Strategic Literature Searching: Part 1. Asking Good Questions

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A well-designed question in a search for clinical information maximizes the potential for discovering the most useful and relevant information. The PICO format was designed for exactly this purpose—to make the search for answers easier and faster, especially for those times when questions arise in the context of a patient visit. PICO (patient/population, intervention, control/comparison, outcome) is the most well-known framework for designing good questions, with PIO, PIC, and PICOT as common adaptations of the basic PICO structure. Several examples of question development and framing are provided that are drawn from the clinical literature, as well as suggested best practices for integration with the patient record. *Int J Evid Based Pract Dent Hygienist 2016;2:22-27. doi: 10.11607/ebh.56*

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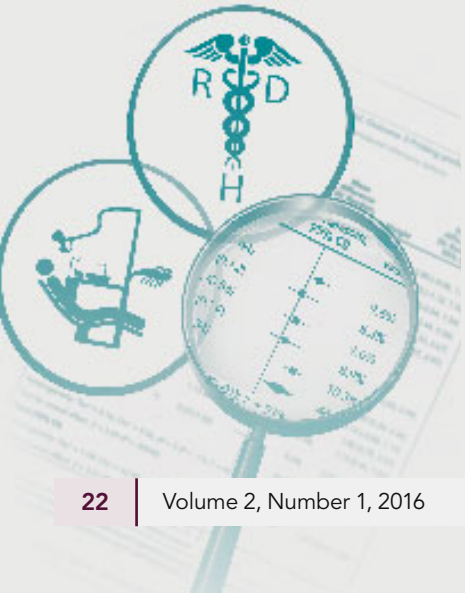

Most people begin Google and PubMed searches the same way—by experimenting with words they think are relevant to the topic and entering those into the search box. However, this is neither an actual question nor a strategically sound approach to finding answers. The first step toward a more dependable strategy is to try to put into words what it is you want to discover; you will find different types of links and articles if you search "diabetes" compared with searching "what causes diabetes." In PubMed, there is an even bigger difference between searching with a fairly simple question and searching with a more specific question that is focused on a goal (for example, "What are the most common oral health risks for patients with uncontrolled diabetes?"). Although some information will be the same, you have a better chance of finding the answer, and finding it quickly, if you can actually say what it is you want to find. Luckily, there are tools that have been developed to help people organize their thoughts in order to form better questions and to structure the question to make it more searchable. PICO is the most well-known tool of this sort.

What is PICO?

PICO is an acronym that stands for *patient* or *population*, *intervention*, *control* or *comparison*, and *outcome*. First proposed in 1995,[1] it has since become the standard against which all other question formats are compared in evidence-based clinical practice. The idea behind its creation was to help clinicians learn how to structure questions that are both relevant to their immediate need and that are more likely to uncover relevant answers.

TABLE 1 PICO considerations

Patient or Population or Presenting Symptom
1. Required: Disease, diagnosis, primary presenting symptom.
2. Fundamental characteristics, such as gender and age or age range.
3. Other patient characteristics that may influence the condition, treatment, or the ability to identify an answer, but which may not be relevant to each condition or patient, such as race, current or prior pregnancy status, socioeconomic status, social support resources, communities, geographic location, etc.
4. Specific medical characteristics used to identify a patient group of interest, such as age at diagnosis, stage at diagnosis, response to standard treatment, or other factors.
Intervention
1. Actions performed by a health care practitioner (HCP) with the intent to correct, improve, or prevent a health challenge, condition, or disease. These include but are not limited to surgery, oral prophylaxis, the prescription of medications, or other therapies.
2. Actions performed by a patient under the advice of an HCP, including but not limited to diet, exercise, tooth brushing, use of an app or other behavioral management tool, etc.
3. Actions performed by a patient of their own choice, with or without the awareness or agreement of their health care provider. These may include complementary or adjunctive treatments, over the counter (OTC), etc.
4. External events or circumstances imposed upon a patient, with or without their consent, such as trauma (either physical or psychosocial), surviving a natural disaster, domestic violence, prior illnesses and exposures, etc.
Control or Comparison
1. Patient comparison or control group with alternative intervention, placebo, or no intervention.
2. Nonpatient comparison group (general population, or recognized statistical norms).
3. Alternative patient population.
4. Treatment or methodology comparison or control.
Outcome
1. Survival/disease-free survival. This may be of the patient, of installed appliance (eg, dental implant), or of original body part (eg, tooth, chewing surface, tissues, organs).
2. Correction, measurable improvement, or reduced incidence of the disease, diagnosis, primary presenting symptom of interest.
3. Measurable differences in specific relevant test results or abilities (eg, pocket depth, chewing ability, tooth stability).
4. Quality of life, satisfaction, pain.

