DECIDE

Introduction to Health Interventions, Policy and Services

Decision-making, Decision Sciences and Evidence-Based Decision-Making

Luís Filipe Azevedo

lazevedo@med.up.pt

Summary

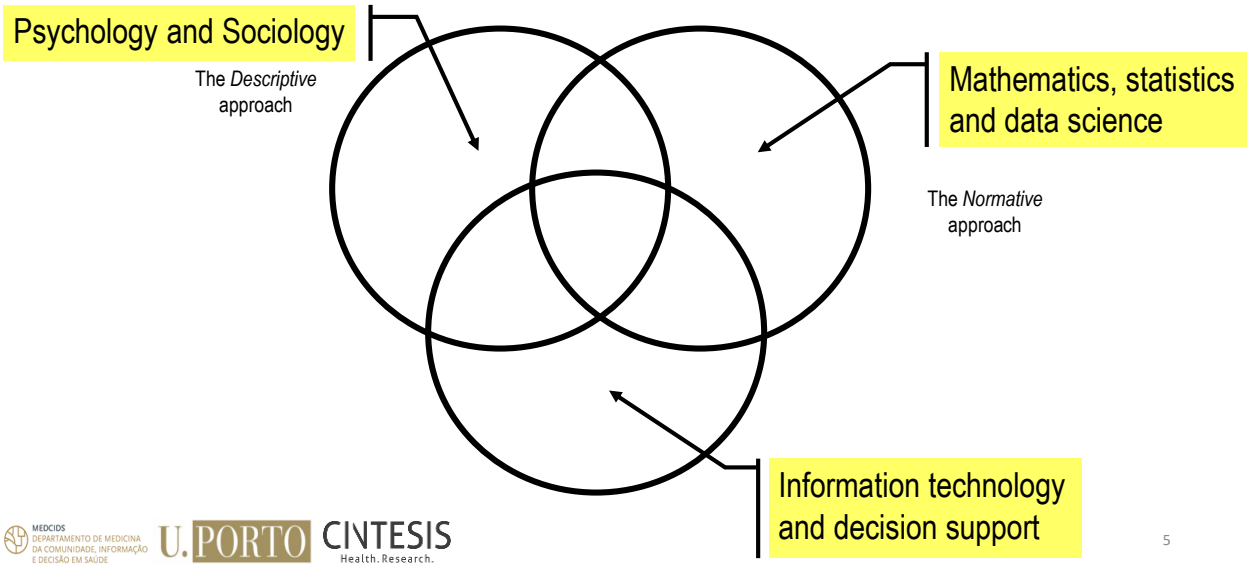
- Decision-making, decision sciences and decision analysis
- The evolution of medicine and evidence-based medicine
- The evidence-based approach
- Translating research into practice and practice into research

Decision-making, Decision Sciences and Decision Analysis

Decision Making

- Life involves making **decisions**!
  - Decision makers require guidelines and expert support
- Most important decisions involve
  - multiple **uncertainties** and **complexities**
  - multiple **outcomes**, which can often be evaluated using multiple **attributes/criteria**
  - Multiple decision-making **stages** and **long time delays** between action and reaction
  - Need **information gathering** and **analysis** at every stage
  - **Multiple decision makers** and **stakeholders** and **conflicting objectives** and **timings**
- Examples in everyday life include business, government policy, medicine, law, and personal decisions

The disciplines of decision making



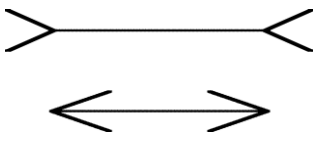
Bounded rationality / prospect theory

System 1

- Fast, intuitive, associative
- Initial reactions swift and appropriate
- Generally very good
- Short term predictions accurate
- Uses heuristics
- Often affected by systematic biases
- Doesn't understand logic and statistics
- Cannot be turned off

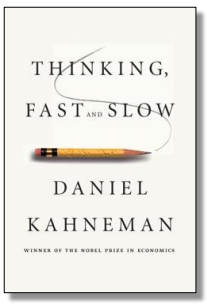
System 2

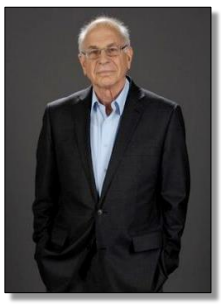
- Slow (lazy)
- Deliberate, self control
- Reasoning & rationality
- Cognitive effort, hard work
- Ego depletion



System 2 (I) knows they are the same length

System 1 still sees the top line longer





Daniel Kahneman

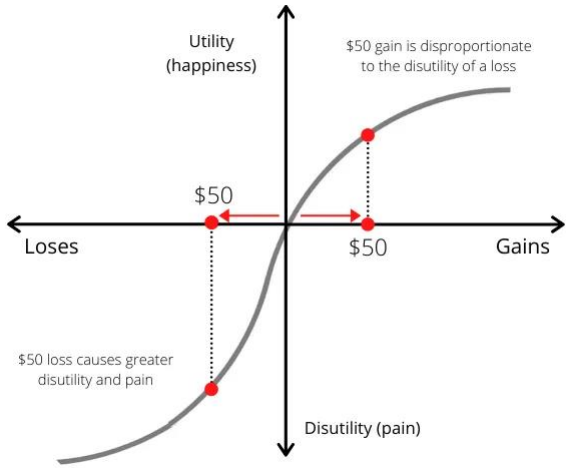
With Amos Tversky and others, Kahneman established a **cognitive basis for common human errors that arise from heuristics and biases** (Kahneman & Tversky, 1973; Kahneman, Slovic & Tversky, 1982; Tversky & Kahneman, 1974), and **developed the prospect theory** (Kahneman & Tversky, 1979).

