

# EBM

## Evidence-Based Medicine

### Course Goals

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1. Understand basic concepts of evidence-based medicine (EBM) and how EBM facilitates optimal patient care.
2. Develop a basic understanding of how clinical research studies are designed and analyzed, and how this can influence whether a study's conclusions are valid.
3. Develop competence in the critical appraisal of common types of clinical research papers and the determination of whether the papers have drawn valid and applicable conclusions.
4. Develop competence in communicating scientific evidence to colleagues.
5. Develop competence in communicating risk and benefit of health interventions to patients.
6. Recognize the role played by physicians in population health.

# Evidence-Based Medicine

## Session Learning Objectives

### **Delivered In: Adult Ambulatory Care**

#### **Preventative Medicine Project**

1. Recognize the difference between screening and diagnostic tests
2. Review typical screening modalities for a given disease.
3. Describe how screening may influence important clinical outcomes (suffering, death).

#### **Didactics - Evidence Based Medicine**

1. Demonstrate familiarity with common biostatistics.
2. Demonstrate the ability to critically appraise literature.
3. Discuss the rationale for evidence based medicine.

### **Delivered In: Digestive, Endocrine and Metabolic Systems**

#### **EBM - Understanding and Interpreting Case Control Studies**

1. Describe characteristics of case-control studies, explain how these characteristics may result in bias, and recognize appropriate methods for minimizing these biases.
2. Discuss the strengths and limitations of case-control studies and the clinical questions best answered by this study type.
3. Recognize a population health perspective, including use of epidemiologic methods for outbreak investigation.

#### **EBM - Interpreting and Applying Results of Case Control Studies**

1. Critically appraise a case control study.

#### **EBM - Interpreting Medical Literature: Applying EBM Concepts to Problems**

1. Apply biostatistics and epidemiology concepts previously presented in Phase I to solve problems relevant to understanding and using the medical literature to inform patient care decision-making.

### **Delivered In: Evidence-Based Medicine: Online Journal Club 1**

#### **Online Journal Club 1 - Case 1**

1. Evaluate a cohort study (including design, strengths and limitations).
2. Apply concepts that relate to validity of cohort studies, including selection bias, confounding, and follow-up.
3. Explain the study's relevance to patient care and clinical decision-making (including establishment of causation vs. association, and communicating results to patients).

### **Online Journal Club 1 - Case 2**

1. Evaluate a case-control study (including design, strengths and limitations).
2. Apply concepts that relate to validity of case-control studies including confounding and recall bias.
3. Recognize appropriate methods to account for confounding.
4. Explain the study's relevance to patient care and clinical decision-making.

### **Online Journal Club 1 - Case 3**

1. Evaluate a study about therapy (including design, strengths and limitations).
2. Apply concepts that relate to the validity of randomized controlled trials including randomization, concealed allocation, intention to treat, blinding, statistical significance, and power.
3. Explain its relevance to patient care and clinical decision-making.

### **Online Journal Club 1 - Case 4**

1. Evaluate a study about screening (including design, strengths and limitations).
2. Apply concepts that relate to the validity of these studies including blinding, use of a gold standard, sensitivity, specificity, and negative and positive predictive value.
3. Explain its relevance to patient care and clinical decision-making.

## **Delivered In: Evidence-Based Medicine: Online Journal Club 2**

### **Online Journal Club 2 - Case 1**

1. Evaluate a cohort study (including design, strengths and limitations).
2. Apply concepts that relate to validity of cohort studies, including selection bias, confounding, and follow-up.
3. Explain the study's relevance to patient care and clinical decision-making (including establishment of causation vs. association, and communicating results to patients).

### **Online Journal Club 2 - Case 2**

1. Evaluate a case-control study (including design, strengths and limitations).
2. Apply concepts that relate to validity of case-control studies including confounding and recall bias.
3. Recognize appropriate methods to account for confounding.
4. Explain the study's relevance to patient care and clinical decision-making.

### **Online Journal Club 2 - Case 3**

1. Evaluate a study about therapy (including design, strengths and limitations).
2. Apply concepts that relate to the validity of randomized controlled trials including randomization, concealed allocation, intention to treat, blinding, statistical significance, and power.
3. Explain its relevance to patient care and clinical decision-making.