Huang et al stated that, "Clinicians have 0.7 to 18.5 questions for every 10 patients they care for. However, answers to two-thirds of the questions are either not pursued or pursued but not found. Subsequent analyses show that almost all unanswered questions could be answered through improved query formulation and better search."[2] The PICO format was designed to make the search for answers easier and faster, especially for those times when questions arise in the context of a patient visit.

Sometimes the patients provide their own questions or they arise from events or clinical observations during or following the patient visit. Given sufficient time, the clinical care process for any individual patient could generate an overwhelming number of questions. The problem usually is not to come up with questions but to focus on those that are most important and immediately relevant and to structure them in a way that is clear and searchable. Richardson et al recommend that, "If you are stuck . . . try this sequence of queries: What is the most important issue for this patient now? What issue should I address first? Which question, when answered, will help me most?"[1]

Ask yourself what is most important at the moment, what the first priorities are in the treatment plan, what will provide the greatest improvement in quality of life for the patient, and what you as the care provider most need to know to achieve these goals. Answering these will usually help to focus questions on a single area or topic. Table 1 gives brief definitions of the four aspects of a PICO question. Let's apply them by walking through an example of question development.

Example: Simple question

Scenario

A patient with bad breath does not believe that toothpaste makes a difference when tooth brushing, and has read that there is no real evidence behind it. The patient wants you to prove it.

Developing the PICO question

What is the "patient"?

While the presenting symptom is bad breath, the patient portion of the description could be phrased in many ways, depending on the actual patient and depending on how much information you expect to find. If you are not sure how much information is available on this question you might start broadly, with just the presenting symptom. If you expect there is much information, then add some descriptive factors to help limit the amount of articles to examine. Some examples of how you might phrase the "patient" part for this PICO question are:

- In patients with bad breath . . .
- In male patients with mixed dentition and bad breath . . .
- In teenaged male patients with bad breath . . .
- In aged partially edentulous female patients with bad breath . . .
- In a primiparous 24-year-old female with morning breath . . .

What is the "intervention"?

In this example, the most focused intervention is the use of toothpaste. You might decide to also include tooth brushing as an intervention, and would need to consider whether that would form the most appropriate question. Is tooth brushing going to be relevant, or will it complicate the question and create confusion or distractions from the main answer you want? Does including "toothpaste" imply tooth brushing? If so, then tooth brushing does not need to be stated. Are you questioning a specific type of toothpaste, either by compounds in the paste or by manufacturer? Are there other factors that might affect the intervention? Examples of how you could phrase the intervention are as follows:

- . . . does the use of toothpaste . . .
- . . . does the use of toothpaste in tooth brushing . . .
- . . . does the use of a zinc-containing toothpaste . . .

What is the "control" or "comparison"?

When you specify a control or comparison group, ideally that concept should be searchable. Sometimes that concept is not able to be directly stated in a search, and has to be implied through other factors. It is important to keep in mind that if you want to search a full PICO question, your life will be easier if the "C" portion represents a searchable concept. Some comparisons you could try in this search are:

- . . . as compared with tooth brushing with water only . . .
- . . . as compared with tooth brushing with baking soda . . .
- . . . as compared with no tooth brushing . . .
- . . . as compared with mouthwash . . .
- . . . as compared with drinking green tea . . .
- . . . as compared with any other alternative . . .

What is the "outcome"?