The principle of "*bounded rationality*"

"The capacity of the human mind for formulating and solving complex problems is very small compared to the size of those problems whose solution is required for objectively rational behavior in the real world or even for a reasonable approximation to such objectivity."

Simon, H.A. (1957). **Administrative Behavior: A study of decision making processes in administrative organizations**, 4th ed. New York: The Free Press.

Prospect Theory – Kahneman & Tversky



Prospect theory assumes that **losses and gains are valued differently**, and thus **individuals make decisions based on perceived gains instead of perceived losses**. Also known as the **"loss-aversion" theory**, the general concept is that if two choices are put before an individual, both equal, **with one presented in terms of potential gains and the other in terms of possible losses, the former option will be chosen**.

There are 3 main factors that influence decision making in prospect theory:

- **Certainty**
  In prospect theory, there are two types of certainty. The first is the certainty of gain, and the second is the certainty of loss.
- **Isolation Effect**
  In prospect theory, the isolation effect occurs when people focus on differences between options rather than similarities. This is to reduce the cognitive strain placed on our brains and simplify the decision-making process.
- **Loss Aversion**
  In prospect theory, loss aversion is where an individual's fear of losses is greater than their joy of gains. In other words, people prefer to minimise losses than maximise gains.

Biases

- Judgment is plagued by random error and systematic biases.
- Appropriate analysis and good judgment often requires mental skills exceeding our capabilities.
  - Capacity of the mind is small relative to the size of the problems.
  - Heuristics and rules of thumb are used to cope with problem complexity.

Good news

➔ This allows us to deal with the real world.

Bad news

➔ This often leads to faulty data acquisition, processing and analysis.

Heuristics and cognitive biases in decision making

Availability	Judgments distorted by easily recalled events
Selective perception	Expectations bias observations
Illusory correlation	Encourages belief that unrelated variables are correlated
Conservatism	Ignoring full effect of new information
Law of small numbers	Overestimating representativeness of small groups
Regression bias	Failure to allow for regression to the mean
Wishful thinking	Probability of desired events judged too highly
Illusion of control	Overestimating personal control over outcomes
Logical reconstruction	"Logical" reconstruction of inaccurately recalled events
Hindsight bias	Overestimation of predictability of past events

Antidotes to counteract cognitive biases

Bias	Antidote
Under-estimating uncertainty	1. Use frameworks for strategic analysis 2. Use multiple perspectives 3. Devil's advocate 4. Consider improbable or unpopular assumptions 5. Re-evaluate over time
Believing chance is predictable	1. Use frameworks for strategic analysis 2. Devil's advocate 3. Consider improbable or unpopular assumptions 4. Re-evaluate over time
Selective perception	1. Use frameworks for strategic analysis 2. Use multiple perspectives 3. Devil's advocate 4. Consider improbable or unpopular assumptions
Anchoring and adjustment	1. Use multiple perspectives 2. Devil's advocate 3. Consider improbable or unpopular assumptions 4. Re-evaluate over time
Seeing opportunities incrementally	1. Use frameworks for strategic analysis 2. Use multiple perspectives 3. Consider improbable or unpopular assumptions
Seeking only confirming evidence	1. Use frameworks for strategic analysis 2. Use multiple perspectives 3. Devil's advocate 4. Consider improbable or unpopular assumptions 5. Re-evaluate over time
Framing biases	1. Use multiple perspectives 2. Devil's advocate 3. Re-evaluate over time
Reasoning by inappropriate analysis	1. Use multiple perspectives 2. Devil's advocate 3. Re-evaluate over time
Escalating commitment irrationally	1. Use frameworks for strategic analysis 2. Use multiple perspectives 3. Devil's advocate 4. Consider improbable or unpopular assumptions 5. Re-evaluate over time

Teisberg, E.O. (1991). "Why do good managers choose poor strategies?" *Harvard Business School Case* 9-391-172.

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health. Research.

HEADS PHD PROGRAMME IN HEALTH DATA SCIENCE

The anatomy of a decision

The "rational" approach to decision making

1. Define the problem.
2. Identify the criteria.
3. Weight the criteria.
4. Generate alternatives.
5. Rate each alternative on each criterion.
6. Compute the optimal decision.

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health. Research.

