



PROTECTING WORKERS'
HEALTH SERIES NO 7

**A PRACTICAL GUIDE FOR
THE USE OF RESEARCH
INFORMATION TO
IMPROVE THE QUALITY
OF OCCUPATIONAL
HEALTH PRACTICE**



WORLD HEALTH
ORGANIZATION

A PRACTICAL GUIDE FOR **THE USE OF RESEARCH INFORMATION TO IMPROVE THE QUALITY OF OCCUPATIONAL HEALTH PRACTICE**

FOR OCCUPATIONAL & PUBLIC HEALTH PROFESSIONALS

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PREFACE

Why a guide?

We, the editors, have both been trained as occupational physicians and occupational epidemiologists. We conducted occupational cohort studies to find out causes of ill health at work. The work of Sackett and colleagues raised our interest in other applications of epidemiology: how to use scientific evidence in professional practice. Their work showed that epidemiology was much more widely applicable in practical daily occupational health care than in occupational cohort studies only. Methods of clinical epidemiology can be usefully applied. After attending a course on Evidence-based Medicine (EBM) we became enthusiastic about the possibilities of applying EBM to our field. It turned out that there was a lot of research-based knowledge, information or evidence, whatever you like to call it, available in the scientific literature that has practical value. We judged this as a most interesting extension of our traditional sources of information such as text books or experts' opinion. For us, it has been much fun to do and very instructive to learn. Since much of the information is available free of charge through the Internet, everyone with Internet access can use it. With this book we hope that we can convey our optimistic experience so far to other occupational health professionals.

For who is this guide intended?

The guide is intended for occupational and public health professionals interested in trying to improve the quality of their work. Retrieving information is not difficult nowadays. However, you need a more systematic approach if you want to be sure that you can rely on the coverage and quality of the information found. Unfortunately, there is not one fixed pathway for the approach. You have to have some interest in experimenting and finding out how the methods of evidence-based medicine suit you best. There are many textbooks available on evidence-based medicine, but none of them is written from the point of view of occupational health. We hope that this book will fill up this gap at least for some part.

What prior knowledge is needed to work through this guide?

There is some discussion about the prior knowledge needed to be able to use research information in occupational health practice. In our view, you need a basic background in health science and some knowledge of epidemiology. You need to be familiar with terms as prognosis and diagnosis and you need some understanding of bias that can distort the results of scientific research. We feel that most professionals in occupational health would have sufficient knowledge to follow the chapters in this book and to be able to use research information in their own practice.

What technical facilities are needed to make best use of this guide?

You need access to the Internet in order to follow the information and to carry out the exercises in the book. You do not need to be on-line all the time, but the least you need is to be connected through a telephone line connection for about an hour or so regularly. We realise that, at this moment unfortunately, this is not possible for all occupational health professionals everywhere in the world.

How was the guide developed?

The guide has evolved from a course book for Dutch occupational physicians. Unfortunately, this can still be recognised easily, since many examples are focussed on physicians. However, we suppose that occupational physiotherapists, occupational health nurses, occupational hygienists, psychologists and ergonomists could also benefit from the book. We were stimulated by our participation in the Network of WHO Collaborating Centres in Occupational Health and the ICOH scientific committee of Occupational Health Services Research and Evaluation to attract other authors and make this into an international project.

What is the structure and what are the learning goals of this book?

We cover all the steps from the moment that questions or an information need in practice is generated, up to the moment that the information is processed in the form of a recommendation to the employer or employee. (figure 1) The various steps are covered in the chapters that follow. In chapter 2 we will focus on the reformulation of questions that arise from practice into questions that can be answered by a literature search. In chapter 3 we will specify what search strategies are best suited for occupational health questions. In chapter 4 we expand on the search strategy by listing databases of interest outside the direct medical scope. In chapter 5 we deal with the methodological quality of the research information found. Finally, in chapter 6 we structure the problem of application in practice of the results found and appraised.

We have incorporated exercises to allow you to practice with the contents of each chapter and to become familiar with your own knowledge management. At the end of the book you will find the answers to the exercises.

To facilitate your learning, throughout the chapters we have included boxes which give examples, tables which are most often checklists and we also highlight practical tips.

The guide aims at developing skills in

- ... asking relevant questions that originate from professional practice
- ... reformulating questions from practice in such a way that it results in the capability of looking for an answer in scientific or evidence-based information sources, for example recently updated manuals, guidelines, journal articles or high quality websites.
- ... performing a focussed search on Internet in the Medline database using the PubMed search engine
- ... globally appraising the value of scientific articles found with regard to reliability and relevance to the question asked
- ... formulating an answer to the question, based on the information found, and applying this in practice.
- ... presenting the result to colleagues, for example in the context of a clinical audit or journal club.

Who reviewed the book?

We would like to thank Dr E Schonstein and Dr D Smith from Australia, Dr P Abeytungu from Canada, Dr S Siriruttanapruk from Thailand, Dr G Delclos from the USA, Dr J Myers and Dr K Renton from South Africa and Dr J Rodriguez-Guzman from Colombia for their valuable suggestions.

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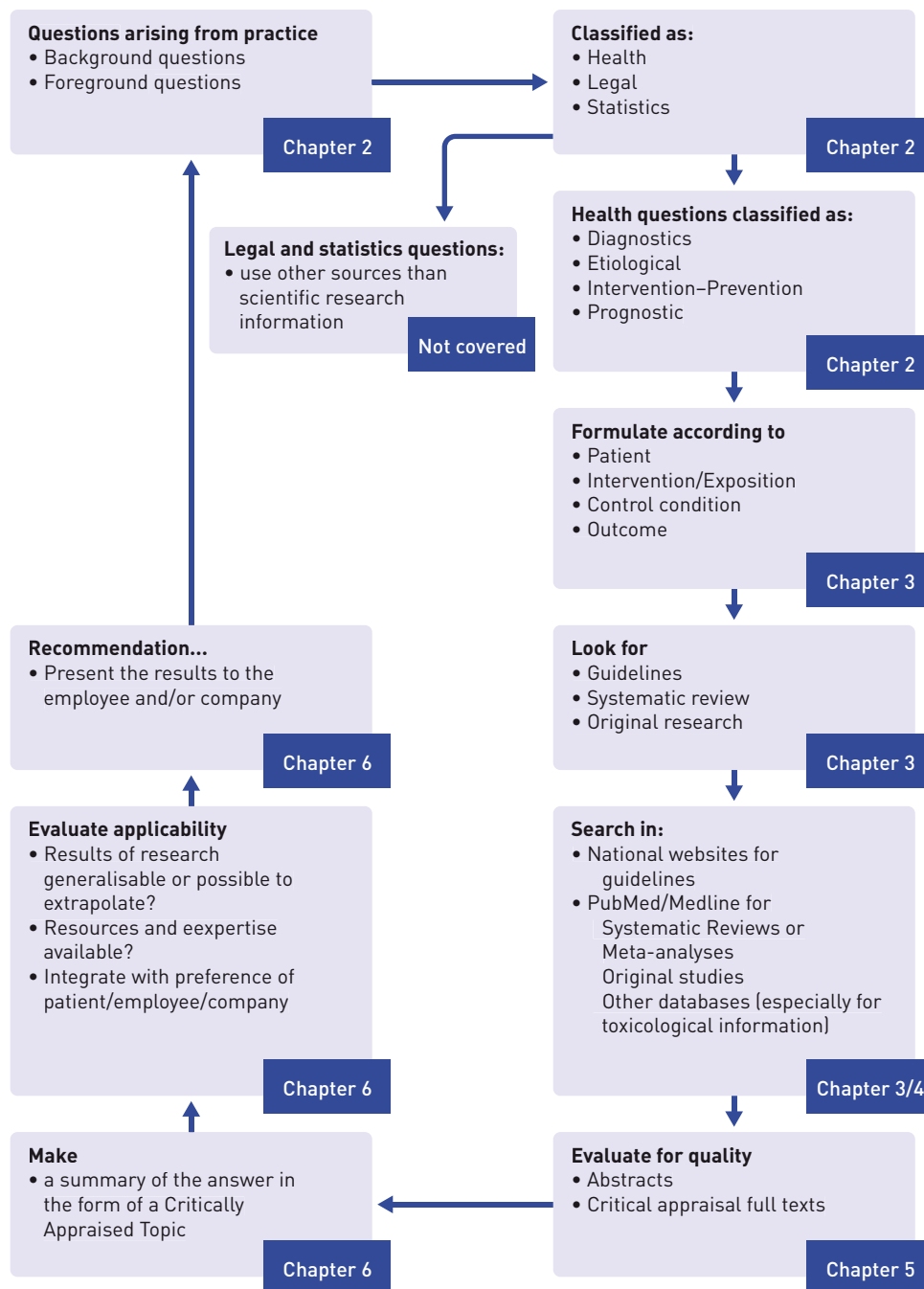


Figure 1: Flow chart for answering questions in practice

Chapter 1

WHY USE RESEARCH INFORMATION?

Main points

- Decisions in professional occupational health care practice are based on: professional expertise, patient / worker / employer preferences and evidence from research information
- Research information is nowadays available through the Internet
- Questions arising from practice can be answered with information from scientific research. This will improve the quality of care.
- Information should be searched for, critically appraised and applied to practice in a systematic way

Introduction

The idea to use research information to improve the quality of occupational health practice originates from evidence-based medicine (EBM). Evidence-based medicine is an area that is becoming increasingly important in the medical field. It promotes the idea that clinical management should be based on three pillars: clinical skills of the doctor, the preferences of the patient and evidence from research. The use of evidence from research has been encouraged by the increasingly easy access to the huge databases of medical literature which, in practice, are consulted far too infrequently. It is for this reason that the possibilities for effective treatment have for years not been made use of in practice, and conversely, that even harmful treatments have at times been applied.¹

This is not different in the area of occupational health care. Traditional views are only slowly changed when there is evidence from scientific research which indicates that there are more effective ways of dealing with practical problems. For example, there is a long standing tradition that workers should be advised to lift with a straight back in a squat position to prevent low back pain. It has been shown, however, that, from a biomechanical point of view, the squat lift is not different from the stoop lift.² In addition, reviews of effectiveness of lifting

instructions show that there is no evidence that these instructions lead to less back pain.³ In spite of this evidence, we are afraid, that most occupational physicians would still advise the use of the squat lift. Another example is the return to work of patients with low back pain. Until the eighties of the last century the advice used to be to rest until the back injury had healed.⁴ Since then, evidence has been accumulating that on the contrary, resting with back pain is harmful and does not add to normal functioning but will increase the risk of suffering from chronic pain.⁵ Nowadays, this advice has been incorporated in many clinical practice guidelines for physicians, including occupational physicians.⁶ We may hope that in this case the implementation of this intervention in occupational health care is better carried out.⁷ Finally, these improvements in the quality of care should lead to a decrease of the number of employees drawing sickness absence and disability insurance benefit as a result of back pain. There is some indication that these figures are decreasing indeed. It is likely that in occupational health care, more than elsewhere in the health sector, certain mechanisms such as employer demands or workers' beliefs and traditions, can maintain ineffective practice. This is why it is important that all occupational health professionals should be able to find and apply the most recent scientific developments in their field.

Box 1.1 Examples of advertisements in Occupational Health

- 'Let us guide you through the world of OCCUPATIONAL HEALTH using Ron's 400 links.'
- 'Everyone who has something to do with occupational health issues can search here with a search engine or per category. Members can communicate with each other via a forum'.
- 'Read about activities that cover the whole range of care for health, safety and welfare of your employees. Download a game and screensaver – FREE!!'

In addition to the development of evidence-based medicine in the past ten years, there has also been an increase in the information supply, particularly through the electronic distribution of information. Every health professional with access to the Internet can access more than 15 million scientific articles that are stored in Medline. Furthermore, there is a whole range of websites that claim to provide us with useful information. If you give an Internet search engine the assignment to search for 'occupational health', you will get millions of hits with persuasive texts like those shown in [box 1](#). The huge amount of information available makes it difficult to make a choice and it becomes increasingly important to be able to assess the quality and reliability of the information provided.

The need to remain up-to-date, combined with the unstructured nature of the information supply on the Internet, makes it absolutely necessary to develop some kind of professional

knowledge management strategy: Where do I get my information from, how do I convert this into knowledge, and how do I apply this knowledge in practice? In the evidence-based medicine strategy, this is a process that can be divided into four stages: formulating a question to be answered, searching for the answer, evaluating the quality of the information found, and applying this to the practical problem.

What is the information need of the occupational health professional?

An important criterion for collecting information successfully is having an insight into the information needs that the occupational health professional has in daily practice. Research conducted among GPs has shown that the majority of their information need is concerned with the field of therapy. A study among Dutch occupational physicians revealed that in their daily practice, the need for different types of information existed.⁸ They have strictly medical questions such as ‘how high is the risk for pregnant employees of a child care centre of being infected with Varicella?’ Then there are requests for information about legal problems and the social security rules such as ‘when do the rules of the disability insurance apply?’ In addition, there are questions about statistics such as ‘where can I find the data on occupational diseases frequencies during recent years and on national sick leave?’

Where do I go to find the information?

Colleagues, medical specialists and other experts, books, journals and courses are the major sources of information.⁸ More recently the Internet has provided us with an overflow of information through health portals and specific websites. Occupational health professionals themselves are realising more and more the importance of knowledge management, through for example, practice guidelines for occupational physicians as developed in some countries. It is unclear to what the extent of implementation of these guidelines is in practice. From research on this topic we can learn that there is still ample room for improvement.^{7;9} The amount of energy and time required to consult these sources varies according to the source. A quick question to a colleague is not a big investment, whereas following a course can be time consuming. Sometimes it is easier to ask an expert, on other occasions it is simpler to get onto the Internet.

Is all information equally useful?

When you ask a question of a colleague whom you know well, you might be able to estimate the degree of reliability of the answer. When you ask a specialist, it is more difficult. Often, you do not know the knowledge they are basing their experiences upon. From a survey we carried out in the Netherlands it turned out that most of the answers of colleagues and even experts

were not based on the latest research evidence and were incorrect.¹⁰ Books and magazines are also sources of a great deal of knowledge, but the quality can vary enormously. Think for example, of the tremendous amount of literature concerning the field of work-related stress or repetitive strain injury. All products and services that are commercially available claim to be effective. The same applies perhaps even more strongly for information on the Internet. However, research into the publications from the pharmaceutical industries has shown that the greater the role of commercial interests, the greater is the tendency to present the results in a more positive light than is the case.¹¹ It is therefore not only necessary to have a structure for looking for information, but you must also be able to assess its quality or reliability. A method has been developed to assess scientific articles so that it is possible to grade the quality of the information made available. This is also known as critical appraisal which we will deal with later in the book.

Once you have found the information, how do you apply it?

A final step in successfully looking for and finding the information, is applying it. When you have found the sick leave figures from a national statistics publication, the next question to ask is whether these figures are comparable with the figures that you yourself want to use for a company. Do they use similar data such as sick leave percentages or sick leave frequencies? If that is not the case, how can you still apply them with a margin of inaccuracy? The same applies for medical information. In an article on the degree of infectiousness of Varicella, the patient population under study can be totally different from the childcare centre where the question originated. Can you still apply and process the results of the literature search in a recommendation to the management and personnel of the childcare centre?

Exercise 1

Sources of information

Write down which sources of information you use in practice and see how they relate to the sources named in the book.

