**Introduction to research**

Systematically build knowledge and efficacy, impact health policy + service delivery, research activities, critical consumer of research literature, enhance understanding.

- Decline of incidence before treatment use/availability – McEwens hypothesis.

**Science** – systematic study of people + environment based on deductions and inferences – general laws formulated from reproducible observations + measurements.

*Deductions*: a process where a general principle is applied to a particular case to explain it.

**Method** – systematic procedure, rules specifying acquisition of knowledge, form of knowledge, evaluate truth or falsity of knowledge

- Quantitative research is often determined by hypothesis.

**Scientific method**

Observations $\leftrightarrow$ hypotheses $\leftrightarrow$ Theories.

**Initial observation** – Senses

**Problem** – Experimental question

**Hypothesis** – Possible rationalisation or likely explanation. Idea formulated to be tested.

Statement that specifies the expected nature of the relationship b/w 2 or more sets of variables.

**Experimentation/observation** – test hypothesis and observe outcome

**Results** – Collect data/calculate

Draw conclusions – summarise results $\rightarrow$ conclusions to explain problem, check hypothesis, solution, implications for others, predict future.

Observations $\rightarrow$ identifying patterns $\rightarrow$ hypothesis $\rightarrow$ Prediction $\rightarrow$ experiments $\rightarrow$ Data $\rightarrow$ draw conclusions.

**Hypotheses** – an explanation that is based on prior scientific research or observations and that can be tested.

**Rules undertaking scientific research (3 basic elements)**

Scepticism – Any proposition/statement is open to analysis and critique

Determinism – events in the world occur to regular laws and causes – the aims of research are to discover these rules and causes

Empiricism – Enquiry ought to be conducted through observation and knowledge verified through evidence.

**Hypothesis Vs Theory Vs law**

Theory – Conjectures representing our current state of knowledge. Specify the causes of events and provide conceptual means for predicting and influencing these events.

**Deductive reasoning (logic)** – Way of seeking truth systematically. Hypothesis can be deducted logically from the statement which specifies the causal relationships postulated by the theories. Moves from general to specific

- Weak if we accept incorrect information

Inductive – Asserting general propositions (hypothesis, theories) about a class of phenomena on the basis of a limited number of observations of select elements.
Alternatives to scientific method

Authority – knowledge is considered true because of tradition or because of experienced or distinguished person

Rationale/reasoning – Assumed that if rules of logic were applied correctly, then the conclusions can be validated

Intuition – Knowledge acquired by sudden insight which arise w/o conscious reasoning.

Research – logical, understandable, confirmable, useful

Total research → effective research → research written up → research published → research used

Sub-standard - Misuse of patients/participants (risk/inconvenience, subsequent inferior treatment/outcomes), misuse of resources (diverted from a more worthwhile cause), misleading published research (future research misdirected).

High quality – Based on work of others, can be replicated, applicable to other settings, logical rationale, doable, generates new questions of is cyclical, incremental.

Steps of research – problem → purpose of study → review of literature → theoretical/conceptual framework → study assumptions → study limitations → hypothesis/research questions → study variables/terms → research design → population → sample → pilot study → data collection → organise data and analyse + interpret → communicate

- Meet purpose, formulated clearly, expressed in measurable terms.

Theoretical framework – When an area of research has strong existing theories in that area of research

Conceptual framework – Informal research, based on what we are currently developing from out research and the literature

Causal pathway – Framework used to understand factors which directly affect an outcome.

Research designs

Types of research: Laboratory, clinical, epidemiological, sociological

Qualitative: (interpretive) Perception, responses, feelings, attitudes
View patients as persons – gain insight into their subjective experiences. Does not usually test hypothesis. Approach to research that emphasises non-numerical and interpretive analysis of social phenomenon. Helps to understand the nature, strength and interactions of variables. Seeks to answer ‘what’. Usually use data to generate hypothesis.

- compliments quantitative: preliminary understanding for research, allows validation through triangulation, exploration of complex information not accessible by quantitative methods.

Documents: study of documentary accounts of events

Passive observation: Systematic watching of behaviour and talk in natural occurring settings

Participant observation: Observations in which the researcher occupies a role/part in the setting, in addition to observing

In depth interviews: face to face conversation with the purpose of exploring issues/topics in detail. Does not use preset questions, but is shaped by a defined set of topics.
Focus groups: Method of group interview which explicitly includes and uses the group interaction to generate data.

Approaches to qualitative research:
Phenomenological: Study and understanding of human conscious experience – understanding how things happen
Grounded theory: Advocates the development of theories to explain social phenomena grounded in data, following process of induction, deduction and verification – Explore w open mind → then understandings arise → generate hypothesis through exploration. No assumptions
Ethnography: Descriptive study, often of an individual or situation, usually written from the prospective of the participant(s) in 1st person – Becoming part of a culture to investigate/gather an understanding, immersing within cultural group.
Quantitative: View patients objectively. Identify and measure important variables which represents the causes/expressions of a clinical condition. Usually structured to test hypothesis. Approach to research that emphasizes the collection of numerical data and the statistical analysis of hypotheses proposed by the researcher.