HEADS PHD PROGRAMME IN HEALTH DATA SCIENCE

Decision Analysis

- Requires **modeling** the decision
  - Several effective graphical modeling methods
- Provides tools for **quantitative analysis** of decisions with multiple uncertainties and/or conflicting objectives
- Provides decision makers with **insight**, not necessarily a solution
  - Example: Multi-way **sensitivity analysis**
- Benefits from using **computational** tools

Decision Models

- **Normative models**
  - **Decision Trees**
  - **Influence Diagrams**
  - **Bayesian/Belief Networks**
  - **(Markov Chains)**
- **Descriptive models**
  - **Fallacies and biases in human decision making and judgment**
  - **Prospect theory (Tversky and Kahnemann)**

CROSSING THE QUALITY CHASM:
A NEW HEALTH SYSTEM FOR THE 21ST CENTURY

1. *Care is based on continuous healing relationships.* Patients should receive care whenever they need it and in many forms, not just face-to-face visits. This implies that the health care system must be responsive at all times, and access to care should be provided over the Internet, by telephone, and by other means in addition to in-person visits.
2. *Care is customized according to patient needs and values.* The system should be designed to meet the most common types of needs, but should have the capability to respond to individual patient choices and preferences.
3. *The patient is the source of control.* Patients should be given the necessary information and opportunity to exercise the degree of control they choose over health care decisions that affect them. The system should be able to accommodate differences in patient preferences and encourage shared decision making.
4. *Knowledge is shared and information flows freely.* Patients should have unfettered access to their own medical information and to clinical knowledge. Clinicians and patients should communicate effectively and share information.
5. *Decision making is evidence-based.* Patients should receive care based on the best available scientific knowledge. Care should not vary illogically from clinician to clinician or from place to place.
6. *Safety is a system property.* Patients should be safe from injury caused by the care system. Reducing risk and ensuring safety require greater attention to systems that help prevent and mitigate errors.
7. *Transparency is necessary.* The system should make available to patients and their families information that enables them to make informed decisions when selecting a health plan, hospital, or clinical practice, or when choosing among alternative treatments. This should include information describing the system's performance on safety, evidence-based practice, and patient satisfaction.
8. *Needs are anticipated.* The system should anticipate patient needs, rather than simply react to events.
9. *Waste is continuously decreased.* The system should not waste resources or patient time.
10. *Cooperation among clinicians is a priority.* Clinicians and institutions should actively collaborate and communicate to ensure an appropriate exchange of information and coordination of care.

CROSSING THE QUALITY CHASM:
A NEW HEALTH SYSTEM FOR THE 21ST CENTURY

INSTITUTE OF MEDICINE
www.iom.edu. Shaping the Future for Health

The evolution of medicine and evidence-based decision-making (EBDM)

Evolution of Evidence-based Medicine

- **18th, 19th and early 20th century**
  - German, French and UK schools establish the biomedical model as the gold standard of medical training and the Flexner Report led to dominance of biomedical model of medical care in North America
- **Mid-Late 20th Century**
  - Rapid growth in biomedical science and new technologies
  - Physicians primary decision makers
    - Lack of coherent synthesis of knowledge enables practice variation (Wennberg)
  - Emergence of Evidence-based Medicine
  - Appearance of Practice Guidelines and Performance Metrics
    - Consensus-based (Professional Societies)
    - Evidence-based (USPSTF, AHCPR, ACP)
    - The National Committee for Quality Assurance (NCQA) (e.g., HEDIS), Pay-for-Performance

End of 20th Century: Health Care Costs Explode

- Birth and rise of Health Technology Assessment agencies in Europe
- Australia and Ontario introduce Cost Effectiveness as a criterion in formulary decisions
- UK establishes NICE
  - Employs EBM and cost effectiveness to ensure rational access to new treatments
  - Increases credibility of these processes
  - Recommends, but does not enforce implementation
- In the US we see the rise of Managed Care and Consolidation of Payers
  - Treatment Guidelines, Preferred Drug Lists/Formularies

Evidence-Based Decision Making

1991 Medicine

1998 Education

2000 Social care, public policy

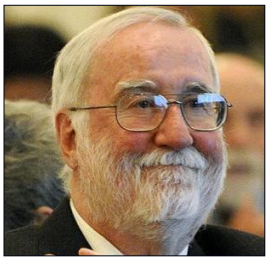
Nursing, Criminal justice,

Policing, Architecture, Conservation

2010 Management

The Evidence-Based Approach

What is Evidence-Based Medicine?



David Sackett

Gordon Guyatt

McMaster University Medical School, Canada

"Evidence Based Medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients"

"Evidence-based medicine is the integration of best research evidence with clinical expertise and patient values"

Sackett DL, Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS: **Evidence based medicine: what it is and what it isn't**. BMJ 1996;312:71-2.

