Formulating research question, hypothesis and objectives

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Key areas

- Spell out research question
- State research hypothesis
- Formulate objectives

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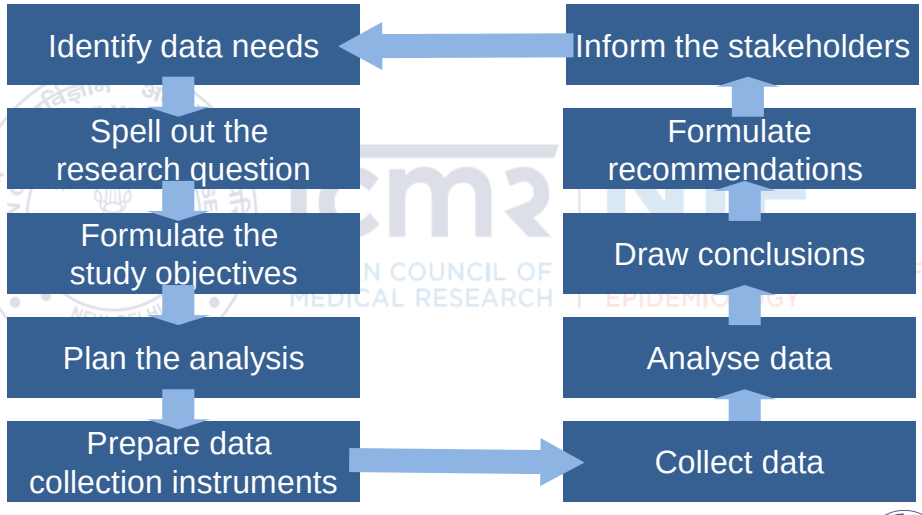
The life cycle of research



Research question

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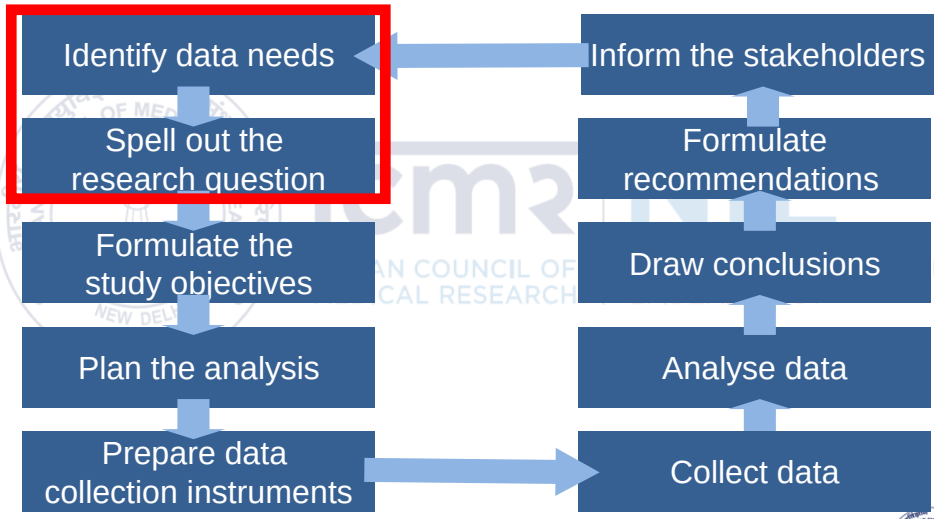

Research question

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What is research question?

- 'Uncertainty' about something in the population that the investigator wants to resolve by making measurements in the study population
- Uncertainty = 'data needs'
- Clear question facilitates to
  - Choose the most optimal design
  - Identify who should be included, what the outcomes should be, and when the outcomes need to be measured

Refining 'ideas' into research questions

- Begins with general uncertainty about a health issue
- Narrows down to a concrete, researchable issue

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Translating uncertainty to research question

- Frames problem in specific terms (clinical/public health/…)
- Focuses on one issue
- Is written in everyday language
- Can use more than one operational verb, if needed
- Should link the question to the potential action that would be taken once the question is answered
- *Is stated as a question!*

Research question sets out

☐ What the investigator wants to *know*

☒ NOT

- ☒ What the investigator might *do* or
- ☒ What the results of the study might ultimately *contribute* to that particular field of science

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Sources of research questions

1. Mastering the published literature

- Continue review of work of others in the area of interest

2. Being alert to new ideas and techniques

- Attending research meetings / conferences
- Having a skeptical attitude about prevailing beliefs
- Applying new technologies to old issues

3. Keeping the imagination roaming

- Careful observation; teaching, tenacity

4. Choosing a guide/mentor

SB Hulley *et al*. Designing Clinical Research, 3rd ed. Lippincott Williams & Wilkins 2007

Two categories of research questions

1. Descriptive questions

- Involve observations to measure quantity
- No comparison groups / interventions

2. Analytical questions

- Involve comparisons / interventions to test a hypothesis

Steps in conceiving a research question

1. Review of state-of-art information
2. Raise a question
3. Decide worth investigating by peer-review
4. Define measurable exposures & outcomes
5. Sharpen the initial question
6. Refine the question by specifying details

Steps in conceiving a research question

e.g., Should diabetics do exercise daily?

1. Review of state-of-art information

- Exercise reduces blood sugar, body fat
- Exercise improves protection against developing diabetes related complications

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Steps in conceiving a research question

2. Raise a question

- *Can exercise help control blood sugar level?*

  Rather vague; Need to define

- *'exercise' & 'blood sugar level'*

Steps in conceiving a research question

3. Decide worth investigating by peer-review

- What is the level of reduction in blood sugar?
  - Fasting or random or post-prandial <i.e., after food>
- What are optimal type, frequency, intensity and duration of exercise?
- What are the risks? What are the other benefits?

