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## **Formulating the research question**

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Research supplies answers to problems, so to get meaningful and useful answers or outcomes, it is vital to ask the correct research question. This fact sheet provides a simple step by step guide to developing a concise research question. It involves a dynamic process whereby the research question can be challenged and modified repeatedly until a robust research question is achieved.

The research topic may be an area of interest to the investigator, or in response to public health concerns; to investigate issues identified by surveillance or to address policy requirements.

The broad research *topic* then needs to be narrowed to a manageable research *problem* satisfying the questions:

- Is the topic relevant?
- Is the problem important enough to warrant extensive research?
- Will the results address the problem?<sup>1</sup>

The research problem is then refined to a researchable *question* with measurable objectives. The type of research methodology chosen will depend on the research question. Qualitative and quantitative methodologies are different, but can be complementary. It is not uncommon to use both qualitative and quantitative methods to answer a research question.

Quantitative research methods develop research objectives from theory and then test them. The research question presents a specific question about the relationship between variables, and a hypothesis may be prepared to predict the result. For example:

*Research topic:* Physical activity and cardiovascular disease  
*Research problem:* Is there a link between lack of physical activity and hypertension?  
*Research question:* Will 30 minutes of moderate activity daily reduce hypertension in office workers?  
*Hypothesis:* Thirty minutes of moderate activity daily in sedentary Queensland Health workers will reduce the median systolic blood pressure by 10mm mercury.

In qualitative methods, formulating research questions is a central element of research as it clarifies theoretical assumptions in the framework and priority aspects about what the researcher wants to know. In some cases, qualitative research may precede the development of the conceptual framework and in other cases may follow it.<sup>2</sup> Qualitative research questions tend to be open and descriptive and may evolve during the project, unlike quantitative research questions which should remain fixed. Words such as: 'seek to understand', 'describe', and 'explore' give clues to the methodology to be used. One general open question may be followed by a number of sub-questions. For example:

*Research topic:* Visual display units  
*Research problem:* Do visual display units affect the health of users?  
*Research question:* To explore how psychosocial aspects of working with visual display units (VDU) are related to job stress and what their consequences are for mental and physical health.  
*Sub-questions:* What are "psychosocial aspects" of work and how are they detected and determined?  
What is "job stress" and how is it detected and determined?  
What is meant by "physical and mental health" and how is it detected and determined?<sup>3</sup>

In conclusion, the research question needs to be specific, concrete and measurable. The process of formulating a research question will promote good research practice. Many hours can be wasted searching for literature or collecting data that is not relevant because the research problem was not refined to a meaningful research question before work began.

### Formulating the research question in a research planning process <sup>4</sup>

Step A	Decide on the research <ul style="list-style-type: none"> <li>▪ Examine the existing data and literature.</li> <li>▪ Define study objectives.</li> <li>▪ Is hypothesis imaginative and testable? If not reconsider the research.</li> </ul>
Step B	Define variables to be measured <ul style="list-style-type: none"> <li>▪ Are they measurable? If not reconsider study objectives, hypothesis and variables.</li> </ul>
Step C	Decide target population <ul style="list-style-type: none"> <li>▪ Is the ideal population accessible? If not reconsider study objectives, hypothesis and variables.</li> <li>▪ Is the accessible population representative? If not reconsider study objectives, hypothesis and variables.</li> </ul>
Step D	Select appropriate research strategy <ul style="list-style-type: none"> <li>▪ Define timeframe.</li> <li>▪ Define sampling or selection timeframe.</li> <li>▪ Is the research strategy feasible? If not reconsider steps A-C.</li> <li>▪ Is the feasible sample or selection strategy adequate? If not reconsider sampling or selection strategy.</li> <li>▪ Calculate sample size.</li> <li>▪ Consider resources to cope with this. You may need to reconsider previous steps if there are inadequate resources.</li> </ul>
Step E	Decide on data collection and analysis method <ul style="list-style-type: none"> <li>▪ Consider quantitative, qualitative methods or both.</li> <li>▪ Consider resources to cope with this. You may need to reconsider previous steps if there are inadequate resources.</li> </ul>
Step F	<ul style="list-style-type: none"> <li>▪ Are pilot studies required? If yes, define objectives for pilot; conduct pilot study.</li> <li>▪ Are there data problems? If yes, reconsider study objectives, variables, research strategy, data collection and analysis method.</li> <li>▪ Are there operational problems? If yes, reconsider steps B-E.</li> </ul>
Step G	Implement Study <ul style="list-style-type: none"> <li>▪ Monitor progress. If problems arise reconsider all steps.</li> </ul>