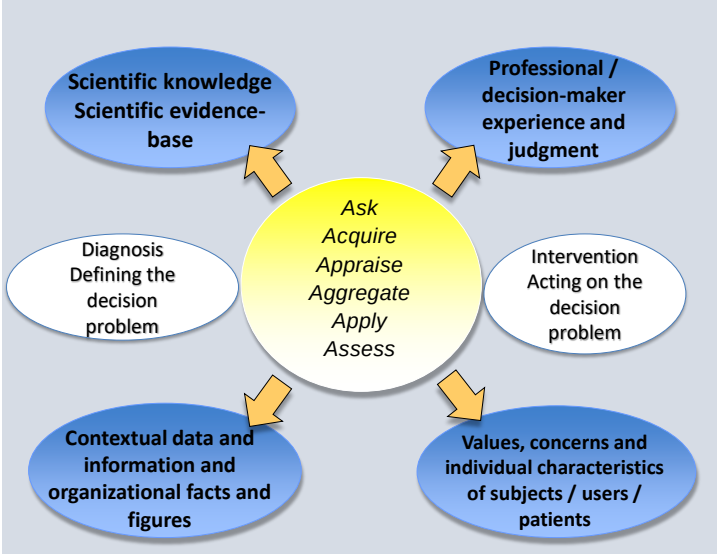
HEADS

Evidence-based . . . .

- **Evidence-based Medicine (EBM)**
  - Patient care based on evidence from the best available studies
- **Evidence-based Decision-Making (EBDM)**
  - EBM extended to include not only patient care, but also healthcare management and policy, public health and population-based decision-making using formal evidence criteria and deliberative processes
  - Adequately integrated with the paradigms and principles of **Person-Centered Decision-Making**, **Shared Decision-Making** and **Personalized Medicine**

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health.Research.

Evidence-based decision-making



6 steps of Evidence-based decision-making

1. ***Ask***: *translate a practical issue into an answerable question*
2. ***Acquire***: *systematically search and retrieve the scientific evidence*
3. ***Appraise***: *critically judge the trustworthiness of the evidence*
    1. **Relevance**
    2. **Validity**
    3. **Impact**
    4. **Applicability**
4. ***Aggregate***: *adequately analyze and synthesize the evidence base*
5. ***Apply***: *incorporate the evidence into the decision-making process*
6. ***Assess***: *evaluate the outcome of the decision taken and improve*

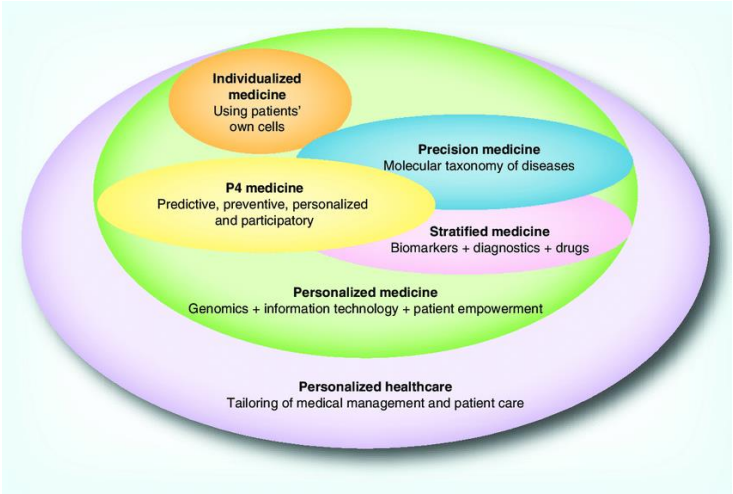
Person-Centered Decision-Making

Catalyst, N. E. J. M. (2017). What is patient-centered care?. NEJM Catalyst, 3(1).

Shared Decision-Making

Agency for Healthcare Research and Quality. The SHARE Approach (2018) August 2018. https://www.ahrq.gov/health-literacy/curriculum-tools/shareddecisionmaking/index.html

Personalized Medicine / Precision Medicine



Personalized medicine is defined as a model for medicine that is **customized based on the individual patient's characteristics (genetic, biological, physical, clinical, psychological, social, economic, etc.). All aspects of care can be personalized** including medical decisions, treatments, practices, products or services used.

- Cirillo, D., & Valencia, A. (2019). Big data analytics for personalized medicine. Current opinion in biotechnology, 58, 161-167.
- Pokorska-Bocci A, Stewart A, Sagoo GS, Hall A, Kroese M, Burton H. 'Personalized medicine': what's in a name? Per Med. 2014 Mar;11(2):197-210. doi: 10.2217/pme.13.107. PMID: 29751382.

Why do we need Evidence-Based Decision-Making?

One of many clarifying examples…

In the early 1980s newly introduced antiarrhythmics were found to be highly successful at suppressing arrhythmias. Arrhythmias are one of the more important complications in myocardial infarction (MI) patients.

Not until a RCT was performed was it realized that, although these drugs suppressed arrhythmias, they actually increased mortality in MI patients.

The **Cardiac Arrhythmia Suppression Trial (CAST)** was a double-blind, randomized, controlled study designed to test the hypothesis that suppression of premature ventricular complexes (PVC) with class I antiarrhythmic agents after a myocardial infarction (MI) would reduce mortality. It was conducted between 1986 and 1989 and included over 1700 patients in 27 centres. The study found that the tested drugs increased mortality instead of lowering it as was expected. The publication of these results in 1991/92, in combination with large follow-up studies for drugs that had not been tested in CAST, led to a paradigm shift in the treatment of MI patients. Class I and III antiarrhythmics are now only used with extreme caution after MI, or they are contraindicated completely.