When thinking of the outcome, you should also consider how the outcome will be assessed or measured. This is especially true when you are including a comparison group, since you would need to apply the same comparison metrics to both groups. Whether or not this metric is included in the actual search, it is recommended to include it in the stated question. It is also important not to confuse one outcome with any others. If we know that tooth brushing reduces periodontitis and that periodontitis is associated with bad breath, it is tempting to add in "reduction of periodontitis" as a desired outcome; however, to do so would make it difficult or impossible to find the first answer. If you are interested in both, better to do two separate searches and to treat the two desired outcomes individually. Outcomes of interest for this patient scenario might be:

- . . . reduce odor?
- . . . reduce volatile sulfur compounds (VSC) (H_2S, CH_3SH) as measured by gas chromatography?

The question, assembled

This is only one example of a completely formatted question you could make from the various pieces listed above: In patients with bad breath, does the use of toothpaste, as compared with tooth brushing with water only, reduce odor? In publications or abstracts, this would often be stated in the following format: (P) In patients with bad breath, (I) does the use of

toothpaste, (C) as compared with tooth brushing with water only, (O) reduce odor?

PICO format modifications

We have been discussing the classic version of PICO—patient, intervention, control/comparison, and outcome. However, as the concepts, practice, and methodologies of evidence-based health care have evolved, they have also been refined. PICO has received a number of significant alterations, which can be considered optional and used as appropriate.

PICOT

The "T" added to the end of PICO stands for *time* or *time frame*. Temporal factors are relevant to many conditions in that healing or improvement may be desired in a specific amount of time or the condition may have endured a specific length of time. This should be used when the topic or question is broad or when the initial test search is a very large number. Adding time to the search statements will make for a more focused search strategy with fewer search results. This is often desired when searching for quick results for evidence-based clinical practice. Table 2 includes two examples[3,4] from the clinical dental literature.

TABLE 2 PICOT examples

Loh et al,[3] 2004	
Patient	In human carious primary molars with reversible coronal pulpitis,
Intervention	Does a pulpotomy performed with ferric sulfate,
Comparison	Compared with formocresol,
Outcome	Result in clinical/radiographic success,
Time	In time periods up to exfoliation?
Toh and Messer,[4] 2007	
Patient	In primary molar proximal lesions,
Intervention	Does the use of one material (GIC, RmGIC, CR, or PAMCR)
Comparison	Compared with the remaining materials
Outcome	Result in higher success rates
Time	When followed for at least 1 year?

PIO and PIC

PIO stands for patient, intervention, and outcome. PIC stands for patient, intervention, and control or comparison. Both of these shortened PICO alternatives are useful primarily when you are finding too few results, the results you have found are not answering your question despite having a well-constructed search, or when you are searching in a topic with a relatively small research base such as dentistry (please note that dentistry is not a small research domain in the sense of what you need to know, only in the sense that it has a small research base in total number of articles when compared with major research areas such as cancer).

Identifying core concepts

Once you have determined what you believe to be the best question, the next step is to break the question down into its most important ideas. If the question is in PICO format, then the hard part is already done. Let's look at the earlier question as an example: (P) In patients with bad breath, (I) does the use of toothpaste, (C) as compared with tooth brushing with water only, (O) reduce odor? The core concepts are:

- (P) bad breath
- (I) toothpaste
- (C) tooth brushing with water OR tooth brushing
- (O) odor

When questions are not phrased in a PICO format or include PICO elements in various orders, breaking the question down into its individual core components is useful. Table 3 shows some examples from recent systematic reviews[5–8] and how core concepts might be identified for those questions. Note that each review has a very different style for questions, and the core concepts identified may include more, fewer, or different concepts than those identified in the standard PICO format.