Steps in conceiving a research question

4. Define measurable exposures & outcomes

- **Exposure:** Exercise
  - *Pre-determined physical activity comprising of any body movement produced by skeletal muscle, resulting in an increase in energy expenditure*
  - *Atleast one session of 60 minutes every day for one year*
  - Could be specific: *walking, jogging or cycling or aerobic…*
- **Outcome**: Fasting blood sugar level

Steps in conceiving a research question

5. Sharpen the initial question

- *Among diabetics, does physical activity for one hour daily help in reducing fasting blood sugar level?*

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Steps in conceiving a research question

6. Refine the question by specifying details

(Study population, operational definitions of variables and study design)

- *What is extent of walking practiced by diabetics (type 2 diabetes) regularly?* [Descriptive question]
- *In order to improve management of type 2 diabetes, we wish to know whether brisk walking by diabetics for atleast one hour daily reduce fasting blood sugar level as compared to those who do not?*

  [Analytical question]

Good research question should pass the *'so what?'* test

- **F**easible
- **I**nteresting
- **N**ovel
- **E**thical
- **R**elevant

SB Hulley *et al*. Designing Clinical Research, 3rd ed. Lippincott Williams & Wilkins 2007

Good research question should pass the *'so what?'* test

- **F**easible
  - Adequate number of participants, technical expertise & resources
- **I**nteresting
- **N**ovel
  - Confirms, refutes or extends previous findings
  - Provides new information
- **E**thical
  - Amenable to a study that ethics committee will approve
- **R**elevant
  - Advance scientific knowledge, improve practice, influence policy

Research question

Statement of research hypothesis

- A specific version of research question
  - Summarizes main elements of study
  - Establishes basis for test(s) of statistical significance
    - Main elements: *Sample, Exposures and Outcomes*
- Stated for analytical questions with comparison groups
  - For research questions with terms: *greater or less than, causes, leads to, compared with, more likely than, associated with, related to, similar to or correlated with*
- Purely descriptive questions DO NOT require hypothesis

Hypothesis

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Example of research hypothesis

Among diabetics (type 2 diabetes) from the study area, who do brisk walking for atleast one hour daily results in average reduction of 10 mg% of fasting blood sugar level as compared to those who do not

Characteristics of good hypothesis

Simple
- One exposure
- One outcome

Specific
- No ambiguity about study participants/variables

Stated in advance
- Written at outset
- Focused on primary objective

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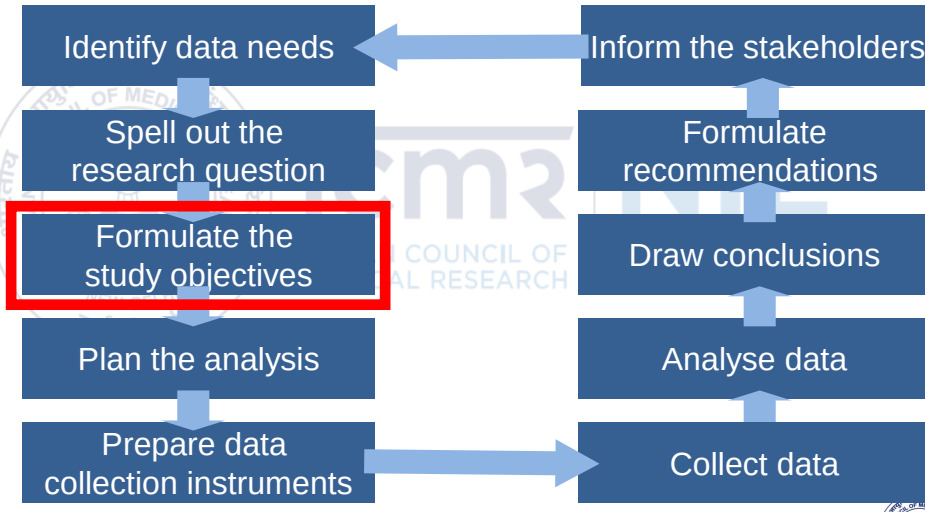
The life cycle of research



Translating research questions to objectives

- Frame in scientific/epidemiological terms
- Take the question in a few limited axis
- Write in scientific/epidemiological language
- Make use of no more than one verb for each
- Sort as primary and secondary
- Be clear about the type of question:
  - Descriptive questions {Measuring a quantity}
  - Analytical/experimental questions {Testing a hypothesis}

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Objectives for descriptive vs. analytical studies

- Descriptive: Estimating a quantity
  - Use the verb"Estimate"
    - E.g., Estimate prevalence of physical activity
- Analytical: Testing a hypothesis
  - Use the verb"Determine"
    - E.g., Determine whether exercise reduces blood sugar level

The research question

- In order to improve management of type 2 diabetes, we wish to know whether brisk walking by diabetics for atleast one hour daily reduces fasting blood sugar level as compared to those who do not?

Primary objective

- Determine the effect of brisk walking for atleast one hour daily on fasting blood sugar level of patients with type 2 diabetes compared those who do not

Good and bad examples of study objectives

- Determine importance of sedentary lifestyle among diabetics
  - Estimate prevalence of physical activity among diabetics
- Assess physical activity and diabetic complications
  - Estimate effect of physical activity on the rate of diabetic complications
- Evaluate depression and diabetes
  - Determine whether depression is more common among diabetics as compared to healthy individuals

Asking yourself the right question

- Two ways to deal with a poor or irrelevant research question:
  - Try to answer it
    - The answer may be of no use of anyone
    - There may be no answer…
  - Try to reframe it
- If your research question is wrong:
  - No good hard work will save your work
- If your research question is right:
  - You have an opportunity to do a good job

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Thank you