Chapter 2

QUESTIONS ARISING FROM PRACTICE

Main points

- Questions arising from practice that you are unable to answer immediately help in learning and improving the quality of your work
- Questions that arise from practice should be converted into answerable questions
- Occupational health professionals currently have more types of questions than can be answered with research information.
- Research information will help in answering foreground questions that are directly related to health such as about medical complaints and health hazards at work
- Classifying your question into domains of practice will help in linking the question to research information in the literature

Questions in practice

Asking a relevant and well-formulated question is important. The type of question determines the source of literature and the formulation of the question determines the yield of information retrieved. The practice of an occupational physician generates many different types of questions. These can be health questions, but also questions about legislation or social security regulations, or about the prevalence or incidence of certain issues. (Box 2.1).

Examples of health questions: “*What is the risk of developing anaemia among lead exposed workers?*” or “*How can I best manage and control health hazards posed by exposure to noise?*”

An example of a question about legislation would be: “*What obligations does an employer in my country have with respect to adequate environmental control measures to prevent lead exposure from recycling batteries?*”

An example of a statistics question would be: “*How many workers in my country are absent from work in those sectors of industry where lead exposure occurs?*”

Differences between the categories are not always clear-cut. For example, the national legislation on levels of exposure is usually linked to a summary of the evidence that this is the level below which no harm will occur. However, searching for the list of maximum permissible

levels of exposure in your country on the Internet requires a different strategy than searching for the results of epidemiological studies that underpin these levels. Since the sources of legal information are so pertinent to a specific country we decided not to elaborate this pathway, recognising at the same time that this information is very relevant for occupational health professionals.

How often do physicians have questions?

This question is difficult to answer as it is strongly related to the study methods used. From the literature it is known that it makes a difference whether physicians are interviewed directly after their consultation of a patient about possible information demands or whether they are asked by means of a questionnaire. An explanation for this would be that physicians have an even greater demand for information of which they are not aware.

Box 2.1 Example of the number of questions that can be generated from practice.

- After every patient contact by a trainee physician in a big American hospital, researchers asked the trainee what questions he/she thought of. In 404 cases of patient contact, 280 new questions were generated, which means 2 questions in every 3 patients.¹²

Table 2.1 Categories of questions in practice

- Health questions: questions that are directly connected to health such as about medical complaints, health hazards at work, work-related disorders
- Background questions: general questions about the origin and mechanisms behind sicknesses; do not produce a concrete answer applicable to practice, but are useful for identifying gaps in knowledge.
- Foreground questions: questions about a specific case in practice; often produce a concrete answer and result in better quality of care.

- Legal questions: concern the application of the law or regulations
- Occupational Safety and Health legislation questions
- Social security regulation questions
- Health and law questions

- Questions about statistics: concerning the prevalence of complaints, the prevalence of working conditions, information about the branch or sector.

Box 2.2 Examples of questions that arise from a situation in practice

- An occupational physician performs health examinations at a refuse collection company. At the request of the client, the health examinations are especially focused on identifying cardiovascular risk factors as well as determining the capacity for physical effort. After a morning spent on giving advice on obesity and stopping smoking, the following questions arose during an informal lunch with a colleague:
- Is the advice to stop smoking given by a physician more effective in reducing the proportion of smokers than no advice?
- Does the Health and Safety at Work Act require participation of employees in this kind of health examination or are they completely voluntary?
- Does a refuse collector who does not comply with norms for physical fitness have a right to a supplementary disability insurance benefit if his salary is reduced?
- Is reference data available about health, work and sickness absence with which the results of this company can be compared?
- How do you determine that the neck complaints of the refuse collector are part of a work-related disease?

Researchers concluded that asking questions is an efficient way of revealing gaps in your own knowledge and that they are a good opportunity for achieving 'self-directed learning'.¹² In the training phase in any case, problems in practice will therefore trigger many questions. Later in professional practice too, similar research shows that many questions are generated to which a physician does not have the answers. In the past, this was something you did not really talk about because by doing this you made it clear that your knowledge was lacking in some way. Nowadays, it is acknowledged that even the most experienced physicians are constantly encountering questions while working in practice and that this is a good opportunity to supplement your knowledge.

Questions that are generated by problems in practice do not only produce learning matter for supplementing knowledge but should also lead to an improvement in the care of the individual patient. After all, by looking for an answer for this particular patient, the policy in practice will be better substantiated. This leads to an improvement in care. There is a limited amount of evidence that suggests that this is indeed the case.^{13;14}

The methods of Evidence-Based Medicine are useful in answering health-related questions only. However the first steps of EBM can be used in a broad context. By making a distinction between different categories of questions in practice, one can purposefully search in different information sources. You find a number of examples of questions that might arise in practice in [box 2.2](#).

These questions are related to different knowledge domains to which an occupational physician has access. After all, it is not just about medical knowledge, but also partially about legal or technical issues. This is important to determine before you start looking for answers. The

search strategy will not be the same one for the different cases. The classification into health, legal and statistics questions seems to be a good way to categorize questions. (Table 2.1)

The questions on the effectiveness of recommendations concerning stopping smoking and the question about determining whether neck complaints are work-related are health-related questions. Answers to these can be found in the medical research literature. The questions on the obligations to participate in a health examination and the right to disability insurance benefit are legal questions. Answers can be found by asking an expert or using a national legal database. The question on reference data is a statistics-related question and can possibly be found from a local statistics source. The developments are not as advanced at the moment to enable us to propose an efficient strategy for searching for answers to all types of questions on the Internet. The use of research information focuses, therefore, on health-related questions.

Background and foreground questions

Health questions in practice can be divided roughly into two categories which will determine your search strategy. There are so-called background questions, and foreground questions. The example in box 2.3 illustrates the differences between a background question and a foreground question:

Box 2.3 Examples of foreground questions that arise from one case seen in practice

An occupational physician working in a rural area in India sees a 45-year-old farmer suffering from dizziness and vomiting after accidental overexposure to Thiodan, an organochlorine insecticide.

In response to this real-life example, the occupational physician has the following questions:

- What is the mechanism that is causing this physical reaction?
- Is there a more effective treatment than 'to wait and see' for this patient?
- What are the prognostic features of recovery?
- Would legal measures be able to prevent further accidental deaths due to overexposure to Thiodan?

Background questions are general in nature and are particularly concerned with the context of a problem. Background questions often concern the origin of a complaint for example about the pathophysiology or epidemiology in general. This type of question does not often have a clear and concrete answer. It assumes a basic knowledge that a physician must have to be able to function. Background questions point to gaps in knowledge that can be answered after a more extensive study of a subject or following a supplementary course. More experienced

physicians ask themselves fewer background questions. Answers to background questions can best be found in a text book about the relevant subject or in a so-called narrative review in a medical journal, in which a specialist covers a great number of aspects of a problem.

Foreground questions are concrete questions concerning a certain aspect of the etiology, prognosis or treatment of a complaint that usually results in a concrete answer that can be directly applied in practice. Answers to foreground questions can best be looked for in guidelines, systematic reviews or using a focused literature search in articles. In contrast to the broadly organized narrative review, a systematic review has a concrete research question and a controllable search strategy. That is why it is called systematic.

In our example, the questions concerning the mechanism of an organochlorine substance to cause vomiting and dizziness is a background question. The question about the effectiveness of a therapy for this patient, the question concerning the prognostic features of recovery of this patient and the effectiveness of preventive measures are typical foreground questions. Answers can be found in the medical literature. To answer the question on effectiveness of therapy we found a Cochrane systematic review on the use of sodium bicarbonate to treat patients with organochlorine poisoning. The conclusion is that there is not enough evidence to use this treatment routinely in practice.¹⁵ In general, it is concluded that there is a lack of evidence for treatment of pesticide poisoning.^{16;17} However, we came across available literature that is pertinent to pesticide poisoning in India and available on line and that would give answers to part of our questions.¹⁸⁻²¹ For questions on chemicals it is sometimes more helpful to consult chemical or toxicological databases. (For endosulfan see: <http://www.atsdr.cdc.gov/tfacts41.html>). We deal with these databases in chapter 4. For the question on prevention through legal measures we found a study that showed the effects of legal restrictions to the use of organochlorine pesticides in Sri Lanka. At first the number of death declined but later they came back at the same level as before.²²

Categories of health questions

Finding the right answer is very much determined by how the question is formulated. Questions that are not formulated clearly lead to unclear answers. The more specifically you can formulate the question, the more chance you have that you will find the answer. The question: 'what is the health situation of painters?' has a much smaller chance of getting a satisfactory answer than the question: 'how big is the risk of getting encephalopathy after 20 years of solvent exposure?'

Although we have restricted ourselves to health questions and foreground questions, we can refine our search strategy further by subdividing our questions even more.

When we talk of health questions, it means that we are looking for the answer in the medical literature. This is where the results of most research have been stored. We assume that the medical interventions improve if we base them on this research data, which then means that we can speak of Evidence-based medicine. With the help of findings from research – the evidence – we can substantiate our recommendations to employees or employers.

Looking for an answer in the literature is made easier by further subdividing the health questions. Based on the questions that doctors or patients have about problems in practice, Sackett has proposed further subdividing the problems.¹ For each patient contact, he distinguishes the following types of health questions (Table 2.2).

- What is the best way I can determine symptoms and complaints, and take decisions about the presence of an illness? These are questions concerning diagnostics. For example: *“What are the criteria for diagnosing a patient with a burnout?”*
- How can I determine the cause of a complaint or an illness? These are questions concerning the etiology of an illness. For example: *“What is the risk of developing asthma when working in a flour mill?”*
- Which treatment or intervention would be most beneficial or least disadvantageous for the patient or employee? These are questions concerning interventions and prevention. For example: *“Is ultra-sound therapy more effective than regular physiotherapy to treat non-specific back pain?”* or *“Is the use of audiometry more effective in noise-reduction than programmes that do not contain audiometry?”*
- In which way will the course of the illness run so that I know whether and in what way I might have to intervene? These are questions concerning the prognosis. For example: *“What is the prognosis for a patient recovering from an operation of a lumbar disk herniation?”*

Table 2.2 Categories of health questions

- **Diagnostic questions:** questions concerning the degree of certainty with which we can determine a certain complaint or its consequences, such as activity limitations
- **Etiological questions:** questions concerning the cause of an illness or the consequences of exposure.
- **Intervention-Prevention questions:** questions concerning the effectiveness of a certain intervention or preventive measure
- **Prognostic questions:** questions concerning the prediction of the course or the consequences of an illness, e.g. recovery, complications, return to work, death.

For the occupational physician, the health questions concerning the employees and health hazards at work can also be classified in this way. Whether there is a need for a further subdivision or an addition of new categories will have to be decided in the future.

The advantage of categorizing questions in this way is that it makes the search for evidence in the literature easier, as well as the process for evaluating the articles found. For each category of questions there is a research procedure with which the problem can best be researched. This means that we have to search the literature for this kind of study in a more focused manner. The best evidence for the effectiveness of a treatment is a study in which patients are assigned at random to the intervention group or the control group, the so-called Randomised Controlled Trial (RCT). The RCT is the research framework that produces the most credible results for a therapeutic or preventive intervention. With an etiological question, we get the best answers by using a cohort study. With a prognostic question, research done based on a cohort of patients who are in the same phase of the illness produces the best results. Because we are looking for the best there is to find in the literature, we will be looking for those studies with that specific kind of research framework. We will elaborate the problems of research designs and methodological quality further in chapter 5.

Practical tip

- ▶ Framing the question that arises from practice is the most important aspect of getting an useful answer from any information source

Exercise 2

Questions arising from practice

Indicate to which category of question the following questions belong:

- a Is the change to non-latex gloves in a hospital in Singapore an effective measure to reduce the number of cases of latex-allergy?
- b Does a 23-year-old temporary worker in the USA who is suffering from pneumonia have the right to continue having her salary paid by the employer?
- c Does unemployment in a 40 year old agricultural worker in Colombia seriously increase the risk of depression and suicide?
- d Can exposure to lead be the cause of anemia in a 25 year old worker of a Kenyan battery shop?
- e Is the fact that a 40-year-old Canadian nurse with non-specific back pain who stays away from work for two weeks a reason to assume that the risk of chronic back pain is high?
- f Are there reference data for health problems experienced by international truck drivers?
- g How does the level of sick leave in my hospital in Thailand compare with the level of sick leave in the health care sector in my country?
- h Are the preventive measures that the occupational physiotherapist proposes for the administrative personnel of a Japanese Bank effective in reducing the number of cases with Repetitive Strain Injury?
- i What is the most effective advice to enhance the wearing of hearing protection for workers in a metal factory in New Zealand?
- j A 47-year-old administrative officer working for the local council in the UK who works a lot with the computer demands that his employer arrange an eye examination. Is this compulsory for the employer?

Exercise 3

Questions in practice

Note down at least 5 questions in practice that you spontaneously ask yourself directly after a patient or employer contact. Classify them into health-, legal- or statistics-related. Divide the health-related questions into etiologic, diagnostic, prognostic or intervention/prevention questions.

Chapter 3

SOURCES OF INFORMATION AND SEARCH STRATEGIES

Main Points

- Search for reliable and up-to-date scientific information
- Text books are quickly outdated
- Higher quality journals offer more reliable information
- Search for guidelines, systematic reviews and next for original studies
- Formulate an answerable question that contains the elements Patients or Workers, Intervention or Exposure, Comparison condition and Outcome (PICO)
- Derive specific search words from the PICO to be used for searching in electronic databases
- Make use of the features of the database Medline through PubMed such as MeSH-terms and clinical search filters
- Use appropriate search terms for occupational health items

What is efficient and reliable?

We mentioned in the introduction that we all use different sources of information, such as various specialty journals, colleagues, etc. An efficient search strategy specifies which source is the best to be consulted. Everyone will develop their own personal search strategy. However, there are a number of rules of thumb for an efficient search strategy for reliable information which we will discuss in this chapter ([Box 3.1](#)).

Text books and manuals

Up until recently, we tended to look for answers to questions we had in medical text books. Often, they are clearly laid out; they offer background information about a particular subject and are comfortable to read. With the rapid rate of increase in knowledge, however, it is almost impossible to keep text books and manuals up-to-date or to complement them adequately with

literature. This has led to the development of electronic versions of important text books, such as Harrison's Principles of Internal Medicine, where this does take place.

Box 3.1 Example of the difference between information from experts and information from the literature

- We asked 14 occupational physicians to ask their experts for an answer to questions from practice. At the same time we had checked what the best evidence based answer from the literature would be. It turned out that only 47% of the 75 experts consulted gave the right answer. Those experts who said that their answers were based on the literature gave a correct answer significantly more often.¹⁰

Sackett recommends therefore not to use traditional text books.¹ They are, after all, largely authority-based and not evidence-based. The author of the text book is an expert and specifies how a particular intervention has to be performed. However, there are also many recent examples that, particularly for concrete foreground questions, experts cannot agree about and for which they simply do not know the best answer.¹⁰

Let's assume that you want the answer to the question of what the best intervention is for an employee with low back pain and you try to find the answer in a text book. In the library you might have a copy of the well known Hunter's textbook of Diseases of Occupation. The copy in our library was from 1987. The register contains only one reference to back pain which refers to whole body vibration. The chapter does not contain any advice on return to work problems. The list of references that complements it contains four references, the most recent one dating from 1984. Not very efficient and not up-to-date. This might have been different with a more recent copy, but due to the production process, the information in textbooks usually lags at least a couple of years behind what you can find on the Internet.

National Journals on Occupational Medicine and Occupational Health

The majority of occupational health professionals subscribe to a local or national journal on occupational health in their national language. These journals usually provide a good overview of the discussion and problems that occur in the national occupational health system. That is why they are a useful source for keeping up-to-date with what is going on in this field. Quite another question is whether we can use these kinds of journals as an efficient and reliable source of information for finding answers to questions in practice. Usually they are not available in electronic form and not indexed in a big database. This implies that we have to look through the paper indexes of a journal, which in general is a lengthy process. Another problem is that the local journals do not contain the best articles. Nowadays there is fierce

international competition among researchers to get their research published in high ranked international journals. The corollary of this is that the local journals are left with lower quality research that is not accepted by international journals. Therefore, those who wish to use the literature to look for evidence for solutions to problems in practice are usually better off using international journals.

