Hierarchy from weakest to strongest: Ecological > Cross sectional > Case-control > Retrospective Cohort > Prospective Cohort > RCT

Type of Study	**Descriptive** (Answers **what=** outcome, **who=** population, **when=** time & **where=** place) (Hypothesis **Generating**) (**No** comparison and intervention) **Describe a population (PO)**				**Analytical** (Answers **how** and **why=exposure, risk factors & mode of** transmission=exposure, risk factors & mode of transmission) (Hypothesis **Testing**) (There is a comparison and intervention) **Quantify the relationship between exposure and outcome (PICO)**				
Study design	**Case Report**	**Case Series**	**Cross Sectional (Survey)**	**Qualitative** **Keywords: focus group**, interview, derive themes, open ended questions, in depth understanding.	**Experimental** **Allocated at random (assigned by the researcher)**	**Observational** **Not randomly allocated (Not assigned by the researcher)** **From observational studies we can infer causal relationships, from experimental studies we can confirm causal relationships.**			
					Individual Data	**Group Data**	**Individual Data**		
					RCT (Keywords: investigating)	**Ecological**	**Cross Sectional (Keywords:** prevalence)	**Cohort (Keywords:** follow up, incidence)	**Case Control**
Definition	-	-	-	A strategy for systematic collection, organization and interpretation of **textual** information. Answers **how and why** a certain phenomena occurs and uses inductive approach to generate novel insights into phenomena. **Inductive theory:** Allows theory to emerge out of the data	Individuals are **allocated at random** to receive one of the several interventions (at least two) **Random allocation: all** participants have a **defined probability** of assignment to a particular intervention. (Advantage of random allocation: is that the 2 groups will be similar apart from the treatment) **Experimental study:** Something is given is done to the experimental group but not the control group and the resulting difference in the outcome is compared.	-	Is a study that quantifies an outcome of interest and/or examines the relationship between disease (or other health related state) and other variables of interest as they exist in a defined population **at a single point in time.**	An **analytical observational study** in which a group of people **(100 or more in size)** with a common characteristic is **followed over time** to find how many reach a certain health outcome of interest (disease, condition, event, death, or a change in health status or behavior) **2 types** distinguished by the **basis of the time** of **occurrence of the disease** in relation to the time **which the investigation is initiated:** (choose based on exposure and move forward to outcome) 1. Prospective 2. Retrospective (data is historical)	a study that compares subjects who have a disease or outcome of interest (**cases**) with subjects who don't have the disease or outcome (**controls**) by looking back **retrospectively** at the frequency of exposure to a risk factor in each group
Study Population	**Single** case	Collection of **similar** cases (more than 1 and less than 60)	**Single** sample from larger population **No** comparison	Process of naturalistic inquiry that seeks in-depth understanding of phenomena within their natural setting (individual, societies & languages)	Highly selected population. Highly controlled environment. Allocation of the exposure is made by the researcher.	**Population** based study (city, country, geographic area) **Usually using secondary data.**	**Single** sample from larger population. **Compares** 2 groups in the sample.	**Two** samples **Exposed** group and **not exposed.** **No** allocation of exposure is made by the outcome.	**Two** samples Group with (**disease**) and group without (**disease**)
Uses When to conduct	-Detailed report of the symptoms, signs, diagnosis, treatment and follow up of an **individual patient.** -Typically **unusual/novel** event.	Detailed report of the symptoms, signs, diagnosis, treatment and follow up of a **group of patients or cases with similar issues.**	- Study **prevalence** of health related events at a **point in time/snapshot** - **Characterize prevalence** of health outcome in a specified population. - Often used to study condition that are relatively **frequent** with **long** duration of expression (nonfatal, chronic conditions)	-**Answers the question why** -Exploring a health problem or issue which little is known. -Produce conceptual models. -Investigation the feasibility, acceptability and appropriateness of potential programmes. -Designing more valid survey instruments. -Identifying problem in ongoing interventions and suggesting appropriate solutions to these problems. -Help in identifying cultural and social factors that affect health care positively or negatively. -Complementing quantitatively collected data by helping to interpret its results.	-Efficacy of an intervention. -Interested in modifying exposures. -**Causality**	- Screening hypothesis at **population** level, * Be aware of ecological fallacy * (which means risk factors at population levels do not convey a risk compared to individual level)	- Screening hypothesis at **individual** level, **Prevalence studies.** - To estimate **prevalence (burden)** of a health condition (disease) or a prevalence of a behavior or risk factor. - Assess **association** between exposure and outcome. - **Knowledge, attitude and practices** of individuals in a population. - Monitor **trends** over time with serial cross sectional studies Ex. NHANS - Hypothesis generation about the cause of the disease.	-Prognosis -Assessing associations between **rare** exposures and a high incidence outcome **over time** -When there is good evidence of association between exposure and disease. -When attrition (loss during follow up) of study population can be minimized. -When funds or time are available (feasible).	- Assess association between exposure and **rare outcome** (rare disease). - Multiple exposures may be associated with a single outcome. -Funding or time is limited: to investigate cause and effect when RCT not ethical or cohort is expensive and not feasible.
