



Asking good clinical research questions and choosing the right study design

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ABSTRACT

Clinicians and researchers seek answers to clinical research questions, primarily by accessing the results of clinical research studies. This paper moves the focus of research enquiry from getting answers to developing good clinical research questions. Using worked examples, the steps involved in refining questions drawn from various sources to create 'answerable' clinical research questions using the 'PICO' principle are described. Issues to consider in prioritising clinical research questions are also identified.

Theoretical and practical considerations involved in choosing the right study design for a clinical research question are then discussed using the worked examples. These include:

- Categorisation of questions according to their central clinical issues;
- Use of preliminary literature searching to identify existing research and further refine questions;
- Identifying whether a quantitative or qualitative research paradigm is best suited to a research question;
- Hierarchies of evidence that rank study designs and how they vary according to central clinical issues;
- Other factors influencing study design selection.

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What this topic is about

1. Asking good questions:
 - a. Sources and examples of questions.
 - b. Which questions should be pursued?
 - c. What is an 'answerable' question?
2. Choosing the right study design:
 - a. What is the question about?
 - b. Has the question been answered?
 - c. What research approach is appropriate?

Common problems and challenges

1. Researchers and clinicians encounter a large number and range of research questions;
2. Prioritising these questions can be challenging;
3. These questions are not often in a form that is 'answerable' from a research perspective;
4. Inadequate consideration of the meaning, structure and intention of research questions can have serious impacts on the subsequent research process.

Tips for researchers

Before embarking on a research project:

1. Prioritise questions from various sources;
2. Specify, refine and structure questions so that they are answerable using the PICO principle;
3. Determine the central clinical issue covered by the question;
4. Use literature searching to establish how the question has been addressed and if necessary, refine the question;
5. Match the question to the appropriate research paradigm and study design, with consideration of resource, feasibility, ethical and topic-specific issues.

Introduction

"Judge of a man by his questions rather than by his answers"
(Voltaire, French author, humanist, rationalist, & satirist; 1694–1778).⁴

Users of medical research, especially clinical practitioners, focus primarily on accessing results of clinical studies to answer clinical questions, most frequently "Does this intervention work?" Comparatively little attention is paid to the questions themselves. Yet failure to think carefully about the meaning, structure and intention of research questions can have adverse effects on every

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subsequent step of the research process, potentially compromising the answers. The fundamental purpose of asking good questions is to match these to an appropriate and feasible study design.

This paper outlines principles and strategies for asking good clinical research questions and identifying appropriate research paradigms and designs.

Asking good questions

Sources and examples of questions

Clinicians and researchers encounter a range of external and self-generated questions on a daily basis. As outlined in Table 1, the focus and nature of these questions varies according to the perspective of the stakeholder. Patients focus on issues of most relevance to their specific situation, such as relief of symptoms; the clinician or researcher considers broader issues, for example choosing from a range of intervention options; colleagues and funders seek justification of interventions and funding allocation, respectively.

Which questions should be pursued?

Because all of the above perspectives and questions are equally valid and important, the task of prioritising these is challenging for clinicians and researchers. This task is influenced by a range of factors including time and resource limitations, clinical urgency, organisational or local research agendas and funding sources. Straus et al.⁶ have identified these factors in the following five question ‘filters’:

1. Importance of question to the patient’s biologic, psychologic or sociologic well-being.
2. Relevance of question to you/your learners’ knowledge needs.
3. Feasibility of answering question in the time available.
4. Level of your/your learner’s/your patient’s interest in question.
5. Likelihood of question recurring in your practice.

Consideration of these can be helpful in identifying which questions to pursue.

What is an ‘answerable’ question?

An ‘answerable’ question in research terms is one which seeks specific knowledge, is framed to facilitate literature searching and therefore, follows a semi-standardised structure.^{6,3}

The many questions encountered by researchers and clinicians are often not ‘answerable’ in research terms. The generating of an answerable clinical research question often involves a degree of specification, or ‘funnelling’, whereby a large topic is broken down into a smaller, more manageable topic or topics. Many researchers’ first experience of the research process is a quest to ‘solve all the problems of the world’, followed by consultation with supervisors or senior researchers which results in substantial focusing of broad initial ideas. This process is critical, as a methodological approach used to address a question that is too broad may lack rigor. Furthermore, lack of focus in a research question creates inefficiencies in the research process itself. It is extremely difficult

Table 1
Sources and examples of clinical questions.

Source	Example
Patients	Can I return to work after my brain injury rehabilitation? How long will this pain last?
Own clinical/research experience	What is the best way to prevent and manage spasticity in Traumatic Brain Injury (TBI) patients? What is the impact of Spinal Cord Injury (SCI) on patients and their families?
Colleagues	Why did you do a CT instead of an MRI for this TBI patient?
Funders	Why should we fund physiotherapy for patients following discharge from SCI rehabilitation?

to recalibrate and reframe a research question once the process of seeking an answer is underway.