Internationally oriented Journals

In the big general medical journals that aim at an international audience, some but not very much work is published about important occupational health problems. These journals are often suitable if you are looking for narrative reviews. In the New England Journal of Medicine, for example, some very instructive reviews were published about back pain, fuzzy vision, capacity for physical effort and tinnitus.²³⁻²⁶

In addition to these general medical journals, there are also a number of specialist internationally oriented journals that publish most articles relevant for the occupational physician in the field of work and health.²⁷ The most important of these are included in the table. It is in these journals that occupational health experts most often find support for their interventions in practice. This is why table 1 indicates whether the journals are available on the Internet. All journals publish at least their Table of Contents (TOC), often including summaries of the articles on the Internet. Some journals make available their entire content (full text). Subscribers to journals can usually view and print these. Nowadays, large university libraries have subscriptions whereby many journals are made available via Intranet and Internet (full text) to employees and students. The Internet versions often offer more possibilities than the printed journals (Table 3.1).

Some international journals offer part of their content for free through the Internet for example the research content of the British Medical Journal. Have a look at <http://www.free-medicaljournals.com/htm/index.htm> for titles that are available without cost. An important initiative is the Highwire website (<http://highwire.stanford.edu>) of the Stanford University Library. They have made available as many free on-line medical journals as possible on their website. Many journals do not have the most recent issues available on line, but they do have the less recent issues dating back over the last ten years, for example. All of these journals have been placed on a website by the library in an easy-to-use manner. Another very important initiative for low-income countries is the Health Internet Network Access to Research Initiative, HINARI. Through the joint effort of international organizations like WHO and private scientific publishers the full text content of over 2000 journals is available to a limited number of low-income countries. More information is available at <http://www.healthinternet.org>.

Table 3.1 List of important medical journals and their internet addresses

Journal	Internet Address
Free access journals	
Journal list	www.freemedicaljournals.com
General Medical Journals (Impact factor)	
Lancet (18.3)	www.thelancet.com
New England Journal of Medicine (34.8)	www.nejm.com
JAMA (21.4)	http://Jama.ama-assn.org
British Medical Journal (7.2)	http://www.bmj.com/
Occupational Health Journals	
Occ Env Med (1.8)	http://oem.bmjournals.com/
Scand J W Environ Health (1.8)	http://www.ttl.fi/internet/english/
J Occ Environ Med (1.5)	www.joem.org
Am J Ind Med (1.5)	http://www.interscience.wiley.com/jpages/0271-3586
Occ Med (0.7)	http://occmed.oupjournals.org/
Int J Occ and Environ Health (—)	http://www.ijoe.com
Int Arch Occup Environ Health (1.4)	http://link.springer.de/link/service/journals/00420/index.htm
Disability and rehabilitation	
J Occup Rehab (0.7)	www.kluweronline.com/issn/1053-0487
Dis Rehab (1.1)	http://www.tandf.co.uk/journals/titles/09638288.html
Dis Soc (0.5)	http://www.tandf.co.uk/journals/carfax/09687599.html
Work (—)	http://www.iospress.nl/html/10519815.html
Ergonomics and Occ Hygiene	
Ergonomics (0.9)	http://www.tandf.co.uk/journals/titles/00140139.asp
Annals of Occupational Hygiene (1.4)	http://annhyg.oupjournals.org/
Journal of Occ and Env Hygiene (succeeds AOH and AIHAJ)	http://www.tandf.co.uk/journals/titles/15459624.asp

An important development in the world of scientific publishing is the start of the so-called open access publishing. The publication process is turned around here. The authors pay for publication of their articles and the reader can download the articles free of charge from the Internet. The list of journals can be found at <http://www.biomedcentral.com>.

The competition for getting scientific articles published is fierce. For many journals, the rejection rate for articles is over 50%. Selection takes place through peer-review, whereby colleagues in the field assess an article on its scientific merits and often suggest major improvements. In this way, the reliability of the international literature is often higher than that of local medical journals, where competition is less.

The quality of a journal is specified in a clear yet rather arbitrary manner by the so-called Impact factor.²⁸ The Impact factor could therefore be some sort of indicator for the level of reliability of a journal. What this really means is that this Impact factor indicates how many articles from a particular journal are cited by other researchers. There are many drawbacks to the system of Impact factors. For example, small disciplines and specialist topics like in occupational health will be cited less often than general medical specialties and topics. That is one of the reasons that occupational health journals do not rank very high on the Impact factor list. Yet, within a category such as occupational health, there is some ground to accept the system as the least bad. As is indicated in the table the higher the Impact factor the higher the significance or reputation of a journal. An alternative to the Impact factor system is provided by the so-called Faculty of 1000. This is an organisation that evaluates and rates the most interesting papers in different fields of life sciences. The organisation is named after the approximately 1000 scientists who are involved in rating the scientific papers that are published. Access is only free for persons from developing countries in line with the HINARI initiative described above. In 2005 they will also start rating medical papers including occupational health. You will find it at <http://www.facultyof1000.com>.

However, the situation outside your home country cannot always be applied to the local situation, which means that despite a high level of reliability, the practical relevance could be lower in studies published in international journals. However, the majority of problems in the field of work and health are of more or less the same type, whether it is the incapacity to work through back complaints, mesothelioma as a result of asbestos exposure, or the effectiveness of screening for TB in health care workers. International journals are therefore a reliable source of information. But the same applies here as elsewhere: performing manual searches in a number of journals is extremely time-consuming. More and more journals are, however, offering the possibility to at least search their archive on the Internet (Occup Environ Med), or are totally full-text on-line (Occup Med). The websites of the relevant journals are in the table. However, it is by far the best strategy to start a search using a recommended literature database such as Medline.

Websites on Internet

Searching on the Internet using general search engines such as Netscape search, Yahoo or Google produces information very rapidly. The quality, however, of this information varies just as much as printed information. Everything is literally all over the place. Although searching on the Internet seems to be quick and efficient, a large part of the time gained by using this method is lost in the assessing of the quality of the information.²⁹ New developments such as Google Scholar are promising and yield nowadays interesting results but the drawback is

that you cannot control which databases the machine searches. You find an evaluation of the search machine at <http://hsl.mcmaster.ca/resources/googlescholar.htm>.

Practice Guidelines

Guidelines that are intended to support the occupational physician in a scientifically based way when taking decisions in practice have a high degree of relevance for solving questions in practice. Questions in practice are the result of difficult decision moments. In many cases, guidelines offer support in the making of these decisions, for example, with information on the most effective intervention. The quality and the scientific basis of guidelines, however, vary greatly. Some guideline producers have, therefore, named their guidelines differently according to the amount of evidence available to support them such as ‘consensus statement’, ‘position paper’ or ‘clinical practice guideline’. Guidelines are offered by some national occupational physician associations such as the American ACOEM at <http://www.acoem.org>, the British Health Net Plus at <http://www.nhsplus.nhs.uk> and the British FOM at <http://www.facocmed.ac.uk> and the Dutch NVAB at <http://www.richtlijnen-nvab.nl> (unfortunately only in Dutch). There is also an American website containing a database with general and specialist guidelines at <http://www.ahrq.gov>.

Table 3.2 Quality rating of occupational health information

Search strategy	Efficiency	Reliability	Up-to-date	Local applicability
Textbooks/manuals	–	–	–	±
Nationally oriented Journals eg the Dutch Tijdschrift voor Bedrijfs- en Verzekeringsgeneeskunde	–	±	+	+
Internationally oriented Journals eg Occupational and Environmental Medicine	–	++	++	±
Internet search engines eg Google	++	--	+	±
Specialised websites	+	±	±	+
National Guidelines	+	++	+	++
Medline: reviews	++	++	++	+
Medline: articles	+	+	++	+
Other specialised databases	+ to ++	++	+	+

Medline, systematic reviews and medical-scientific literature

Medline is the most comprehensive medical database, with records going back to 1966. Medline is accessible without any charge via the search engine PubMed at: <http://www.pubmed.gov>. (Table 3.2)

Since the medical literature has become more widely available through the use of computers, the practice of making systematic reviews has come into existence. A systematic review is an article in which the findings of a large number of studies have been summarized in a systematic manner. A good systematic review therefore contains all relevant studies, for example, about a certain intervention. In addition, a systematic review is set up in such a way that the results are controllable and repeatable. The conclusions of a systematic review are therefore of great value for practice. It is strongly recommended to consult systematic reviews first when looking for an answer to a question in practice.

The Cochrane Collaboration is an organization whose aim is to collate as much scientific foundation for medicine/treatment in the health care sector as possible in the form of systematic reviews. The reviews must conform to strict criteria if they are to receive the seal of approval from the Cochrane Collaboration. The reviews offer the possibility of gaining an unambiguous answer to questions in practice. The abstracts of the reviews can be found in Medline. The whole articles can only be accessed via the Cochrane Collaboration, as a subscribed member at: <http://www3.interscience.wiley.com/cgi-bin/mrwhome/106568753/HOME>. For many countries free access is possible. For Latin America free access is possible in Spanish, Portuguese or English through <http://www.bireme.br>. Low-income countries can get free access through <http://www.healthinternetwork.org>. Recently, the Cochrane Collaboration introduced a special entity that is involved in gathering evidence and stimulating reviews on occupational health topics. It is called the Cochrane Occupational Health Field and can be found at www.cohf.fi.

It will often be the case that no reviews are available. In that case, we are compelled to look at the original studies. Again, Medline is perfectly suited for this purpose. However, it requires some practice before you can get productive results when searching for original articles in Medline.

Other databases containing scientific literature

Nowadays, more and more databases that contain references to scientific literature come available. For example, the Cochrane Collaboration maintains a database with references to as many randomised controlled trials as they can locate. Also specialist organisations have developed their own databases with literature such as the one for physiotherapeutic interventions called PEDRO and that can be found at <http://www.pedro.fhs.usyd.edu.au/index.html>. Then, there

are databases that contain specific occupational health information such as toxicological data. In a separate chapter we deal with these other databases on the Internet that contain useful information for occupational health professionals.

If you start using research information to answer health-related questions we strongly recommend that you start with getting familiar with Medline. When you are more experienced you can widen your scope to other databases as well.

Converting questions in practice into answerable questions: PICO

Box 3.2 Examples to illustrate the working of the PICO system

- A 52-year-old administrative worker complains to her occupational physician of irritated eyes, without there being any indication of specific refraction problems. She works for the greater part of the day at a computer screen and wonders whether her complaints could be caused by the computer work. The **P**atient is typified as a '52-year-old healthy woman', the **I**ntervention/exposure as 'computer work', the **C**ontrol condition as 'no computer work', and the **O**utcome as 'irritated eyes'. These terms are translated into concrete search terms or keywords. We will discuss this in more detail later on.
- You are working at the labour inspectorate in Kenya and you are presented with the problem of a 25 year old unskilled worker in a battery shop where batteries are recycled. He complains that he is suffering from anemia and that his doctor has told him that it is due to the lead levels. The shop has just been inspected and was found to have adequate environmental control measures. You wonder if some workers could be more sensitive to lead exposure than others. You want to find from the literature what the risk factors are for anemia among lead exposed workers. The **P** is a 'healthy 25-year old male employee', the **I** is 'exposure to lead', the **C** is 'no exposure to lead' and the **O** is 'anemia'.
- A 30-year-old nurse in a hospital in Thailand comes to see you at a primary care facility, because her colleague contracted Tuberculosis from work. She wants to know if she should better be vaccinated with BCG, which although old fashioned might be effective. What should you advise? The **P** is a 'healthy 30 year old nurse', the **I** is 'BCG vaccination', the **C** 'no BCG vaccination', the **O** is 'Tuberculosis'.

The process of looking for answers to questions in a focussed way can be improved by making use of the PICO system. The abbreviation stands for the fact that in every well-formulated question, the elements P for patient, I for intervention, C for control condition, and O for Outcome should be included. Expressed simply, you could say that you want to know whether for a certain person, given a certain event or intervention, and in comparison with a control condition, a certain outcome will be caused. The reason for using PICO is not simply because

we learn to formulate a question as precisely as possible, but also that we get good search terms or keywords that can lead to answers in scientific articles.

The P for patient is included because we also want the results of our search strategy to be applicable for the patient or employee to which our problem is applicable. It could be someone with a specific illness, gender, or age.

The reason we specify both the Intervention and the Control Condition is that we are looking for answers in scientific articles. An article about the effectiveness of an intervention, for example, will never produce an answer that the intervention is generally effective. There will always be a control situation with which the intervention is compared, for example the use of a placebo or an alternative intervention that has already been proven to be effective. When we do not have an intervention question but, for example, an etiological 'is this caused by the work situation' question, then we can use the E for exposure instead of the I for intervention. The question needs then to contain the element of exposure. The examples in [box 3.2](#) will serve to clarify what we mean here.

For occupational health professionals, a specification of the O for Outcome is of importance. In this way, the search strategy is specified concerning the outcome of the intervention or illness in which we are interested. It can, for example, be the chance of the result being fatal. In the field of work and health, however, it will more often concern return-to-work or incapacity to work.

[Table 3.3](#) below contains a summary of what we have just outlined.

Table 3.3 Examples of the application of the PICO formulation of questions from practice

Problem	Patient / Employee	Intervention / Exposure	Control condition	Outcome
Computer work and irritated eyes	52-year-old healthy female administrative worker with irritated eyes	The majority of the day working at a computer screen	Little or no computer work	Irritated eyes
Lead exposure and anemia	25-year-old healthy male employee	Exposure to lead	Little or no exposure to lead	Anaemia
Vaccination for Tuberculosis	30-year-old female exposed to Tuberculosis at work	BCG vaccination	No vaccination	Tuberculosis

After having formulated a PICO, we have gone through the whole process of formulating a question in practice and the search strategy. We have decided whether we are dealing with a health question, we have determined whether it is an etiological, prognostic, a diagnostic, or a intervention/prevention question, and we have defined the question in PICO terms. The next step is to perform the actual search action.

Searching in Medline using PubMed

Searching in Medline can be done in various ways. One of these is via the search engine PubMed. As with every computer programme, you will first need to become familiar with the possibilities and the limitations of PubMed. Everyone has their own particular learning style for this. Some people learn by doing, others want to read the whole user manual and go through the process step by step. Choose your own strategy and make sure that you become familiar with working with PubMed as this will make the search process easier. PubMed has its own online Tutorial that can help you through the process step by step (http://www.nlm.nih.gov/bsd/pubmed_tutorial/m1001.html). For those who would rather read a text there is the possibility of downloading a manual from http://www.nlm.nih.gov/pubs/web_based.html. We are assuming that you will make use of the possibilities available to you to become familiar with PubMed. We will now discuss which strategy is the most efficient, although this is meant to complement the user manual and not to replace it.

Search terms and MeSH terms

You can usually not just use the terms from your PICO to search in PubMed. You have to translate them into search terms. When you use PubMed for your search, you type in 'search terms' or 'key words' that will serve as keys to look for the articles in which you are interested. There are basically two types of search terms. There are special search terms that Medline employees have attached to each article: Medical Subject Headings, or abbreviated MeSH terms. In addition to these, you can search using 'free text words'. This means that the title and summary of each article in the database is searched for matches with the search words you have specified. If you want you can also specify that only the title or only the abstract should be searched by typing special tags behind your search words. However, the indexers at Medline have been fairly consistent. That is why we recommend that you always start your search process with MeSH terms. First, you have to find these MeSH terms. PubMed has created a special utility for this in the form of a MeSH browser. You type your search terms here and the programme will display the MeSH terms that are available and how they have been defined. In view of the fact that PubMed is an English-language programme, you will possibly have to translate terms from your native language into English. This is often a difficult task when you have to deal with all kinds of technical occupational health terms. For this reason, we have included in the appendix a list of MeSH terms widely used in the occupational health service sector.

