

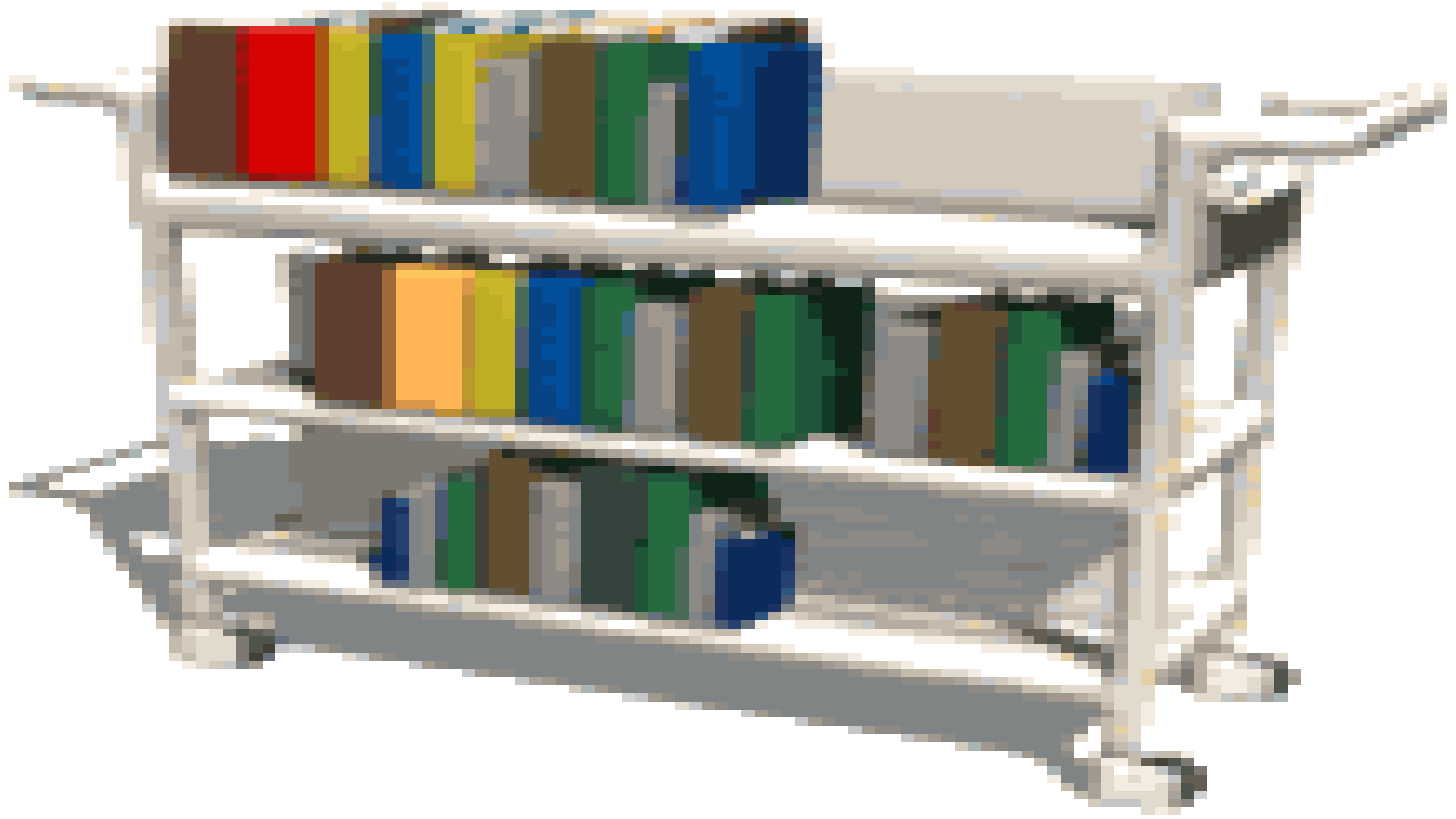


# **IN THE NAME OF GOD**

---

## **Evidence – Based Medicine**

# What do you think about EBM?





# Minimum reading to keep up-to-date with pediatrics

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- 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?



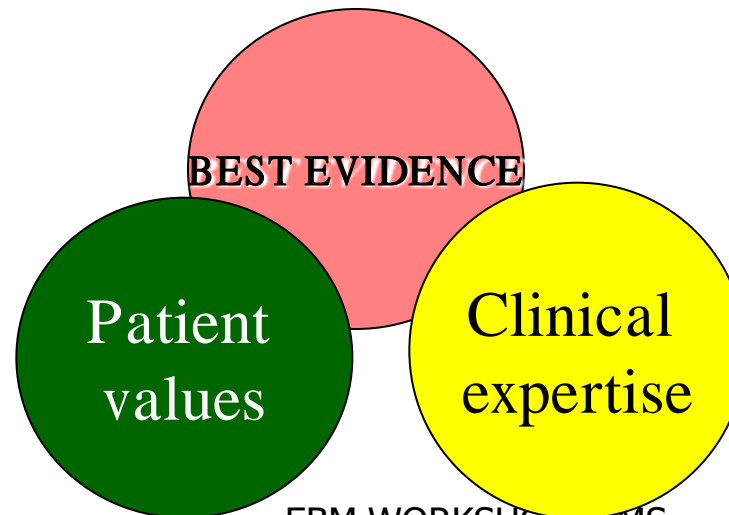
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- Evidence-based medicine (EBM) is an important change in the way physicians practice, teach, and do research.

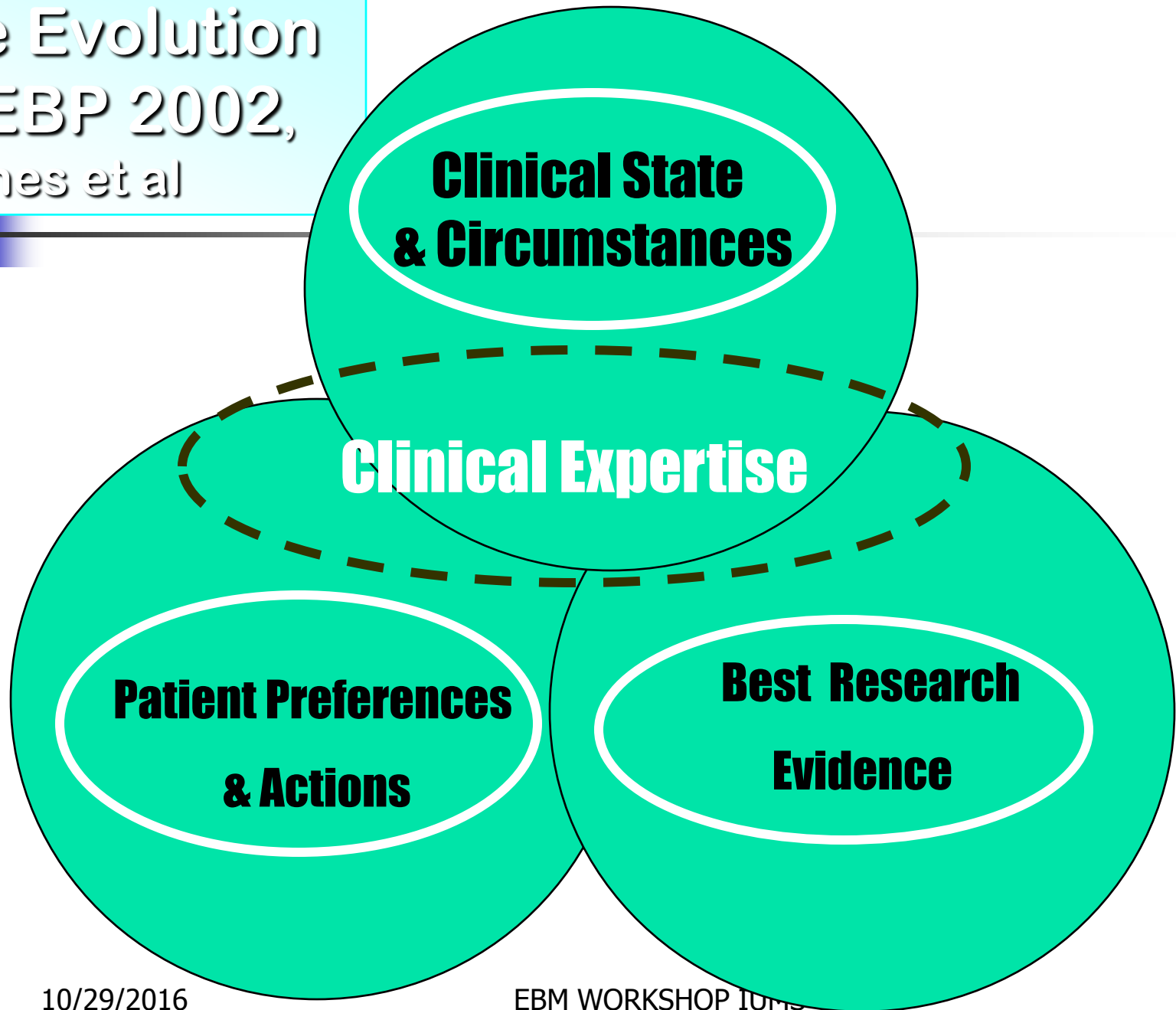
# DEFINITION

■ 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.

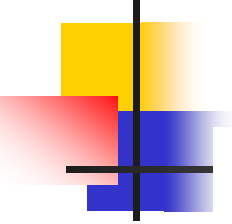




# EBM OBJECTIVES

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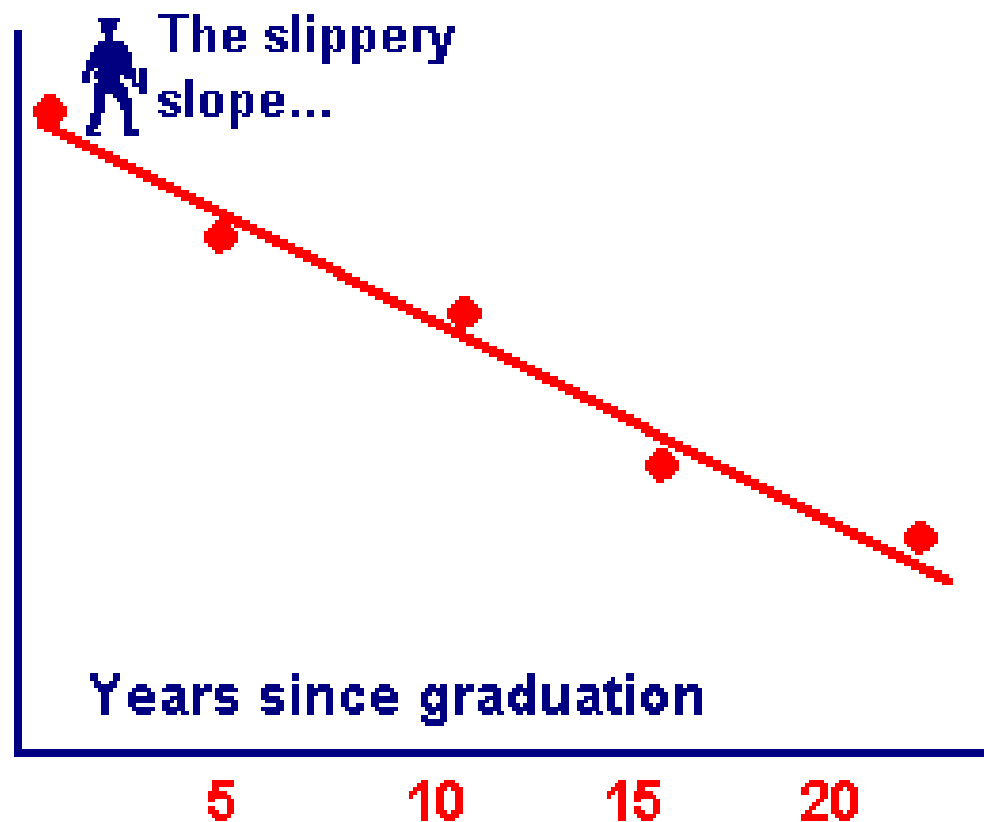
- KEEPING YOUR SKILLS UP TO DATE
  - MEMORY DECREASE
  - NEW TREATMENT METHODS
- SAVING TIME
- SAVING LIVES
- SUPPLEMENTING CLINICAL JUDGEMENT(EBM MODEL)



