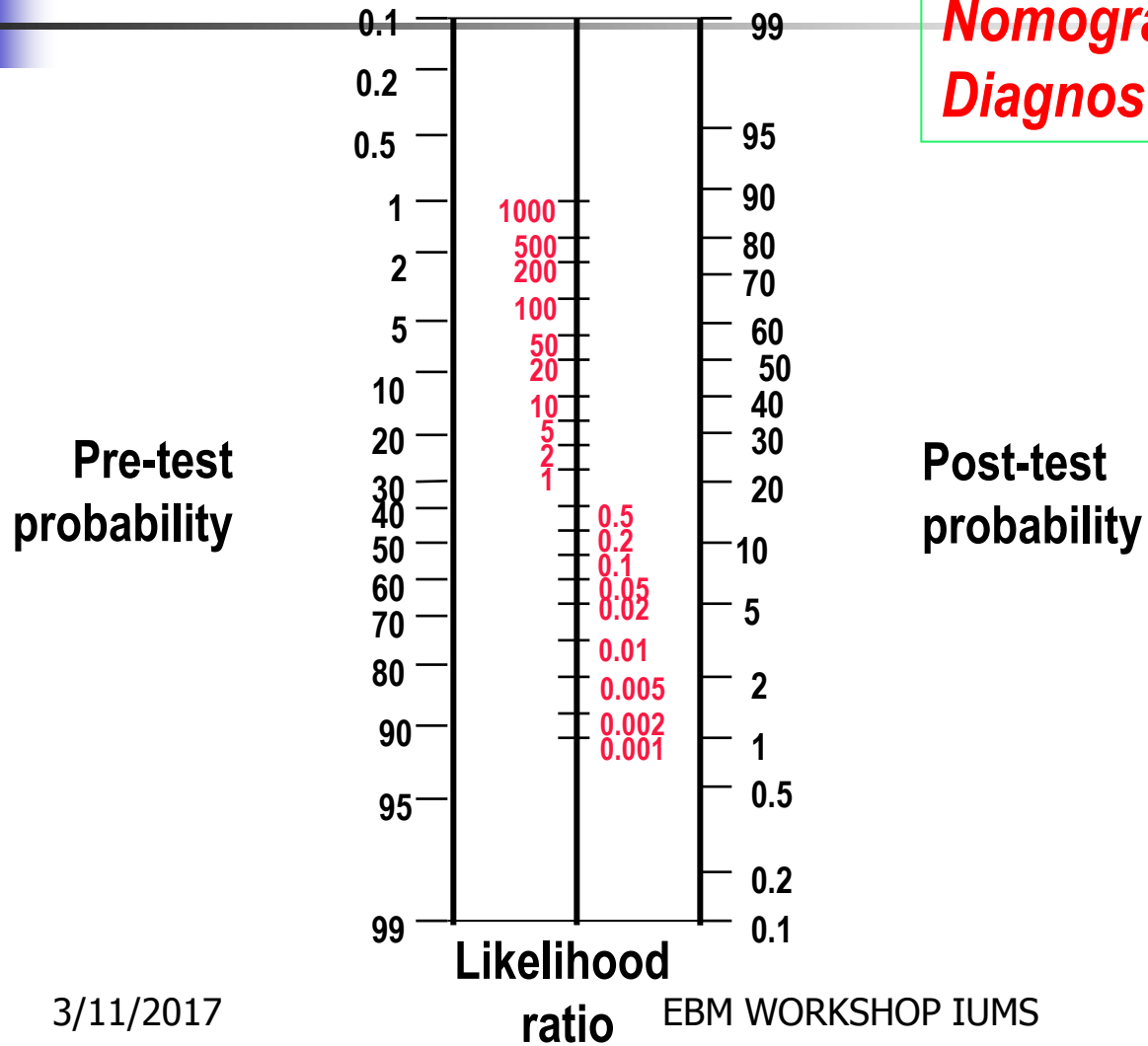
- LR can be derived for diagnostic tests that have multiple levels or categories of results
- LR from different, independent tests can be used together sequentially to easily calculate a single estimate of a patient's post test probability of disease

statistics

Calculating posttest probability



statistics



Nomogram for interpreting Diagnostic test result



statistics

- You are consulted to visit a **62-year-old man** with **3 months history of severe back pain**. His weight remained stable. CBC and routine biochemistry were normal. **ESR was 52 mm / hour**. An x-ray of the lumbar and thoracic spine was reported to showing degenerative changes.
- what is your approach to this patient?



statistics

Clinical findings predicting cancer as a cause of back pain

LR	Finding
■2.7	Age > 50 years ■
■2.7	Unexplained weight loss ■
■14.7	Previous history of cancer ■
■3.0	Persistent pain despite 1 month of treatment ■
■2.6	Duration of this episode > 1 month ■
■1.6	Severe pain ■
■2.4	ESR > 20 ■
■19.2	ESR > 50 ■
■55.5	ESR > 100 ■
■15.2	Hematocrit < 30% ■
■120	Lytic or blastic lesion on spine x-ray ■



statistics

Given that the **probability of malignancy** as the cause of **persistent back pain** in the general population is about **0.3%** , what is the effect of patient's ESR on the **probability of malignancy** in this patient?