→ The strength of quantitative is its reliability, the strength of qualitative is validity. In general quantitative research is deductive, and qualitative is inductive.

Validity: The extent to which the test measures what it is intended to – close to the truth
Reliability: The extent to which a test/measurement result is reproducible – same results.

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Epidemiology: Study of distribution and determinants of health – application of study to control health problems. Essential to have a clear definition of a case of the disease being investigate – i.e. the symptoms, signs or other characteristics.
Ecological studies: (correlational) – units of analysis are population/groups rather than individuals.
Types of studies: Descriptive, observational (Cross-sectional), analytical, observational (Case-control, cohort), experimental (trials).

Pro- Vs retro-spective: refers to the timing of date collection, not the relationship b/w exposure and effect.

Potential errors in epidemiological studies

Random error: divergence due to chance alone, of an observation on a sample from the true population value, leading to a lack of precision in the measurement of an association.

3 major sources = individual biological variation, sampling error, measurement error.

Systematic error/bias: When there is a tendency to produce results that differ in a systematic manner from the true values. Epidemiologists usually have no control over study participants.

Selection bias: Occurs when there is a systematic difference b/w the characteristics of the people selected for a study or not. If a disease/factor under investigation itself makes people unavailable for study.

Measurement bias: Occurs when individual measurements/classifications of disease/exposure are inaccurate. E.g. in retrospective Recall bias occurs when there is a differential recall of information by cases and controls – e.g. cases may be more likely to recall a past exposure → can lead to either exaggeration or underestimation of the degree to which the effect is associated w the exposure.

Confounding: Problem if an extraneous factor itself is unequally distributed b/w exposure groups – may even possible change the apparent direction of associations. It may create the appearance of a cause-effect relationship that in reality does not exist. For a variable to be a confounder, it must be a determinant/risk factor of the occurrence of disease and w the exposure under investigation.

Controlling confounding:

Randomisation: Ensuring potential confounding variables are evenly distributed among groups being compared – sample size needs to be large

Restriction: Used to limit the study of people w certain characteristics (e.g. by taking away smokers, diabetics, ages, sex limitations etc)

Matching: process of selecting controls so that they are similar to the cases in certain characteristics (to control the variability of cases as much as possible). Cases and controls may differ in characteristics or exposures other than the one that is targeted for study.

Stratification: Measurement of the strength of associations in well-defined and homogenous categories of the confounding variable

Validity: Low reliability, high validity = measured values are spread out, but the mean of the measured values are close to the true value.

Experimental study

Research design involving random allocation of subjects into group and the application of different interventions → Aim = validate the difference in outcomes due to non/intervention. Involves an active attempt to change a disease determinant – e.g. exposure or behaviour, or the progress of a disease (treatment).
Randomised controlled trials: Study a new prevention/therapeutic regime. Subjects allocated into treatment or control group → results by comparing outcomes. Ensure groups being compared are equivalent – allocated randomly by chance. Can include a set of criteria so study group is relatively homogenous.

Field trials: People disease-free but presumed to be at risk – e.g. divide into treatment (vaccine) and control (placebo) → used to evaluate interventions aimed at reducing exposure w/o necessarily measuring the occurrence of health effects.

Community trials: Treatment groups are communities rather than individuals.

Observational study
Situation where researcher studies the phenomenon w/o deliberate intervention.

Descriptive study: limited to a description of the occurrence of a disease in a population.

Analytical study: Takes further by analysing relationships b/w health status and other variables.

Prevalence: Total # cases of disease ÷ total population
The overall occurrence of a particular disease in a specific population at a specific time point.

→ Overall impact of a disease in a community, need for health care

Incidence: # new cases over a time period ÷ population at risk at start of period
The occurrence of new cases of a disease/condition within a specified time frame. Easier to measure prospectively.

→ Identify factors associated w disease, measuring strength of association b/w a factor and disease.

Prevalence/cross sectional study
Often 1st stage of research – looks for potential relationships. Measure of exposure and affect made simultaneously. Relatively easy and economical.

(Point-prevalence – Present) – can make comparisons
Study population → divide into free-from/with disease/outcome → divide both categories into those w or w/o risk factors for disease.

Used in investigating etiology of a disease. Both exposure and disease outcome are determined simultaneously for each subject.

Cohort study design (opposite to control study design) – follow-up/incidence studies
(Cohort – Present → future). Exposed/unexposed! Pro- or retrospective. Exposure → link to disease.

Study population in present (exclude those already with outcome), the free-from-disease → divided into +ve/-ve disease risk factor → in future evaluated w +ve/-ve disease/outcome.

Variables of interest are specified and measured. Expense of cohort can be reduced by using routine sources of information (e.g. disease registers etc). Costs can be reduced by using a historical cohort (identified on the basis of records of previous exposure) = retrospective. Because it is taken from a start point – can examine a range of outcomes.