Directionality When the exposure and outcome assigned or measured	-	-	-	-	**Exposure** is assigned **before outcome** is measured.	Exposure and outcome **BOTH** measured at the **SAME** time (simultaneously) at **population** level.	Exposure and outcome **BOTH** measured at the **same** time (simultaneously) at **individual** level.	**Exposure** measured **before outcome** is measured. (prospectively)	**Outcome** measured **before** exposure is measured.
Formulas	-	-	**Prevalence= Cases/Total population x 100**	-		-	**Prevalence odds ratio= (a/b)/(c/d)**	1. **Incidence rate** 2. **Estimation of risk:** Relative risk & Attributable risk	**Odds ratio= (a/b)/(c/d)**
Strengths and Advantages	-Detecting novelties. -Generating hypothesis. -Educational value. -Allows in-depth understanding.	-Useful for hypothesis generation. -Informative for very rare disease with few established risk factors.	-Cheap and simple. -Ethically safe.	-Provide depths and details. -Create opness. -Stimulates people's individual experiences.	-One treatment is directly compared to another to establish superiority. -This study design can make **causal inferences.** -Minimum bias	-	-Quick and easy to conduct. -**Multiple** outcomes and exposure can be studies. -Data on all variables are collected only **once**. -Measure prevalence of all factors under investigation. -Good for describing and generating hypothesis	-**Multiple** outcomes can be measured for one exposure. -Can look at **multiple outcomes.** -Good for measuring **rare exposure.** -Exposure is measured before the onset of the disease in prospective study (Measure temporality) -Can measure incidence. -Demonstrate causality.	-Cost effective. -**No** long follow period. -Study of disease with **long latency period.** -Study of **rare disease** -Examining **multiple exposures.**
Weakness, Disadvantages and Issues	-Lack of ability to generalize. -No possibility to establish cause-effect relationship. -Publication bias.	-Can't study cause and effect relationships. -Can't assess disease frequency.	**Not** suitable to study **rare** or **highly fatal disease** or a **disease with short duration.**	-Usually fewer people. -Less easy to generalize. -Dependent on skills of the researcher.	-Resource , expensive -Results may not mimic real life. -Ethical implications: denying treatment to one group, ability to provide informed consent.	-	-Difficult to determine **temporality** between exposure and outcome. **(Temporal ambiguity)** -Associations identified may be difficult to interpret. -**Susceptible to bias** due to low response and misclassification due to recall bias.	-Costly and time consuming. -Poor choice for the study of a rare disease (rare outcome). -**Loss to follow up (due to long term follow up) which makes it prone to bias .** -Knowledge of exposure status may bias classification of outcome. -Classification of individuals (exposure or outcome status) can be affected by changes in **diagnostic criteria.** -Differential **misclassification** of subjects (major source of bias and may lead to over or underestimate of the effect between exposure and outcome). -**Selection bias** (occurs more in case control) (due to healthy worker effect ,outcome ascertainment differs between exposed and unexposed and loss of follow up is different among exposed and unexposed). -Prone to **confounding.** -Being in the study may alter participant's behavior. -Participants may move between one exposure category. -**Problems related to measuring exposures:** The individuals in the control group are truly unexposed and those in the exposed group may change their behavior in relation to the exposure.	-Poor choice for rare exposures. -Limited to examining one outcome. -Prone to bias: observer, selection and recall. -Unable to estimate incidence rate (unless the study is population based). -Confounding (reduced by matching)
Biases	Publication bias	-	-	-	-**Selection bias** (If random allocation is not done) -**Information bias** (decreased when blinded "masked". It happens because patients may bias their response due to their knowledge of treatment or biased outcome assessment because investigators have knowledge about the treatment)	-	-Selection bias (Sampling bias) **-Recall bias**	Selection bias	-**Selection** bias -**Ascertainment** bias: **recall bias (major problem and most common)**, **observer** bias, different data collection tools may be used for the controls. -**Berkson's** bias: hospital based controls may have disease that share risk factors with outcome of interest.