## **Online Journal Club 2 - Case 4**

1. Evaluate a study about screening (including design, strengths and limitations).
2. Apply concepts that relate to the validity of these studies including blinding, use of a gold standard, sensitivity, specificity, likelihood ratios, and negative and positive predictive value.
3. Explain its relevance to patient care and clinical decision-making.

## **Online Journal Club 2 - Case 5**

1. Evaluate a meta-analysis based on a systematic review.
2. Apply concepts that relate to its validity, including asking a focused clinical question, specifying inclusion criteria, comprehensiveness of literature search, quality assessment of included studies, and assessment of heterogeneity.
3. Explain its relevance to patient care and clinical decision-making.

## **Delivered In: Hospitalized Adult Care**

### **Evidence Based Medicine Project**

1. Effectively search evidence based medicine resources to obtain original primary literature.

## **Delivered In: Integrated Clinicians Course 7003**

### **EBM – Applying Biostatistics and Epidemiology Concepts to Solve Problems**

1. Apply biostatistics and epidemiology concepts previously learned in Phases I & II to solve problems relevant to understanding and using the medical literature to inform patient care decision-making.

### **EBM – Critically Appraising Randomized Control Trials**

1. Use a critical appraisal guide to appraise the validity of a trial.
2. Describe the importance of intention-to-treat analyses.
3. List the differences between various measures of treatment effect including absolute risk difference, relative risk, relative risk difference, and number needed to treat/number needed to harm (NNT/NNH).
4. Differentiate clinically relevant endpoints from surrogate endpoints in the evaluation of treatment effects.

## **Delivered In: Integrated Clinicians Course 8004**

### **Evidence Based Medicine: Applying Biostatistics and Epidemiology Concepts to Solve Problems**

1. Apply biostatistics and epidemiology concepts previously learned in Phases I & II to solve problems relevant to understanding and using the medical literature to inform patient care decision-making.

### **Evidence Based Medicine: Critically Appraising Diagnostic Studies**

1. Describe the concept of validity, as it pertains to the results of diagnostic studies.
2. Use a critical appraisal guide to appraise the validity of a diagnostic study.
3. Define, calculate and apply to patient care decisions each of the following: sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio, pre-test probability, and post-test probability.
4. Estimate post-test probabilities given a pre-test probability and a measure of accuracy (e.g., a likelihood ratio or sensitivity and specificity).

## **Delivered In: Life Cycle**

### **LC - Breast Cancer Screening: Primary Care Perspective**

1. Describe desirable attributes of screening tests.
2. Review the perils of screening tests including issues related to lead time and overdiagnosis bias.
3. Identify commonly used screening tests for breast cancer and how to optimize their use by quantifying the benefits and harms as applied to an individual patient.
4. Clarify and apply biostatistics commonly used to describe screening tests including sensitivity, specificity, predictive values, likelihood ratios, relative risk, absolute risk, risk difference, number needed to screen and number needed to harm.
5. Assess an individual patient's risk of developing breast cancer and implement an appropriate preventive regimen including screening and chemoprevention.
6. Assess an individual patient's risk of being a BRCA mutation carrier and when to refer for additional testing and counseling.
7. Summarize differences in breast cancer screening guidelines from professional societies and recognize the origins of those differences.
8. Discuss the potential impact of public health messaging on how patients and clinicians perceive benefits and harms of breast cancer screening.

## **Delivered In: Molecules to Medicine**

### **Introduction to EBM: Facts & Numbers for Patient Care**

1. Explain the value of evidence over opinion in making medical decisions and in the practice of life-long learning.
2. Define evidence-based medicine (EBM). Explain the EBM cycle of asking clinical questions, using appropriate resources to select high quality evidence, and applying evidence to individual patients.
3. Describe the evidence hierarchy.

### **EBM: Interpreting Clinical Trials 1**

1. Understand the difference between random error and bias and how these can be minimized. Define validity.
2. Describe characteristics of randomized controlled trials (RCTs) such as randomization, blinding, allocation concealment, intention-to-treat analysis (as compared with per-protocol or as-treated analyses), and follow up, and explain how these characteristics reduce bias.
3. Explain the circumstances in which it is appropriate to use risk ratios and how they are interpreted.
4. Understand type 1 and type II errors, null hypotheses, alpha level, power, p-values and confidence intervals. Accurately interpret p-values and confidence intervals in a clinical context.