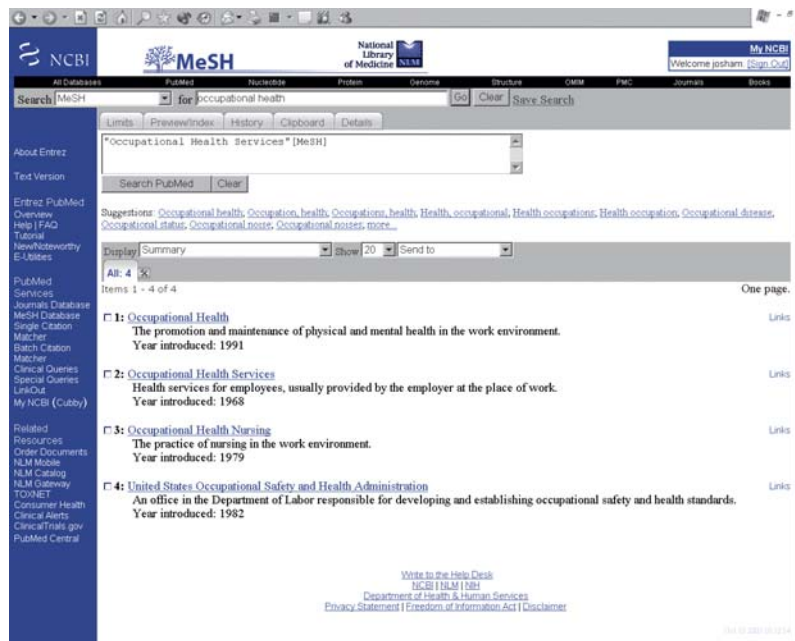


Figure 3.1 Screenshot of PubMed’s page with results of using the MeSH-browser for ‘occupational health’. The MeSH-browser can be found in the blue column on the left.

Search Results

As a practitioner, you will want to have articles that match your search as precisely as possible. We call this a specific search, analogous with specificity and sensitivity of diagnostic tests. In addition, it is also possible that you want to know as much as possible about a subject and that you don’t mind articles that are not directly relevant or applicable. This is called a sensitive search. Screening thousands of articles just to see if there is anything useful in them is extremely time-consuming if you wish to answer a question in practice. But you might still remember that there is an inverse relationship between sensitivity and specificity. Those search words that are very specific are usually not very sensitive. Put in other words, if you find only the articles you want, you will usually miss many others that are on the same topic. You have to keep this in mind if you find contradictory results in articles.

As we have mentioned before, we recommend that you first look for systematic reviews, since these already contain summaries of all the available research about a particular subject. You can restrict your search to systematic reviews by making use of a search filter, under the ‘Clinical Queries’ button. This filter adds the search term **AND systematic[sb]** to your search words and retrieves all articles that are indexed as systematic review by Medline. Another way of restricting your results to reviews or to meta-analyses is to use the Limits-button in the main screen and tick the appropriate boxes.

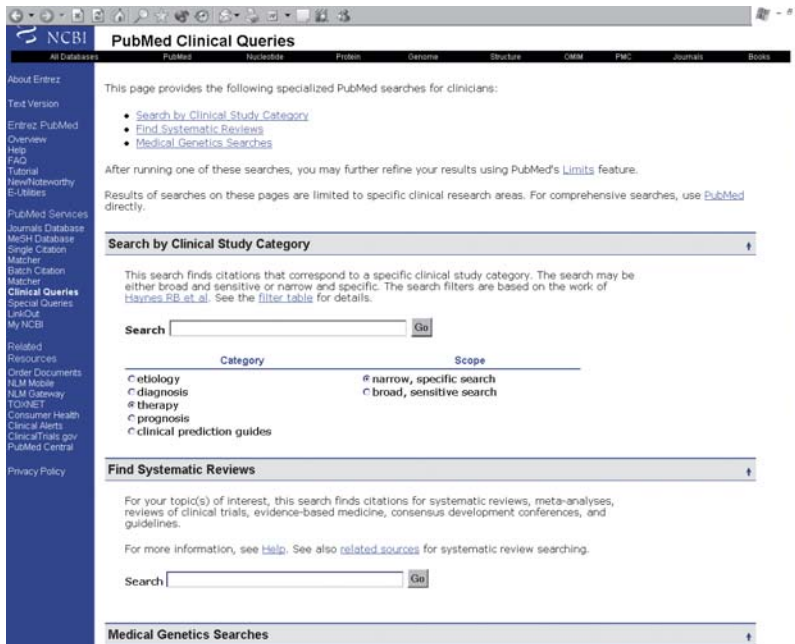


Figure 3.2 PubMed’s page with Clinical Queries which allows you to use preset search filters of clinical relevance. The clinical queries button can be found in the blue column on the left.

The trick is to get a result that is manageable in terms of numbers of articles. A good result lies in the range of 10 to 50 articles.³⁰ If the number that you retrieve is too large you can use the ‘Limits’ button to further specify the articles you want, for example, limit to only ‘English-language’ and ‘adults’. You can also decrease the number retrieved by using the ‘core clinical journals’ button that restricts your search to high quality journals only. Usually, you will be interested in articles published in the last five or ten years, which gives you a possibility to limit the results. It is good to realize that PubMed displays the articles in chronological order. Viewing the first few screens will sometimes be enough to find what you want. Another option to limit the results is to use different search words that are more specific and less sensitive. We will expand on that further on.

If you get a message stating that few or no articles about a subject can be found, the most probable cause is that you have typed a word or words incorrectly in the search field. Check your spelling carefully. If you are looking for articles about blood pressure and you type in **bloodpressure** (as one word), this will produce only 25 articles in which the same spelling mistake has been made! It appears then that there are only a few articles about that subject. The correct spelling (as two words) will produce over 250 000 articles. The same holds for asthma spelled incorrectly (17 articles) and asthma spelled correctly (over 83 000 articles). An

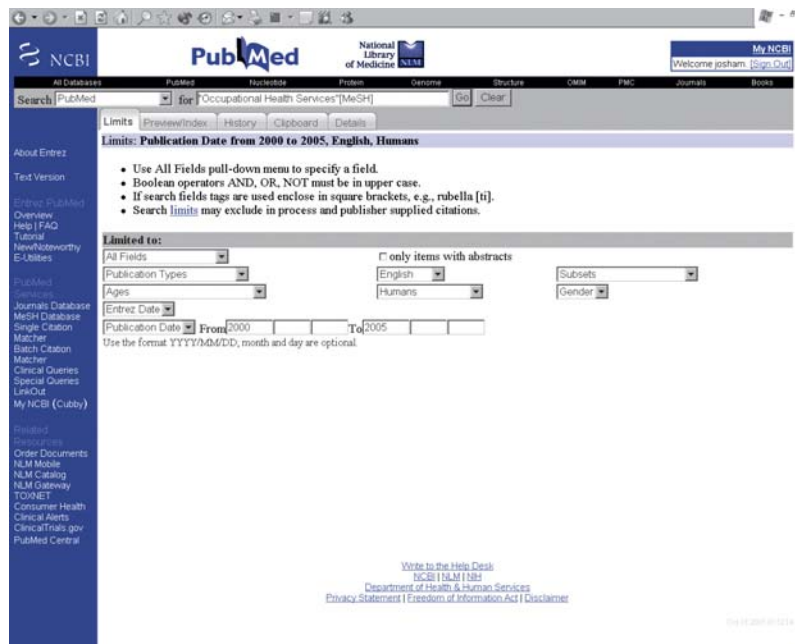


Figure 3.3 PubMed's page with limits for searches. Here limits are set to time, language and publication date. The limits button is displayed after every search at the top of the results page.

advantage of the use of the MeSH-term utility is that it prevents these spelling mistakes. You can also increase the number of hits by truncating your search words. This means that you break the word off at an appropriate letter and replace the rest with the asterisk *. For example **worker*** would retrieve articles that contain worker, workers, worker's and workers'.

Search filters

As we mentioned before, questions in practice are categorised into types of health questions: etiological, intervention/prevention, prognostic, and diagnostic. This corresponds to the kind of research that is needed to result in a good answer to the question. To aid this process, PubMed contains so-called search filters that automatically generate search terms for the type of research that you are looking for. These filters can be found by clicking the 'Clinical Queries' button. They add search terms to your own search words as you can see from the search window in the main screen. The search terms are developed by extensive research into what are the most sensitive and specific search words for the specified type of articles.³¹⁻³⁴

Make use of these filters. Depending on whether the search results are too many or too few, you can specify if you want a sensitive search or a specific search. Start with a specific search.

Search terms for occupational health situations

As a result of the nature of their work, occupational health professionals will be interested in questions that are concerned with work and health. Unfortunately, Medline does not contain a single MeSH term that covers all occupational health studies. It is really unfortunate that the MeSH term Occupational Health is used only to tag articles that contain a very broad description of the health of working populations. As a result most articles in occupational health journals are not tagged with this MeSH term. However, on the contrary, as a free-text word it is quite specific for occupational health articles. Therefore, do not use the MeSH term only but just type occupational health in the search window. That will ensure that you get also articles with the text words occupational health but that are not indexed as such. The same holds for other MeSH terms referring to work or employment. They are only used to designate very specific types of articles.

(occupational[tw] OR worker*[tw]) is the most specific combination of search terms in PubMed to retrieve articles on work-related topics.³⁵ If you want to widen the scope of your search and retrieve as many articles on work as possible the following is the best combination of search terms **(work*[tw] OR occupation*[tw] OR prevention*[tw] OR protect*[tw])**. However, remember that widening the scope will also increase the number of false-positives, the number of articles that are not about work but still will be included in your search results.*

Box 3.3 Examples of search strategies for occupational health studies

- Most specific combination of search terms for occupational health studies: **(occupational[tw] OR worker*[tw])**
- Most sensitive combination of search terms for occupational health studies: **(work*[tw] OR occupation*[tw] OR prevention*[tw] OR protect*[tw])**

If you want to experiment yourself with search words for work and their combinations the following single terms can be useful:

- sensitive terms: **work***, **occupation***, **prevention***, **pain***, **expos***, **protect***
- specific terms: **occupational health**, **protect***, **employ***, **reduction**, **industr***, **work*[ti]**, **injur***, **worker***, **pain**

* The abbreviations between square brackets are special tags that PubMed uses to search only in certain fields in the database. Default it searches in all fields. The tag [ti] means that only the title field is searched. The meaning of the other tags is. tw=text word , mh = medical subject heading, sh= subject heading. See PubMed tutorial for more tags

Medline does not contain an unambiguous search term for sickness absence. This is a problem if we are looking for articles about sickness absence as a result of an illness caused by the work situation such as in cancer patients. The combination of **neoplasm[mh]** (cancer) and **worker*** produces predominantly articles about cancer as an occupational illness. The combination of **back pain** and **work*** produces articles about the risk factors causing back pain as well as articles about the duration of the sickness absence for people who suffer from back pain complaints. The terms **sick leave[mh]**, **work disability**, **absenteeism [mh]**, **employment status [mh]**, **work capacity**, **vocational rehabilitation [mh]**, **occupational health [mh]**, **return to work**, **retirement[mh]**, **work status** can all be used, preferably as a combination of terms connected with **OR**, to locate studies on sickness absence. The terms indicated with **mh** are also MeSH terms.³⁶

You can increase the specificity of these by searching only in the title with **sick leave[ti]** or **return to work[ti]**.

To search for studies on the occupational origin of diseases in Medline, the best strategy is to start with the proper term for the occupational disease. If this does not exist, use a specific term for the occupation or type of industry in combination with terms for disease or symptoms. To improve the sensitivity of the search, a search term for the specific risk factor should be added. If there is no occupational title, it is worth trying general search terms like occupational diseases or occupational risk. For example use carpal tunnel syndrome and posture. The sensitive search under Clinical Queries produces also good results in etiologic questions regarding potential risk factors at work given a disease or health complaint.³⁷

Search terms for intervention studies

It is generally agreed that the best evidence for the effectiveness of intervention studies comes from Randomised Controlled Trials. That is why PubMed contains a search filter under the button Clinical Queries that specifically searches for randomized controlled trials. However, in occupational health it is often difficult to randomize patients or workers due to practical and political reasons.³⁸ Therefore, we would like to use more types of studies to serve as evidence for effectiveness of interventions such as controlled trials and before-after studies with a control group. To that end we developed a search strategy for intervention studies that includes all types of studies in which an intervention has been evaluated. If you want to follow this policy and search for all types of intervention studies use the following combinations of search terms:

- specific: **[program[tw] OR “prevention and control”[sh]]**
- sensitive: **[effect*[tw] OR control*[tw] OR evaluation*[tw] OR program*[tw]]**

Box 3.4 Example of transforming a PICO into search terms and a search strategy

During your consulting hour as occupational physician a 45-year-old nurse who has been on sick leave for the previous three months comes to you. She tells you that she has become increasingly apathetic and tired. She thinks that it has something to do with her sleeplessness. Because of her sleeplessness, she can no longer concentrate and is unable to make decisions. She feels guilty about reporting sick and the whole process, but in the state that she is in, she cannot return to work in the near future. The GP prescribed antidepressants, but she doesn't want anything to do with that chemical trash.

At her own initiative, she has started taking St. Johns wort that she bought in the form of a herbal tea at the local pharmacy. In a popular woman's magazine that her daughter reads, there was an article about it which stated that it was good for regaining energy.

You are worried about the prognosis and think that she really should be taking the antidepressants so that the duration of the complaints, and therefore her absence from work, can be reduced. You realise that you know nothing about St. Johns wort and decide to do a literature search via PubMed and to see whether the woman's magazine was right.

You decide to start working systematically. You have a clear health question. The question is about the effectiveness of therapy. The PICO looks like this: P for 45-year-old depressed female nurse, I for St John's wort, C for placebo or for antidepressants, O for reduction of complaints of depressive disorder, or return-to-work. You are aware of the fact that PubMed and Medline are English-language databases and that you must therefore type your search terms in English. The proper translation for the herb, according to your English dictionary is St John's wort. You decide that the profession and the age are not that important in the first instance and that you will look for systematic reviews for therapeutic research into the effectiveness of St John's wort in comparison with placebo or antidepressants. Therefore you do not use the MeSH term **antidepressive agents[mh]** but only the term **depressive disorder[mh]** to designate the outcome. In the MeSH browser, the MeSH term for St John's wort turns out to be **Hypericum[mh]**, the active ingredient in St John's wort. We will use this together with **depressive disorder[mh]** in 'clinical queries' whereby we check the checkbox 'systematic reviews'.

This produces 14 reviews about the working of St John's wort, including a Cochrane review and reviews in authoritative journals such as JAMA and Annals of Internal Medicine. The results of these are virtually unanimously positive about the effect of St John's wort on depression compared to placebo, in particular for minor depression. The side-effects appear to be minimal and seem to lie particularly in the area of drug interaction. The majority of the journals are accessible on line, if you have a subscription, or are prepared to pay for the information. At least one prominent journal, the British Medical Journal, has the whole article available for viewing free of charge on the Internet.