#### References

1. Kerr, C., Taylor, R. & Heard, G. (1998) *Handbook of Public Health Methods*. pp.10-15 McGraw-Hill Australia.
2. Sarantakos, S. (1998) *Social Research*. pp. 119-120 MacMillan Education Australia.
3. Piller, N., Crotty, M., Weller, D., and Coveney, J (1999) *Research in Primary Health Care: Theory and Practice*. pp. 13-16 Flinders University
4. Kerr, C., Taylor, R. & Heard, G. (1998) *Handbook of Public Health Methods*.pp.10-15 McGraw-Hill Australia.

# FORMULATING THE RESEARCH QUESTION

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## *Where do questions come from?*

- From patient-centered questions in routine clinical practice:
  - diagnosis “What do I have, doctor?”
  - etiology “Is it because I did X?”
  - prognosis “How long do I have?”
  - treatment or prevention “Will Y do me any good?”
- From new treatments or diagnostic tests “Are they better than what we have?”
- From physician and patient experiences “What causes quick consultations?”

## *The research process*

- Step 1 - Identify knowledge gap
- Step 2 - Formulate the research question
- Step 3 - Search for existing information
- Step 4 - Focus the research question
- Step 5 - Design the study
- Step 6 - Refine the specific aims and objectives of the study

## *Defining a good question*

- Importance
- Interest
- Answerability

## *Importance of research question* *The “so what?” test*

## *Interest of research question*

- Motivation
- Innovation
- Topicality
- Ethical considerations
- Political considerations
- Social considerations

## *Answerability of research question*

- Type III error: Asking the wrong question  
*“Far better an approximate answer to the right question, which is often vague, than an exact answer to the wrong question, which can always be made precise.” - John Tukey*
- Type IV error: Asking a question not worth answering

## *Types of questions*

### Variance questions

- Focuses on difference and correlation
- “Is (are) there” “Does” “How much” “To what extent”
- Quantitative/Clinical
- Starting point or primary determinant of the design

### Process questions

- Focuses on “how” and “why” things happen
- Qualitative

## *Components of the clinical question*

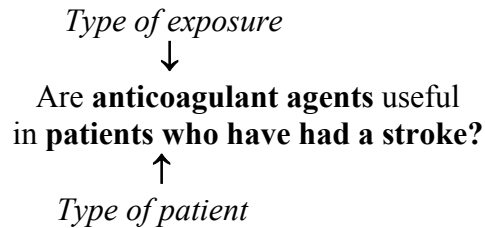
Population - type of person

Intervention (exposure) - type of exposure

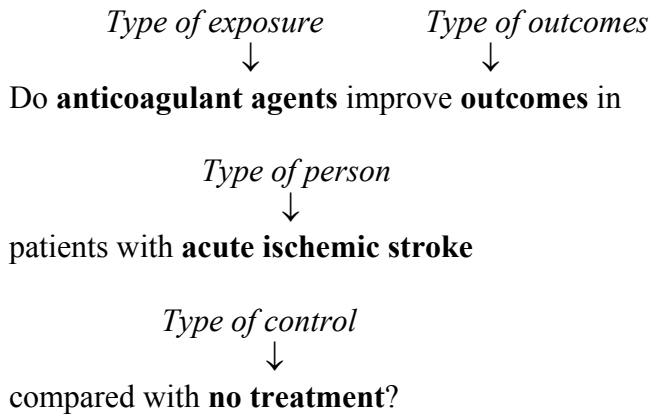
Comparisons - type of control

Outcomes - type of outcome

## *Refining the clinical question*



## *The well-formulated question*



## *Operationalizing the research question*

- Each component (variable) of the research question needs to be defined in terms of the operations required to measure them.
- These need to be specified in the Specific Aims section of a grant.

## *PICO - Population*

Example: Is amoxicillin effective for otitis media?

- Is “otitis media”
  - otitis media according to physician diagnosis?
  - otitis media based on tympanometry readings?
  - fever and ear pain?
- Do you consider infants and adults?

## ***PICO - Intervention***

Is amoxicillin effective for otitis media?

- Are antibiotics effective for otitis media?
- Are any drugs effective for otitis media? Decongestants?
- Are any treatments effective for otitis media? Myringotomy? Humidifier?