statistics

Clinical findings predicting cancer as a cause of back pain

LR	Finding
■ 2.7	Age > 50 years ■
■ 2.7	Unexplained weight loss ■
■ 14.7	Previous history of cancer ■
■ 3.0	Persistent pain despite 1 month of treatment ■
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■ 2.4	ESR > 20 ■
■ 19.2	ESR > 50 ■
■ 55.5	ESR > 100 ■
■ 15.2	Hematocrit < 30% ■
■ 120	Lytic or blastic lesion on spine x-ray ■

statistics

Calculating posttest probability



Pretest odds × likelihood ratio = posttest odds



statistics

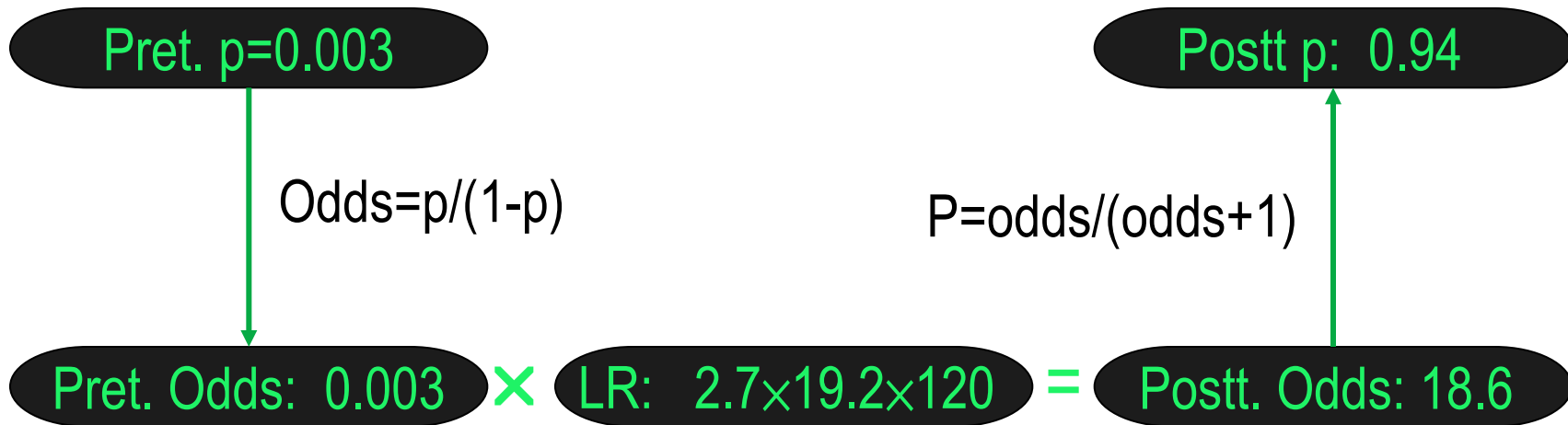
Consider that x-ray of spine in this patient shows a **lytic lesion** then what will be the probability of malignancy in this patient considering also patients **age** and **ESR**?

statistics

Clinical findings predicting cancer as a cause of back pain

LR	Finding
2.7	Age > 50 years
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120	Lytic or blastic lesion on spine x-ray

statistics



Pretest odds \times LR1 \times LR2 \times LR3 = posttest odds



statistics

Thank You!
Any Question?



statistics

PROGNOSIS

CONFIDENCE INTERVAL

a range of values that includes the true population value

- Expressed with a given degree of expected certainty such as 95%

$$X \pm SE$$

- For example, Frequency of lung cancer =4.1% could have 95% CI of -1.0 to 9.2



statistics

Thank You!
Any Question?



statistics

THERAPY

- **Relative Risk (RR)**
- **Relative Risk Reduction (RRR)**
- **Absolute Risk Reduction (ARR)**
- **Number Needed to Treat (NNT)**



statistics

		Disease		
		Present	Absent	
Exp.	Positive	A	B	A+B
	Negative	C	D	C+D

statistics

$$\text{EER} = A/(A+B)$$

$$\text{CER} = C/(C+D)$$

$$\text{EER} = 100/1000$$

$$\text{CER} = 400/9000$$

		Disease		
		Present	Absent	
Exp.	Positive	A 100	B 900	A+B 1000
	Negative	C 400	D 8600	C+D 9000

statistics

Absolute Risk Reduction

$$ARR = CER - EER$$

$$ARR = C / (C + D) - A / (A + B)$$

$$ARR = 200 / 1000 - 600 / 1000$$

Disease

Present

Absent

Exp.	Positive	A 600	B 400	A+B 1000
	Negative	C 200	D 800	C+D 1000

statistics

Relative Risk

- Risk Ratio is the ratio of risk of the outcome event in the experimental (intervention or treated group) to the risk in control group

$$RR = EER/CER = [A/(A+B) / C/(C+D)]$$

$$RR = 600/1000 / 200/1000$$

		Disease		
		Present	Absent	
Exp.	Positive	A 600	B 400	A+B 1000
	Negative	C 200	D 800	C+D 1000

3/11/2017



statistics

Relative Risk Reduction

$$RRR = [(CER - EER) / CER]$$

$$RRR = 1 - RR$$

$$RRR = [(200/1000 - 600/1000) / 200/1000] \times 100$$

Disease

Present

Absent

Exp.
Positive

A	B
600	400

A+B
1000

Negative
3/11/2017

C	D
200	800

C+D
1000



statistics

Number Needed to Treat

- **NNT is particularly useful to clinicians who want to know whether the probable benefits of some treatments or intervention will be worthwhile in their patients**
- **$NNT = 1/ARR$**
- **$NNT = 1/0.041 = 24$**



statistics

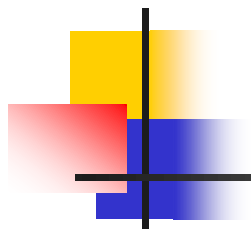
Thank You!
Any Question?