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

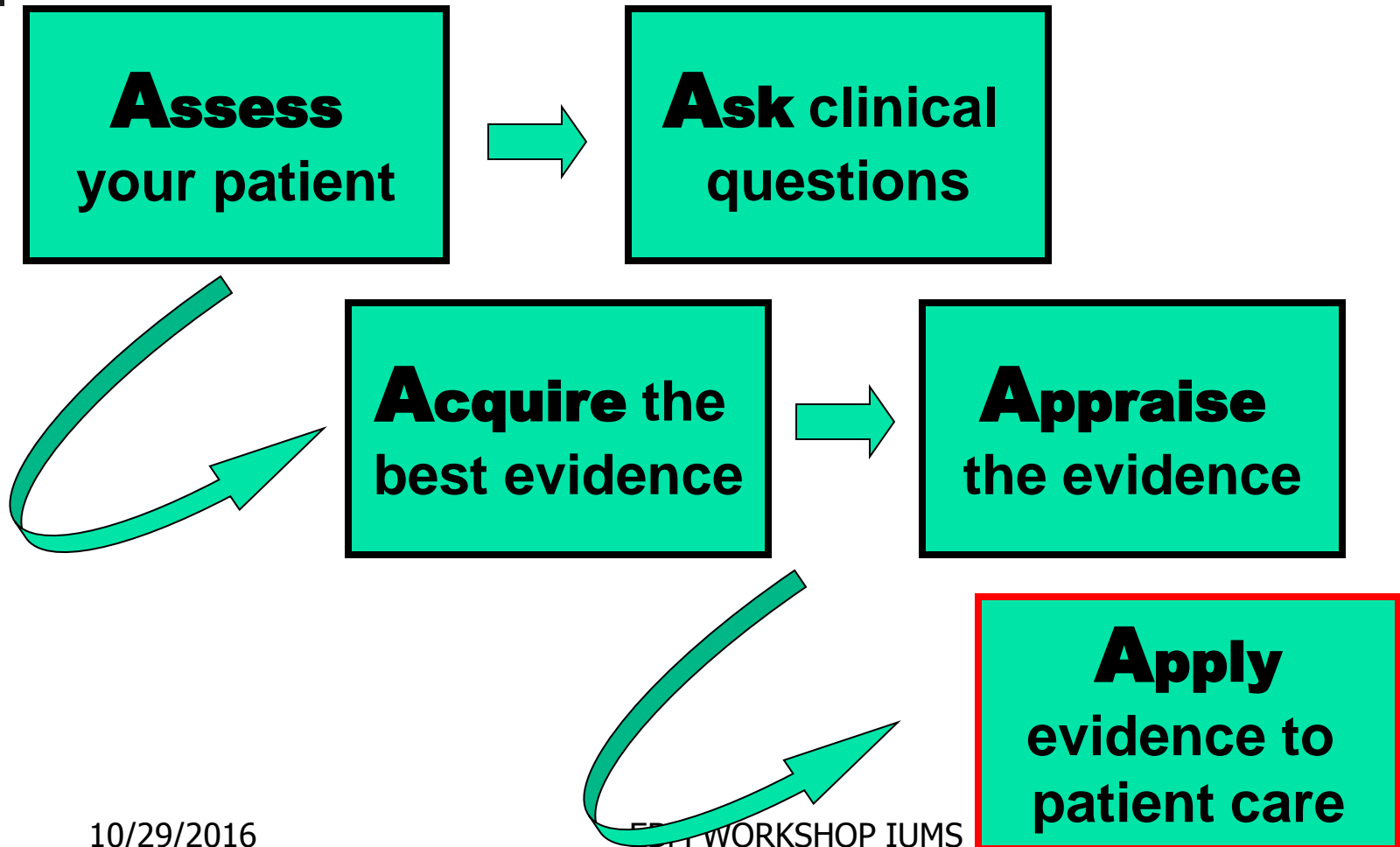
- افزایش اعتماد به نفس پزشکان بالینی در اخذ تصمیم بالینی
- افزایش توانائی پزشکان در جستجوی اطلاعات
- عادت به مطالعه را در پزشکان می افزاید
- امکان توجیه منطقی تصمیمات درمانی را برای بیماران فراهم می کند.
- طراحی دستور العمل مشترک برای تصمیمات بالینی توسط متخصصین محلی



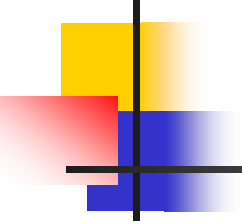
# مضرات EBM

- 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

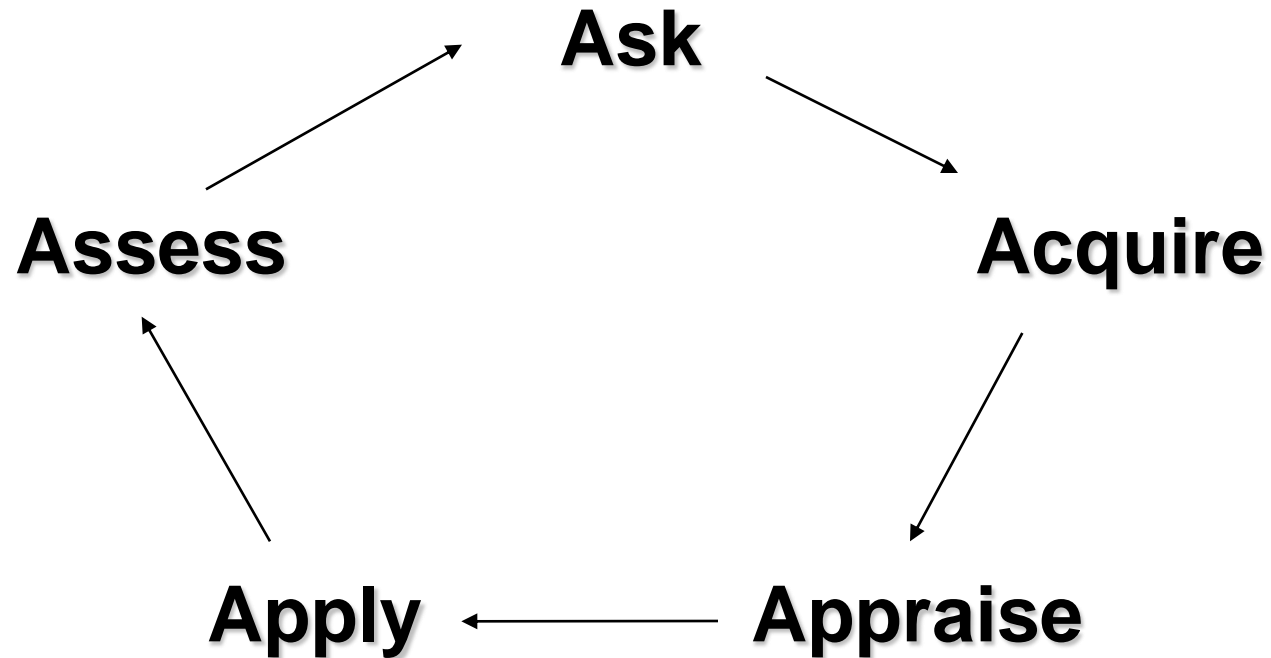


# EBM PROCESS

- 
- 
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

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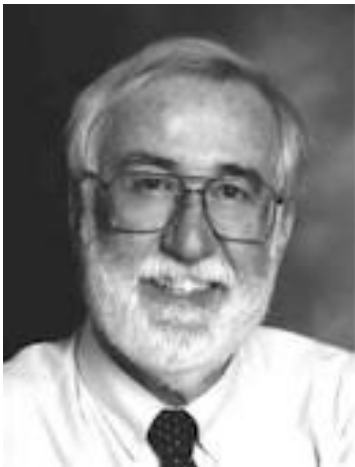
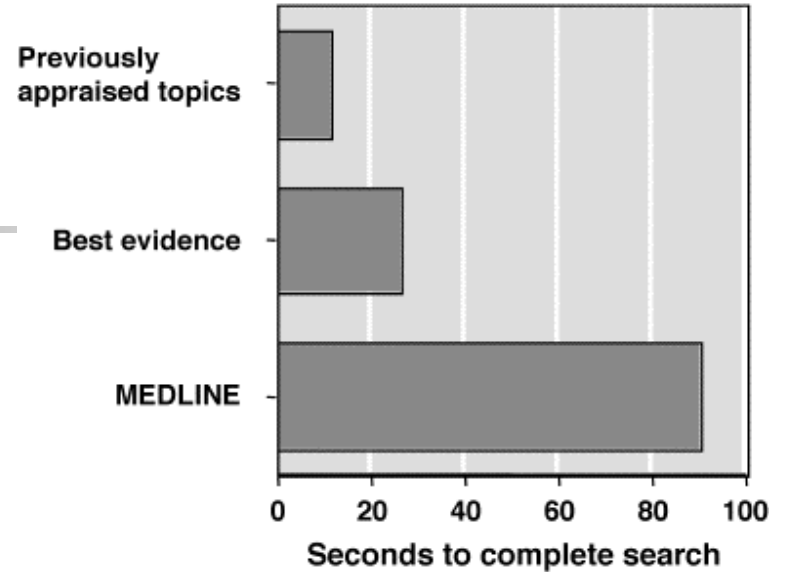
# The Practice of EBM

---

- **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

10/29/2016



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 population (problem)
- 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

---

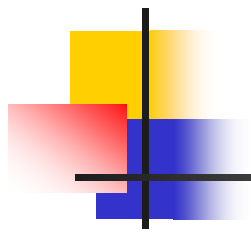
- **P** -controlling for confounding factors, do otherwise healthy children
- **I** -exposed in utero to cocaine
- **C** - compared to children not exposed
- **O** - have increased incidence of learning disabilities at age six years?