The CAST trial revealed Excess mortality of 56/1000.

By the time the results of this trial were published, at least 100,000 such patients had been taking these drugs.

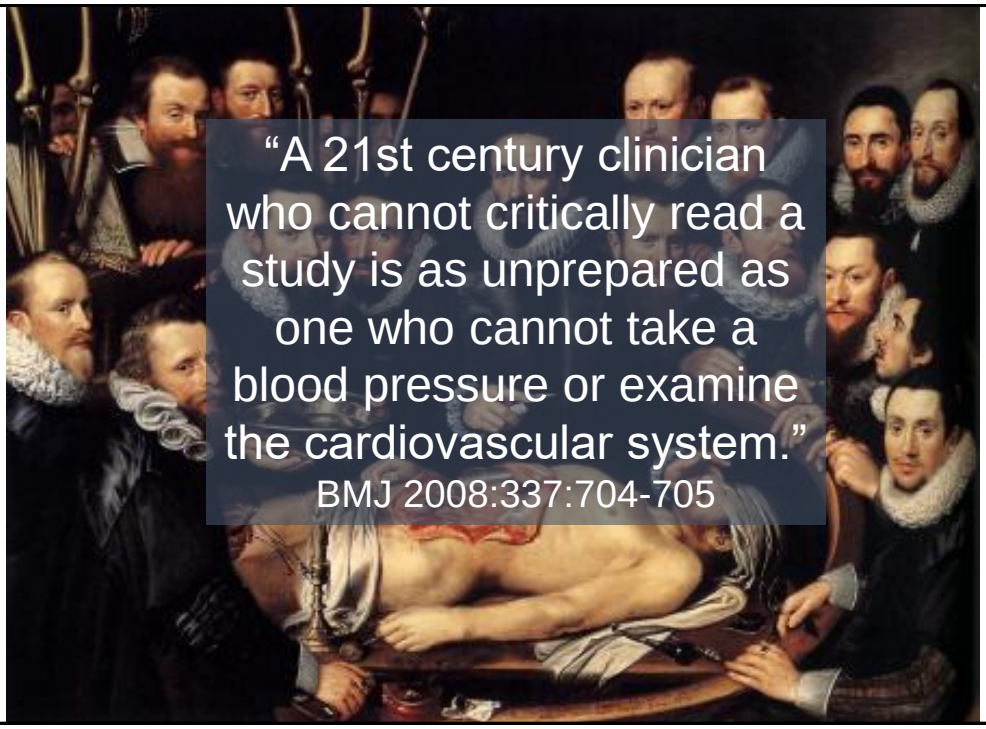
1. "Preliminary Report: Effect of Encainide and Flecainide on Mortality in a Randomized Trial of Arrhythmia Suppression after Myocardial Infarction". New England Journal of Medicine. 321 (6): 406–412. 1989. doi:10.1056/NEJM198908103210629. PMID 2473403.
2. Echt, D. S.; Liebson, P. R.; Mitchell, L. B.; Peters, R. W.; Obias-Manno, D.; Barker, A. H.; Arensberg, D.; Baker, A.; Friedman, L.; Greene, H. L.; Huther, M. L.; Richardson, D. W. (1991). "Mortality and Morbidity in Patients Receiving Encainide, Flecainide, or Placebo". New England Journal of Medicine. 324 (12): 781–788. doi:10.1056/NEJM199103213241201. PMID 1900101.

about 1/2 of 'valid' evidence today is out of date in 5 years

about 1/2 of valid evidence is not implemented

"...and, as you go out into the world, I predict that you will, gradually and imperceptibly, forget all you ever learned at this university."

ScienceCartoonsPlus.com



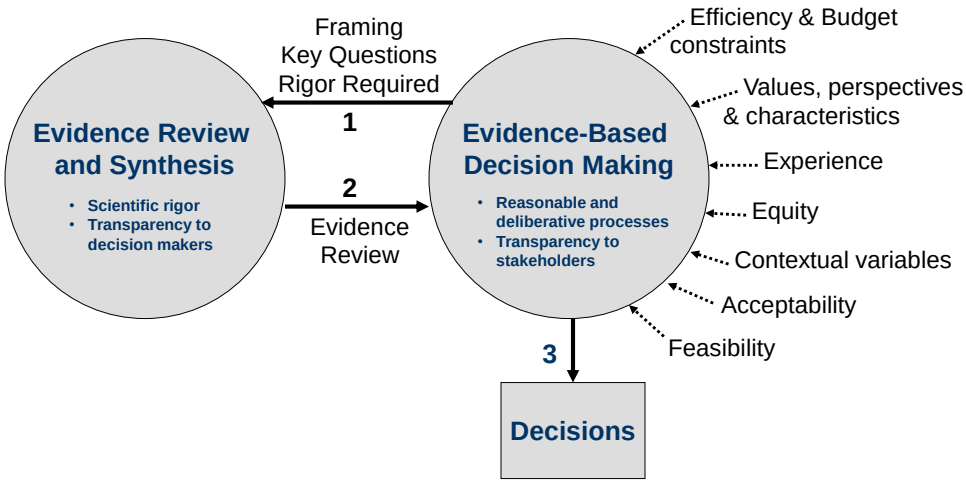
HEADS

Goals of Explicit, Evidence-based Approach

- **Credibility**
- **Transparency**
  - People can understand what you did
- **Systematic**
- **Reproducibility, limit bias**
  - Different people would get same result
- **Identify gaps in evidence**
  - Highlight where we need better evidence
- **Reduce the chance of "getting it wrong"**

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health.Research.