Practical tips

- ▶ Subscribe to e-mailed tables of contents of the most important scientific journals
- ▶ Insert a list the web addresses of the most important scientific journals in your favourites for easy access
- ▶ Become familiar with PubMed by taking the on-line tutorial
- ▶ The use of MeSH terms in PubMed will prevent making typing mistakes, but make sure that they really cover your topic
- ▶ For searching articles on work-related topics in PubMed use the combination of search terms **[worker*[tw] OR occupational[tw]]** in addition to the topic
- ▶ If you want to widen the search in PubMed use the combination of search terms **[work* OR occupation* OR prevention OR protect*]** instead

Exercise 4

PICO

Formulate PICOs for the following questions in practice:

- A 50 year old miner is diagnosed with silicosis. Now he has contracted tuberculosis. You want to know if this could be caused by the medical condition he already has.
- A 58-year-old metal worker complains about ringing in the ears. He wants to know if there is anything that can be done about this.
- A 25-year-old IT specialist in the ICT department is suffering from pain in the forearm diagnosed as repetitive strain injury. The physiotherapist says that instead of the standard physiotherapy exercises, he is better off with massaging the connective tissue. He asks your advice as an occupational physician.

Exercise 5

Searching in PubMed

- Repeat the search on the effectiveness of St Johns wort and check if the resulting articles are the same as we found: ³⁹⁻⁵² If there are any disparities try to explain why.
- Perform a search on the occurrence of anemia after being exposed to lead in tropical countries. Can you find the most interesting article on this topic? ⁵³

Exercise 6

PICOs and search strategies for the results of exercise 3

In the health questions formulated in exercise 3 (see page 22), you can now specify the PICO and develop and carry out the search strategy!

Chapter 4

DATABASES OF INTEREST TO OCCUPATIONAL HEALTH PROFESSIONALS

Introduction

The information needs of occupational health professionals include a variety of topics such as exposure assessment, risk appraisal and management, clinical evaluation, development of prevention standard and implementation of guidelines. This means that not all needs can be met through medical databases like Medline only. However, in addition to Medline there are a number of other powerful databases accessible through the Internet. The various databases can be imagined to represent a virtual library which can make the needed information available in an easy way.

How to find more occupational safety and health databases?

The simplest way of accessing a database with the aim of searching for information useful to solve a professional problem is to find the information by using the web. This approach however has several shortcomings as mentioned before, the most important of which is that the information is not always appraised and reliable. The Internet provides an easily accessible forum to disseminate both accurate and inaccurate information, so it has the potential to facilitate but also to jeopardise healthcare information. A search carried out with the search engine Google™ in December 2004 looking for “database” and “occupational health” retrieved four hundred thousand hits. It is clearly too time-consuming to try to appraise all this information. However, the most reliable databases are among the first twenty entries. Their characteristics (topics, structured or unstructured information) are presented here to provide the readers with an overview of the web resources on occupational safety and health information which can be imagined as an easy-to-access virtual library. We would like to stress that the rapid evolution

of the web may make the information of databases that are not regularly updated obsolete. Therefore, we present only a selection of well recognized databases which are accessible for free from everywhere and are based on valued scientific information.

Databases in the US National Library of Medicine

In addition to Medline the United States Library of Medicine administers a number of other databases that can be searched through the Gateway of the US National Library of Medicine (NLM) (<http://gateway.nlm.nih.gov/gw/Cmd>). This user friendly approach is recommended for users who are new to NLM's online resources and do not know what information is available there or how best to search for it. Let us suppose that we are looking for information about the chemical formaldehyde. The search through the Gateway identified 26 582 Journal Citations, 139 Books/Serials, 291 Consumer Health reports, 42 Meeting Abstracts, 373 Other Collections. The results could be browsed or another search could be performed by introducing some selection criteria, for example time limits or other terms. For example by adding the term *work* the search found 1183 Journal Citations, 1 Book/Serials/Avs, 169 Consumer Health and 3 Meeting Abstracts. By limiting the time to the years 2003 and 2004 only 54 Journal Citations are found which can be browsed efficiently. (Box 4.1).

The Specialized Information Services at the US NLM

The Specialized Information Services (SIS) of the NLM (<http://sis.nlm.nih.gov/index.html>) are responsible for information resources and services in toxicology, environmental health, chemistry, HIV/AIDS, and specialized topics in minority health and include several databases of interest for occupational health professionals. It provides access to TOXNET (<http://toxnet.nlm.nih.gov>), a cluster of databases on toxicology, hazardous chemicals, and related areas. It allows an integrated search of any or all of the following databases: Hazardous Substances Data Bank (HSDB), Integrated Risk Information System (IRIS), Chemical Carcinogenesis Research Information (CCRIS), and Genetic Toxicology (GENE-TOX).

Searching TOXNET with the term formaldehyde results in

- 9909 hits in *TOXLINE Special* and includes references to literature on biochemical, pharmacological, physiological, and toxicological effects of chemicals
- 254 in *DART Special, the database of the Developmental and Reproductive Toxicology and Environmental Teratology Information Center* which includes literature on developmental and reproductive toxicology
- 392 in *HSDB (Hazardous Substances Data Bank)* which includes data on human and animal toxicity, safety and handling, environmental fate

- 11 in *IRIS (Integrated Risk Information System)* which provides data from the Environmental Protection Agency in support of human health risk assessment, focusing on hazard identification and dose-response assessment
- 5 in *ITER* which presents information on chemical risks from authoritative institutions worldwide, including the US Environmental Protection Agency, the US Agency for Toxic Substances and Disease Registry, Health Canada, the Dutch National Institute of Public Health and the Environment, the International Agency for Research on Cancer, as well as independent parties whose risk values have undergone peer review
- 2 in *GENETOX* which includes peer-reviewed mutagenicity test data from the Environmental Protection Agency
- 5 in *CCRIS (Chemical Carcinogenesis Research Information System)* with data on carcinogenicity, mutagenicity, tumor promotion, and tumor inhibition provided by the National Cancer Institute
- 793 in *TRI (Toxics Release Inventory)* which provides annual estimated releases of toxic chemicals to the environment
- 1 in *CHEMIDplus* which contains chemical synonyms, structures, regulatory list information and links to other chemicals databases

Note that TOXNET also includes information on non chemical topics such as ergonomics and biological risk. A search carried out with the term *ergonomics guideline* and with the term *tuberculosis AND work* found 220 and 426 hits respectively, several of which are not included in a search carried out with MEDLINE.

US Databases at Science.gov

Science.gov (<http://www.science.gov/>) is a joint representation of 12 US agencies' authoritative information resources. The following agencies contribute to science.gov: Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services -Food and Drug Administration, National Institutes of Health, National Library of Medicine-Interior, Environmental Protection Agency, National Aeronautics and Space Administration. The resources can be accessed by a gateway to 47 million pages of information in over 1 700 websites and 30 databases that are continuously updated. Each agency has selected data, including research and development results, from within its agency for inclusion. Two major types of information are included — selected authoritative science Web sites and often difficult to access scientific databases. Searching for information for formaldehyde results in 112 hits, several of which are not included in MEDLINE.

The NIOSH website

The National Institute for Occupational Safety and Health (NIOSH) (<http://www.cdc.gov/niosh/homepage.html>) is part of the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services in the US. It is the federal agency responsible for research and recommendations for the prevention of work-related injury and illness. The NIOSH site provides information regarding best practices in specific occupational situations and comprehensive advisory guidelines for certain occupational hazards. The NIOSH Web site (<http://www.cdc.gov/niosh/srchpage.html>) features many different types of databases and information resources. They are categorized by chemicals, injuries, illness & hazards data, publications, respirators and other personal protective equipment, agriculture and construction.

The most popular databases include the International Chemical Safety Cards, NIOSH Pocket Guide to Chemical Hazards, and NIOSHTIC-2. The last one (<http://www2a.cdc.gov/nioshtic-2/Nioshtic2.htm>) is a searchable bibliographic database of occupational safety and health publications, documents, reports and other communication products.

Haz-Map® (<http://hazmap.nlm.nih.gov>) is an user friendly and easy to use database designed for occupational professionals to assist them in the recognition of diseases caused by toxic chemicals. This software could also be used in education and as a module of a computer-based patient record system. Haz-Map links jobs to hazardous job tasks which are linked to occupational diseases and their symptoms.

The Registry of Toxic Effects of Chemical Substances (RTECS) (<http://www.cdc.gov/niosh/rtecs/default.html>) is another NIOSH-produced database with over 130 000 chemicals' toxicity data. It is available only via paid subscription as well as through different providers (Silver Platter or the Canadian Centre for Occupational Health and Safety <http://www.ccohs.ca>).

The Agency for Toxic Substances and Disease Registry website

Another CDC agency charged with evaluation of health risks from environmental exposure is the Agency for Toxic Substances and Disease Registry (ATSDR, (<http://www.atsdr.cdc.gov/atsdrhome.html>)). ATSDR developed several electronic toxicology resources. One of these is HAZDAT (Hazardous Substance Release/Health Effects Database, <http://www.atsdr.cdc.gov/hazdat.html>) listing the contents of pollution point-sources.

The Occupational Safety and Health Administration website

According to its mission to assure the safety and health of Americas workers by setting and enforcing standards, OSHA (<http://www.osha.gov/>) provides information on its website on chemicals, ergonomics and biological agents. Searching for *formaldehyde* the database returns 19 documents which can be browsed integrally for information about preventive measures

Box 4.1**Example of the use of a specific database to search for information on Formaldehyde**

Searching HAZDAT for formaldehyde provides useful information such as Highlights, What is formaldehyde? What happens to formaldehyde when it enters the environment? How might I be exposed to formaldehyde? How can formaldehyde affect my health? How likely is formaldehyde to cause cancer? How does formaldehyde affect children? How can families reduce the risk of exposure to formaldehyde? Is there a medical test to show whether I've been exposed to formaldehyde? Has the federal government made recommendations to protect human health? A link to the profile of the chemicals exists, which reports the toxicological and adverse health effects. Each peer-reviewed profile identifies and reviews the key literature related to hazardous substances toxicological properties. The information is summarised in so-called ToxFAQs in a format that is in lay language, very user-friendly and that can be printed and handed out to individual patients.

such as medical surveillance, communication duties or removing workers from their job for medical reasons. Searching for ergonomics the site returns 1118 documents. The advanced search facility can limit the search for example to occupational safety and health standards and then returns 9 documents.

The Material Safety Data Sheets (MSDS)

The material safety data sheets are informative material directed at workers' protection based upon legislative duties (OSHA's Right to Know rule, EU directive 89/391 about the employer's duty of providing workers with information about safety and health risks, protective and preventive measures). MSDS are practical and invaluable in assessing health effects of commercially available chemicals. Information includes chemical and physical properties, health hazards, first aid recommendations, personal protection, fire and reactivity data, spill and disposal procedures, storage and handling.

Several MSDS databases exist providing access to the up-to-date material from manufacturers and suppliers. Although most MSDS are available through commercial sites, MSDS resources include two academic institutions integrating information from different sources. The University of Cornell (<http://msds.ehs.cornell.edu/msdssrch.asp>) and the University of Vermont (<http://siri.uvm.edu>) combine content from manufacturers and governmental sites and permit free access to clinical and safety activities (<http://hazard.com/msds>).

Another powerful site (partially free) for chemical identification that provides external references, is CS Chemfinder (<http://www.chemfinder.com>), which searches for individual chemical ingredients only. Chemfinder is a database of links to hundreds of websites. It includes government websites and other sites on international standards for toxic labelling,

Table 4.1

Websites from chapter 4 and personal judgement of the authors about the quality of the site with respect to the efficiency of searching and the usefulness of the information

Name	Web address	Quality
Gateway of the US National Library of Medicine (NLM)	http://gateway.nlm.nih.gov/gw/Cmd	++
Specialized Information Services	http://sis.nlm.nih.gov/index.html	++
TOXNET	http://toxnet.nlm.nih.gov	++
Science.gov	http://www.science.gov/	+
National Institute for Occupational Safety and Health (NIOSH)	http://www.cdc.gov/niosh/homepage.html	+
NIOSHTIC-2	http://www2a.cdc.gov/nioshtic-2/Nioshtic2.htm	++
Haz-Map®	http://hazmap.nlm.nih.gov	++
Agency for Toxic Substances and Disease Registry (ATSDR)	http://www.atsdr.cdc.gov/atsdrhome.html	++
Hazardous Substance Release/Health Effects Database (HAZDAT)	http://www.atsdr.cdc.gov/hazdat.html	+
Occupational Safety Health Administration	http://www.osha.gov/	+
Cornell University	http://msds.ehs.cornell.edu/msdssrch.asp	+
University of Vermont	http://hazard.com/msds	+
CS Chemfinder	http://www.chemfinder.com	++
International Programme on Chemical Safety (IPCS)	http://www.who.int/ipcs/en/	+
IPCS INCHEM	http://www.inchem.org/	+
The International Chemical Safety Cards (ICSC)	http://www.ilo.org/public/english/protection/safework/cis/products/icsc/	+
International Occupational Safety and Health Information Centre (CIS)	http://www.ilo.org/public/english/support/lib/dblist.htm	++
Legislative Texts (LEGOSH)	http://www.ilo.org/public/english/protection/safework/cis/legosh/index.htm	+
The International Hazard Datasheets on Occupations	http://www.ilo.org/public/english/protection/safework/cis/products/hdo/htmold/idhindex.htm	++
Canadian Centre for Occupational Health and Safety Resource (free resources)	http://ccinfoweb.ccohs.ca/chemindex/search.html	+
The Virtual Health Library	http://bvs.isciii.es/i/index.php	+

toxicology compendia, chemical information on structures, physical parameters, safe handling, and disaster preparation.

Databases of international organizations

International Programme on Chemical Safety

Another tool to find information on chemical safety and management of chemicals is developed by the International Programme on Chemical Safety (IPCS at <http://www.who.int/ipcs/en>). IPCS is a programme of WHO, ILO, the United Nations Environment Programme and the Canadian Centre for Occupational Health and Safety. The IPCS INCHEM database (<http://www.inchem.org/>) includes thousands of full-text documents. When we search for *formaldehyde* again the search yields 156 documents. The first is the monograph of Environmental Health Criteria (EHC) on Formaldehyde, which is freely accessible. The ECH series includes comprehensive data from scientific sources for the establishment of safety standards and regulations in different countries. Each monograph is based on a comprehensive literature search of available original scientific publications and reviews. It provides an evaluation of risks for human health and the effects on the environment. The second document that is retrieved belongs to the Concise International Chemical Assessment Documents (CICADS). This series includes critical information on chemical risks and provides extensive peer-reviewed scientific information on the effects of chemicals on humans in a concise and authoritative way. The information does not necessarily represent the decisions or the stated policy of the United Nations Environment Programme, the International Labour Organization, or the World Health Organization.

Box 4.2 Example of a database on chemical substances

The IPCS INCHEM gives access to the International Chemical Safety Cards (ICSC) (<http://www.ilo.org/public/english/protection/safework/cis/products/icsc/>). Peer reviewed information is presented by international experts on how to give advice to enterprises, workers' representatives and other interested stakeholders. The information is available in several languages (Chinese, Korean, Dutch, Russian, Finnish, Spanish, French, Swahili, German, Thai, Hungarian, Urdu, Italian, Vietnamese, Japanese) which makes this database an invaluable tool for non-native English-speaking professionals.

The Environmental Health Criteria series provides a link to the Summaries and Evaluations of the International Agency for Research on Cancer (IARC) which gives details about the existing evidence on the carcinogenicity of the chemical. The same database can be accessed

from the list of chemicals that are considered to be carcinogenic. Another document useful for risk characterisation is provided by a monograph on the assessment of allergic hypersensitization associated with exposure to chemicals. It is also possible to search Health and Safety Guides (HSG) directly from a list of chemicals. These documents provide concise information for decision-makers on risks from exposure to chemicals, with practical advice on medical and administrative issues.

