question and its value in adding knowledge and understanding.

LEVELS OF RESEARCH QUESTIONS

Research question refers to the precise focus of original and independent research that leads to useful *findings.* Subsidiary questions guide the *operational stages* of the inquiry, the steps as one builds the answer and *address assumptions by doing experiments.*

A higher-level question shows the more general class of knowledge that the research could contribute: It is the essence of the question, and could be the reason for investigation. It actually is the *significance of findings.*

PROCESS OF GENERATING A RESEARCH QUESTION

The most important prerequisite for this research is a well-cultivated curiosity. This seems to be a common characteristic possessed by notable researchers. Beyond being curious, these individuals also had the patience and tenacity to follow a question until satisfied with the answer.

TIPS TO GENERATE A GOOD RESEARCH QUESTION

Though formulating a research is a tedious task, but still some useful tips could be given to ensure formulation of a good research question (Table 2.2).

STEPS IN FORMULATING RESEARCH QUESTIONS

Formulating a research question starts with an idea. However, it has to be backed by practical methods and methods (Table 2.3). A good research question should be able to study the variables under considerations, the population being studied and the testability of the question.

Table 2.2: Useful tips to form a research question

- Careful observations
- Look at draft of research question/hypothesis
- Application of new technology
- Based upon experience
- Scientific communications
- Skeptical attitude
- Question validity of commonly held beliefs
- Revise and rewrite

Table 2.3: Formulating a research question

- Generate on idea
- Identify a question
- Modify the question
- Form a hypothesis

Remembering Attributes

There are several features that a good research question encompasses (*see* acronym below). FINER is a widely used criteria.

FINER Criteria for Suitability of Research Question

- **Feasible**
  - Adequate numbers of subjects?
  - Adequate technical expertise?
  - Affordable in time and money?
  - Is it possible to measure or manipulate the variables?
- **Interesting**
  - To the investigator/sponsor?
- **Novel**
  - To the field/to the audience**?**
- **Ethical**
  - Potential harm to subjects?
  - Potential breech of subject confidentiality?
- **Relevant**
  - To scientific knowledge/theory?
  - To organizational, health or social management and policy?
  - To individual welfare?

Bibliography

1. Blaikie, N. (2000). Designing social research.
2. Examples derived from studies designed by Di Buchan (skilled migrants) and Marsden award winners: JE Reese (stories); B Thompson

Greek letters (e.g. α, β) are used to represent parameters.

Alpha (α) is the significance level; probability of committing a Type 1 Error (α = 0.05). In other words, *p* = probability value (*p* = 0.05).

Null hypothesis = (H_0: $\mu_1 - \mu_2 = 0$ or H_0: $\mu_1 = \mu_2$) and the alternative hypothesis = (H_1: $\mu_1 - \mu_2 \neq 0$ or H_1: $\mu_1 \neq \mu_2$). Alternative hypothesis is also depicted as H_A.

Types of Hypothesis

It can be of several types, but broadly of two types:

a. **Research hypothesis:** This is a statement of the relationship among two or more variables or groups. The acceptance or rejection of a research hypothesis is based on resolving a logical alternative with a null hypothesis. For example, graduate students who read the text in research methodology will score higher in Msc/MD/PhD entrance examination than students who did not read their research methodology book.

Research hypotheses can be stated as ***directional*** or ***nondirectional***. Directional hypotheses predict the specific relationship among two or more variables or groups:

$$H_0: \mu_1 \leq \mu_2 \quad H_1: \mu_1 > \mu_2$$

Directional hypothesis specifies the direction of the relationship between independent and dependent variables.

Nondirectional hypotheses predict that there will be differences among two or more groups, but *do not specify the direction of the differences.*

$$H_0: \mu_1 = \mu_2 \quad H_1: \mu_1 \neq \mu_2$$

Nondirectional hypothesis shows the existence of a relationship between variables but no direction is specified.

b. **Statistical hypothesis:** Statistical Hypotheses are mathematical, or logical statements that help researchers interpret the results of the research. Statistical hypotheses consist of the null hypothesis (H_0), the hypothesis of no difference and the ***alternative hypothesis*** (H_1 or H_A) which is similar in form to the research hypothesis.

Null: (H_0: $\mu_1 - \mu_2 = 0$)

Alternative: (H_1: $\mu_1 - \mu_2 \neq 0$)

Null hypothesis: The absence of a relationship or difference in the results; any relationship or difference is due to chance or sampling error. For example, there will be no difference in the comprehensive test scores of students who read the text in research methodology and those who did not read their research methodology book.

Alternative: Alternative hypothesis expresses a relationship between the variables under study. It points a direction and requires "assumption" that is specified and objective.

Students who read the book of research methodology will score higher on their comprehensive exams than graduate students who did not read their research methods text.

The null hypothesis always implies that there is no relation or statistical difference between variables or groups while the alternative hypothesis implies that there is a meaningful relationship among variables or groups.

A clearly formed hypothesis is the key to success. It should have several characteristics (Table 5.3).