Dynamic Relationship Between Evidence Review & Synthesis and Evidence-based Decision Making



Adapted from: Teutsch S, Berger M, Evidence Synthesis and Evidence-based Decision Making: Related But Distinct Processes.Medical Decision Making 2005;25:487-9.

HEADS

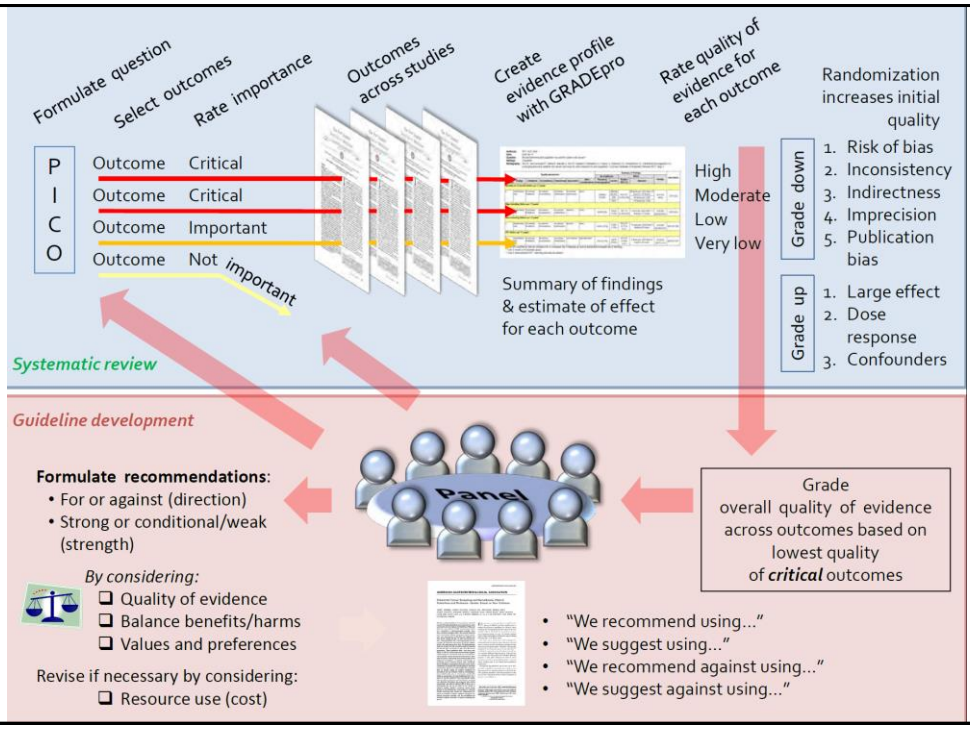
GRADE

Grading of **R**ecommendations **A**ssessment, **D**evelopment and **E**valuation

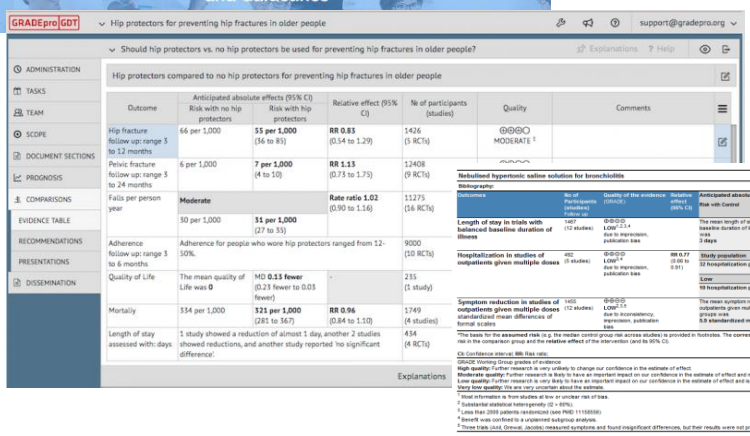
- System (and common language) that
  - was developed and updated by GRADE Working Group
  - has been endorsed by large number of organisations
  - expresses degree of confidence one can place in **quality of evidence** and **strength of recommendation**
- System for assessing quality of evidence of a body of evidence based on
  - study design
  - criteria for downgrading/upgrading

- GRADE Handbook: https://gdt.gradepro.org/app/handbook/handbook.html
- Atkins D, Best D, Briss PA, et al. Grading quality of evidence and strength of recommendations. BMJ. 2004;328:1490–1494.
- Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336:924–926.

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health.Research.



https://gradepro.org/



Integrating Evidence into Practice and Research that Informs Real-World Practice

HEADS

If we want **more evidence-based practice**, we **need more practice-based evidence**.