**In horse racing terms,
10 horses running
you bet on 1 horse**

Odds of winning are 1:9
(you Vs. the rest)

Risk of winning is 1:10
(you Vs. all the whole field)



HARM

OR

NNH



statistics

Odds ratios

- **Cannot use relative risk unless we are looking forward in time (cohort study, RCT)**
- **For case-control study, can calculate the odds ratio (OR) which tells us the odds of having had a certain exposure in diseased versus not diseased (dead or alive)**
- **Note, in rare diseases (a situation where you are likely to perform case-control study) OR approximates RR pretty well**



statistics

Odds ratio = $\frac{\text{odds of exposure for cases}}{\text{odds of exposure for controls}}$

	Controls	Cases	
1643	984 (b)	659 (a)	Smokers
373	348 (d)	25 (c)	Non-smokers
2016	1332	684	



statistics

- **The odds of lung cancer patient having smoked is the ratio of the number of cases who smoked to those who did not ($659/25 = a/c$)**
- **The odds of a controls having smoked is the ratio of the number of controls who smoked to those who did not ($984/348 = b/d$)**



statistics

$$\begin{aligned}\text{Odds ratio} &= \frac{a/c}{b/d} \\ &= ad/bc \text{ (cross product)} \\ &= 9.32\end{aligned}$$

Interpretation ???



statistics

NNH

Rates of adverse events due to treatment (**R**)
number needed to harm (NNH)

$NNH = \frac{1}{R}$ = the reciprocal of the actual difference in rates of bad adverse events between experimental (**R**, **R1**) and control (**R2**) group.

$NNH = \frac{1}{R_1 - R_2}$ = the number of patients who must be treated with the experimental treatment in order for one to experience a harmful event

statistics

CER =

EER =

RR=

RRR=

ARR=

NNT=

Disease

Present

Absent

		Disease		
		Present	Absent	
Exp.	Positive	300 A	1200 B	A+B 1500
	Negative	100 C	900 D	C+D 1000



statistics

Odds ratio =

	Controls	Cases	
1400	800 (b)	600 (a)	Smokers
450	400 (d)	50(c)	Non-smokers
1850	1200	650	



statistics

Thank You!
Any Question?



DECISION MAKING

What is a Decision?

A decision is an irreversible choice among alternatives to allocate valuable resources



DECISION MAKING

Decision Making Strategies

- Group Strategies
 - Brainstorming
 - Delphi Method
 - Nominal Group Technique
- Individual Strategies
 - Implicit favorite model
 - Satisfying (“administrative”) model
 - Maximizing (“rational-economic”) model
 - Markov model



DECISION MAKING

Decision Analysis

- **A systematic, structured approach to decision making when consequences are uncertain.**
- **Decision analysis is a formalization of the medical decision-making process.**



DECISION MAKING

Uses of Decision Analysis

- identify *available options* when faced with a decision
- predict the *consequences* or outcomes of each option
- assess the *probability* of occurrence for each outcome
- determine the *value* of each outcome
- select the option that will yield the *best “pay-off”*

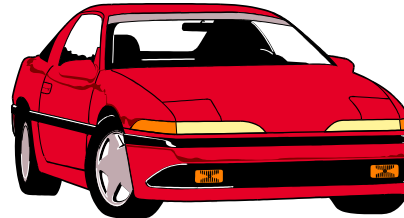
The Decision-Making Process

Identification
of a
Problem



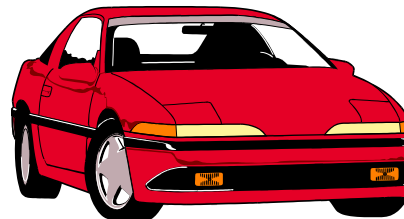
I need to buy
a new car.

Identification
of Decision
Criteria



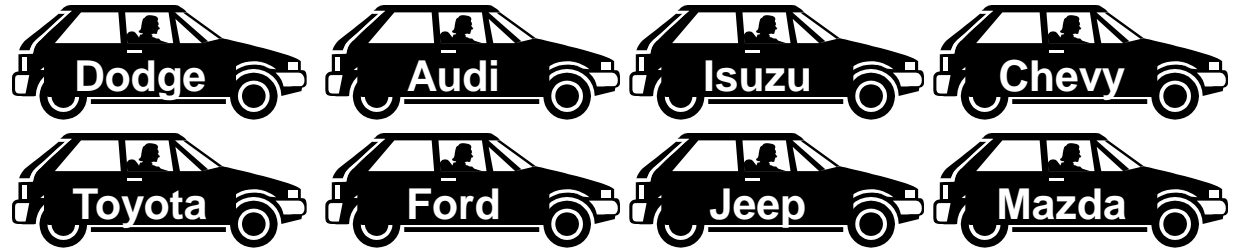
- Price
- Interior Comfort
- Durability
- Repair Record
- Performance

Allocation
of Weights
to Criteria



- | | |
|-------------------|----|
| •Price | 10 |
| •Interior Comfort | 8 |
| •Durability | 6 |
| •Repair Record | 4 |
| •Performance | 2 |

Development
of
Alternatives



Analysis
of
Alternatives

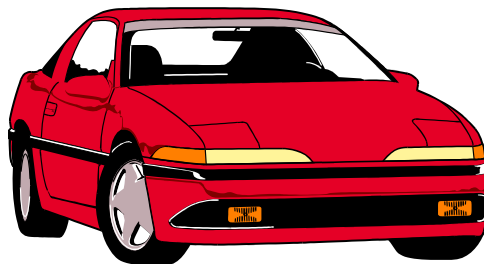
Toyota	•Price •Comfort •Durability •Repair Record •Performance	Dodge
Ford		Audi
Jeep		Isuzu
Mazda		Chevy

Selection
of an
Alternative



The Toyota
is the best.