Other interesting databases are the IPCS/EC Evaluation of Antidotes Series and the Pesticide Data Sheets (PDSS). The first gives guidance on the use of antidotes to treat poisoning. There is information on the clinical use, mode of action and efficacy of antidotes and practical information for toxicologists and allied health professionals. The PDSS give basic peer-reviewed toxicological information on individual pesticides and are regularly updated. Basic information is available on the safe use of pesticides that are used widely in public health programmes or that have a high or an unusual toxicity record.

International Occupational Safety and Health Information Centre

The CIS (<http://www.ilo.org/public/english/protection/safework/cis/products/dbs.htm>) collects and disseminates information within the framework of the Programme on Safety and Health at Work and the Environment of the International Labour Office. With the cooperation of more than 120 national institutions on the prevention of occupational accidents and diseases, it is an international cornerstone from where individuals can easily access relevant and up-to-date information on occupational safety and health issues. A variety of useful database are integrated in the Programme.

The CIS bibliographic database contains about 65 000 citations of documents dealing with laws and regulations, chemical safety data sheets, training material, articles from periodical publications, books and standards. Every record contains a detailed bibliographic description, a full abstract and key words drawn from the CIS Thesaurus.

The Legislative Texts (LEGOSH) (<http://www.ilo.org/public/english/protection/safework/cis/legosh/index.htm>) includes relevant information about the legislation on occupational health and safety of approximately 140 countries and international organizations.

The International Hazard Datasheets on Occupations (<http://www.ilo.org/public/english/protection/safework/cis/products/hdo/htmold/idhindex.htm>) is a resource containing information on the hazards, risks and notions of prevention related to a specific occupation. Each datasheet presents in a standard format different hazards to which a worker is or may be exposed to. It provides several measures for the prevention of occupational accidents and diseases.

The Canadian Centre for Occupational Health and Safety Resource

An interesting and well-built site is provided by the Canadian Centre for Occupational Health and Safety (CCOHS, <http://www.ccohs.ca>), which provides access mostly by subscription to reference materials and databases on toxic risks (Material Safety Data Sheets) and hazard management (MSDS Management Service and CHEMpendium™) some of which are described above. A freely accessible database is the Specialized Databases section (<http://ccinfoweb.ccohs.ca/chemindex/search.html>). Searching for *formaldehyde* retrieves 1984 hits in CHEMINDEX, 18 in OSH Answers. OSH Answers is also very useful to retrieve information for educational purposes. It provides answers to common questions like *How does allergic contact dermatitis develop? What occupations are at risk? What are the preventive measures?*

The CCOHS also provides free access to the ILO Encyclopaedia of Occupational Health and Safety.

The Virtual Health Library

According to the Pan American Health Organization's (PAHO/WHO) plan, a number of institutions from Latin America and Spain developed the Virtual Health Library (VHL) (<http://bvs.isciii.es/i/index.php>). VHL is a tool developed to spread information through the web. The access to the databases is in Spanish, Portuguese and English. The database includes both national information (Índice Bibliográfico Español en Ciencias de la Salud, Base de Datos para la Investigación en enfermería en España) and international bibliographic information from different resources, in addition to different catalogues of information (Serials in Health Sciences). Searching for *formaldehyde* yields (http://bases.bvs.br/public/scripts/php/page_show_main.php?home=true&lang=en&form=simple) 12363 hits, most of which from Medline. The search can be refined to restrict the number of results.

Note

The cited databases were accessed in the period 5–22 Dec 2004. Access to all links was made on 14–15 March 2006.

Practical tips

- ▶ Use ToxFAQs to inform patients about the toxicological features of chemical compounds. To be found at <http://www.atsdr.cdc.gov/toxfaq.html>
- ▶ More answers to Frequently Asked Questions can be found at <http://www.ccohs.ca/oshanswers> (also in French)

Exercise 7

Database

Take the Endosulfan example from chapter 2 and find the most appropriate database that gives information on the health hazards and how to prevent them.

Chapter 5

CRITICAL APPRAISAL OF RESEARCH ARTICLES

Introduction

When we have found the article that meets our search criteria, the next step is to look for the results and the methods used in the article. The authors often formulate a descriptive conclusion about the results in the abstract, for example: "... data suggest that drug X is more effective than placebo in the treatment of mild to moderate depression". At this point, however, the reader cannot become convinced about the extent of the effectiveness of drug X. Is it very much more effective or only just measurably more effective with probably no meaningful clinical improvement compared to placebo? That is why it is important to look for data that tells us more about the degree of probability and the order of magnitude of the results of the research.

Once we have an idea about the results the next step is to assess their credibility. This is highly dependent on the methods used or, put in other words, of the methodological quality. The process of assessing the methodological quality is called critical appraisal. The better or the more appropriate the methods are for the purpose of the study, the higher we will value the quality. As a consequence we are more inclined to believe that the results of the study are the 'true' results and not distorted by some kind of bias. Previously, we have seen that the quality of the scientific literature is highly variable. Therefore the critical appraisal of the articles that we consider valuable for the answers to our questions, is an important aspect. We will first go through a more general notion of the evaluation of the study results. Then, we will apply criteria for the critical appraisal to the various types of research. We will provide a checklist for quality for each type of study design that we have taken over from Sackett et al.¹ Due to a restriction of space we can only briefly go through all the notions involved in critical appraisal. For those who want to study critical appraisal in more detail, there are many good text books

available, both small^{1;54} and comprehensive^{55;56}. The users' guide to the medical literature is also available as an article series free of charge on the following website <http://www.cche.net/usersguides/main.asp>

Evaluating study results

First of all it is important to realize what the value of the result is when there is *no* effect of the exposure or intervention of interest. When we want to measure a difference in blood pressure in two groups, the no-effect value is obviously 0. However, when we express the outcome of interest in the form of a risk ratio (RR) the value of no effect is 1. The risk ratio is the fraction of the risk of the exposed group divided by the risk in the control group. If both are similar, indicating no excess or no diminished risk, the value of the risk ratio is 1. The same holds for the rate ratio and the odds ratio, which have a slightly different meaning, but have the same value of 1 indicating no effect. This has important implications for evaluating the results.

In the majority of articles, the authors try their best to indicate the degree to which the results have been determined by coincidence by performing a statistical test which provides more insight into this. The authors mention, for example, the results of the study and then the p-value: e.g. RR 1.3, $p < 0.05$. The indication p is smaller than 0.05 means that there is less than 5% chance that the outcome is the result of coincidental factors. For the majority of researchers, 5% is the upper limit for results to be considered statistically significant. A research result with a p-value of 0.06 is just a fraction less unfavourable than a p-value of 0.05. However, it can no longer be considered as being statistically significant.

Instead of this rather abrupt transition from 'having an effect' to 'not having an effect', increasing use is being made of 95% confidence intervals (95% CI). Such an interval gives the same information as the p-value, but also something extra. For example in an article, you find the following RR = 1.3 and 95% CI = 0.9–1.8. This means, that there is only a 5% chance that the 'true' value of the observed risk ratio will lie outside this confidence interval even if we would take into account all possible coincidental factors. Now we want to be confident that the risk in the exposed group is greater than in the control group. With a RR of 1 there is no increase in risk and with a RR lower than 1 there is even a protective effect of the exposure. In this example we cannot be sure whether exposure actually increases the risk. The RR of 0.9 at the lower limit of the interval indicates the opposite. But still most of the confidence interval lies above 1. Only if the 95% confidence interval lies entirely above 1 we can be more confident that there is a harmful effect. A 95% confidence interval that lies entirely below 1 means that there is a protective effect.

Etiological research

Etiological research is research about the causal origin of an illness. The researcher wants to detect why some people have caught a certain illness and others not. This is most reliably done by studying contrasts in exposure among a well defined study group. In order to achieve a reliable comparison the preferred study method is a cohort study. A cohort is a well defined population of an exposed group and a non-exposed group. In a prospective cohort an exposed group and a non-exposed group are studied over a period of time with regard to the incidence of illness. The pros for a prospective design are that it allows accurate and reliable data collection; the cons are that the study may become extremely long lasting and expensive. That is why we sometimes have to rely on a case-control study design. Instead of waiting for the cases to develop during exposure, we work in reverse order and study if exposure is higher in a sample of cases compared to a group of healthy controls. However, the case-control design is more liable to distortion of the results.

Table 5.1 Checklist methodological quality of etiological research

- 1 Were the exposed group and the control group comparable with each other regarding all other factors than the exposure?
- 2 Was the exposure and the outcome measured in the same way and in a valid way for both groups? Did the determination of the outcome take place 'blind' before the exposure?
- 3 Did the follow-up of the research group last long enough to be able to observe the outcomes?

The results of etiologic research are usually expressed in terms of a relative risk, either being a risk ratio or a rate ratio (RR). The relative risk is the incidence of the illness in the exposed group divided by the incidence in the control group.

If you can answer all three items about methodological quality mentioned in table 1 positively, then you may consider the research of adequate methodological quality. If not, you should be suspicious of the possibility of bias that has distorted the results.

Diagnostic research

Diagnostic research is, in its simplest form research about accuracy of a given test to detect the presence or absence of a disease. The test can be any sort of item such as found by a clinical or laboratory test or imaging. In real life though, it is not a single test through which we determine a diagnosis. Before a test is applied one already has a certain level of suspicion or certainty about the diagnosis. Therefore, many researchers sort out how much a test adds to the prior probability of a certain diagnosis.

If you find an article about diagnosis look for the results in terms of sensitivity and specificity. (Table 5.2) The usefulness of a test for the exclusion or verification of an illness can be indicated, amongst other ways, by these well-known notions of sensitivity and specificity. A mnemonic for the meaning of these notions is SNout and SPin. A sensitive test is used to ‘rule out a disease’: SNout. A negative result (there is no illness) of a test with a high sensitivity gives a high degree of certainty that the patient does not have the illness or that the disease is ruled out. A specific test is used to ‘rule in a disease’: SPin. It is only with a positive result of a test with a high specificity that we have a high degree of certainty about the presence of the illness in that particular patient. However, in general, high sensitivity and high specificity do not go together.

Box 5.1 An example of the use of test characteristics

In case of a lumbar disc hernia we can use the straight leg raising test, also called Lasègue’s test, to indicate the possible presence or absence of a herniated disc. The straight leg raising test has a high sensitivity and a low specificity for the presence of an acute herniated disc. When you as occupational physician find a negative straight leg raising test with a patient with back complaints and radiating pain into the legs, then you can be almost certain that there is no herniated disc present. On the other hand, if you find a positive test result, there will still be a big chance that no disc herniation is present since the specificity of the test is low.

In the case of a specific patient, we are interested in the likelihood of illness after we have performed the test. How big is the chance that someone has the illness after showing positive in the test? This is indicated by the term positive predictive value. It will be implicitly clear here that the chance after the test also depends on the chance of illness before we perform the test. This chance ‘beforehand’ is determined by the degree in which the illness is prevalent within the population that you treat as a physician. The value of any test in an occupational health

		Disease	
		Yes	No
Test	Positive	a	b
	Negative	c	d

Table 5.2
Two by two table to clarify diagnostic study questions

sensitivity = true positive test rate = $a/(a+c)$
specificity = true negative test rate = $d/(b+d)$

setting, which usually implies a low risk population, is different from that in the orthopedic surgery setting where the prevalence of herniated discs is of course higher.

A test is therefore most useful if, after the test result, the chance of illness in patients is shown to be much higher or much lower. This is after all information on the basis of which you can start treatment or can provide well-substantiated advice. Some studies calculate diagnostic likelihood-ratios (LR) that are useful test characteristics. The likelihood-ratio of a positive test result (LR+) indicates the ratio of the chance of a positive result for the sick with the chance of a positive result for the non-sick. If the chance of a positive test result for the sick and non-sick is equally high, then the test has not produced much useful information. The LR of 1 is therefore not informative. An LR of 10, on the other hand, is very informative. On average, many tests have an LR of 2 or 3. Similarly, we can calculate a likelihood-ratio (LR-) for a negative test result. This indicates the ratio of the chance of a negative result for the sick with the chance of a negative result for the non-sick. An LR of 0,1 is in this case very informative.

In good diagnostic research a relevant consecutive series of patients is studied who present with complaints that raise the suspicion of a certain disease. All patients are examined equally. Everyone receives the test under study and a proper gold standard test to give the researchers the reference diagnosis. A good reference test (gold standard) is the best available test to diagnose the disease. It can be a invasive procedure to obtain a sample for histopathological examination or some imaging method or it could be an expert consensus after a long follow-up.

Table 5.3 Checklist quality criteria for diagnostic research

-
- Was the diagnostic test compared with a reference test that is considered as the 'golden' standard for this diagnostic research?
- Was the test applied in an appropriate spectrum of patients?
- Was the reference test applied without the researchers having knowledge about the result of the diagnostic test?
- Was the test applied again on a second independent group of patients?

Again if a study meets all the criteria mentioned in table 3 it can be judged as being of reasonable quality, if not then we should be suspicious that the results are distorted by some kind of bias.

Intervention / Prevention research

Intervention research is about assessing the effectiveness of a certain intervention such as treatment, screening or another preventive action compared to another intervention or no intervention in a certain population. For example: is personal advice for smoking cessation

more effective than banning smoking at work in reducing the number of smokers among office workers? The best study method for this type of study questions is the randomized controlled trial (RCT). The hallmark of such a study is that the intervention is randomly assigned to the study participants. By chance it is decided if someone receives the intervention or not. This design is considered the least liable to bias, because the randomization procedure makes the intervention and control group comparable. The more the intervention group and control group are comparable the surer we can be that the effect can be ascribed to the intervention. However, an ideal study setting almost never occurs.

Box 5.2 Example of situations in which RCTs are not possible to evaluate interventions

- Effects of measures at national level cannot be evaluated with a RCT
- Interventions that can be easily taken over by control persons can not be evaluated with a simple RCT. Then, clusters of persons, such as departments should be randomised.

Sometimes randomization at the individual level is not possible. Especially in occupational health, interventions are often applied at the group level such as at a department or at a whole factory. For instance a study on rewards or penalties connected to the use of personal protective equipment cannot use individual randomization. A solution to this problem is to randomly allocate the intervention to departments or companies. This is called cluster randomization which indicates that the randomization unit is larger than a single person.

Sometimes randomization is not feasible for other reasons. Then the next best is a controlled trial in which the intervention is deliberately assigned to an intervention group without randomization. The effect in the intervention group is compared to a concurrent control group that is hopefully very similar. Usually this is difficult to ascertain and the risk that the results are biased is greater than with the RCT.

Table 5.4 Checklist methodological quality of intervention studies.

- Was the allocation to intervention and control group random?
- Did the follow-up of patients take place over a sufficient period of time and was it comprehensive?
- Were all patients analyzed in the group to which they were first assigned?
- Especially when allocation is not done on a random basis: were the control group and intervention group comparable at the start of the study?
- Were the intervention group and control group treated equally, with the exception of the intervention?
- Were the outcomes determined without the researchers knowing to which group (intervention or control) the patients belonged (blind)?

Some interventions, like legislative actions, cannot be evaluated by means of randomly allocating the intervention or choosing a suitable comparison group. In that case a proper way of assessing the effectiveness of the action is to observe and measure the condition among workers before and after the action, the so called before-after (BA) study design. Measurements should be repeated at several time points before and after the action. The repeated measurements can make up for the lack of a control group and control for concurrent time trends that are not due to the intervention. This study type is called interrupted time series (ITS).