‘Answerable’ clinical research questions have four essential ‘PICO’ components⁶:

1. P: Patient and/or problem;
2. I: Intervention (or exposure, diagnostic test, prognostic factor, etc.);
3. C: Comparison Intervention (if relevant);
4. O: Outcome.

The general format of a ‘PICO’ question is:
“In [Population], what is the effect of [Intervention] on [Outcome], compared with [Comparison Intervention]?”

The ‘PICO’ question components are framed with ‘Intervention’ questions in mind, but several question types can follow a similar format. The key principle of the ‘PICO’ approach is that important components of the question are identified and defined or specified. Table 2 shows how using the PICO approach facilitates ‘drilling down’ of the questions identified earlier (Table 1). In the first two examples, interventions are identified; in the second a measurable outcome is also specified; in the third, the ‘intervention’ is identified as diagnostic rather than therapeutic, which has important implications for study design.

There are some cases in which departure from the ‘generic’ PICO format is warranted. For example, an answerable version of the question “Can I return to work after my brain injury rehabilitation?” may be: “What prognostic factors influence return to work in patients following TBI rehabilitation?” In other cases, the original question is sufficiently specific that no modifications are required, such as “What is the impact of SCI on patients and their families?” Although the final question is not strictly in the ‘PICO’ format in these examples, the key principles of identifying and specifying the important question elements have been considered.

Choosing the right study design

What is the question about?

The development of an answerable clinical research question using the ‘PICO’ principles facilitates the important process of categorising the question according to its central clinical issue,⁶ as illustrated in Table 3. This table shows that therapeutic interventions are only one of a number of clinical issues that can be

Table 2
Use of the ‘PICO’ principle to convert clinical questions to answerable clinical research questions.

Original question	Answerable clinical research question (PICO elements in italics)
What is the best way to prevent and manage spasticity in TBI patients?	In patients with severe TBI, what is the effect of <i>casting</i> on <i>spasticity</i> , compared with <i>pharmacological management</i> ?
Why should we fund physiotherapy for patients following discharge from SCI rehabilitation?	In patients following <i>SCI rehabilitation</i> , what is the effect of <i>community-based physiotherapy</i> on <i>functional status</i> , compared with <i>standard care</i> ?
Why did you do a CT instead of an MRI for this TBI patient?	In patients with suspected TBI, what is the diagnostic value of <i>CT</i> , compared with <i>MRI</i> ?

Table 3

Categorisation of clinical research questions according to central clinical issues.

Clinical research question	Category ⁶
In patients with severe TBI, what is the effect of casting on spasticity, compared with pharmacological management?	Therapy: selecting treatments that are effective and worthwhile
In patients with suspected TBI, what is the diagnostic value of CT, compared with MRI?	Diagnostic tests: selecting diagnostic tests with acceptable precision, safety, expense, etc.
What prognostic factors influence return to work in patients following TBI rehabilitation?	Prognosis: estimating likely clinical course and anticipating complications
What is the impact of SCI on patients and their families?	Experience and meaning: empathy and understanding of patient situations

addressed by clinical research questions. There are many other categories in addition to those identified in Table 3, including aetiology, prevention and differential diagnosis.⁶ This process of categorisation is an important precursor to considerations of study design.

Has the question been answered?

Once the key elements of the question have been specified and the broad question category identified, it is important to identify how this or similar questions have been addressed by existing published research. A systematic database search of appropriate major medical databases can:

- Identify how many primary and secondary studies address the question;
- Identify PICO elements and definitions;
- Help to determine the feasibility of answering the question using primary or secondary research;
- In doing so, focus and refine the question.

This continuation of the ‘funneling’ of the question may result in refinement or alteration of some PICO elements. For example, a search for articles addressing the question “In patients following SCI rehabilitation, what is the effect of community-based physiotherapy on functional status, compared with standard care?” could raise the following issues:

- Existing literature may focus on specific subgroups of SCI such as quadriplegics or paraplegics, necessitating *population* refinement;
- Outcomes other than function may be more widely reported in the literature, prompting consideration of whether function is the most appropriate *outcome*;
- Particular study designs such as Randomised Controlled Trials (RCTs) may not be represented in relevant literature, raising questions of feasibility or ethical limitations to using such designs;
- There may be a large body of literature addressing this question but no systematic review, in which case a systematic review may be more useful than another primary study.

Many clinicians and researchers, particularly those not engaged in evidence-based medicine or systematic reviewing, baulk at the notion of spending their limited time performing an in-depth

literature search at the question development stage. However, an investment of time at this point in the research process more than offsets the potential time and resources wasted in pursuing an inappropriate question, or one that has been comprehensively addressed already.

What research approach is appropriate?