Type of Question	Suggested best type of Study 
------------------	--

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

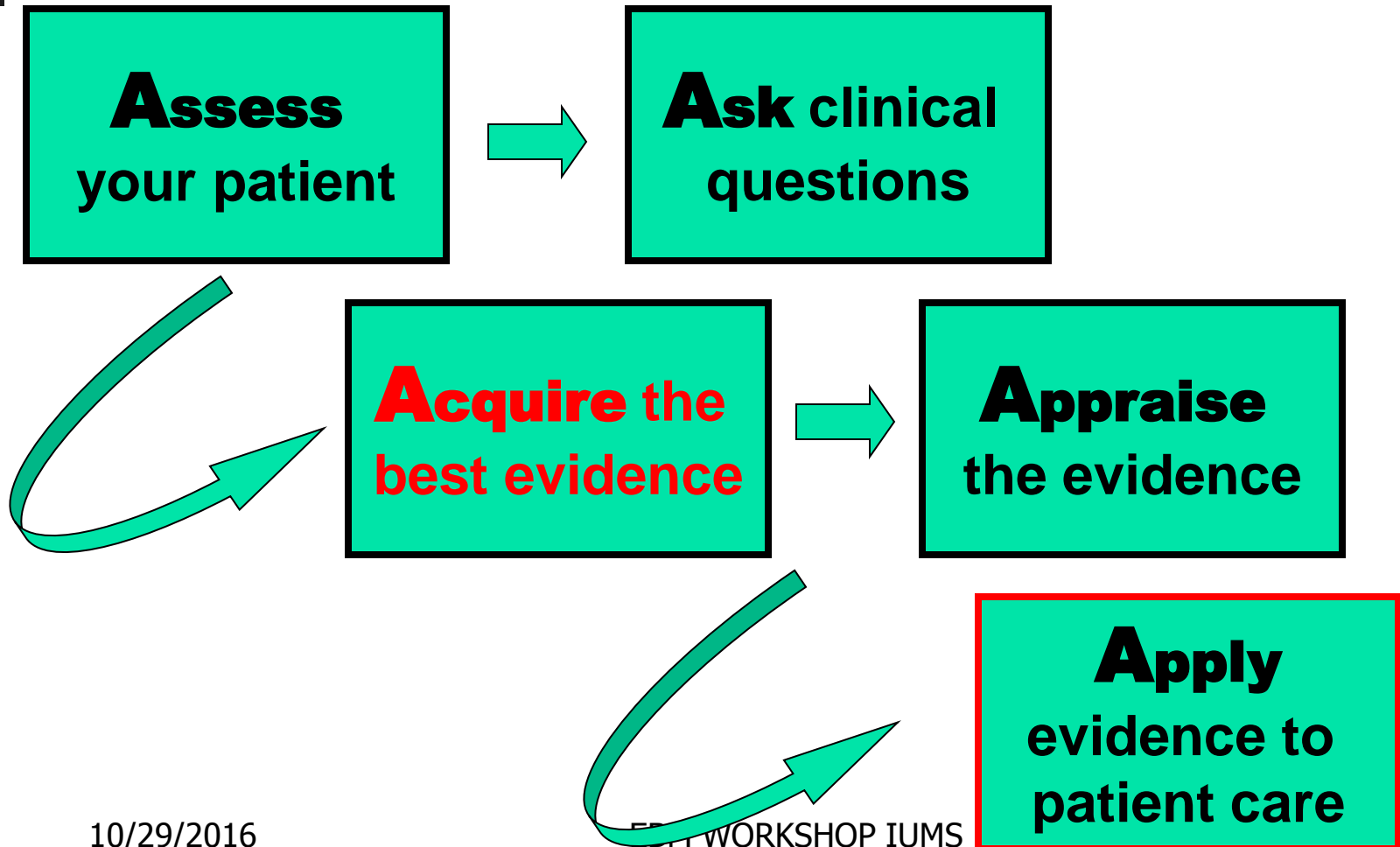






**THANK YOU**  
**ANY**  
**QUESTIONS?**

# EBM Method





# How to Learn About Best Information Resources?

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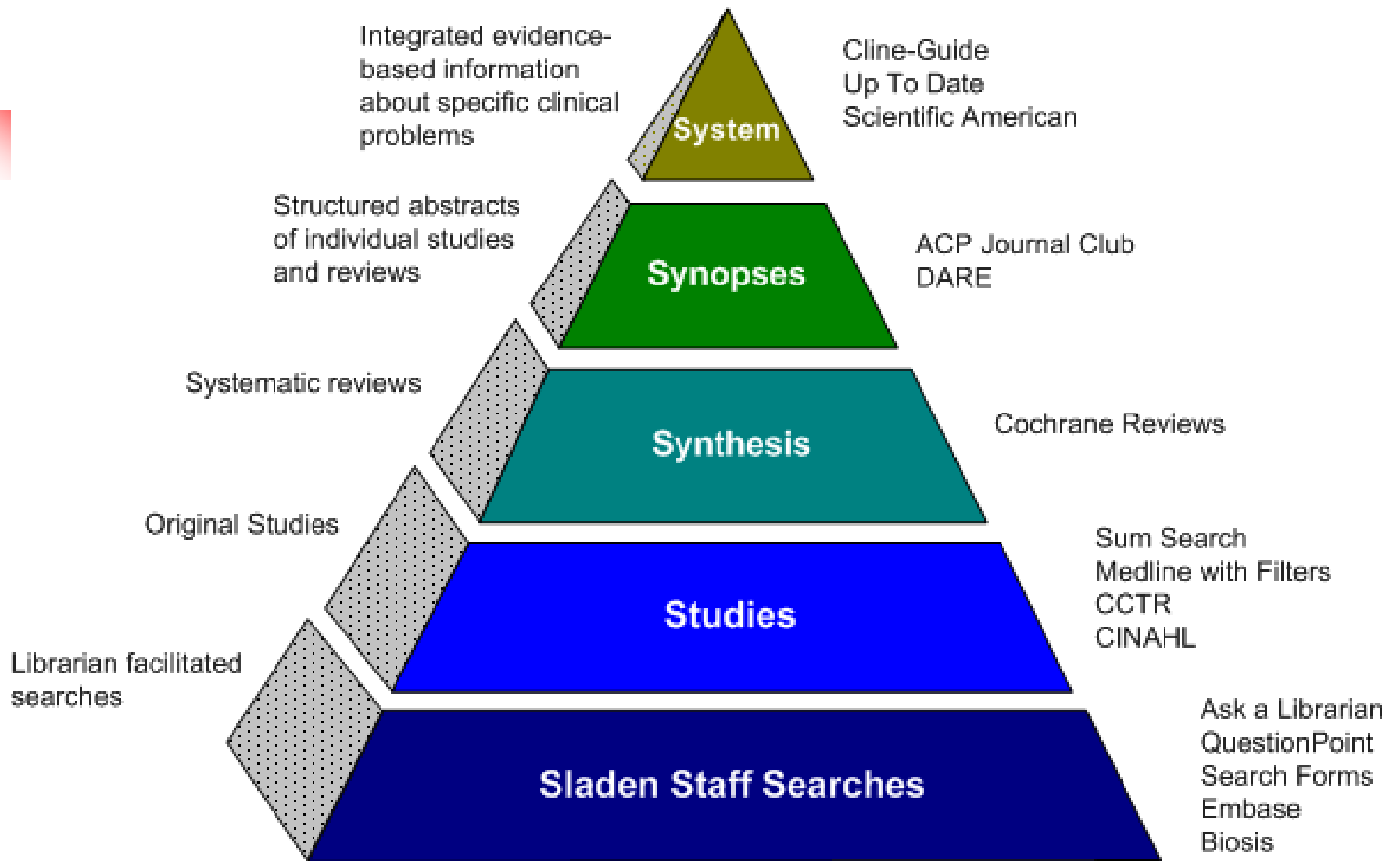
- From librarians (hands-on training)
- From experts in medical informatics
- Courses/ Tutorials

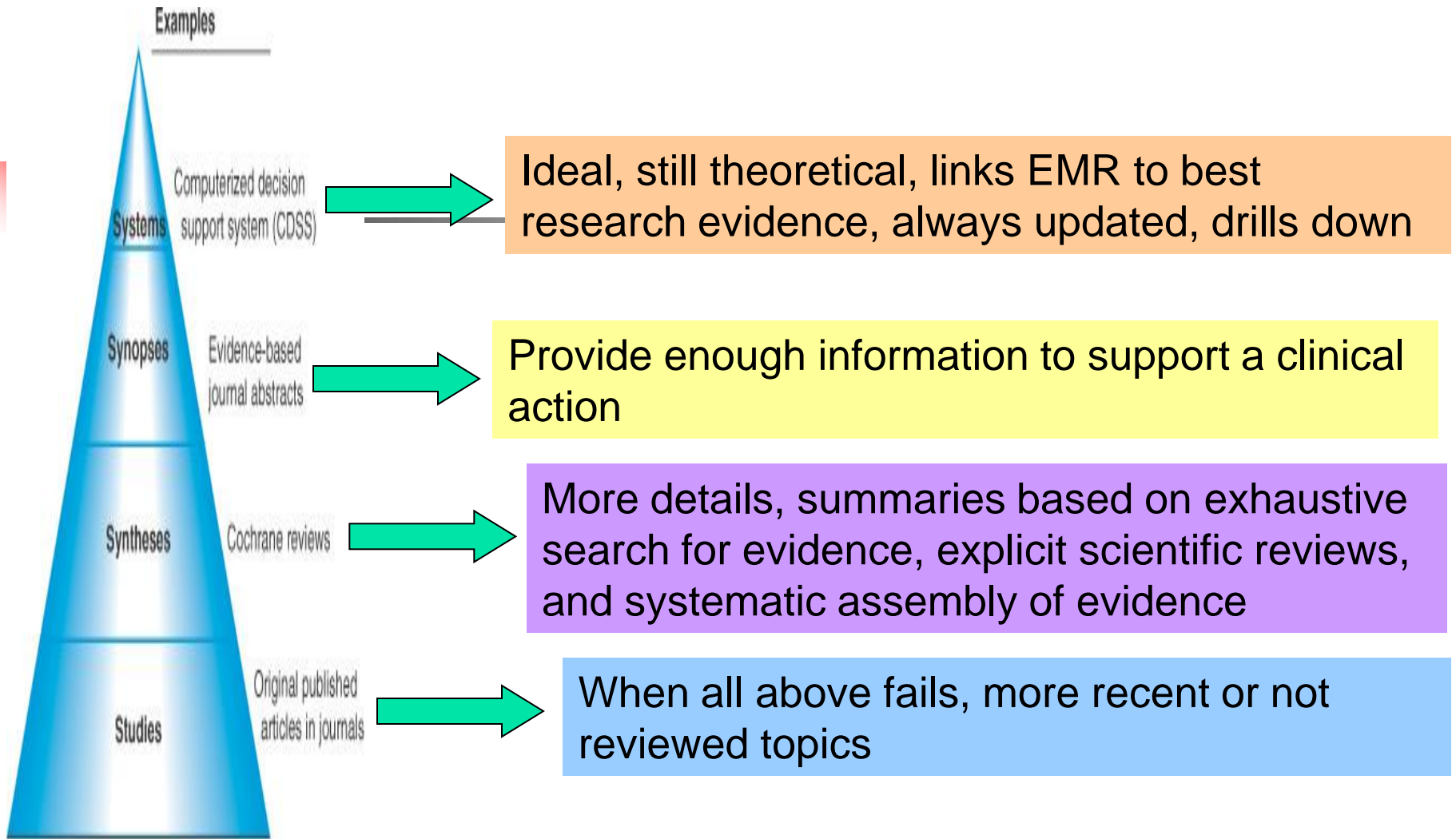
# Searching for Answers:

## The “4S” Approach of Haynes

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

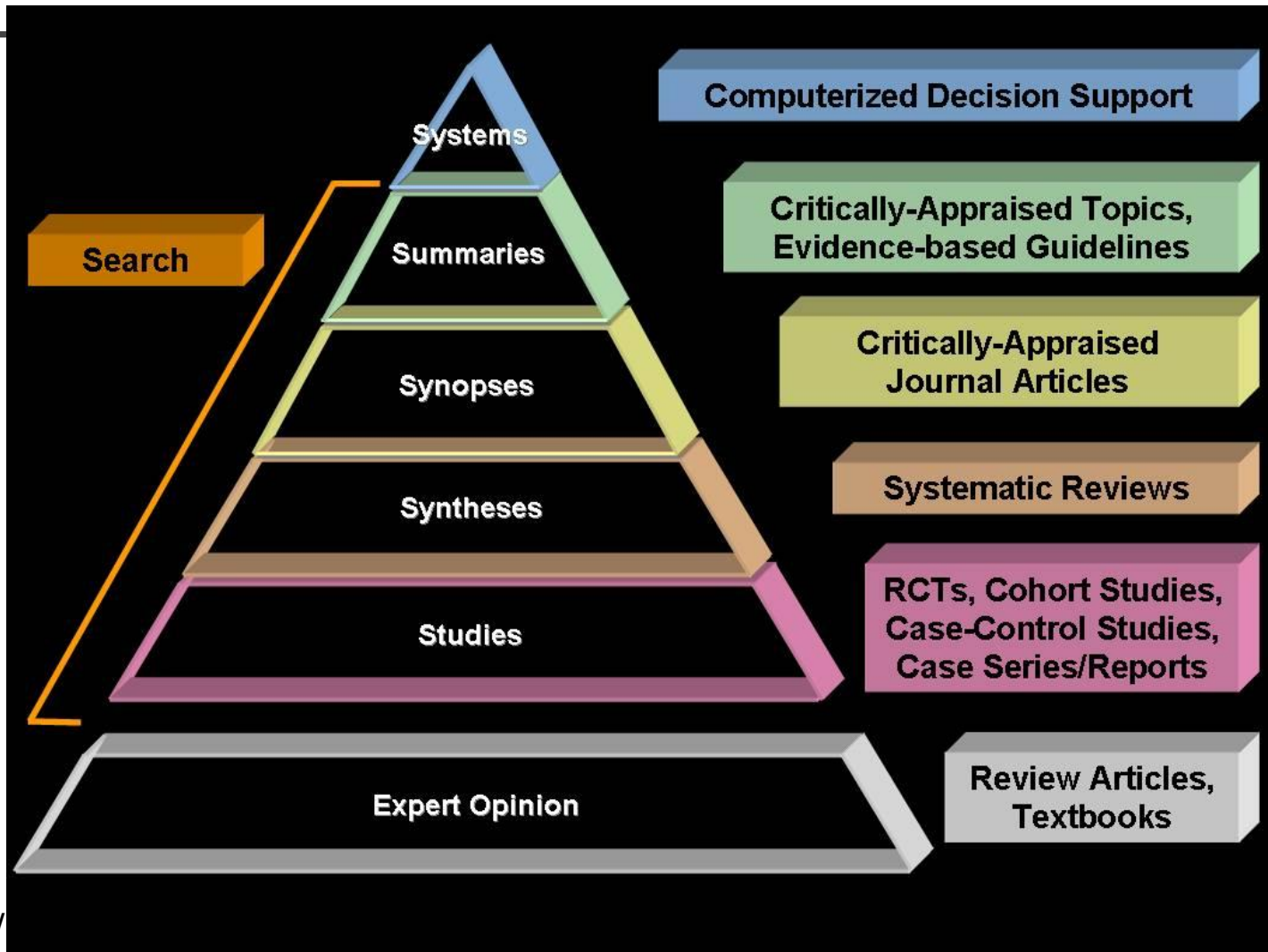
- **Systems** (comprehensive resources)
  - Clinical Evidence ([www.clinicalevidence.com](http://www.clinicalevidence.com))
  - Collection of evidence-based guidelines
- **Synopses** (structured abstracts)
  - Evidence-Based Mental Health (<http://ebmh.bmjournals.com/>)
  - ACP Journal Club ([www.acpjc.org](http://www.acpjc.org))
- **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](http://www.acpjc.org)

- **Evidence Based Medicine:**

[www.ebm.bmjournals.com](http://www.ebm.bmjournals.com)

- **Evidence Based Nursing:**

[www.ebn.bmjournals.com](http://www.ebn.bmjournals.com)

- **Evidence Based Mental Health:**

[www.ebmh.bmjournals.com](http://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



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# **Textbooks are only useful for “background questions”**

(Pathophysiology of clinical  
problems)