Larry Green (www.lgreen.net)

Efficacy vs. Effectiveness

Clinical Trials	Clinical Practice
Efficacy	Effectiveness
Single diagnosis	High-risk patients with co-morbid conditions
Drug vs. placebo	Multiple drug choices and alternatives
Exclusions of user groups e.g., elderly	Use is generally unlimited
Clinical endpoints, biomarkers	Death, disability, QoL
Genetics/biology	Sociology/psychology
"Artificial" settings	**Real world clinics**

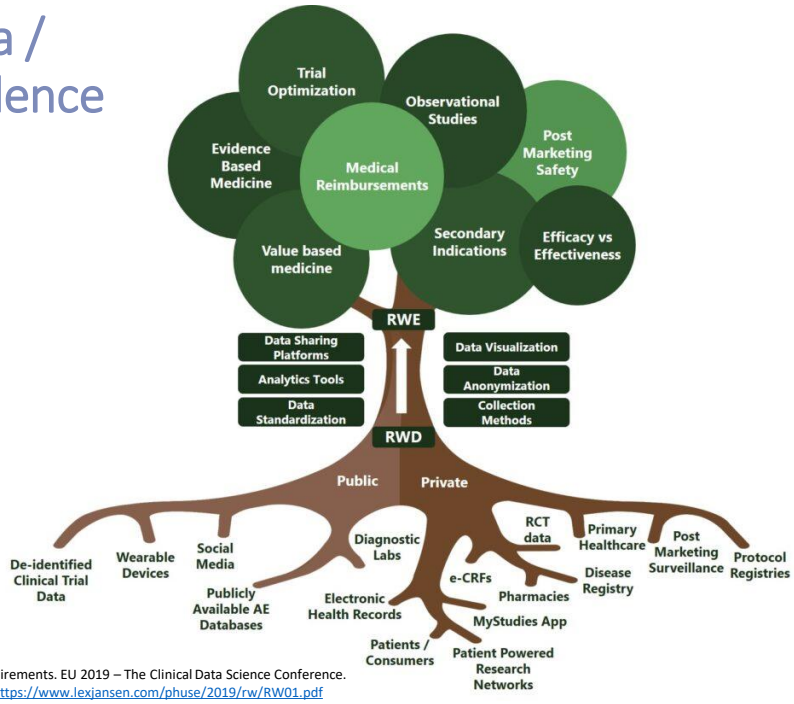
HEADS

Integration of Evidence-Based Processes into Practice

- Efficacy vs. Effectiveness
- Decision oriented
- Post-marketing surveillance
- Quasi-experimental methods
- Learning networks (voluntary, self-organizing)
- Rapid cycle from problem identification to hypothesis testing
- Integration of evidence into practice
- Quality improvement and measurement

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health.Research.

Real World Data / Real World Evidence



Utilizing RWD and RWE: An Introduction to Core Concepts and Requirements. EU 2019 – The Clinical Data Science Conference. 10-13 November 2019, Amsterdam, The Netherlands. Available at https://www.lexjansen.com/phuse/2019/rw/RW01.pdf

HEADS

Translating Research into Practice and Policymaking:

The GRADE Evidence to Decision (EtD) framework

- Building on the **GRADE approach** to make judgments about the strength of recommendations, the **DECIDE project** [https://www.decide-collaboration.eu] developed **Evidence to Decision (EtD) frameworks** for different types of healthcare decisions, including:
  - **Clinical recommendations**
  - **Coverage decisions**
  - **Health system or public health recommendations and decisions**

Interactive Evidence to Decision Framework – Example Frameworks: https://ietd.epistemonikos.org/#/list/examples

Alonso-Coello, Pablo, et al. "**GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction.**" bmj 353 (2016): i2016.
Alonso-Coello, Pablo, et al. "**GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines.**" bmj 353 (2016): i2089.
Moberg, Jenny, et al. "**The GRADE Evidence to Decision (EtD) framework for health system and public health decisions.**" Health research policy and systems 16.1 (2018): 45.

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE U.PORTO CINTESIS Health.Research.