The more criteria in table 4 are met by a study the more confident we can be that there will be little bias that will distort the results and affect the study credibility

The evaluation of the results of intervention studies requires some special attention. Because we are interested, by definition, in a protective effect arising from an intervention,

Box 5.3
Example of differences between absolute and relative risks as the results of an intervention study

		Control Group	Intervention Group	Relative risk reduction	Absolute risk reduction	NNT
Study outcome 1	Adverse outcome rate	0.3	0.2	30%	0.1	10
Study outcome 2	Adverse outcome rate	0.003	0.002	30%	0.001	1000

the results are often expressed in terms of relative risk reduction. This figure indicates the degree by which the risk of an adverse outcome is reduced as a result of the intervention. It is calculated by subtracting the incidence in the intervention group from the incidence in the control group and dividing the result by the incidence of the control group ($I_c - \frac{I_i}{I_c}$).

Take note, however, that the relative risk reduction is often a misleadingly high number. The relative risk reduction can, for example, be 30%. To what extent this is a practical relevant risk reduction for an individual depends on the size of the absolute risk. It makes a big difference whether we are able to reduce a risk of 3 per 1 000 by 30%, or a risk of 3 per 10. In the first case, the absolute risk reduction amounts to 0.001, and in the second case to 0.1. In both cases, the relative risk reduction is 30%, but the absolute risk reduction differs by a factor of 100!

To make the effectiveness of an intervention more transparent, the number needed to treat (NNT) has been devised. This figure is a measure of the effectiveness of an intervention, and it

indicates the number of patients that have to be treated or for whom an intervention must be performed to prevent a negative outcome in **one** case. The lower the **NNT**, the more effective the intervention is. It is simple to conclude that the **NNT** can be calculated as the reciprocal of the absolute risk reduction. Similar to the number needed to treat, the number needed to harm can be calculated in the case of harmful side-effects of an intervention or the harmful working of a certain exposure. Here too, the measure is the number of persons who have to use the medicine or that have to be exposed to cause one case with a negative effect. The more harmful the exposure, the smaller the number needed to harm.

Prognostic research

Table 5.5 Checklist for quality of a prognostic study

- Was it a representative group of patients, who were all in the same phase of the illness?
- Did the follow-up of patients take place over a sufficient period of time and was it comprehensive?
- Were the outcomes determined without the researchers having any knowledge of the prognostic factors (blind)?
- Were statistical corrections made to take into account the influence of prognostic factors that were simultaneously present?

Prognostic research gives answers to the question of which features other than an intervention best predict the outcome among patients who have been diagnosed with a disease or who have a certain disability status. This is valuable information for both the physician and the patient. The physician can, for example, select patients for treatment based on prognostic factors. Patients can get a more accurate prognosis of the course of their disease.

Prognostic factors are best established in a cohort of patients in a similar phase of their disease. Such a cohort is called an inception cohort. The cohort is studied with regard to presence or absence of a specific risk factor.

The criteria in [table 5.5](#) indicate the quality of prognostic studies

Reviews

We have already discussed the difference between a narrative review and a systematic review. To answer our questions in practice, we attach the greatest value to a systematic review. The aim of a systematic review is to summarize data from different studies, preferably in one figure. This is especially appropriate for data from studies on interventions, in which the same remedy is studied in different RCTs. The data of all patients from all RCTs can then often be combined or “statistically pooled”. In that case, we talk of a meta-analysis. The outcome is then

a relative risk or odds ratio as if it only concerns one RCT. Their outcomes are more reliable because of the much larger groups of patients.

In the majority of cases, however, it is not useful to analyze the data from different studies as though they originate from one study. Then a meta-analysis is not useful because the studies are too heterogeneous. There are, however, other possibilities for creating a summary. Especially in evidence based guidelines there are measures to assess the strength of evidence, which directly influences the strength of the recommendation. It is common to use four levels of evidence ranging from high quality evidence to no evidence or very low quality evidence usually denoted with the letters A to D.⁵⁷

Practical tips

- ▶ To interpret a rate ratio use the following rule of thumb
RR > 1 means that the exposure or intervention poses a risk, RR < 1 means that there is a protective effect and RR = 1 means that there is no effect
- ▶ To interpret a 95% confidence interval around a RR see if it contains 1, for a 95% confidence interval around a difference see if it contains 0
- ▶ Use checklists and not your gut feeling to assess the methodological quality of studies

Exercise 8

Evaluating study quality

- a Download the intervention study by Jellema 2002 from Occup Med and evaluate the quality.⁵⁸
- b Download the study by Kivimäki 2003 from the British Medical Journal and evaluate the quality.⁵⁹

Chapter 6

APPLICATION OF SEARCH RESULTS TO THE QUESTION IN PRACTICE

Formulating the search result

It is our experience that the concrete formulation of the search result is often left out. This is partly because it is not always possible to find an answer to the question and partly because we are very happy to search in PubMed, find a few abstracts, print them off, and then leave it at that. However, this often induces a feeling of vague dissatisfaction because we have only partly solved the problem. Especially with problems that arise more frequently, it is important to follow through the process of solving the problem or answering the question thoroughly. This means looking up or requesting articles, reading them, evaluating or appraising them and then drawing the conclusion. The conclusion must provide the answer to our question. This is often easier said than done, and this is usually the reason that we often do not go any further than reading the abstract.

Table 6.1 Checklist for the form of an answered question or Critically Appraised Topic

- State the question
- Summarize the answer in one sentence
- Describe the context
- State the PICO
- State the search terms
- Describe briefly the study found and its validity
- State the results in terms of quantity
- State the date, your name and email address.
- State the references of the article used.

As well as being personally satisfying, formulating an answer has two other advantages. In the first place, we can provide the patient or the organization with a concrete answer to their question. This gives the patient or organization the opportunity to make well-founded choices. In addition, there are certainly other occupational physicians who would be helped by knowing the answer to your question in practice. After all, the likelihood of a question in practice being unique is very small. Other physicians will also have these same questions. They will be very pleased to be able to make use of your answer. Such an answered question is also called a Critically Appraised Topic (CAT). A CAT contains as short a summary as possible of the question, the search strategy, the result, and the answer to the question. An electronic file with questions in practice that have been answered in compliance with the EBM method would be a welcome facility for an occupational health professional. The form of an answered question or CAT is shown in the table and its aim is to provide a summary of the findings and the answer on a maximum of one A4. We slightly adapted the CAT format that is used by the Centre for EBM in Oxford. However, one must bear in mind that the acquired knowledge from your search and appraisal of the search results are perishable. You must regularly and always check if there is new information available for your question. For clinical questions a database is set up by the Centre for EBM in Oxford. Check their website: <http://www.cebm.net/cats.asp>

Applicability of the result of the search action

Once we have summarized and written down the result of our search action, there is one step left in applying EBM, namely the translation and application into practice. We have already partly solved that problem by formulating the question in PICO terms. Because we have introduced as many characteristics of our question in practice as possible, we already have some guarantee that it is applicable to our problem. After all, it concerns, amongst other things, the problem of the generalisability of the results of the study. Are the patients or employees who took part in the study described in the article comparable with the employee who is sitting in front of us? To increase the power of their research, researchers often set very strict demands or inclusion criteria on the patients or exposure conditions that can be included in their study. This results in considerable differences between the patients studied and real patients. It is often the case that only men between the ages of 20 and 40 years old with no other disease or complication take part in the study since this is likely to produce a homogeneous effect. In practice, the employee sitting in front of you is often someone with more than one problem. The question is whether in that case you can expect to see the same effect.

With results that cannot be immediately generalized, the question of extrapolation comes up. Can we extrapolate the results of the study to other patients or exposure situations that

better match our own situation in practice? The results of a cohort study into the effects of postures adverse to health performed in the meat industry cannot be directly applied to an employee with RSI working for the municipality in the finance department. The results of a study into counselling by social workers of overstrained employees in the United States will not be directly applicable to teachers in schools in China.

Table 6.2 Checklist for the application of search results to practice

- Is my practice problem or patient different from the problem or patient in the study?
- Are the results of the study generalisable or able to be extrapolated to my problem or patient?
- Do I have the same resources available to me as the researchers so that I can apply the same intervention?
- What is the preference of the patient/employee, and what is the preference of the organization?

Just as the patients or employees in a study are often selected according to strict criteria, it is also possible that the intervention is rather specialized, therefore requiring special resources or tools to perform the intervention. The question is whether such an intervention is applicable in our own practice. For example, in the study by Loisel et al in Canada, an ergonomic intervention was performed that resulted in patients with back pain returning to work earlier.⁶⁰ But this was only made possible with the aid of a subsidy and after extensive negotiations between employer and employee. One wonders whether such an intervention could be applied in the average occupational health service in South Africa. O'Neill reports in his article on ergonomics that there is a big difference between industrially developing countries and industrially advanced countries.⁶¹

Ultimately, the preferences of the patient or an organization determine whether an intervention can be performed. In Leung's study, it is shown that prophylactic INH treatment for mine workers with silicosis is effective to prevent tuberculosis in Hong Kong. However, it may be possible that in your country or workplace environment prophylactic INH treatment is not an option due to costs.⁶²

Many occupational physicians complain that managers of factories or firms are unwilling to take proper measures to decrease the noise levels in their firm. It could be helpful to confront the manager with evidence from the literature. As an occupational health professional, you could use the study by Prince et al that shows that the risk of a hearing handicap at age 65 (> 25 dB loss averaged over 1,2,3 and 4 kHz) that can attributed to a noise exposure of 90 dB(A) during 10 years is around 30%.⁶³ You could also use the figures reported by Concha-Barrientos

Box 6.1 An example of giving concrete risk information

A 50-year-old teacher was treated by the cardiologist with a stent, because he was suffering from angina pectoris. A re-stenosis of his vessels had occurred and he had been on the waiting list for several months for another stent. The cardiologist advised him to 'take it as easily as possible'. This was interpreted by the person involved as 'not going to work' because the chance was high that the results would be fatal. He would actually prefer to work. A PubMed-search revealed that angina pectoris that had not been treated previously would have fatal consequences in 3% of the cases, particularly in the first six months after being diagnosed. Recent research among patients on the waiting list for a CABG operation demonstrates that the risk is the same. This was a risk that was reassuring for the person involved. In view of the fact that he enjoyed his work, which was not particularly mentally or physically demanding, it was decided that he should start working again. Concrete information about the level of the risk involved had a positive effect here.⁶⁵

who calculated that the relative risk of being hearing impaired (>41 dB loss over 0.5, 1, 2 and 4 kHz) at age 65 after exposure at work to 90 dB(A) is 2.8.⁶⁴

The way you present the evidence found to the employee or organization is important. We recommend that you quantify the information as much as possible. After all, this provides those involved with the opportunity to interpret the figures in their own way. Therefore, do not say that 'there is a small chance that you will get back pain from doing heavy work', but rather 'in your case, the chance of getting back complaints is approximately 1%'.

It is conceivable that the occupational physician sends the organization the original articles along with a summary of the results found. In many organizations, sufficient expertise is available to be able to evaluate the information internally.

Practical tip

- ▶ Use research information to quantify outcomes. This avoids confusion about risks being great or effects being small and clarifies the discussion about the meaning of results

Exercise 9

Applying the results to practice

Download the case reports by Monduzzi (2005) and Grandi (2005) from Occupational Medicine (<http://occmed.oupjournals.org>) and analyse how they applied the results to their practice.^{66;67}

REFERENCE LIST

- 1 **Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB.** Evidence-based medicine; how to teach and practice. 2 edition ed. London: Churchill Livingstone; 2000.
- 2 **van Dieen JH, Hoozemans MJ, Toussaint HM.** Stoop or squat: a review of biomechanical studies on lifting technique. *Clin Biomech (Bristol, Avon)* 1999; 14(10):685–696.
- 3 **Hignett S.** Intervention strategies to reduce musculoskeletal injuries associated with handling patients: a systematic review. *Occup Environ Med* 2003; 60(9):E6.
- 4 **Wiesel SW, Cuckler JM, Deluca F, Jones F, Zeide MS, Rothman RH.** Acute low-back pain. An objective analysis of conservative therapy. *Spine* 1980; 5(4):324–330.
- 5 **Hilde G, Hagen KB, Jamtvedt G, Winnem M.** Advice to stay active as a single treatment for low back pain and sciatica. *Cochrane Database Syst Rev* 2002;(2):CD003632.
- 6 **Verbeek JH.** Vocational rehabilitation of workers with back pain. *Scand J Work Environ Health* 2001; 27(5):346–352.
- 7 **Schonstein E, Kenny DT.** Diagnoses and treatment recommendations on workers compensation medical certificates. *Med J Aust* 2000; 173(8):419–422.
- 8 **Schaafsma F, Hulshof C, van DF, Verbeek J.** Information demands of occupational health physicians and their attitude towards evidence-based medicine. *Scand J Work Environ Health* 2004; 30(4):327–330.
- 9 **van der Weide WE, Verbeek JH, van Dijk FJ, Doef J.** An audit of occupational health care for employees with low-back pain. *Occup Med (Lond)* 1997; 47(5):294–300.
- 10 **Schaafsma F, Verbeek J, Hulshof C, van Dijk F.** Caution required when relying on colleagues' advice; a comparison between professional advice and evidence from the literature. submitted *BMC Health Services Research* 2005.
- 11 **Bodenheimer T.** Uneasy alliance—clinical investigators and the pharmaceutical industry. *N Engl J Med* 2000; 342(20):1539–1544.
- 12 **Green ML, Ciampi MA, Ellis PJ.** Residents' medical information needs in clinic: are they being met? *Am J Med* 2000; 109:218–223.
- 13 **Jousimaa J.** The clinical use of computerized primary care guidelines [University of Kuopio, Finland; 2001.
- 14 **Straus SE, Jones G.** What has evidence based medicine done for us? *BMJ* 2004; 329(7473):987–988.
- 15 **Roberts D, Buckley N.** Alkalinisation for organophosphorus pesticide poisoning
1. *Cochrane Database Syst Rev* 2005;(1):CD004897.
- 16 **Buckley NA, Karalliedde L, Dawson A, Senanayake N, Eddleston M.** Where is the evidence for treatments used in pesticide poisoning? Is clinical toxicology fiddling while the developing world burns? *J Toxicol Clin Toxicol* 2004; 42(1):113–116.
- 17 **Buckley NA, Roberts D, Eddleston M.** Overcoming apathy in research on organophosphate poisoning
2
184. *BMJ* 2004; 329(7476):1231–1233.
- 18 **Dewan A, Bhatnagar VK, Mathur ML, Chakma T, Kashyap R, Sadhu HG et al.** Repeated episodes of endosulfan poisoning. *J Toxicol Clin Toxicol* 2004; 42(4):363–369.
- 19 **Eyer F, Felgenhauer N, Jetzinger E, Pfab R, Zilker TR.** Acute endosulfan poisoning with cerebral edema and cardiac failure. *J Toxicol Clin Toxicol* 2004; 42(6):927–932.
- 20 **Kutluhan S, Akhan G, Gultekin F, Kurdoglu E.** Three cases of recurrent epileptic seizures caused by Endosulfan. *Neurol India* 2003; 51(1):102–103.
- 21 **Venkateswarlu K, Suryarao K, Srinivas V, Sivaprakash N, Jagannadharao NR, Mythilai A.** Endosulfan poisoning –a clinical profile. *J Assoc Physicians India* 2000; 48(3):323–325.