Implementation
of the
Alternative



Appraisal of
Decision Results



DECISION MAKING

Steps in Decision Analysis

- **Formulate an explicit question**
- **Create a decision tree**
- **Calculate the expected value of each decision alternative**
- **Choose the decision alternative with the highest expected value**
- **Use sensitivity analysis to test the conclusions of the analysis**



DECISION MAKING

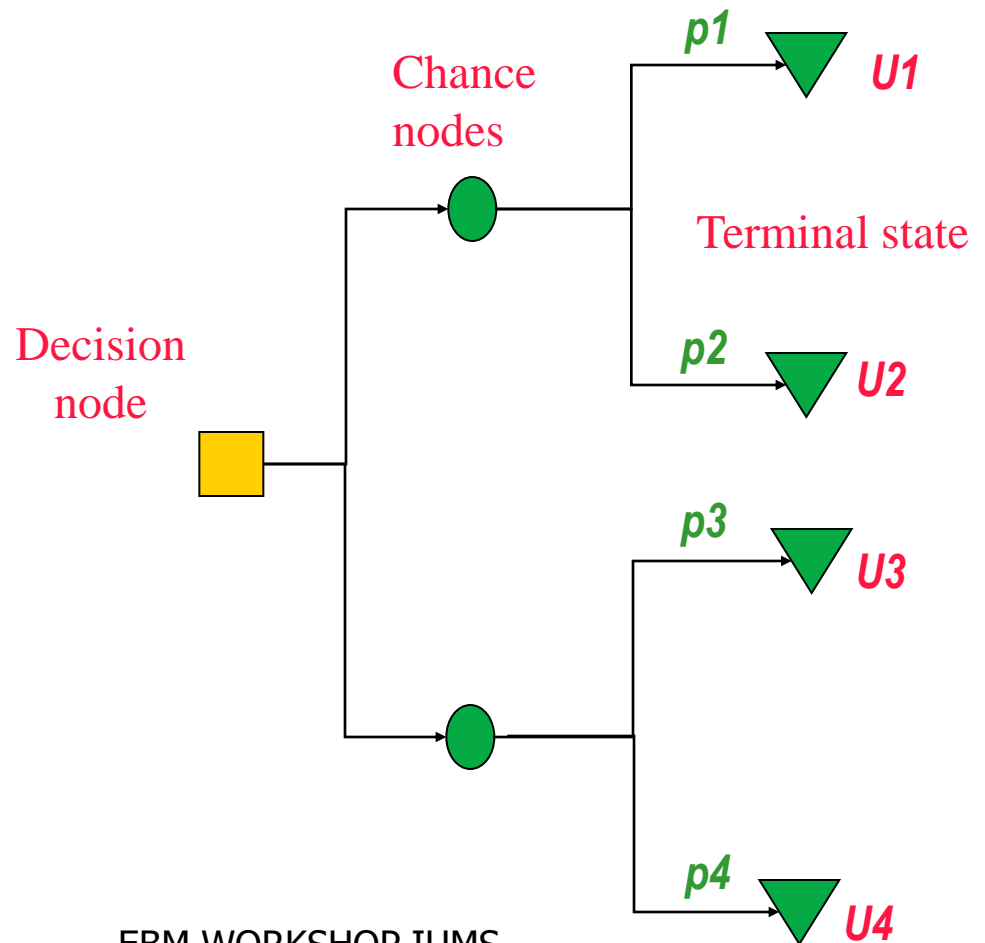
Decision tree

Decision node: represented on the tree as a **square**, is a crossroads in clinical medicine at which the physician must choose an action or strategy.

Chance nodes: which appear as **circles** on the decision tree represent events that are beyond our control; they are the uncertainty in clinical medicine.

Terminal state: which appears as **triangles** on decision tree represents one of the final outcomes

DECISION MAKING





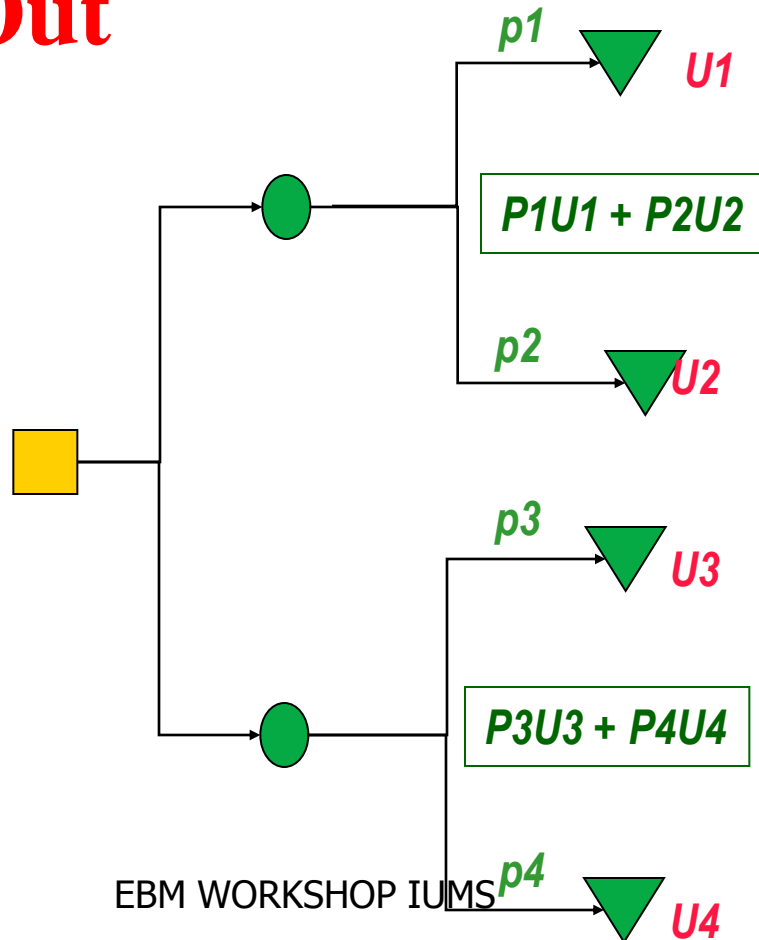
DECISION MAKING

Averaging Out

- Process of calculating an event from several conditional probabilities
- Multiply the probability of each branch by the value attached to it and sum the values of all branches of the node