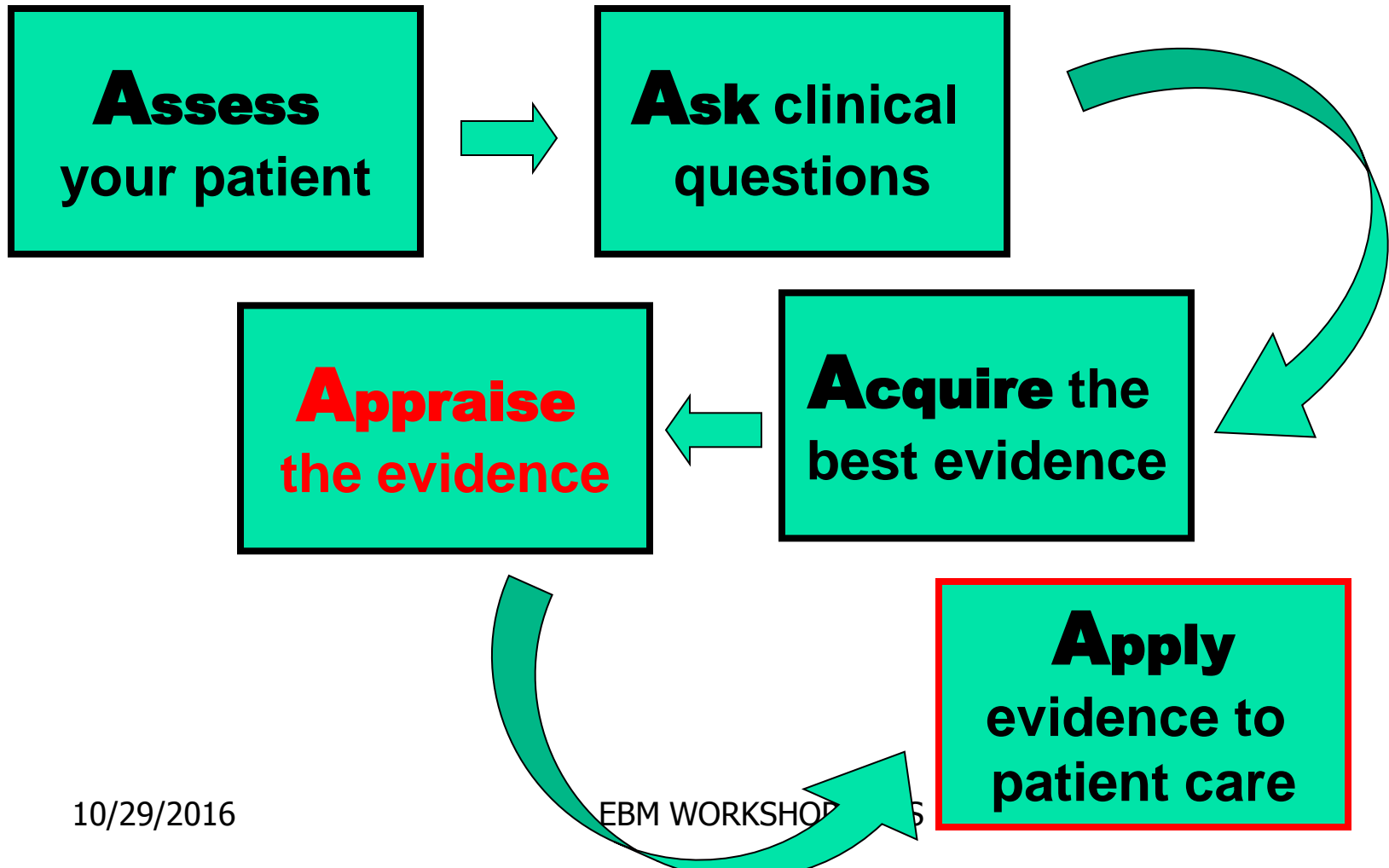
# Alternatives to the “4S” Search Approach



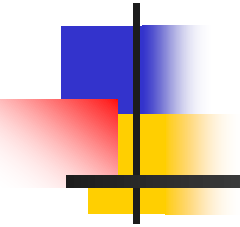
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- TRIP database ([www.tripdatabase.com](http://www.tripdatabase.com))
  - Searches Cochrane, DARE, collections of systematic reviews and guidelines, and some on-line journals
  - Links to PubMed clinical queries
- SUMSearch (<http://sumsearch.uthsca.edu>)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

# EBM Method



# CRITICAL APPRAISAL





# 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 . . . .*

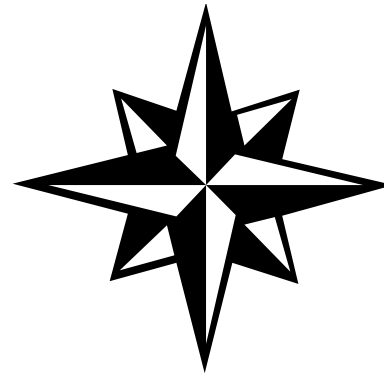


- . . . true
- . . . important
- . . . applicable to their patients!

# KEY QUALITY PARAMETERS

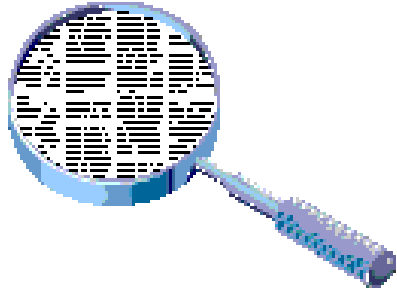
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- VALIDITY
- RELIABILITY
- IMPORTANCE



# 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

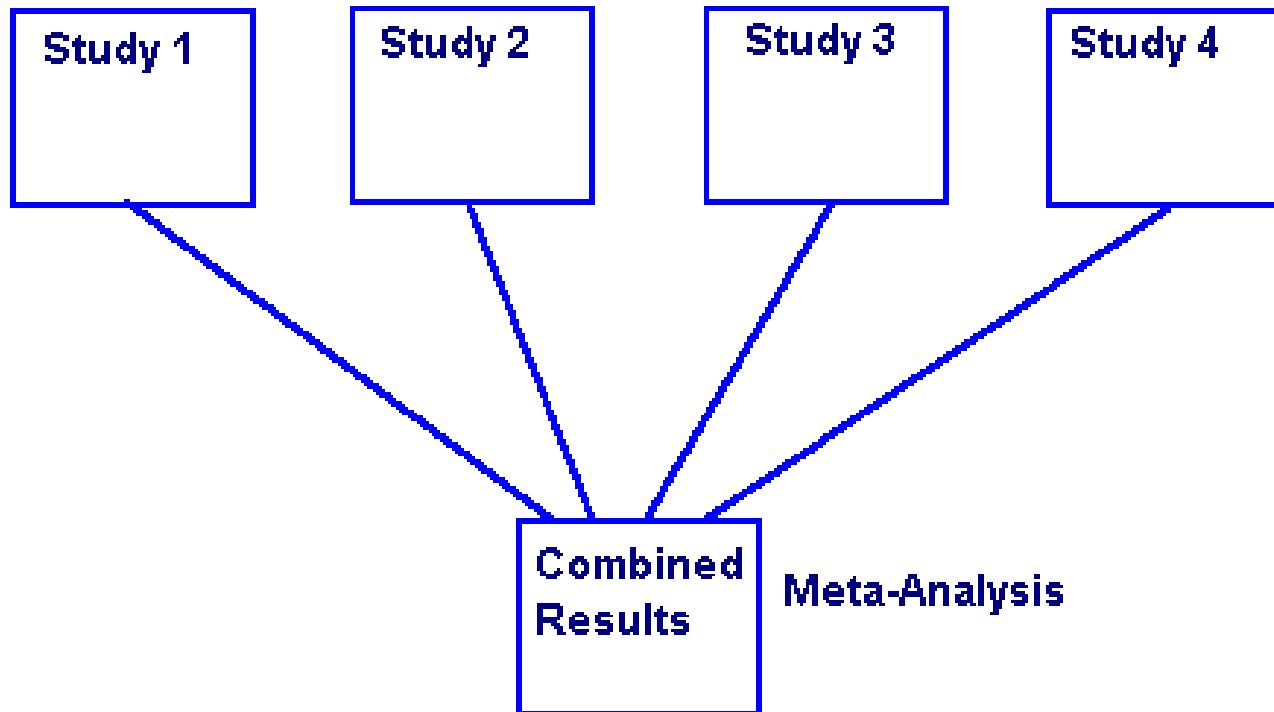
- **Failure to link findings to current literature**
- **Inappropriate inferences**
- **Failure to critique own work**
- **Little insight or direction provided**