## ***PICO - Comparisons***

Example: Is amoxicillin effective for otitis media?

- Does this translate to:
  - Efficacy - vs. control or placebo
  - Comparative efficacy - vs. standard therapy

## ***PICO - Outcome***

Example: Is amoxicillin effective for otitis media?

- Does amoxicillin prevent long-term hearing loss?
  - Requires trials with long-term follow-up
  - Requires trials which assess hearing
- Does amoxicillin reduce pain?
  - Requires trials which assess pain

## ***The FINER criteria for a good research question***

- Feasible
  - Adequate number of subjects
  - Adequate technical expertise
  - Affordable in time and money
  - Manageable in scope
- Interesting
  - Interesting to the investigator

## *The FINER criteria for a good research question*

- Novel
  - Confirms or refutes previous findings
  - Extends previous findings
  - Provides new findings
- Ethical
- Relevant
  - To scientific knowledge
  - To clinical and health policy
  - To future research directions

## *Visualizing the research question*

- Visual refining of a research question can help in making a verbal commitment to it.
- Having a conceptual or theoretical framework also helps toward refining the research question.

## *Conceptualization theory construction Concept analysis*

### Principles

- Concepts should be clearly defined and well differentiated from other concepts (epistemological principle)
- Concepts should be coherently and systematically related to other concepts (logical principle)
- Concepts should be applicable to the world or operationalized (the pragmatic principle)
- Concepts should be appropriate to their use in context (linguistic principle) Morse, et al., 1996

## ***Relations of concepts Conceptualization types of research***

- Descriptive Research - Identify and fully describe the defining characteristics and particulars of concepts of interest
- Exploratory Research - Discover what other phenomena cause or coexist with the concept
- Explanatory Research - Shift from asking what factors are related to the concept to why they are related

## ***Interactive patient model Benefits of a well-formatted research question***

- Aids in reducing the work for a literature review
- Aids in the development of hypotheses
- Aids in the development of a conceptual or theoretical framework
- Aids in clarifying relationships among variables

## ***The qualitative research question***

- The research question is the result of an interactive design process rather than the starting point
- Initial questions are designed to focus and develop more specific questions during the research process

## ***Refining the qualitative research question***

- What you want to understand by doing the study vs. what you want to accomplish
- Example: “What is the best way to increase medical students’ knowledge of science?” vs. “How do exemplary teachers help medical students learn science?”
- In interview studies your research questions identify the things you want to understand; your interview questions generate the data that you need to understand these things.



## ***Approaches to the qualitative research question***

- Instrumentalist questions focus on what can be observed: “How are exemplary teachers observed to teach basic science?”
- Realist questions incorporate beliefs, feelings, and intentions as fallible evidence to be used critically to test ideas about what is going on: “How do exemplary teachers help medical students learn science?”

## ***Kinds of qualitative questions***

- Questions about the meaning of events and activities to the people involved in them
- Questions about the influence of the physical and social context on these events and activities

## ***Example of small grant concept paper***

Comments from the Chief of NIMH Health and Behavioral Science  
Research Branch:

- A detailed, empirically-supported conceptual/theoretical framework that guides specific aims, selection of measures, analysis, etc. is a critical foundation for any application.
- In addition to somatization disorder, would you be measuring depression and anxiety disorders/symptoms/related disability as part of the “stress-related symptoms?”
- Are there particular medical outcomes of interest based on prevalence estimates in this population from the existing literature? A more focused range of mental and medical outcomes would probably enhance the statistical power of your proposed study
- Explicit relevance to mental disorders/symptoms/related disability should be reflected in the title, abstract, theoretical framework, specific aims, measures and analyses.

## *Example of small grant concept paper*

Comments from CPRC staff review:

- The section on significance and description of this “special population” was informative but need to describe types of incarceration a bit more e.g., difference between a jail, prison, detention in terms of how the individual moves through the system.
- Although the research questions are stated on page 4 and outlined in the Aims, some reviewers felt a defined hypothesis would help focus the study on outcomes.
- Always ask the question--so what? What difference will this research make in the health of the American public? Some thoughts--perhaps an outcome is a set of screening question(s) useful to primary care practitioners’ assessment of the patient. Or, if you decide to research and explore the impact on children as noted on page 3 of the concept paper, an outcome could be expansion of funding for support groups as part of the improved care recommendations.