Hypothesis Testing

After formulating a hypothesis; frame the hypothesis in a format that is testable, i.e. develop it a study design. Finally, one is expected to test the hypothesis.

Table 5.3: Characteristics of good hypothesis

- Constructs are clear
- Relationship (sign, direction if experimental, type of moderation) is clear
- Population often included
- Design/statistical method often clear
- Mean differences clear
- Comparison specified

or three). Generally, case reports describe a new or unique finding, e.g. previous undescribed disease, unexpected link between diseases, unexpected new therapeutic effect or, e.g. adverse events. These are often the starting point of someone getting started into medical writing.

Clinical Case-series

These are consecutive set of cases of a disorder/disease which derive from the practice of one or more healthcare professionals or health-care setting. Clinical case series are of value in epidemiology for studying predictive symptoms, signs and tests. They are also useful for creating case definitions, clinical education, audit and research. They are hence very useful for health services research and establishing safety profiles (Table 6.3).

Table 6.3: Features of case series

- Group of patients with a similar diagnosis
- Assesses prevalent disease
- Cases may be identified from a single or multiple sources
- Report on new/unique condition
- Realistic design for rare disorders

Importance of Case Reports—Case Series in Medicine

Case reports and case series can be well received, and have significant influence on subsequent literature and possibly on clinical practice. Many are followed by clinical trials or by other epidemiological studies. Often, report rare conditions for which trials may not be feasible are reported as case reports or case series. One should however be wary of publication bias favouring positive results in case series. This may not always be the case though (Table 6.4).

Study Flow

Mostly an exploratory study can give us ideas about the variables that one can use to frame research question. Once a research question develops, then one can form a hypothesis and chose a study design depending upon hypothesis. The idea can be tested by cohort/case control or by clinical trials. Table 6.5 details the type of study designs and what they are supposed to do.

Table 6.4: Advantages and disadvantages of case series

Advantages
• Useful for hypothesis generation
• Informative for very rare disease with few established risk factors
• Characterizes averages for disorder
Disadvantages
• Cannot study cause and effect relationships
• Cannot assess disease frequency

Table 6.5: Study designs and what they can explore

Descriptive	*Case-control*	*Cohort*	*Clinical trials*
Hypothesis developing study	Relation to outcomes can be investigated	Link with exposure can be studied	Proof of the found experi-mentally

Cross Sectional Study

Cross sectional study is a descriptive study in which disease and exposure status is measured simultaneously in a given population at a given time. Cross sectional studies can be thought of as providing a "snapshot" of the frequency and characteristics of a disease in a population at a particular point in time. This type of data can be used to assess the prevalence of acute or chronic conditions in a population. However, since exposure and disease status are measured at the same point in time, it may not be possible to distinguish whether the exposure preceded or followed the disease, and thus cause and effect relationships are not certain. It can measure prevalence and can show association between variables. However cause and effect cannot be determined.

Cross sectional study is often used to study conditions that are relatively frequent with long duration of expression (nonfatal, chronic

interest? What is the sampling frame? What is the type of sample and what size sample is needed? Lastly, how much will it cost?

SAMPLING METHODS

Sampling Population

It is important to as to what is population of interest? To whom do you want to generalize the results? Population of interest could be all doctors, school children, Indians as a whole, women aged 15–45 years and lot of others. However, one cannot study the population as a whole. One would have to take a fraction of the whole population. Sampling procedure and participation (response) could affect the sample to be taken for study. When population is very small, and when does not expect a very high response; then population as a whole could be taken as well. Census is also another example where whole population has to be taken. Two major types of sampling are given below (Table 8.1).

Table 8.1: Major types of sampling procedures

Probability	*Non-probability*
• Systematic	• Convenience
• Simple random	• Snow ball-Judgement
• Cluster	• Quota

Sampling could be of many types: broadly, it is of two main types: probability and non-probability sampling.

Probability Sampling

Probability sampling is a sampling technique in which every member of the population will have a known, nonzero probability of being selected. This form of selection utilizes random selection. The tool of selecting individuals by this method should be such that there are equal probability of being chosen, e.g. flipping through a coin, lottery, etc.

Non-probability Sampling

Non-probability sampling employs no statistical techniques for measuring random sampling error in a non-probability sample. Therefore, generalizability is **never** statistically appropriate. Units of the sample are chosen on the basis of personal judgment or convenience. The selection is based upon the subjective judgment of the researcher rather than selection methods.

Simple Random Sampling

Sample random sampling assures that each element in the population has an equal chance of getting selected. Random number generator could be used. This sample is considered to be unbiased and supposed to have independence. Each individual has an equal chance of getting selected.

Probability of selection is = sample size/ population size

Advantages of simple random method is that minimal knowledge of population needed. Both external and internal validity are high.

The disadvantage is high cost; low frequency of use and needs a sampling frame. It does not use researchers' expertise. However, it may have a larger risk of random error than stratified random sampling.

The selection of subjects can be done by picking up a random number and the select the rest of the subjects in a random fashion. Figure 8.1 gives the details in a diagrammatic manner. Likewise, the same can be done using table of random number which can