# Finding the Evidence



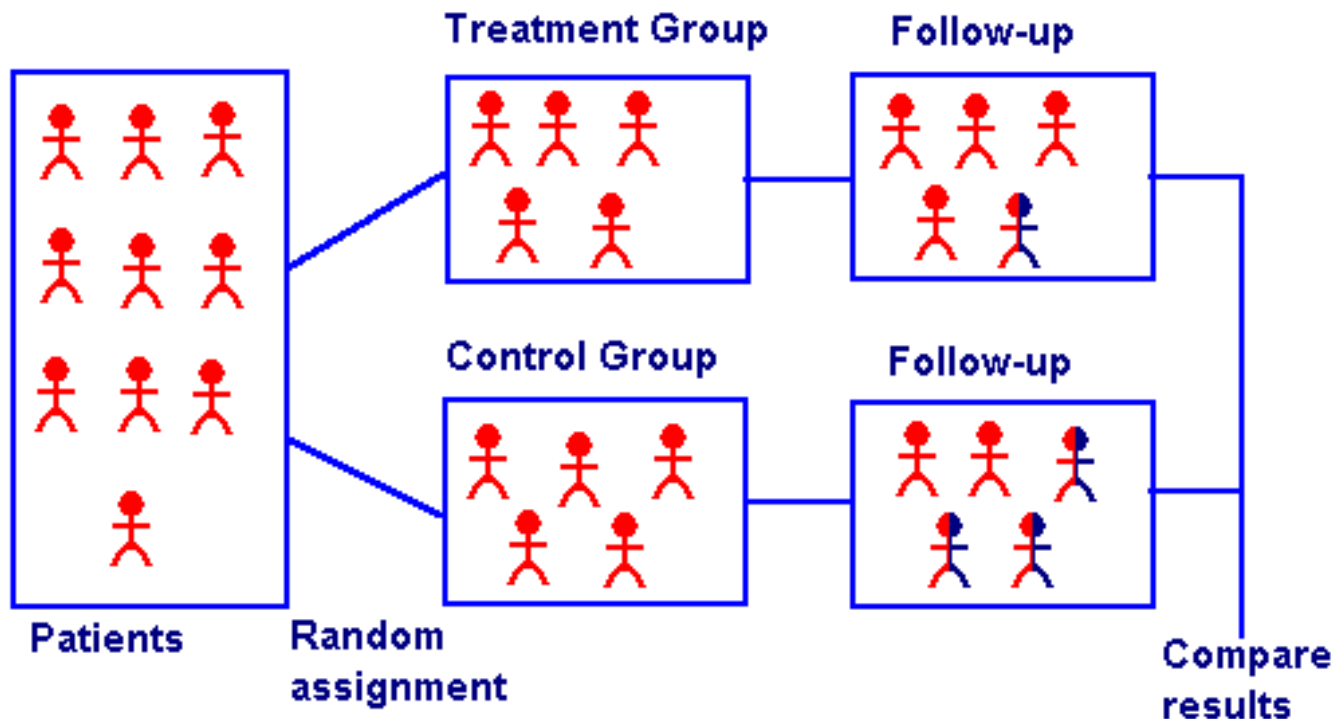
# Finding the Evidence

## Systematic Reviews and Meta-Analyses



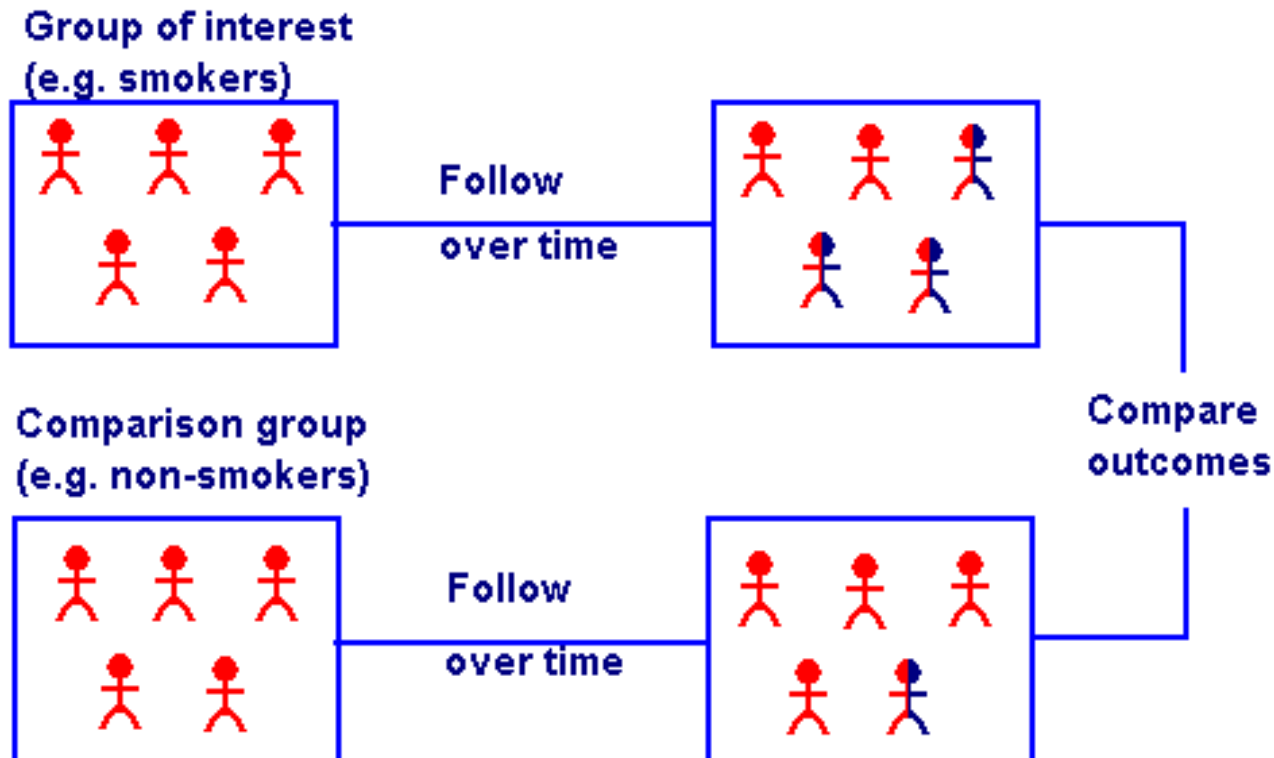
# Finding the Evidence

## Randomized Controlled Studies



# Finding the Evidence

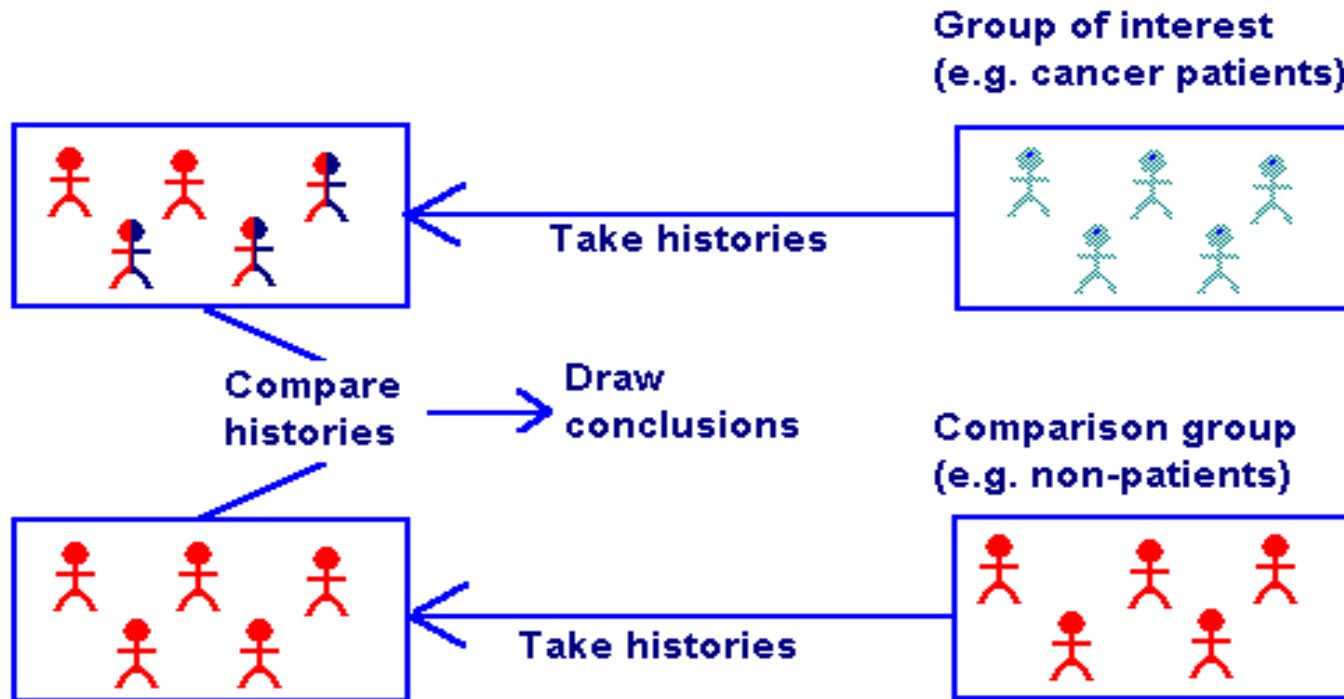
## Cohort Studies





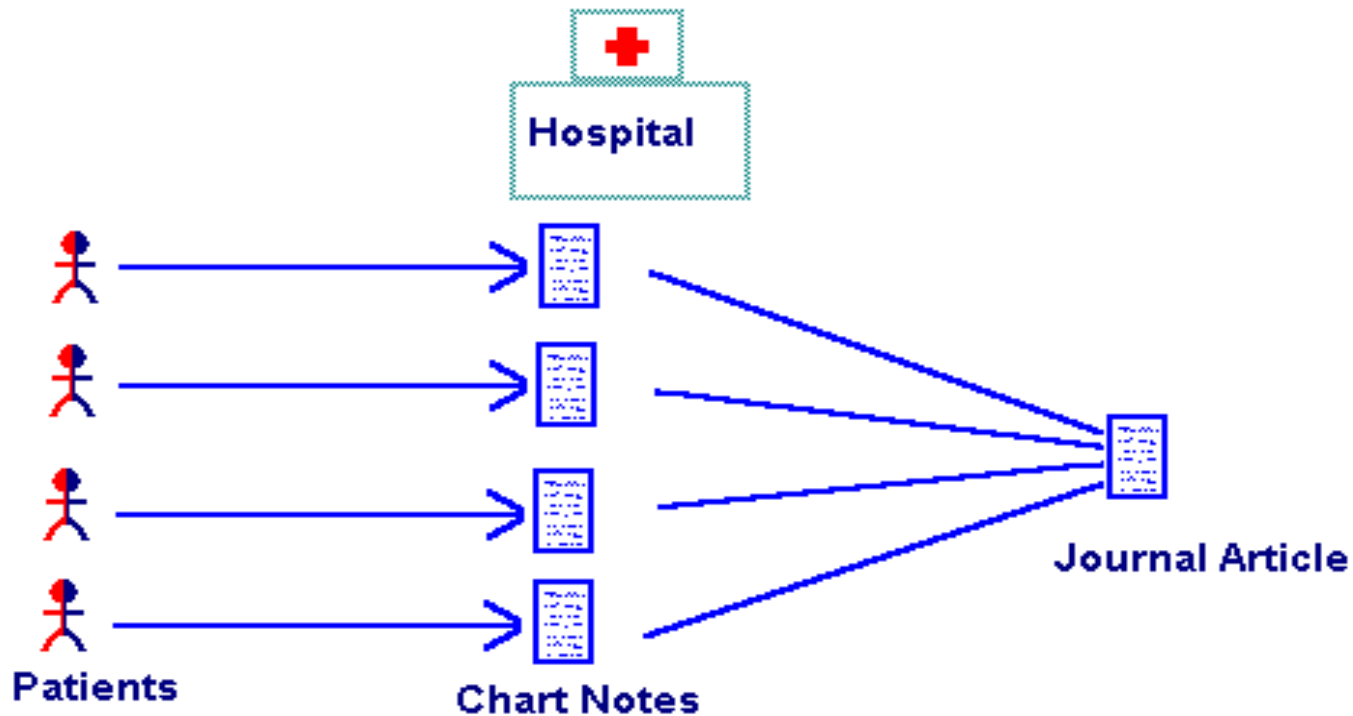
# Finding the Evidence

## 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

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

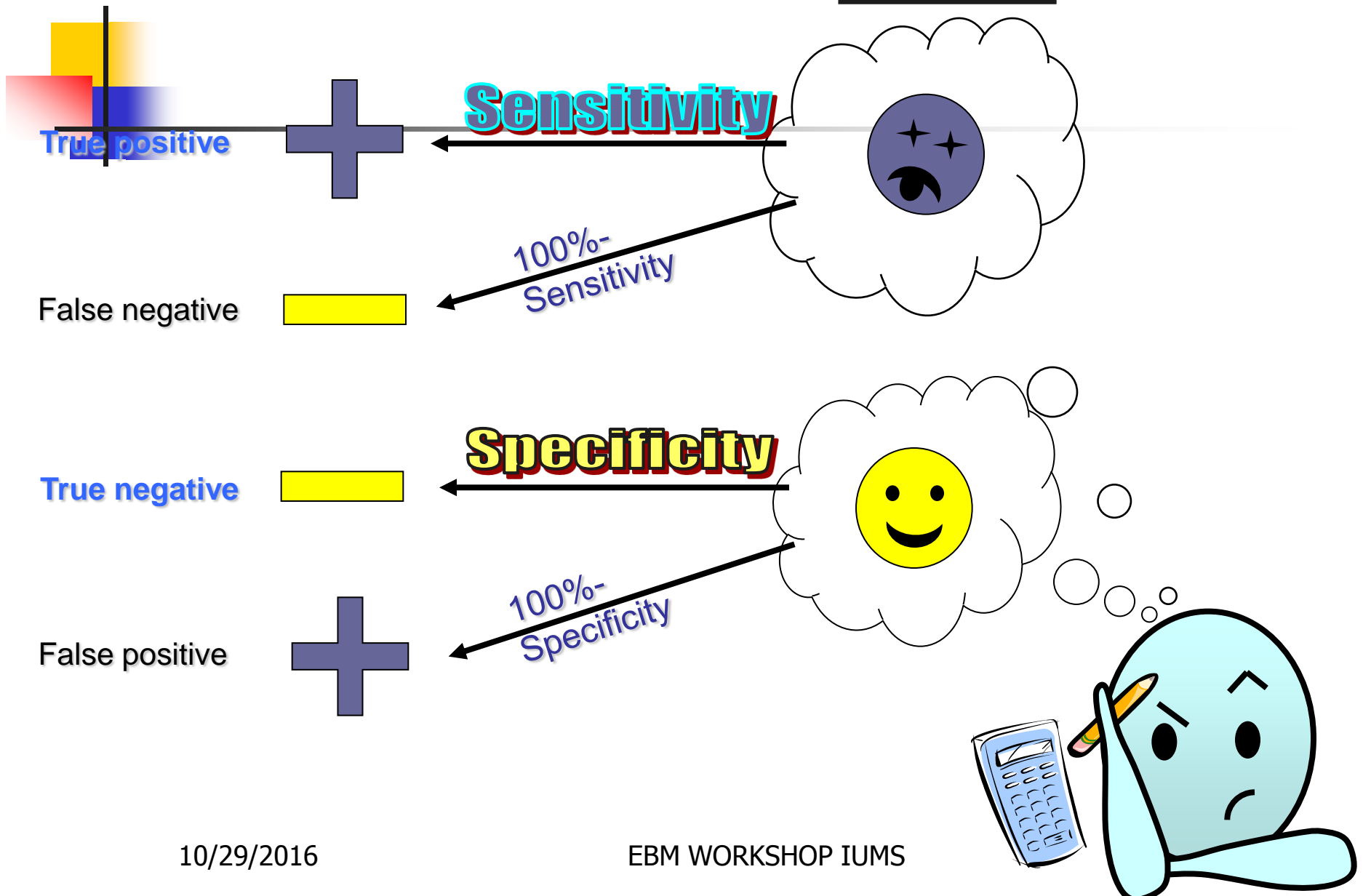
$$\text{Specificity} = 211 / (16 + 211) = 93\%$$