### *Revised specific aims*

- To estimate the percentage of adult female primary care patients with an incarcerated family member, and determine if practice-specific rates vary by practice characteristics such as proportion of minority populations served and proportion of underinsured patients
- To describe and compare adult female patients with and without the family incarceration experience with regard to biopsychosocial characteristics (sociodemographics, medical problems, physical/psychological symptoms, perceived stress, stressful life events, substance use, coping, social support, family functioning, presenting complaints, mental health symptoms, quality of life, and service utilization), and
- To investigate the relationship between family member incarceration and health outcomes (health related quality of life and its components) and service utilization.

# How to formulate a research question

Using the literature

Sarah Dennis



# How to formulate a research question?

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# Aims

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- ◆ How to identify a research idea
- ◆ How to identify whether it has been studied already using the literature
- ◆ How to formulate a research question from the research idea

# How to identify a research idea

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- ◆ Originate from everyday clinical problems
- ◆ Let it lie before pursuing
- ◆ If it still seems worthwhile – follow it up

# PICO principle

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Dissect what you want to know into its  
component parts



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# PICO

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**P**opulation or patients

**I**ntervention or indicator

**C**omparator or control

**O**utcome





# Population or Patient

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- ◆ Who are you interested in?
- ◆ How would you describe the patients or population of interest?
- ◆ Be precise
- ◆ Be brief

# Population or Patient

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## Example

✕ Asthmatics

- ✓ Adults with mild to moderate asthma (treated with  $\beta_2$ -agonists alone or with inhaled corticosteroids  $\leq 1$ mg daily)

# Intervention or Indicator

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- ◆ Cause
- ◆ Risk factor
- ◆ Prognostic factor
- ◆ Treatment or intervention
- ◆ Be precise
- ◆ Be brief

# Intervention or Indicator

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## Example

- ✓ High saturated fat diet
- ✓ Smoking
  
- ✓ Regular use of salbutamol

# Comparator or Control

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- ◆ What is the alternative to the intervention?
- ◆ May not always be necessary
- ◆ Be precise
- ◆ Be brief

# Comparator or Control

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## Example

- ✓ Low saturated fat diet
- ✓ Not smoking
  
- ✓ Salbutamol as needed

# Outcome

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- ◆ What do I hope to accomplish?
- ◆ What could this exposure really affect?
- ◆ Be precise
- ◆ Be brief

# Outcome

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## Example

- ✓ Death
- ✓ Glycaemic control
- ✓ Asthma control



# PICO Question

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In mild to moderate adult asthmatics (**P**), does the regular use of salbutamol (**I**) compared to as needed use (**C**) result in worse asthma control (**O**)?

# Activity 1

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- ◆ Read each example carefully and write a couple of sentences that identify the underlying idea the research was interested in.
- ◆ In your own words write the main question that the authors were trying to answer and list:
  - ◆ Population or patients
  - ◆ Intervention or indicator
  - ◆ Comparator or control
  - ◆ Outcome

# Principles of Literature Review

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# Principles of Literature Review

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- ◆ "Knowing the field" is a vital part of research and evaluation
- ◆ Demonstrates awareness of major theories, structures and debates in a topic area, and who is thinking about it
- ◆ Without this, it is difficult to put together a credible research proposal and almost impossible to carry out research successfully

# Why is it important?

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- ◆ Determines the extent to which your issue has been previously researched
- ◆ Identifies past relevant studies and methods used
- ◆ Helps refine your research question
- ◆ Places your research in the wider context
- ◆ Adds valuable background to the study
- ◆ Suggests areas for further investigation

# A good review.....

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- ◆ Relates your topic of interest to the broader topic
- ◆ Shows the expert reader that you have surveyed a broad range of relevant and appropriate literature
- ◆ Demonstrates that a number of different approaches to understanding the material will be used
- ◆ Helps you to produce an original study

# Not just a summary

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A literature review is a conceptually organized synthesis of the results of your search. It must

- organize information and relate it to the thesis or research question you are developing
- synthesize results into a summary of what is and isn't known
- identify controversy when it appears in the literature
- develop questions for further research

# Skills required

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To do a good review you need to employ the two sets of skills:

- **Information seeking:** The ability to scan the literature efficiently and identify a set of potentially useful articles and books.
- **Critical appraisal:** The ability to apply principles of analysis to identify those studies which are scientifically valid. Your readers want more just than a descriptive list of articles and books.



# Practical considerations

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- ◆ What structure suits my literature review best?
- ◆ What should I leave out?
- ◆ What quotations should I include?
- ◆ How am I going to keep track of my searches?
- ◆ What referencing system should I use?