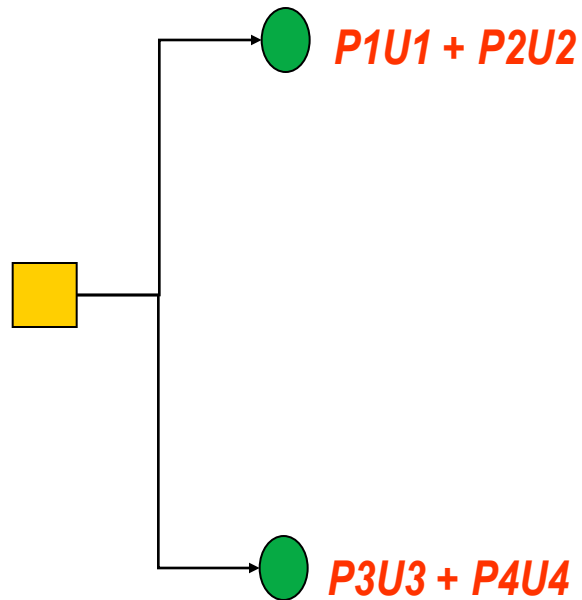
DECISION MAKING

Averaging Out

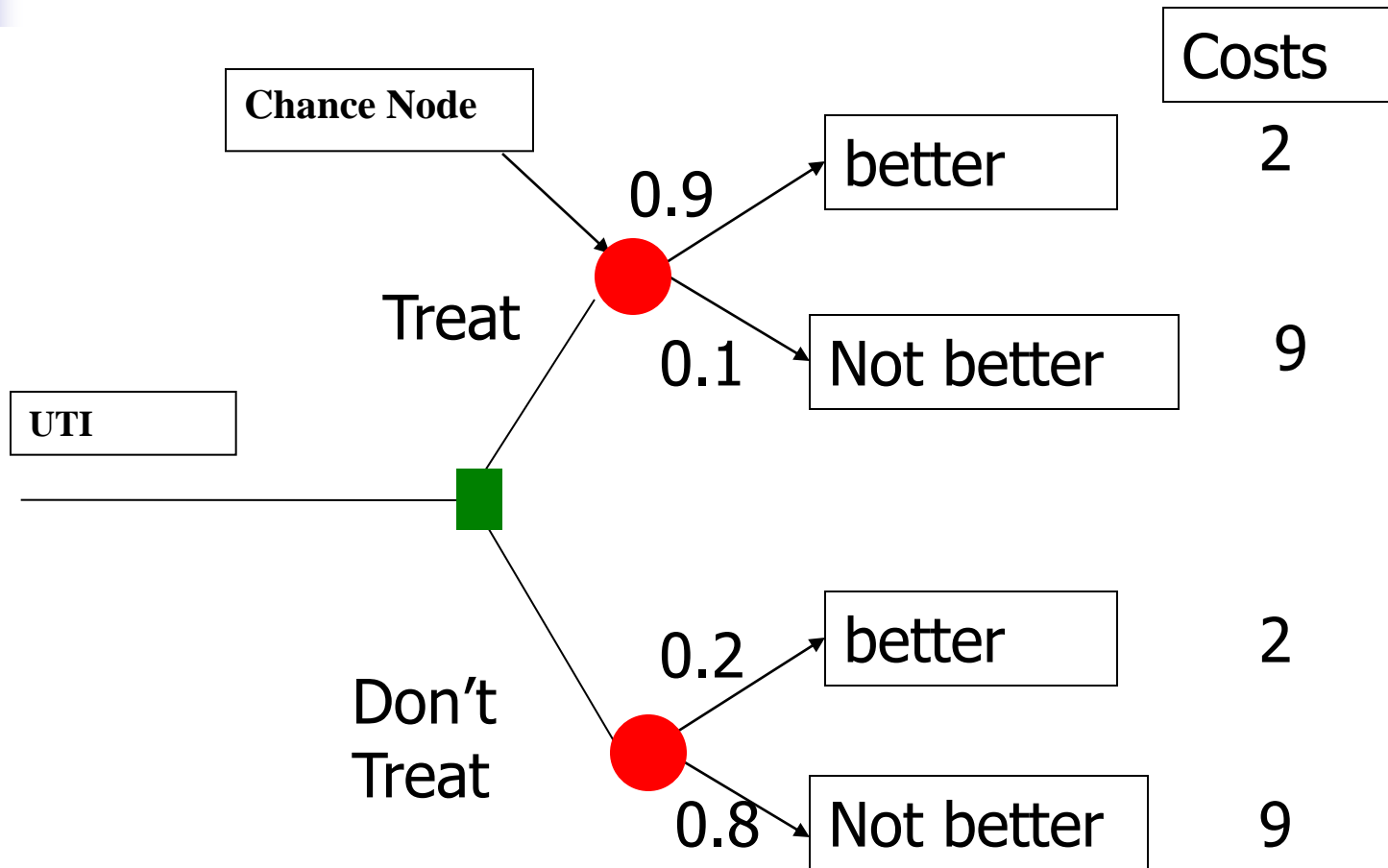


DECISION MAKING

Folding Back