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

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

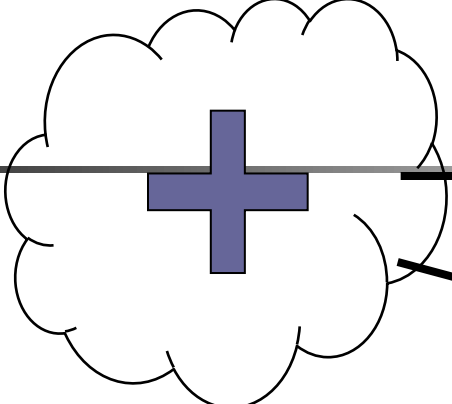
# Test Result

# Diagnosis



# Test Result

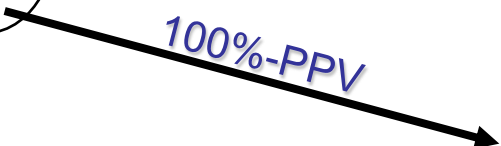
# Diagnosis



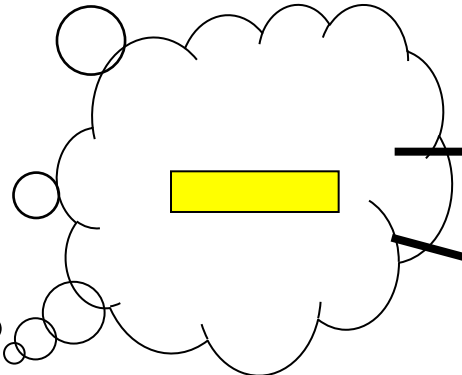
**PPV**



True positive



False positive



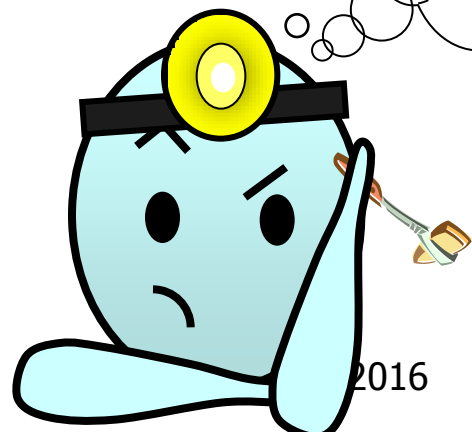
**NPV**



True negative



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

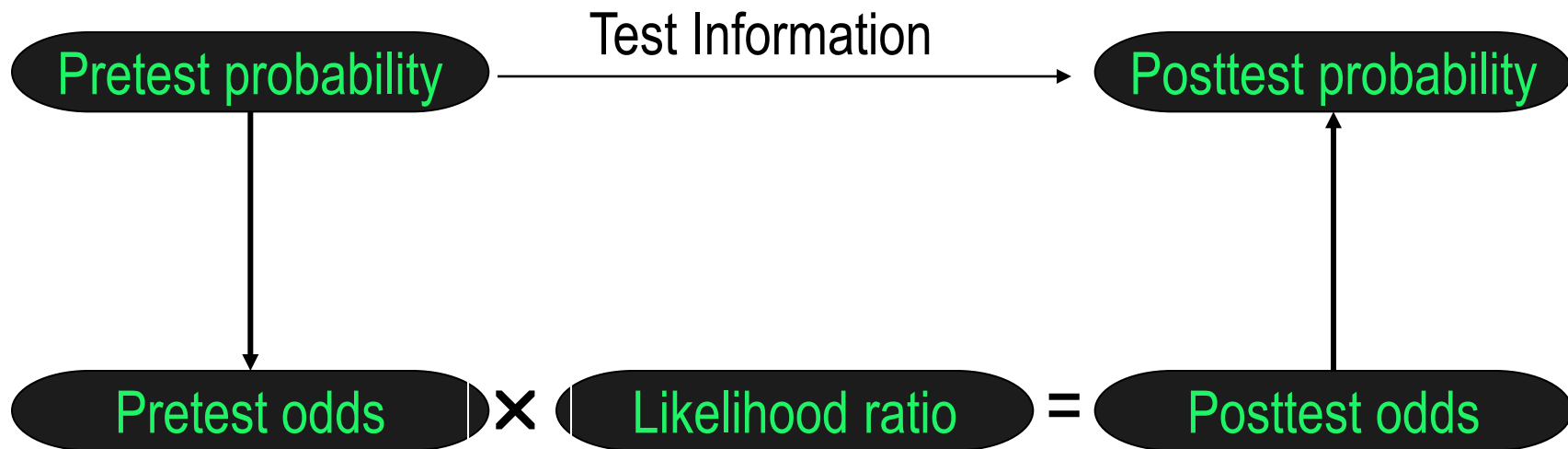
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## Likelihood ratio

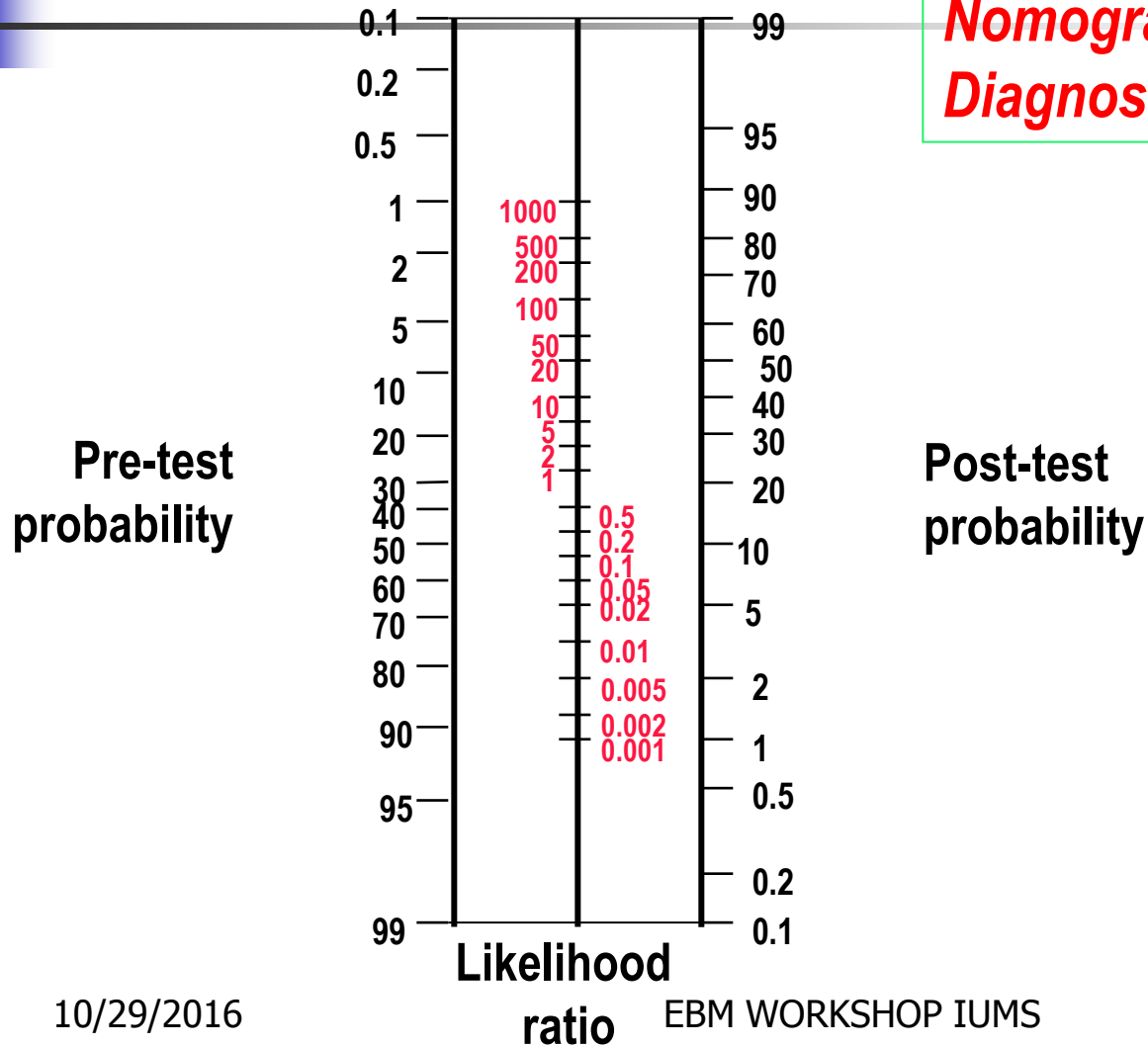
- LR can be derived for diagnostic tests that have multiple levels or categories of results
- LR from different, independent tests can be used together sequentially to easily calculate a single estimate of a patient's post test probability of disease

# statistics

## Calculating posttest probability



# statistics



*Nomogram for interpreting Diagnostic test result*





# statistics

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- 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

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## 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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■ 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

## 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

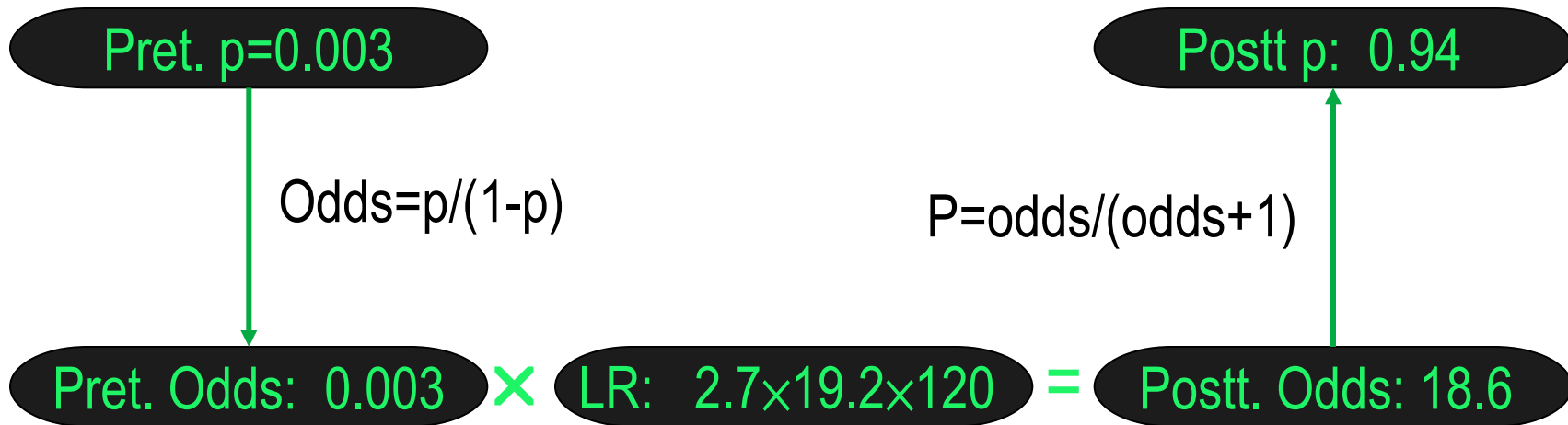
## Clinical findings predicting cancer as a cause of back pain

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15.2	Hematocrit < 30%
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

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## THERAPY

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



# statistics

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		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

		A	B	
Exp.	Positive	600	400	A+B 1000
	Negative	200	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

10/29/2016





# statistics

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## 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 600	B 400	A+B 1000
	Negative	C 200	D 800	C+D 1000



# statistics

---

## Number Needed to Treat

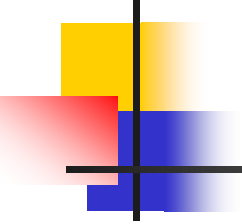
- NNT is particularly useful to clinicians who want to know whether the probable benefits of some treatments or intervention will be worthwhile in their patients
- $NNT = 1/ARR$
- $NNT = 1/0.041 = 24$



**statistics**

---

**Thank You!**  
**Any Question?**

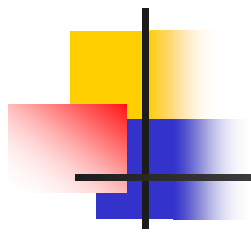


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In horse racing terms,  
10 horses running  
you bet on 1 horse

*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

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## 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

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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

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- 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

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

Interpretation ???



# statistics

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## 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

		A	B	
<b>Exp.</b>	Positive	300	1200	A+B 1500
	Negative	100	900	C+D 1000
		C	D	



# 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

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## 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

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## 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

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## 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”*

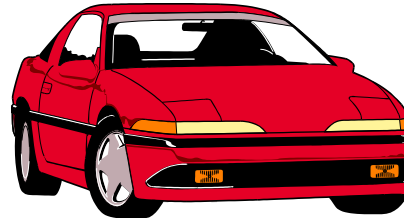
# The Decision-Making Process

Identification  
of a  
Problem



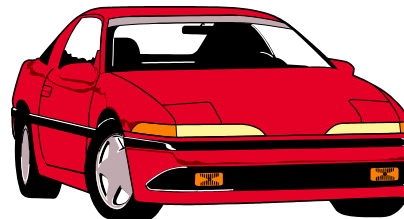
I need to buy  
a new car.

Identification  
of Decision  
Criteria



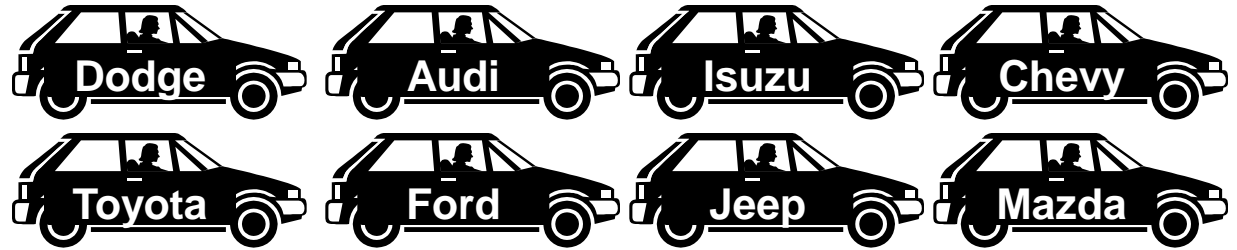
- Price
- Interior Comfort
- Durability
- Repair Record
- Performance

Allocation  
of Weights  
to Criteria



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

Development  
of  
Alternatives



Analysis  
of  
Alternatives

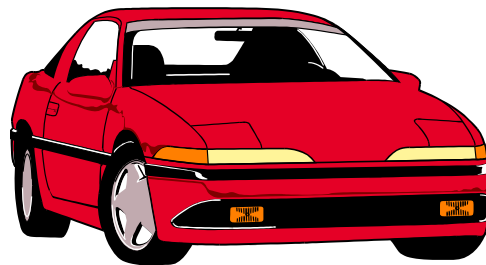
Toyota	•Price •Comfort •Durability •Repair Record •Performance	Dodge
Ford		Audi
Jeep		Isuzu
Mazda		Chevy

Selection  
of an  
Alternative



The Toyota  
is the best.