Ordering concepts

When searching a concept related to a particular patient, it is helpful to add brief notes in the patient's record regarding the question, search, selected findings, and recommendations. If it ever becomes necessary to return to these notes, it can be useful to have a standard structure to ensure consistency for all patients, to maintain professionalism, and to make

TABLE 3 Core concept examples

Van Strydonck et al,[5] 2012	
QUESTION	Does CHX mouthrinse as a monotherapy or as an adjunct to mechanical oral hygiene, in randomized controlled clinical trials (RCTs), have an effect on plaque and parameters of gingival inflammation as compared with a placebo rinse, a control rinse, or regular oral hygiene when used by healthy adults with gingivitis over a minimum of 4 weeks?
Patient	Healthy adults with gingivitis
Intervention	CHX mouthrinse
Comparison	Placebo rinse, control rinse, OR regular oral hygiene
Outcome	Gingival inflammation OR plaque
Time	A minimum of 4 weeks
Methodology	Randomized controlled clinical trials (RCTs)
Roberts and Moule,[6] 2011.	
QUESTION 1	Can chlorhexidine gluconate reduce ventilator-associated pneumonia rates in intensive-care patients?
Patient	Intensive-care patients
Intervention	Chlorhexidine gluconate
Outcome	Reduce ventilator-associated pneumonia rates
QUESTION 2	Can tooth brushing reduce ventilator-associated pneumonia rates in intensive-care patients?
Patient	Intensive-care patients
Intervention	Tooth brushing
Outcome	Reduce ventilator-associated pneumonia rates
Hossainian et al,[7] 2011	
QUESTION	What are the effects of oxygenating mouthwashes on plaque accumulation and parameters of gingival inflammation in adults, when compared with positive or negative control mouthwashes or with no oral hygiene, when used as a monotherapy or as an adjunct to daily oral hygiene?
Patient	Adults
Intervention	Oxygenating mouthwashes
Comparison	Control mouthwashes OR no oral hygiene
Outcome	Gingival inflammation OR plaque
Kunnen et al,[8] 2010.	
QUESTION	None stated. Question inferred in this paragraph: "Women with diseases associated with chronic low-grade inflammation, such as diabetes mellitus, hypertension, obesity and arterial diseases are at an increased risk of developing pre-eclampsia. Because periodontal disease is also associated with low-grade inflammation, it can be hypothesized that patients with periodontal disease have an increased risk of developing pre-eclampsia. A number of studies recently focused on a possible relationship between periodontal disease and pre-eclampsia. The aim of this review is to evaluate the published scientific evidence for this possible relationship."
Patient	Pregnant women
Intervention	Periodontal disease
Outcome	Pre-eclampsia

it easier for you to decipher and explain the notes later, as well as to make it easier to reconstruct the search strategy. Using the PICO format for forming the question is one helpful strategy.

Organizing the search concept groups according to PICO is valuable for multiple reasons. First, adopting and applying a consistent structure across steps of the search process facilitates cognitive organization of the elements and issues, and helps ensure consistency in practice across different searches for different patients. Second, when building a search strategy it is not unusual to find it necessary to return

to the plan and revise it. It is helpful in the process of revision to have placed the most important concepts at the beginning and move down the list. Then, if you do need to revise the search, you can remove search terms near the end without risking accidentally deleting key search concepts. Third, while PubMed is not a database that functions this way, some search interfaces give greater weight or importance to the concepts placed first in the search strategy[9] and consideration of this is commonly recommended as a best practice in developing search strategies. Therefore, it is sometimes best to list concepts in the order of their importance when defining the overall search statement.[10] Because of this, it is recommended to form the habit of placing the patient first in the search strategy, just as the patient is at the heart of health care.

For these reasons, consider the sequence or order of the search groups as having utility and significance in the search process. Consider what is most important in the search and position that concept as the first part of the search strategy, continuing with the second most essential concept, and so forth. Typically, the most important part of the question will be the patient or the patient's diagnosis or presenting symptoms, which can serve as a surrogate for the patient in a PICO-formatted question and search. The question will make little or no sense if these are removed. Removing a concept to see if you can still make sense of the question is a useful approach to determine the relative importance of the various concepts.

Conclusions

While PICO-formatted questions are commonly recommended as a standard base for developing effective searches in evidence-based practice, the elegant simplicity of the structured formula has sometimes led to either inflexibility in applying the PICO structure or an oversimplification of the nuances that contribute to its efficacy. This outline of the development of the classic PICO structure and its variants, provided with detailed examples, hopefully has provided the reader with a context for assessing the strengths, weaknesses, and often overlooked subtleties of using PICO-formatted questions.

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