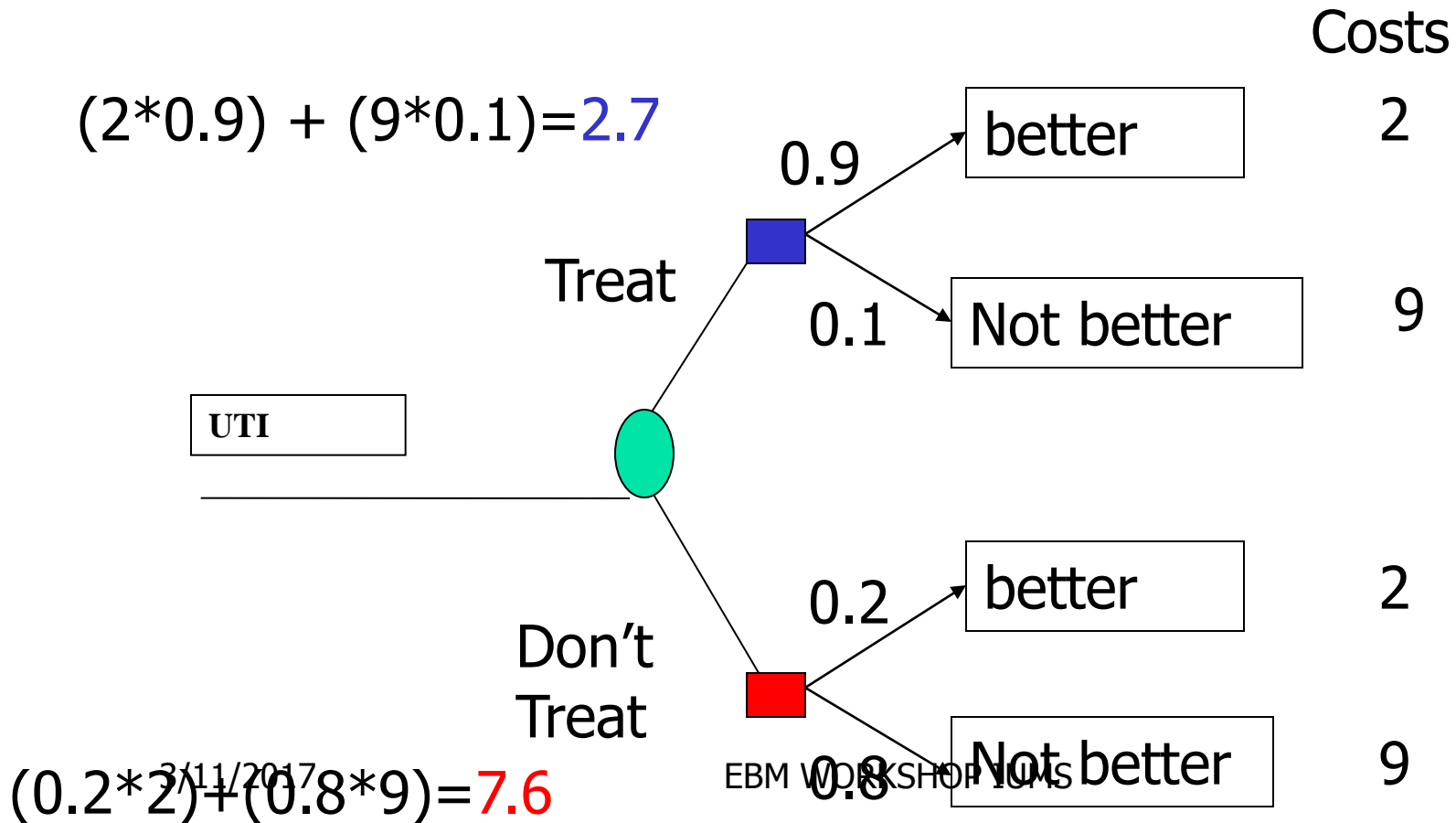


DECISION MAKING



DECISION MAKING

Rollback Costs





DECISION MAKING

What does the patient think?

