‘Errors may lurk in our best theories. It is the responsibility of the professional to search for these errors’ – Sir Karl Popper (1902 – 2001)
Discussing and questioning the fundamental concepts, principles and methods is relevant to medicine and medical education.
A helpful way to do this:

- Exploiting interfaces:
  1. Within the profession (Intra-disciplinary and interdisciplinary)
  2. With other professions (Mathematics, Philosophy, Computer science, engineering etc.)
Exploiting interfaces

Collaborating at the interface

Additive effect

Understanding the interface

Multiplying effect
Consuming research evidence: Extremes in the clinician’s reaction

- Pig-headed conservatism
- Naive gullibility
Crucial limiting factors

- Information overload
- Limited resources
The volume of research information
Epidemic proportions of Systematic Reviews and Meta-analysis in PubMed
This means:

- 24,358,442 citations in 2016 in Medline
- >450,000 / week
- 67,000 / day
- Growing by 7% / year
- Doubling every 10 years
- To read all the articles published in a day one would require > 2.5 years of continuous reading without sleeping
Usefulness of Currently Produced Meta-analyses

(ioannidis, JPA: Milbank Quarterly Sept. ‘16)
Other interesting statistics:

- Number of facts one can learn and retain – 9 facts per hour
- When confronted with a problem one can only evaluate and remember up to 7 concepts at any one time
- The knowledge base of a clinician is >15 million facts and steadily increasing
- To keep abreast one needs to read about 20 articles/day (Shanefelt, T)
- The average clinician dedicates about 1 hour /week or less for reading research (de Dombal, FT)
- Netprints provide more transparency and openness but increase the information load exponentially
- Only 6% of drug advertising material is supported by evidence (Tuffs, A)
- Evidence could change clinical decisions in 30 – 60% of cases (Djulbegovic, B)
- Only 10% of global research funding goes towards diseases which account for 90% of the world burden of disease (Global Forum for Health Research)
Advantages:

i. Financial backup

ii. Easier passage from research to market
Disadvantages:

i. Negative effects on objectivity of the researchers

ii. Negative effects on the value of research to society

iii. Skewing of research

iv. Interpretative bias of research results

v. Spiking of results

vi. Threatening of researchers

vii. Interruption of trials

viii. Blocking of publication

ix. Distraction of the clinical researcher from his other duties, e.g.... Teaching, clinical work etc…
The Clinician’s Reaction

i. Ignoring new data

ii. Uncritical acceptance

iii. Denial

iv. Critical evaluation
Clinical Research Designs

i. Observational studies

ii. Experimental studies
Hierarchy of evidence in clinical research designs

- Systematic Reviews
- Critically-Appraised Topics [Evidence Syntheses]
- Critically-Appraised Individual Articles [Article Synopses]
- Randomized Controlled Trials (RCTs)
- Cohort Studies
- Case-Controlled Studies Case Series / Reports
- Background Information / Expert Opinion

TRIP Database searches these simultaneously

FILTERED INFORMATION

UNFILTERED INFORMATION
Preferential Choice of Design

Therapy → R.C.T’s
Testing of diagnostic aids → Cross sectional survey
Screening → Cross sectional survey
Prognosis → Longitudinal cohort study
Aetiology → Cohort or case-control study
Deficiencies in Clinical Research

i. Failures of follow-up

ii. Failures of definition

iii. Failures of experimental techniques and assessment
(A) Failures of follow-up

- Absence
- Inadequate
- Inaccurate data
(B) Failures of Definition

- **Vague diagnosis**  e.g. Non-specific abdominal pain

- **Imprecise symptoms**  e.g. Unquantified weight loss or anorexia
Systematic biases

Interpretation biases

Fallacies of reasoning
56 described (Sackett, DL). The most relevant are:

i. Selection bias
ii. Performance bias
iii. Exclusion bias
iv. Detection bias
v. Non-adherence to uncertainty principle
vi. Gender bias
vii. Financial bias
viii. Identity bias
ix. Bias from omitted research
x. Statistical errors
Selection Bias

Example of a non-randomised trial with selection bias

Michelangelo Buonarroti
Giudizio ‘Universale’ on altar wall of the Cappella Sistina (about 1540)
Consequent on the subjective element in scientific enquiry:

- Confirmation bias
- Rescue bias
- Auxiliary hypothesis bias
- Mechanism bias
- “Time will tell” bias
- Orientation bias
At least 15 ‘Fallacies of Reasoning’ are frequently encountered in medical research. Probably the most common are:

- **Cum / Post hoc ergo propter hoc** - Fallacy of causal relationship: Mistaking subsequence with consequence.

- **Anecdotal evidence**
"Logical fallacies" is a contradiction in terms

- One should rather say: “Fallacies of reasoning”
- Even great scholars make mistakes.
Why do researchers produce useless material?

- Lack of rigor in design and analysis
- Lack of knowledge of fallacies of reasoning and biases
- Having an excessive and irrational commitment to statistical significance
- A mania for new theory
- A love for novelty
- Tendency to salami slice and produce redundant and incoherent work
- Coercion
Possible solutions to information overload:

(A) Clinician’s (personal) measures:
1. Ask: “Is the study worthwhile?”
2. Check list
3. ? Narrowing one’s field of competence

(B) Institutional measures:
1. Delivering on priorities
2. Encouraging research with clinical impact
What can one personally do?

- Ask the relevant questions............
i. Does it add anything to what is known?
ii. Is it applicable to one’s practice?
iii. Design?
iv. Systematic bias?
v. Was the assessment blind?
vi. Adequate sample size?
vii. Duration and completeness of follow – up?

and..........................
Checklists for assessing evidence

Several available e.g. one published by the Centre for Evidence Based Medicine – University of Oxford
1. Checking the various sections of the structure of a study

2. Checking the particular type of study
If the answer to any of the questions is “no”, you can save yourself the trouble of reading the rest of it.
Institutional measures:

- Delivery on priorities (different prioritisation approaches not just top-down):
  1. Implementing collaboration amongst stakeholders including patient – professional partnership
  2. Using practice guidelines to review priorities
  3. Promoting evidence-based health care

- Encouraging *research with clinical impact*

- *Select* researchers

- Exploiting interfaces
Mandatory production of clinical research is inefficient and wasteful: Good clinicians or examiners may not have the aptitude.

The mandatory nature results in increasing the already unmanageable volume of evidence further.

The general quality of the research published will inevitably be adversely affected.

Other priorities e.g. clinical skills may be lost

Only those with the right attitude and abilities should be selected and encouraged to do medical research

It is critical appraisal of research evidence which should be mandatory.
Can we keep up to date?

Yes, with some difficulty and help:

- Personal and institutional measures
- Publishers of scientific journals and learned societies should adopt efficient filters to contain volume fairly
- Ensure a firewall between commercial interest and medical evidence
- Industry should be more socially conscious and honest
- Doctors, patients and the general public should be made aware of the uncertain nature of scientific hypothesis
Conclusion

Sir Karl Popper (1902-2001)

Aristotle (384 BC-322 BC)
Any Questions?
Thank you!