There are two broad research paradigms: *quantitative* and *qualitative*. Most biomedical studies are quantitative; that is, numerical data is collected and analysed. However, numbers and statistics are not always the most appropriate approach to a clinical research question. Where research questions pertain to subjective phenomena such as feelings, attitudes and emotional responses, a qualitative research paradigm should be used. Qualitative research emphasises in-depth exploration and description, rather than numerical measurement, of variables.⁸ This results in a rich and deep understanding of the topic under study.²

Qualitative and quantitative research paradigms have distinct methodological underpinnings that influence every aspect of study conduct including sampling, data collection and data analysis. It is therefore critical to match the research paradigm to the clinical research question prior to more in-depth consideration of study design (as described below) to ensure that the eventual study results are valid and useful. Such considerations apply to both primary and secondary (literature review) research.

Table 4 summarises key differences between qualitative and quantitative research approaches using two clinical research questions described earlier. An in-depth description of these differences is beyond the scope of this paper.

What study design is appropriate?

There are numerous quantitative and qualitative study designs. Because most biomedical study designs are quantitative, this section will focus on the quantitative research paradigm.

The most appropriate quantitative study design for a given clinical research question is dependent upon the nature of the question being asked. As discussed earlier, questions pertain to a variety of central clinical issues such as therapy, diagnosis and prognosis (see Table 3). Each of these issues belongs in a distinct quantitative research category, for which a range of study designs is possible.

Study designs are often ranked from most to least robust in a ‘hierarchy of evidence’. For the central clinical issue ‘therapy’ identified in Table 3, the hierarchy of evidence for this research

Table 4

Example of quantitative and qualitative clinical research questions.

Clinical research question	Data	Approach	Design example	Analysis example
In patients following SCI rehabilitation, what is the effect of community-based physiotherapy on functional status [Functional Independence Measure; FIM score] compared with standard care?	Numerical	Quantitative	RCT	Statistical
What is the impact [emotional responses, attitudes] of SCI on patients and their families?	Non-numerical	Qualitative	Focus group	Qualitative content analysis

category ranks a systematic review of RCTs highest, followed by RCT (the highest ranked primary study), Pseudo-RCT, Non-Randomised Controlled study, and Case Series designs.¹ Importantly, hierarchies of evidence differ according to research category. For example, if the central clinical issue is 'prognosis' (Table 3), a Prospective Cohort Study – not an RCT – is the highest ranked primary study design for this research category.¹ There are many published 'hierarchies of evidence' with varying study design descriptions and categories, predominantly dealing with 'therapy' or intervention-based research. However, a good example of a hierarchy that illustrates the principle of how study design varies according to research category is the hierarchy of the Australian National Health and Medical Research Council (NHMRC).¹ This document also has extensive explanatory notes.

The choice of study design is influenced by a range of factors other than ranking in a hierarchy of evidence. These include resources (staff, infrastructure, time), feasibility and ethical considerations. In some cases, specifics of the population, condition or intervention under study also influence study design. For example, the generally low number of SCI patients at any one clinical centre has necessitated the creation of networks for multicentre studies. Furthermore, the heterogeneity of SCI as a condition leads to consideration of further issues such as specificity and stratification.⁷

Conclusion

This paper has examined the issue of question development by considering two key principles: asking good questions and choosing the right study design. Identification and consideration of these principles is a critical first step in the research process. Giving careful thought to these issues can substantially focus

emerging questions and aid in the determination of how they may be best addressed in research terms.

However, the nature of human enquiry, combined with the complexity of medicine, is such that no matter how well refined and structured a clinical research question is, and how comprehensively it has been answered by a single study:

"The outcome of any serious research can only be to make two questions grow where only one grew before" (Thorstein Veblen, US economist & social philosopher; 1857–1929).⁵

Disclosure statement

The author has no conflicts of interest to declare in relation to this paper.

References

1. Coleman K, Grimmer-Somers K, Hillier S, et al. NHMRC additional levels of evidence and grade for recommendations for developers of guidelines: Stage 2 consultation. NHMRC (National Health and Medical Research Council); 2008. Available at http://www.nhmrc.gov.au/guidelines/consult/consultations/add_levels_grades_dev_guidelines2.htm [Accessed November 12, 2009].
2. Giacomini MK, Cook DJ. Users' guides to the medical literature. XXIII. Qualitative research in health care B. What are the results and how do they help me care for my patients? Evidence-Based Medicine Working Group. *JAMA* 2000;284:478–82.
3. Flemming K. Asking answerable questions. *Evidence-Based Nursing* 1998;1:36–7.
4. QuotationsPage.com. Voltaire Quote; 2007. Available at <http://www.quotationspage.com/quote/28697.html> [Accessed November 12, 2009].
5. QuotationsPage.com. Veblen quote; 2007. Available at <http://www.quotationspage.com/quote/32057.html> [Accessed November 12, 2009].
6. Straus S, Richardson W, Glasziou P, Haynes R. Evidence-based medicine: how to practice and teach EBM. Edinburgh: Elsevier; 2005, 16, 20, 21.
7. Tator CH. Review of treatment trials in human spinal cord injury: issues, difficulties, and recommendations. *Neurosurgery* 2006;59:957–82 [discussion 82–7].
8. Thomas RM. Blending qualitative and quantitative research methods in theses and dissertations, 1st ed., Thousands Oaks: Corwin Press, Inc.; 2003.