Implementation  
of the  
Alternative



Appraisal of  
Decision Results



# DECISION MAKING

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## 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

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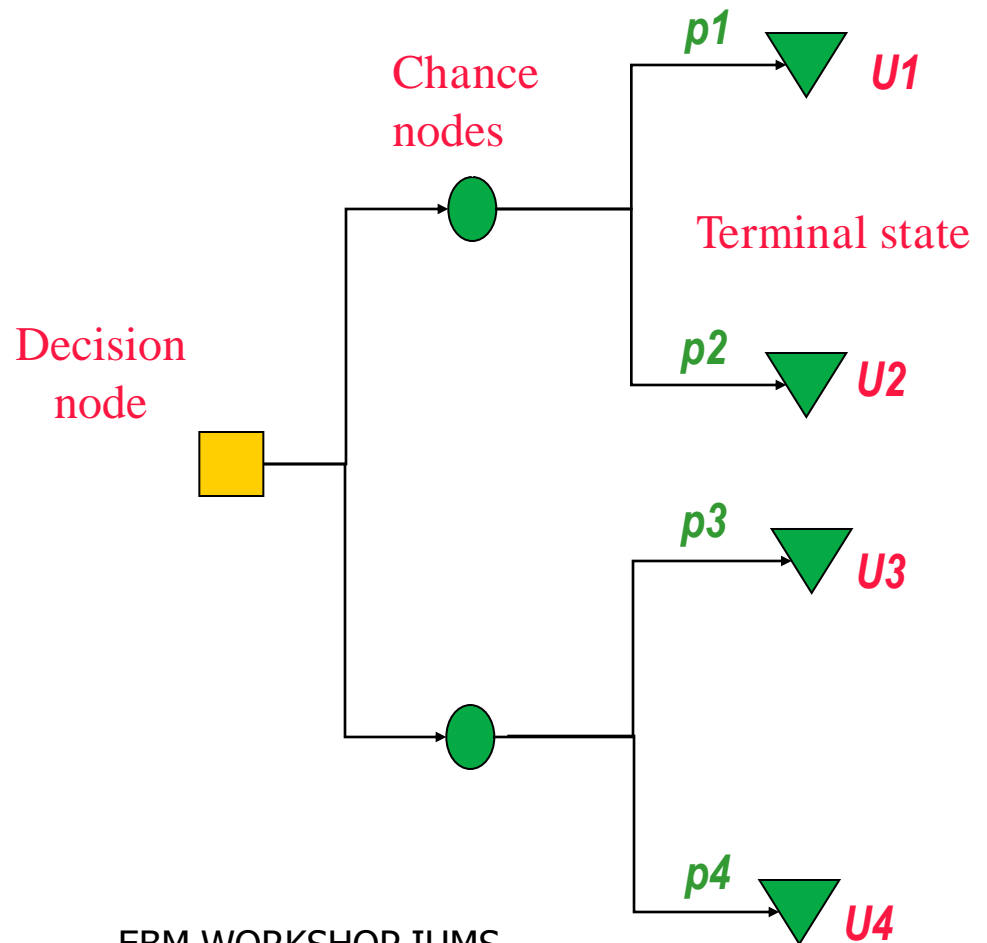
## Decision tree

**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

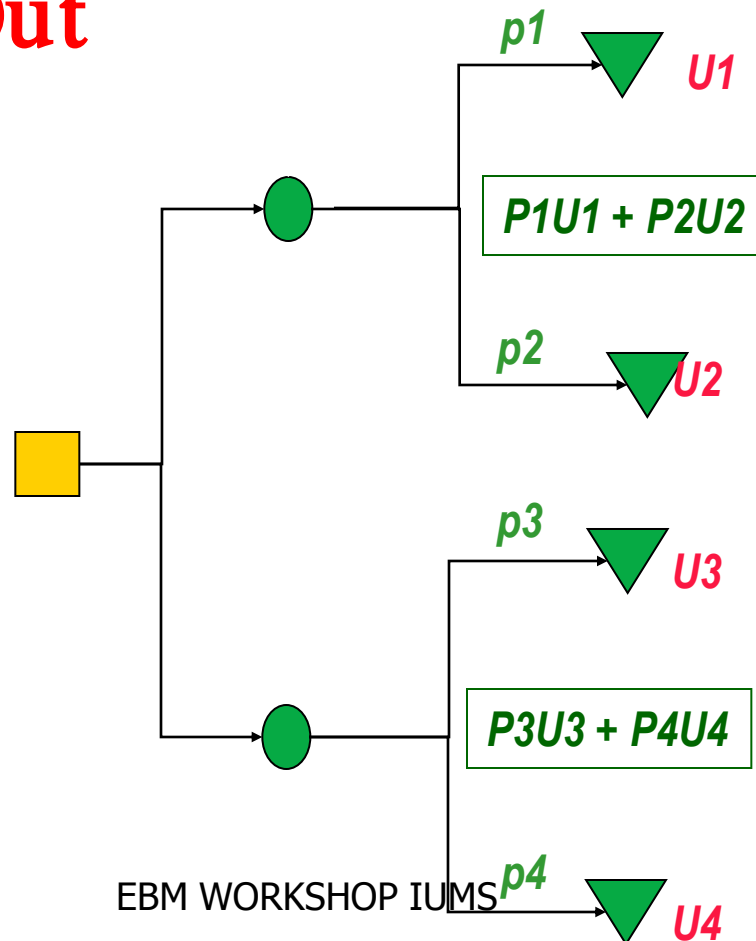
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## Averaging Out

- 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

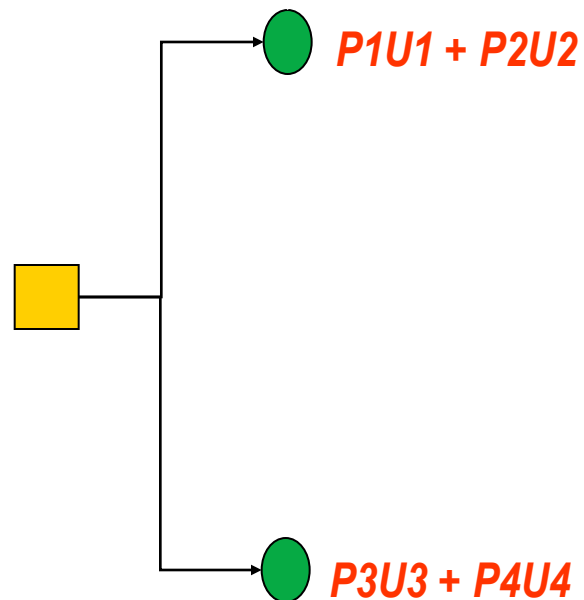
## Averaging Out



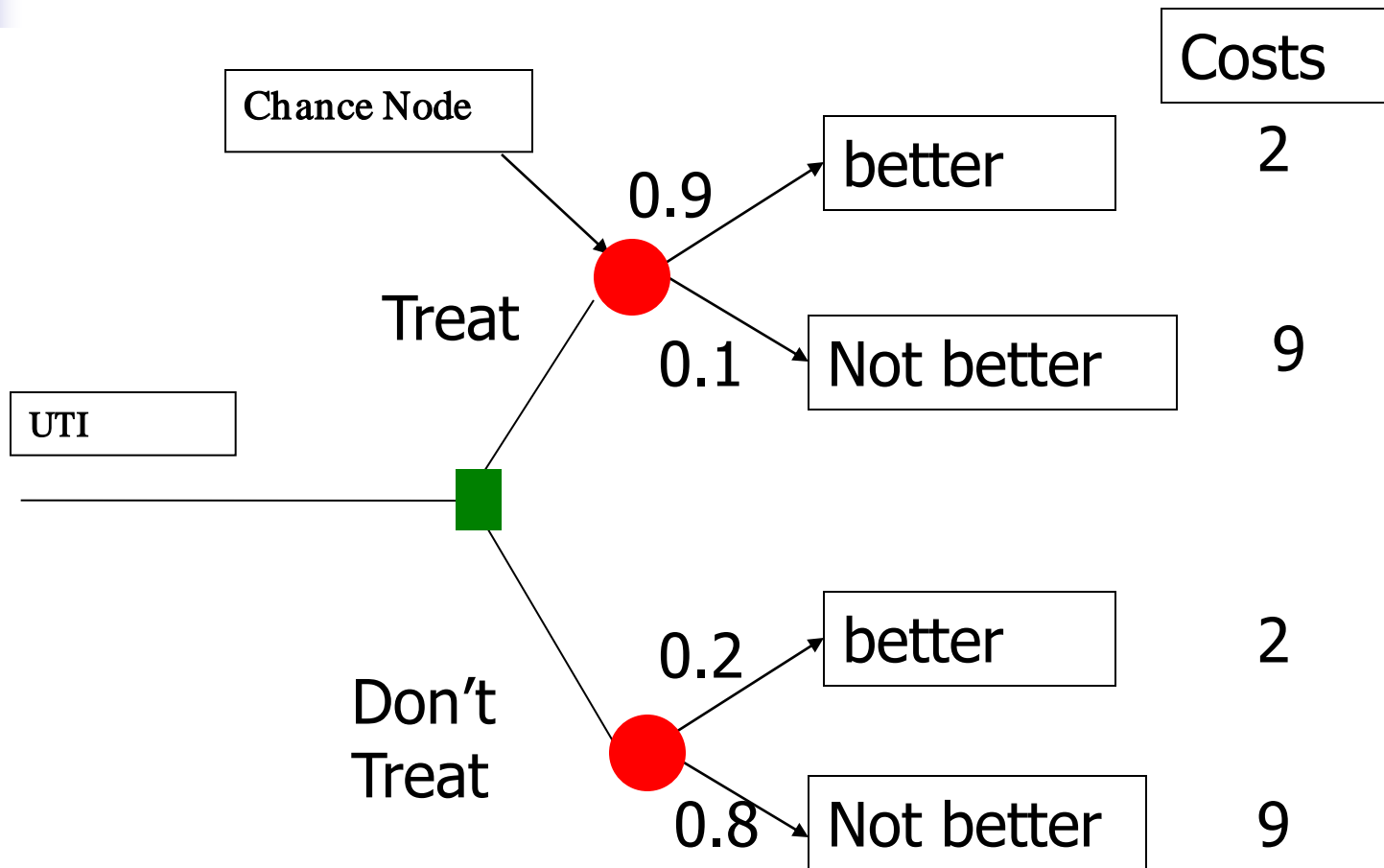


# DECISION MAKING

## Folding Back

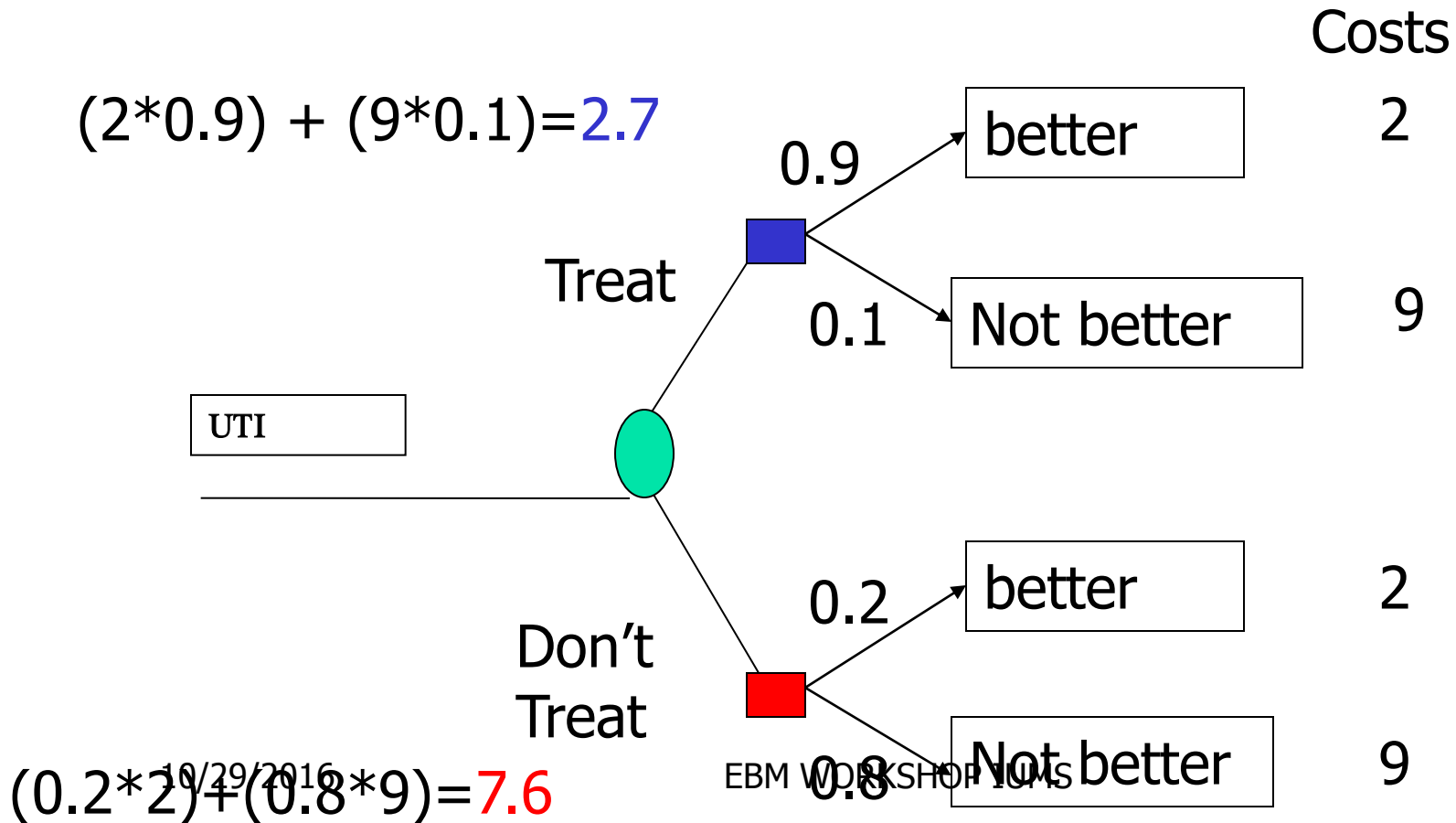


# DECISION MAKING



# DECISION MAKING

## Rollback Costs





# DECISION MAKING

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## What does the patient think?