**PHReNet**

Primary Health Care Research Network

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# Questions

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- ◆ What broad bodies of literature have relevance to my research topic (local and international)?
- ◆ What methods & results have previous researchers in the field produced?
- ◆ What theoretical model(s) relate to my research?
- ◆ What methodologies have been used by other researchers in this field?
- ◆ What are the most recent research findings in the field?
- ◆ What gaps and contradictions exist among these findings?
- ◆ What new research questions do these findings suggest?

# Where do I search?

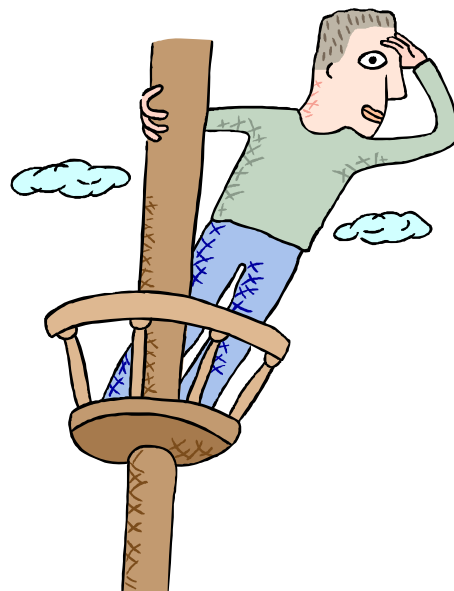
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- ◆ Colleagues and students working in related areas
- ◆ Literature review sections in the literature you are reading
- ◆ Library databases and indexes
- ◆ Librarians
- ◆ Conference proceedings
- ◆ Dissertations



# Basic Searching

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# Searching Medline

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## Clinical Information Access Program (CIAP)

<http://www.ciap.health.nsw.gov.au/>

**Access to most databases**



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# Planning your search

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- ◆ What is your question?
  - Population, intervention, (comparison intervention) and outcome
  - Identify key search terms (keyword search)
  - What are the limits? e.g. English, time, age range
- ◆ Where to look?
  - PubMed, Cochrane Library, Ovid
- ◆ Common search terms

# What is Boolean Logic?

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**Enter the word of interest and combine with “and”, “or” and “not”**

**e.g.**

- 1. “hypertension”**
- 2. “therapy”**
- 3. 1 and 2**

# Search Fields

<b>Field</b>	<b>Meaning</b>	<b>Syntax</b>
abstract	word in abstract	asthma.ab
author	author	dennis-s.au
journal	journal	lancet.jn
MeSH	Medical Subject Headings assigned by reviewer	ulcer.me
title	word in title	asthma.ti
textword	word in title or abstract	asthma.tw
unique identifier	unique identifier	91574637.ui
year	year of publication	1986.yr



# Example in Medline

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Type:

- |   |                        |  |
|---|------------------------|--|
| 1 | cervical cancer.ti     | [returns >750 articles]  |
| 2 | survey.ti              | [returns >4500 articles]   |
| 3 | learning disability.ti | [returns >100]   |
| 4 | BMJ.jn                 | [ >1000s of articles]  |
| 5 | 1 and 2 and 3 and 4    | [ returns only those articles with “cervical cancer” and “survey” and “learning disability” in the title and published in BMJ] |

(from How to Read a Paper by Trisha Greenhalgh. BMJ Books 2001)



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# Do I explode or focus?

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## Type in diabetes

### ◆ Focus

- restrict to articles that are actually about diabetes

### ◆ Explode

- diabetes is subdivided into lots of sections and explode includes all the sub-divisions

# How do I limit the results?

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## **The results can be limited by ticking:**

Full text

Humans

English language

Review

Abstracts

EBM reviews

Publication year

Age range



# There are too many irrelevant papers

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## Refine your search as you go

1. Use “not” to remove irrelevant terms associated with relevant terms
2. Link search words – to find “home help” type **home adj help.tw**
3. More than one adjacent word – to find community mental health care type **community adj2 care.tw**

# There are no papers

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- ◆ Reduce the number of limits
- ◆ Search textwords
- ◆ Explode

# Which MeSH?

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- ◆ Look for the MeSH listing on a paper that is relevant and you can find on Medline
- ◆ Use tree command to find where a word is placed in the MeSH headings
  - **tree diabetes**

# Still can't find anything?

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Look in other databases:

CINAHL – nursing and allied health

Cochrane Library

Embase – drugs and pharmacology

Psyclit – psychology, psychiatry etc

PEDRO - physiotherapy

# Still struggling

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- ◆ **Attend a course at Liverpool Hospital Library**
- ◆ **Make an appointment with a medical librarian**



# Activity 2

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- 1. Formulate a PICO question for your research topic of interest**
- 2. Identify the most appropriate databases to search for articles**
- 3. Write out the key words for your search**
  - MeSH, limits etc
  - Use of “and” “or” and “not”
  - Explode or focus

# Summary

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- ◆ PICO principles
- ◆ Literature review
- ◆ How to search in Medline

# Activity 3

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- ◆ Try the results of Activity 2
- ◆ In view of the evidence found revise the PICO question
- ◆ What problems did you encounter?
- ◆ Bring the results to the next workshop

## NHMRC Human Research Ethics Handbook

### Principles of Ethical Conduct

#### Research merit and safety

##### NS 1.13

**Every research proposal must demonstrate that the research is justifiable in terms of its potential contribution to knowledge and is based on a thorough study of current literature as well as prior observation, approved previous studies, and where relevant, laboratory and animal studies.**

All research involving humans needs to have both value and validity. That is, the research must demonstrate that, because of prior research, it is justifiable to seek the information to which the research is directed. Second, the research needs to be so designed that it is likely to lead to the discovery of new knowledge. HRECs need to be satisfied that these conditions are met, and may need to draw on expertise outside their membership for advice. (See NS 2.19.)

##### Points to consider

- Is there a clear hypothesis?
- Is the research likely to yield new knowledge, enhance understanding or clarify existing uncertainty?
- Has this, or similar, research been carried out before in the same, or similar, contexts?
- Could a systematic review of the literature demonstrate the importance of the research question?
- Do the researchers have the necessary expertise to analyse and interpret the results of the research project?
- Has a statistician been involved in the preparation of the research proposal? If not, should a statistician be consulted?
- Has the research project been designed to account for, or avoid, biases in participant selection, data collection, data analysis and data interpretation?

# Sources of Information

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**Trisha Greenhalgh. How to read a paper.  
2002 BMJ Books.**

**Centre for Reviews and Dissemination**

<http://www.york.ac.uk/inst/crd/search.htm>

**Centre for Evidence Based Medicine**

<http://www.cebm.net/searching.asp>



# Website Resources Disclaimer

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- ◆ This presentation can be used for the purposes of study and research.
- ◆ In using this work for these purposes, The University of New South Wales Primary Health Care Research Network (PHReNet) and the author (Dr Sarah Dennis) of this presentation expects that their work should be acknowledged and referenced fully.



## Formulating a Research Question

All research begins with a question derived from a general topic that piques your interest, often through general reading, topical discussion, lectures, family experiences, etc. In many cases the general topic is set by your Instructor.

Generally, the question should be:

1. Relevant.

The question should have some bearing on the topic and remain within the limits that were set beforehand.

2. Interesting.

Choose a topic that interests and stimulates you otherwise searching could become tedious.

3. Focused and specific.

The question should not be too broad or vague. You can however begin with a broad question and then narrow it down to be more specific. You can narrow the question down by:

- a particular aspect, e.g., economic, psychological
- a particular time period
- a particular event e.g., 9/11, rape, divorce
- a geographical area
- gender
- age group

The result should be a question for which there are two or more possible answers. The following examples illustrate how to narrow broad topics to create focused research questions.

<u>Broad topic</u>		<u>Narrowed topic</u>		<u>Focused topic</u>		<u>Research Question</u>
Women's health	→	Women and cancer	→	Women smokers and breast cancer	→	Is there an association between cigarette smoking and breast cancer risk?
Computer games	→	Computer game violence	→	Computer game violence and children	→	How does violence in computer games affect children?
Eating disorders	→	Teenagers and eating disorders	→	Teen peer pressure and	→	What role, if any, does peer pressure play in the

bulimia

development of bulimia  
among teens?

4. Researchable.

You should get a feel for what materials will be available to you. Know what the Library has to offer in the way of books and standard reference sources, indexes/databases, and services to acquire resources that are not in-house.

Sometimes your question seems doable at first but when you begin your research, it turns out not to be the case. Because most often you are doing a literature search for the results of previous research (as opposed to original research), it is recommended that you do a preliminary search to test if you can get enough material, and then, if necessary, revise your question.