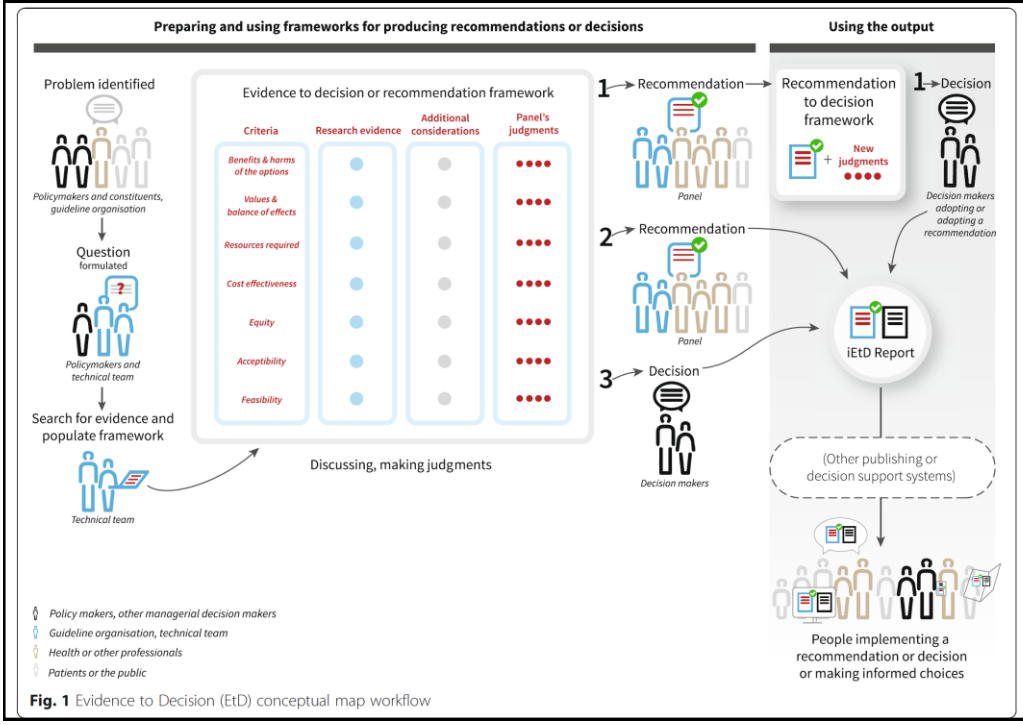
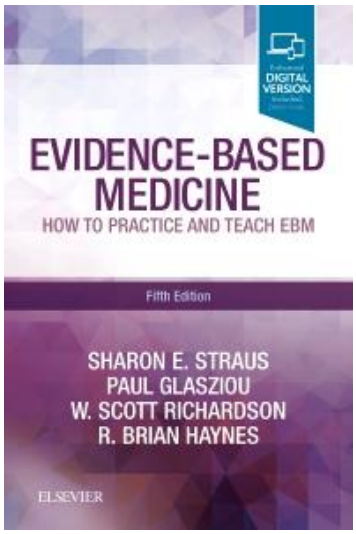


Fig. 1 Evidence to Decision (EtD) conceptual map workflow

Moberg, Jenny, et al. "**The GRADE Evidence to Decision (EtD) framework for health system and public health decisions.**" Health research policy and systems 16.1 (2018): 45.

Recommended readings

HEADS



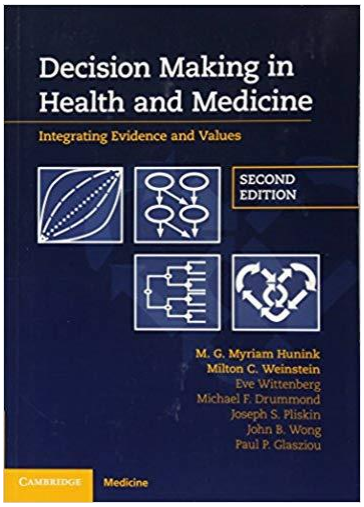
Straus SE, Glasziou P, Richardson WS, & Haynes RB.

Evidence-Based Medicine: How to Practice and Teach It (5th Edition).

Edinburgh: Elsevier, Ltd., 2019.

MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE
U.PORTO
CINTESIS Health.Research.

Recommended readings

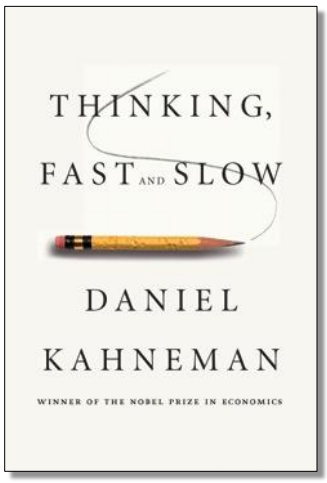


Hunink MGM, Glasziou, P, Siegel, J, Weeks, J, Pliskin. J, Elstein, A & Weinstein, M.

Decision making in health and medicine: integrating evidence and values.(2nd ed).

Cambridge ; New York: Cambridge University Press, 2014.

Complemmentary readings

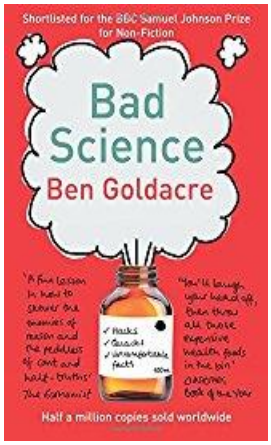


Kahneman, D. (2011).

Thinking, fast and slow.

New York: Farrar, Straus and Giroux.

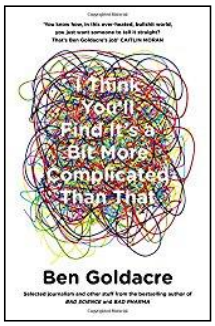
Complemmentary readings



Bad Science

Ben Goldacre
Harper Perennial 2009

And others from the same author…



MEDCIDS DEPARTAMENTO DE MEDICINA DA COMUNIDADE, INFORMAÇÃO E DECISÃO EM SAÚDE · U.PORTO · CINTESIS Health. Research.

Questions?