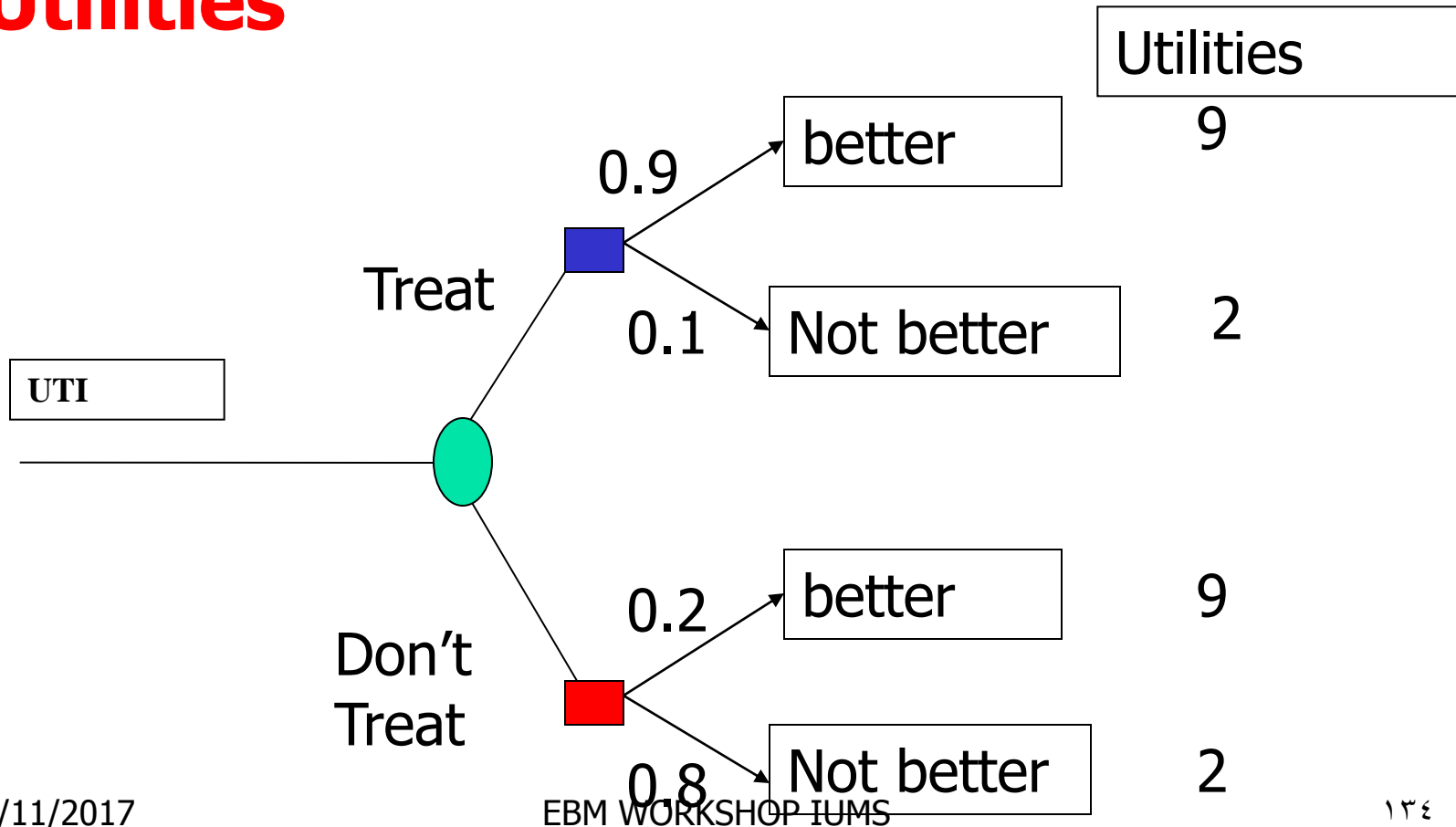
- **Utilities** (e.g QALYs)