## **EBM: Applying Clinical Trial Results**

1. Critically appraise an RCT.
2. Explain the difference between statistical significance and clinical significance.
3. Calculate and apply risk ratios and absolute risk. Explain the circumstances in which they are appropriate to use and how they are interpreted.
4. Calculate number needed to treat/harm (NNT/H), absolute risk reduction and relative risk reduction. Differentiate between disease-oriented outcomes and patient-oriented outcomes.
5. Describe barriers to understanding evidence and explain appropriate techniques for communicating numeric and other information to patients.
6. Identify and use summary sources, practice guidelines, pre-appraised sources, and sources of individual studies.

## **EBM: Observational Study Basics**

1. Recognize differences in study design for both observational and experimental studies.
2. Explain how characteristics of observational studies may result in bias.

## **EBM: Finding Disease 1**

1. Describe characteristics of a screening test.
2. Calculate and apply common diagnostic/ screening test information including sensitivity, specificity and predictive values.

## **EBM: Interpreting Observational Studies**

1. Define epidemiologic concepts of incidence, mortality, case fatality and prevalence.
2. Recognize differences in study design for cohort studies and randomized controlled trials. Discuss the strengths and limitations of each and the clinical questions best answered by each study type.
3. Define criteria for inferring causality from statistical associations and apply to an example.
4. Describe characteristics of cohort studies, explain how these characteristics may result in bias, and recognize appropriate methods for minimizing these biases. Critically appraise cohort study.

## **EBM: Interpreting Statistics**

1. Define statistical measures commonly used in the medical literature, including sampling, normal distribution, mean, median, mode, variance, standard deviation, and range.
2. Recognize statistical methods commonly used in the medical literature, including t-test, Chi-square test, Correlation, Multivariate analysis, ANOVA, linear regression, logistic regression, survival analysis, Kaplan-Meier curve, Cox proportional hazards model. Understand how to interpret their results.

## **EBM: Finding Disease 2**

1. Describe characteristics of cross-sectional studies, explain how these characteristics may result in bias, and recognize appropriate methods for minimizing these biases.
2. Discuss the strengths and limitations of cross-sectional studies and the clinical questions best answered by this study type.
3. Explain the difference between risk and odds. Calculate an odds ratio. Explain the circumstances in which each is appropriate to use and how each is interpreted.
4. Calculate and apply common diagnostic/screening test information including sensitivity, specificity, and predictive values. Describe how predictive values are influenced by disease prevalence.
5. Explain appropriate techniques for communicating numeric and other information from screening and diagnostic studies to colleagues and patients.

## **EBM: Best Evidence = Systematic Reviews**

1. Distinguish between narrative review articles, systematic reviews, and meta-analysis and understand issues in using them such as publication bias, forest plots, and heterogeneity.
2. Evaluate a meta-analysis and apply concepts that relate to its validity, including asking a focused clinical question, specifying inclusion criteria, comprehensiveness of literature search, quality assessment of included studies, and assessment of heterogeneity. Explain its relevance to patient care and clinical decision-making.

## **EBM: Interpreting Clinical Trials 2**

1. Evaluate a study about therapy. Apply concepts that relate to validity of RCTs including randomization, concealed allocation, intention-to-treat, and blinding.

## **EBM Small Group (Required): Using Medical Literature for Patient Care**

1. Evaluate a cohort study. Apply concepts that relate to validity of cohort studies, including selection bias, selection of comparison group, exposure measurement, confounding, and loss to follow-up. Explain its relevance to patient care and clinical decision-making.
2. Define criteria for inferring causality from statistical associations including Hill criteria and apply to an example.
3. Explain the difference between statistical significance and clinical significance. Understand p-values and confidence intervals. Accurately interpret p-values and confidence intervals in a clinical context.
4. Recognize statistical methods commonly used in the medical literature, including t-tests and chi-square tests, correlation, ANOVA, logistic regression, linear regression, survival analysis/Cox proportional hazards model, Kaplan-Meier curve, forest plot. Understand how to interpret their results.
5. Evaluate a study about therapy. Apply concepts that relate to validity of RCTs including randomization, concealed allocation, intention-to-treat, blinding, significance, and power. Explain its relevance to patient care and clinical decision-making.
6. Calculate number needed to treat/harm (NNT/H). Explain how it can be used to communicate risk to patients.
7. Describe barriers to understanding evidence and explain appropriate techniques for communicating numeric and other information to colleagues and patients.