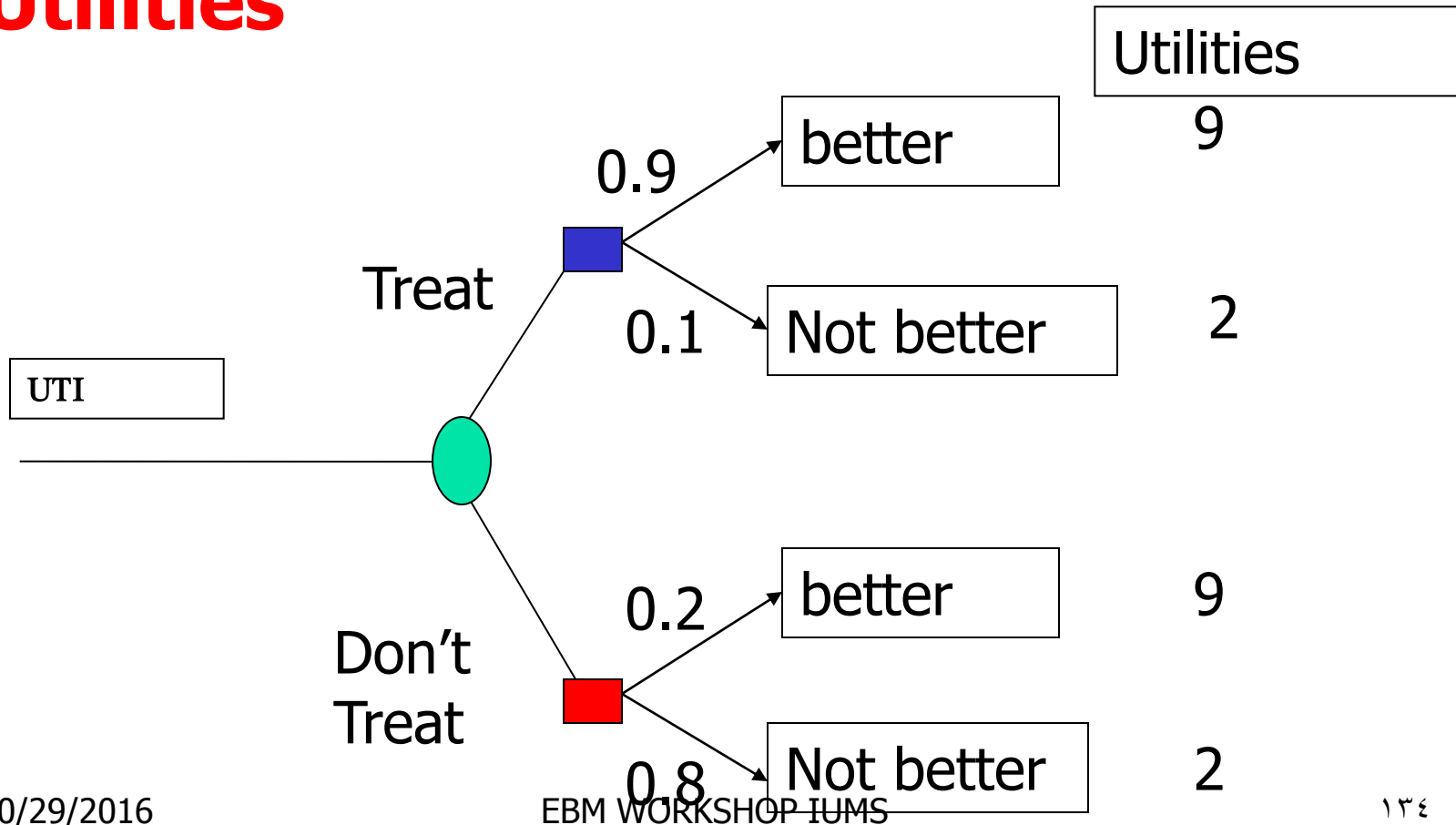
- Utilities (e.g QALYs)

## Three common methods for calculating personal utilities

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

# DECISION MAKING

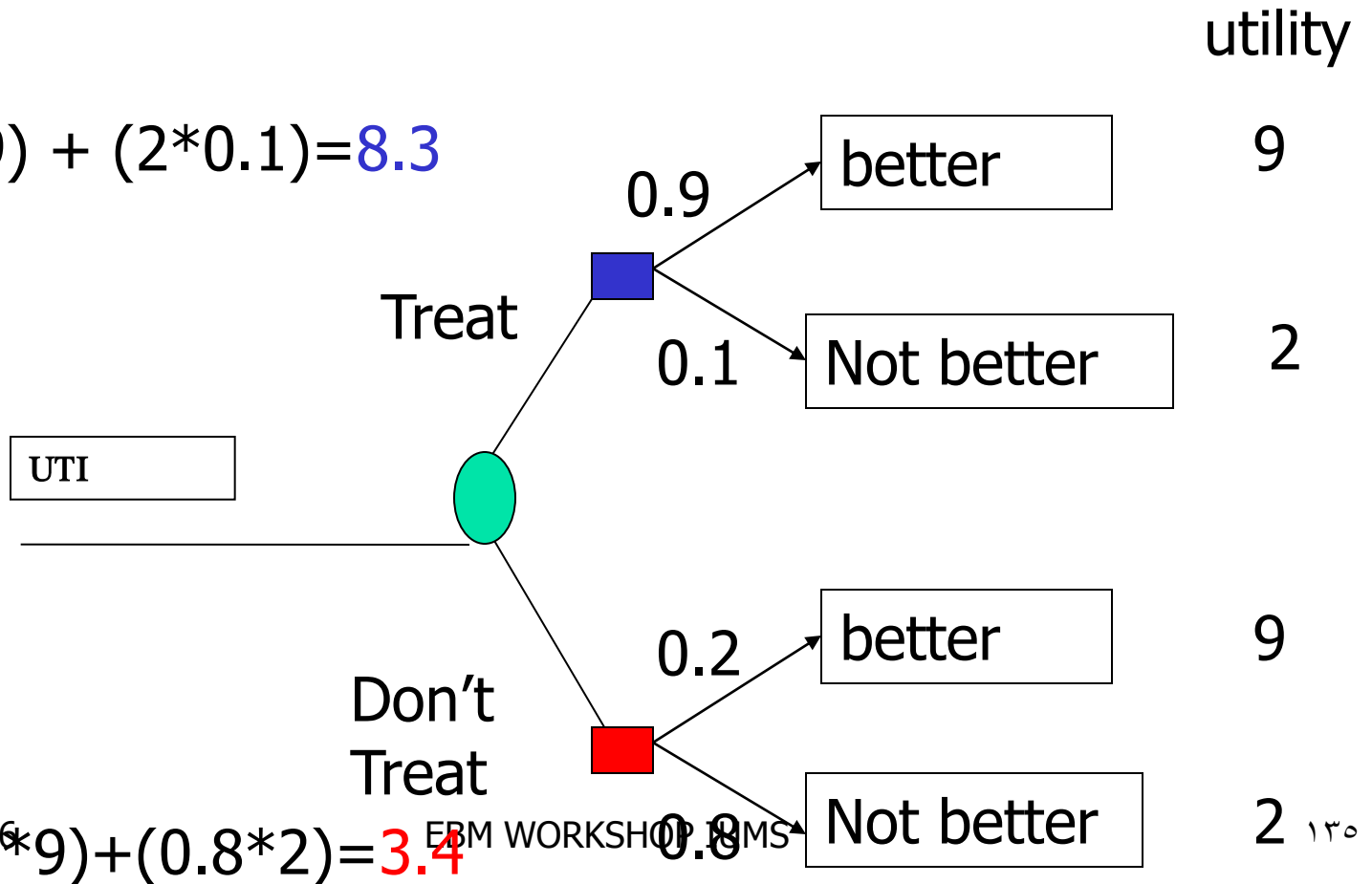
## Utilities



# DECISION MAKING

## Rollback

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





# DECISION MAKING

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## 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

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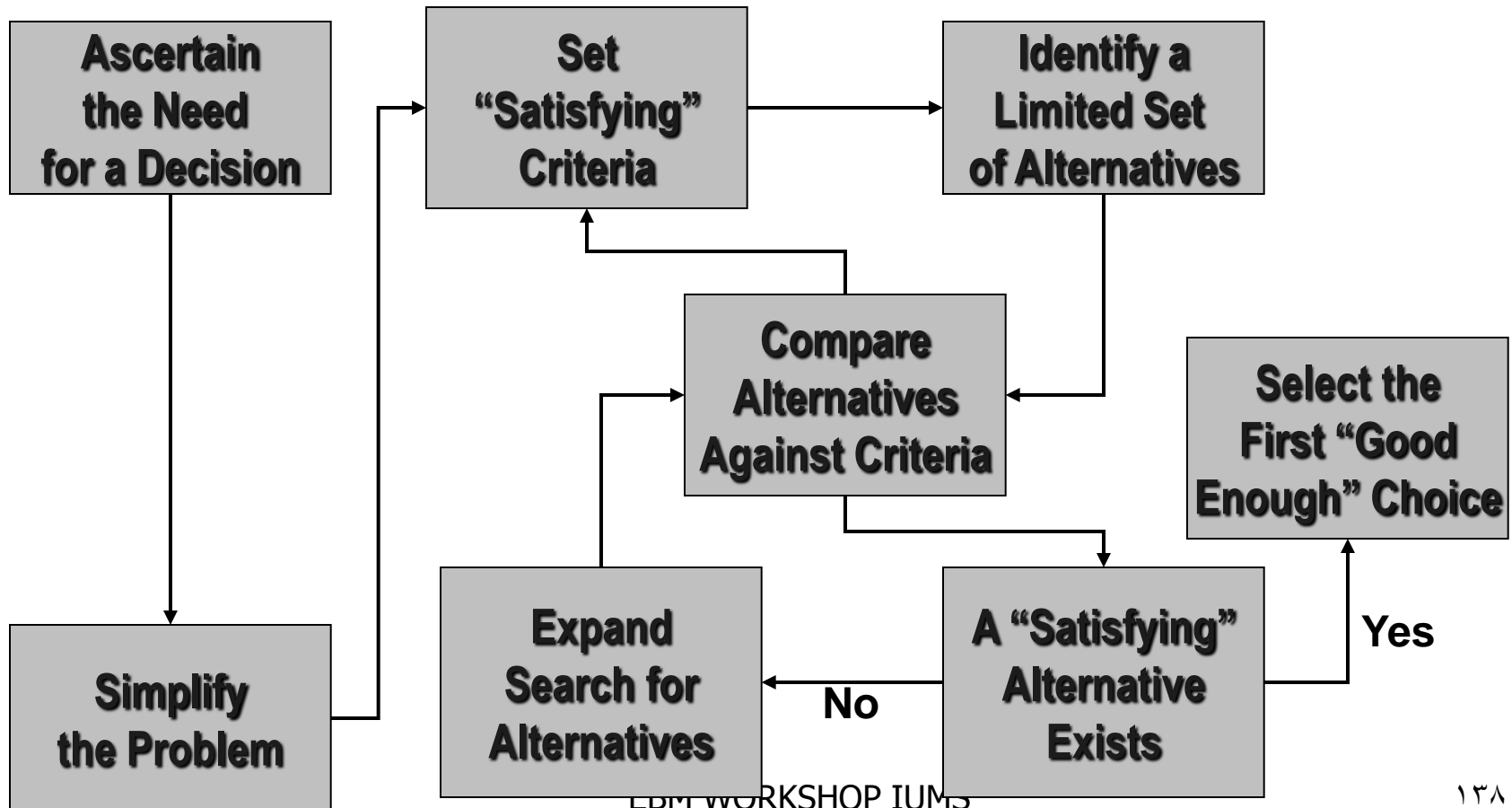
## Individual Decision Making Models

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



# DECISION MAKING

## A Model of Bounded Rationality





# DECISION MAKING

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## 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



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**Thank You!**  
**Any Question?**