Three common methods for calculating personal utilities

- **Visual analog scale**
- **Time trade-off**
- **Standard gamble**

DECISION MAKING

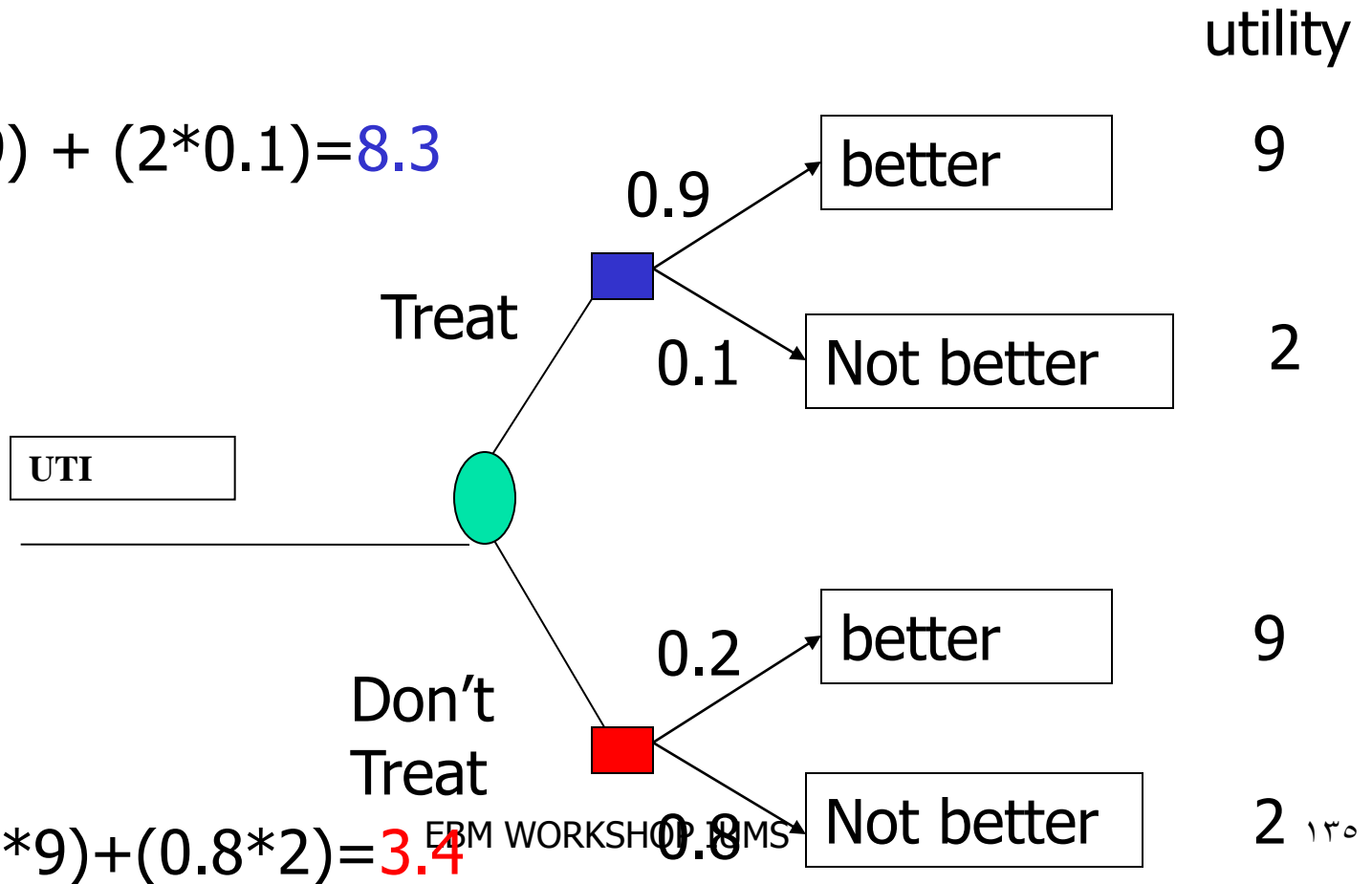
Utilities



DECISION MAKING

Rollback

$$(9 \times 0.9) + (2 \times 0.1) = 8.3$$





DECISION MAKING

Results

- More people get better (90 % vs 20%)
- It is cheaper (2.70 vs 7.60)
- The utilities are better (8.3 vs 3.4)

TREATMENT OPTION IS MUCH BETTER THAN NO TREATMENT



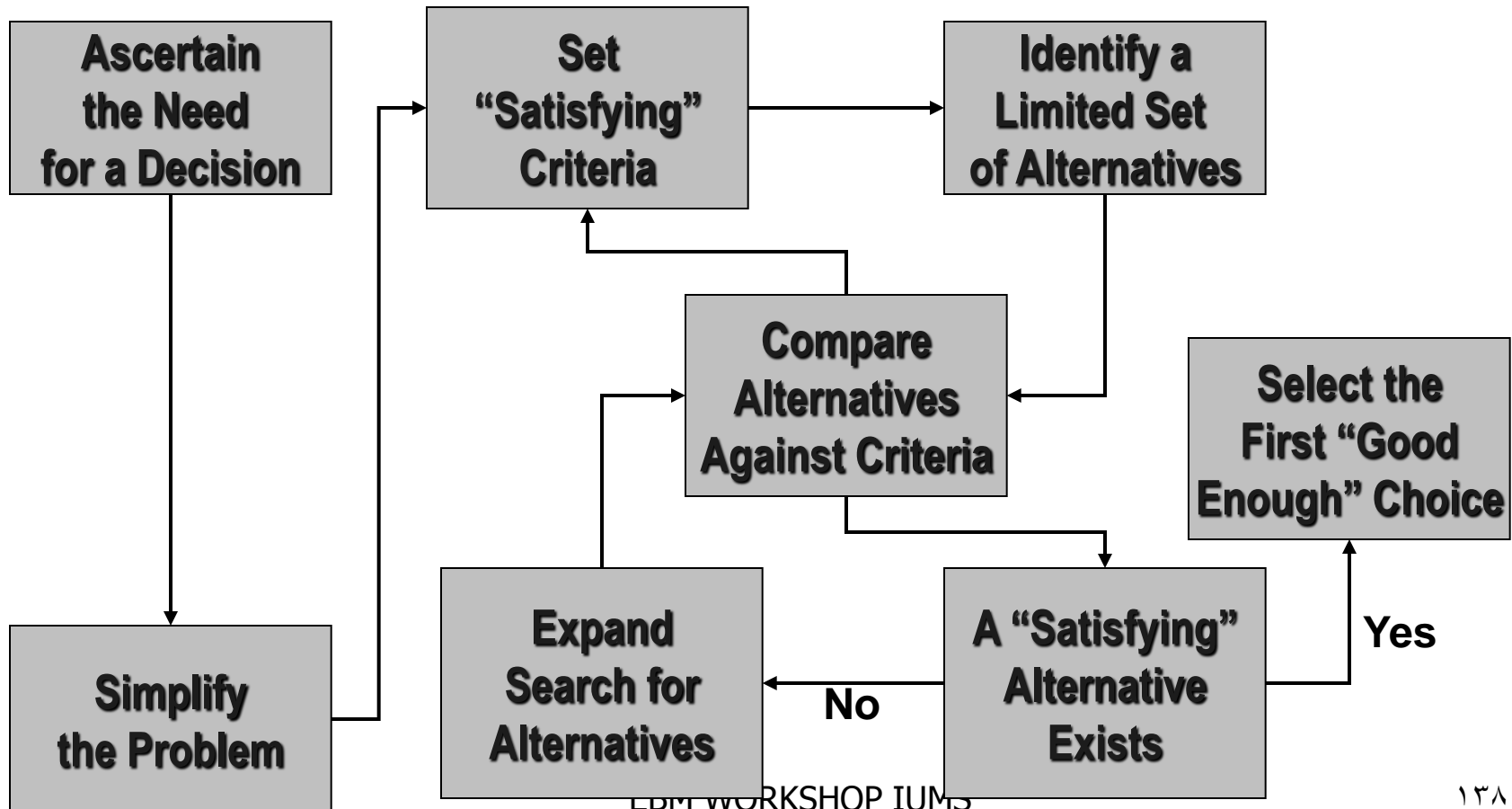
DECISION MAKING

Individual Decision Making Models

- Implicit favorite
- Satisfied (“administrative”)
- Maximizing (“rational-economic”)
- Markov

DECISION MAKING

A Model of Bounded Rationality





DECISION MAKING

Sensitivity Analysis

Sensitivity analysis tests the stability of an analysis over a range of **probability estimates and **value** judgments**

One-way sensitivity analysis

Two-way sensitivity analysis



Thank You!
Any Question?