- 22 **Roberts DM, Karunaratna A, Buckley NA, Manuweera G, Sheriff MH, Eddleston M.** Influence of pesticide regulation on acute poisoning deaths in Sri Lanka
5. *Bull World Health Organ* 2003; 81(11):789–798.
- 23 **Deyo RA, Weinstein JN.** Primary Care: Low Back Pain. *N Engl J Med* 2001; 344:363–370.
- 24 **Shingleton BJ, O'Donoghue MW.** Primary Care: Blurred Vision. *N Engl J Med* 2002; 343:556–562.
- 25 **Jones NL, Killian KJ.** Exercise limitations in health and disease. *N Engl J Med* 2000; 343:632–641.
- 26 **Lockwood AH, Salvi RJ, Burkard RF.** Tinnitus. *N Engl J Med* 2002; 347(12):904–910.
- 27 **Gehanno JF, Thirion B.** How to select publications on occupational health: the usefulness of Medline and the impact factor. *Occup Environ Med* 2000; 57(10):706–709.
- 28 **Garfield E.** How can impact factors be improved? *BMJ* 1996; 313:411–413.
- 29 **Kunst H, Groot D, Latthe PM, Latthe M, Khan KS.** Accuracy of information on apparently credible websites: survey of five common health topics. *BMJ* 2002; 324:581–582.
- 30 **Allison JJ, Kiefe CI, Weissman NW, Carter J, Centor RM.** The art and science of searching MEDLINE to answer clinical questions. Finding the right number of articles. *Int J Technol Assess Health Care* 1999; 15(2):281–296.
- 31 **Haynes RB, Mckibbin KA, Wilczynski NL, Walter SD, Werre SR.** Optimal search strategies for retrieving scientifically strong studies of treatment from Medline. submitted 2004.
- 32 **Wilczynski NL, Haynes RB.** Developing Optimal Search Strategies for Detecting Clinically Sound Causation Studies in MEDLINE. *Proc AMIA Symp* 2003;719–723.
- 33 **Haynes RB, Wilczynski NL.** Optimal search strategies for retrieving scientifically strong studies of diagnosis from Medline: analytical survey. *BMJ* 2004; 328(7447):1040.
- 34 **Wilczynski NL, Haynes RB.** Developing optimal search strategies for detecting clinically sound prognostic studies in MEDLINE: an analytic survey. *BMC Med* 2004; 2(1):23.
- 35 **Verbeek JH, Salmi J, Pasternack I, Jauhiainen M, Laamanen I, Schaafsma F et al.** A search strategy for occupational health intervention studies. *Occup Environ Med* in press 2005.
- 36 **Haafkens J, Schuring M, Moerman C, van Dijk F.** Searching bibliographic databases for literature on chronic disease and work-participation. submitted 2005.
- 37 **Schaafsma F, Hulshof CT, Verbeek JH, van Dijk FJ, Bos J, Dyserinck H.** Developing search strategies in Medline on the occupational origin of diseases. submitted 2005.
- 38 **Verbeek J, Husman K, van DF, Jauhiainen M, Pasternack I, Vainio H.** Building an evidence base for occupational health interventions. *Scand J Work Environ Health* 2004; 30(2):164–170.
- 39 **Roder C, Schaefer M, Leucht S.** [Meta-analysis of effectiveness and tolerability of treatment of mild to moderate depression with St. John's Wort]. *Fortschr Neurol Psychiatr* 2004; 72(6):330–343.
- 40 **Werneke U, Horn O, Taylor DM.** How effective is St John's wort? The evidence revisited. *J Clin Psychiatry* 2004; 65(5):611–617.
- 41 **Hammerness P, Basch E, Ulbricht C, Barrette EP, Foppa I, Basch S et al.** St John's wort: a systematic review of adverse effects and drug interactions for the consultation psychiatrist. *Psychosomatics* 2003; 44(4):271–282.
- 42 **Schulz V.** [New therapeutic studies and meta-analysis. St. John's wort extract vs. synthetics]. *Pharm Unserer Zeit* 2003; 32(3):228–234.
- 43 **Manber R, Allen JJ, Morris MM.** Alternative treatments for depression: empirical support and relevance to women. *J Clin Psychiatry* 2002; 63(7):628–640.
- 44 **Whiskey E, Werneke U, Taylor D.** A systematic review and meta-analysis of *Hypericum perforatum* in depression: a comprehensive clinical review. *Int Clin Psychopharmacol* 2001; 16(5):239–252.
- 45 **Shelton RC, Keller MB, Gelenberg A, Dunner DL, Hirschfeld R, Thase ME et al.** Effectiveness of St John's wort in major depression: a randomized controlled trial. *JAMA* 2001; 285(15):1978–1986.

- 46 **Nangia M, Syed W, Doraiswamy PM.** Efficacy and safety of St. John's wort for the treatment of major depression. *Public Health Nutr* 2000; 3(4A):487-494.
- 47 **Mulrow CD, Williams JW, Jr.,** Chiquette E, Aguilar C, Hitchcock-Noel P, Lee S et al. Efficacy of newer medications for treating depression in primary care patients. *Am J Med* 2000; 108(1):54-64.
- 48 **Linde K, Mulrow CD.** St John's wort for depression. *Cochrane Database Syst Rev* 2000;(2):CD000448.
- 49 **Williams JW, Jr.,** Mulrow CD, Chiquette E, Noel PH, Aguilar C, Cornell J. A systematic review of newer pharmacotherapies for depression in adults: evidence report summary. *Ann Intern Med* 2000; 132(9):743-756.
- 50 **Snow V, Lascher S, Mottur-Pilson C.** Pharmacologic treatment of acute major depression and dysthymia. American College of Physicians-American Society of Internal Medicine. *Ann Intern Med* 2000; 132(9):738-742.
- 51 **Berner MM, Ruther A, Stieglitz RD, Berger M.** [The concept of „evidence-based medicine“ in psychiatry. A path to a more rational psychiatry?]. *Nervenarzt* 2000; 71(3):173-180.
- 52 **Linde K, Ramirez G, Mulrow CD, Pauls A, Weidenhammer W, Melchart D.** St John's wort for depression –an overview and meta-analysis of randomised clinical trials. *BMJ* 1996; 313(7052):253-258.
- 53 **Suplido ML, Ong CN.** Lead exposure among small-scale battery recyclers, automobile radiator mechanics, and their children in Manila, the Philippines. *Environ Res* 2000; 82(3):231-238.
- 54 **Crombie IK.** The pocket guide to critical appraisal. London: BMJ Books; 1996.
- 55 **Sackett DI, Haynes RB, Guyatt GH, Tugwell P.** Clinical epidemiology: a basic science for clinical medicine. 2nd ed. Boston: Little Brown; 1991.
- 56 **Users' guides to the medical literature: essentials of evidence-based clinical practice.** Chicago: AMA press; 2001.
- 57 **Schüneman HJ, Best D, Vist G, Oxman AD.** Letters, numbers, symbols and words: how to communicate grades of evidence and recommendations. *CMAJ* 2003; 169(7):677-680.
- 58 **Jellema P, Bierma-Zeinstra SM, Van Poppel MN, Bernsen RM, Koes BW.** Feasibility of lumbar supports for home care workers with low back pain. *Occup Med (Lond)* 2002; 52(6):317-323.
- 59 **Kivimaki M, Leino-Arjas P, Luukkonen R, Riihimaki H, Vahtera J, Kirjonen J.** Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees. *BMJ* 2002; 325(7369):857.
- 60 **Loisel P, Abenheim L, Durand P.** A population-based, randomized clinical trial on back pain management. *Spine* 1997; 22:2911-2918.
- 61 **O'Neill DH.** Ergonomics in industrially developing countries: does its application differ from that in industrially advanced countries? *Appl Ergon* 2000; 31(6):631-640.
- 62 **Leung CC, Law WS, Chang KSTCM, Yew WW.** Initial experience on rifampin and pyrazinamide vs isoniazid in the treatment of latent tuberculosis infection among patients with silicosis in Hong Kong. *Chest* 2003; 124(6):2112-2118.
- 63 **Prince MM, Stayner LT, Smith RJ, Gilbert SJ.** A re-examination of risk estimates from the NIOSH Occupational Noise and Hearing Survey (ONHS). *J Acoust Soc Am* 1997; 101(2):950-963.
- 64 **Concha-Barrientos M, Campbell-Lendrum D, Steenland K.** Occupational noise, assessing the burden of disease from work-related hearing impairment at national and local levels. 9, 1-32. 2004. Geneva, WHO. Environmental burden of disease series.
- 65 **Koomen EM, Hutten BA, Kelder JC, Redekop WK, Tijssen JG, Kingma JH.** Morbidity and mortality in patients waiting for coronary artery bypass surgery. *Eur J Cardiothorac Surg* 2001; 19(3):260-265.
- 66 **Monduzzi G, Franco G.** Practising evidence-based occupational health in individual workers: how to deal with a latex allergy problem in a health care setting. *Occup Med (Lond)* 2005; 55(1):3-6.
- 67 **Grandi P, Franco G.** Practising evidence-based occupational health in workers' groups: how to prevent sickness absence caused by influenza. *Occup Med (Lond)* 2005; 55(1):7-9.

Appendix 1

MEDICAL SUBJECT HEADINGS (MESH) IN MEDLINE RELATED TO OCCUPATIONAL HEALTH

List of Mesh-terms as available in the Mesh-browser in PubMed in May 2005
(<http://www.nlm.nih.gov/mesh/meshhome.html>)

absenteeism	health care quality	prognosis
accidents, occupational	health education	program evaluation
accident prevention	health promotion	protective devices
activities of daily living	health services	public health
benchmarking	health surveys	public health practice
biologic monitoring	healthy worker effect	quality assurance
burnout, professional	insurance, disability	quality of health care
chronic disease	job satisfaction	quality of life
clinical trials	life style	quality-adjusted life years
community health services	mass screening	randomized controlled trials
cost of illness	nursing	recovery of function
data collection	occupational diseases	reference standards
diagnosis	occupational exposure	referral and consultation
diagnostic services	occupational health	rehabilitation
diagnostic techniques and procedures	occupational health nursing	rehabilitation, vocational
disability evaluation	occupational health services	retirement
disabled persons	occupational medicine	risk
disease susceptibility	occupational therapy	risk assessment
disorders of environmental origin	occupations	safety
employment	parental leave	safety management
employment supported	patient education	sensitivity
environment and public health	patient satisfaction	sentinel surveillance
environmental exposure	personnel downsizing	sheltered workshops
environmental monitoring	personnel management	sick leave
environmental pollutants	personnel selection	social work
environmental pollution	personnel turnover	specificity
epidemiologic measurements	physical therapy	stress, psychological
epidemiologic methods	poisoning	supported employment
epidemiologic studies	population characteristics	therapeutics
ethics committees	population surveillance	therapy
evaluation studies	practice guidelines	treatment failure
exercise therapy	pregnancy outcome	treatment outcome
gatekeeping	preventive health services	unemployment
genetic predisposition to disease	primary prevention	vocational guidance
guidelines	probability	work
hazardous substances	professional autonomy	work capacity evaluation
health care access	professional corporations	workers' compensation
health care evaluation	professional practice	workload
	professional staff committees	workplace

Appendix 2

ANSWERS TO EXERCISES

Exercise 1

I found that I have a very regular pattern of looking up information. I have a few recent text books about epidemiology, evidence-based medicine and occupational health. I use them when I am not familiar with a subject. For most medical questions I use Medline through Internet. I have an additional list of websites that I can use for retrieving information. In addition, I am a subscriber to one general medical journal, one local occupational health journal and a number of e-mail alerts that send me automatically the tables of contents of a number of journals. (JV)

Exercise 2

- a Latex gloves from Singapore: Health question. Intervention/Prevention: risk of latex allergy
- b Temporary worker USA: Legal question.
- c Agricultural worker Colombia: Health question. Etiological: risks of unemployment
- d Worker in battery shop Kenya: Health question. Etiological: risks of lead exposure
- e Canadian nurse: Health question. Prognostic: risk of chronic back pain
- f Truck drivers: Statistics question.
- g Hospital personnel in Thailand: Statistics question
- h Japanese bank employees: Health question. Intervention/Prevention: physiotherapy-ergonomics
- i New Zealand metal factory: Health question. Intervention/prevention: effect advice on ppe
- j UK administrative worker: Legal question.

Exercise 3

You can send your answers to the authors at jos.verbeek@ttl.fi to check if the categorisation is right.

Exercise 4

- a P: Miner. I/E: Silicosis. C: No silicosis O: Tuberculosis
- b P: Metal worker probably with noise-induced-hearing-loss I/E: any intervention C: any control O: tinnitus
- c P: IT-specialist with forearm pain. I/E: connective tissue massage C: other forms of physiotherapy, no treatment O: forearm pain

Exercise 5

- a Check the results from the reference list as follows: ³⁹⁻⁵² Disparities can be explained by time difference. We did our search in 2004.
- b We searched with **anemia[mh] AND lead[mh] AND worker***. This yielded 15 studies of which the 4th study was the one by Suplido et al.⁵³

Exercise 6

You can send a summary of your results to the authors at jos.verbeek@ttl.fi to check the quality of your search strategy.

Exercise 8

- a If we consider Jellema et al 2002 as a research project to study the perceived benefit of lumbar supports it would qualify as an intervention study. The checklist would be as follows: 1. no 2. yes 3. not applicable 4. not applicable 5. not applicable 6. yes. It would mean that the quality of this study as an intervention study is low.
- b The study by Kivimäki et al would qualify as an etiological study and yield the following score on the checklist: 1. yes, through statistical comparison 2. yes, validated questionnaire for exposure, mortality data for outcome taken blind from registry. 3. yes, 25-year follow-up is long enough to observe outcome. It would mean that the quality of this study as an etiological study is high.

Exercise 7

Information about Endosulfan

Most useful information is accessible at the following links. Time allotted for retrieving information is 40 min

Name	Web address		
Gateway of the US National Library of Medicine (NLM)	http://gateway.nlm.nih.gov/gw/Cmd	833 medline 2296 TOXLINE Special 56 HSDS	http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+115-29-7
Specialized Information Services	http://sis.nlm.nih.gov/index.html	3579 TOXLINE Special	
TOXNET	http://toxnet.nlm.nih.gov	3579 TOXLINE Special	
Science.gov	http://www.science.gov/	194	http://www.science.gov/search-cgis/dexpldcgi?qry1650804895.results;194
National Institute for Occupational Safety and Health (NIOSH)	http://www.cdc.gov/niosh/homepage.html	34	
NIOSH TIC-2	http://www2a.cdc.gov/nioshtic-2/Nioshtic2.htm	6	
Haz-Map®	http://hazmap.nlm.nih.gov	1	http://hazmap.nlm.nih.gov/cgi-bin/hazmap_generic?tbl=TblAgents&id=234
Agency for Toxic Substances and Disease Registry (ATSDR) {	http://www.atsdr.cdc.gov/atsdrhome.html	4	http://www.atsdr.cdc.gov/toxprofiles/phs41.html
HAZDAT (Hazardous Substance Release/Health Effects Database)	http://www.atsdr.cdc.gov/hazdat.html	1	http://www.atsdr.cdc.gov/gsql/toxprof.script?in_toxn=endosulfan
Occupational Safety Health Administration	http://www.osha.gov/	14	
Cornell University	http://msds.ehs.cornell.edu/msdssrch.asp	54	http://msds.ehs.cornell.edu/msds/msdsdod/a420/m209909.htm
University of Vermont	http://hazard.com/msds	8	http://www2.siri.org/msds/mf/cards/file/0742.html
CS Chemfinder	http://www.chemfinder.com	1	http://chemfinder.cambridgesoft.com/result.asp

“I found the booklet to be excellent from the point of view of helping the reader develop useful research questions, find data, test its validity and report the findings. The practical examples help demonstrate what the authors are trying to achieve. It should be compulsory reading for all researchers. The booklet is medically oriented, however the principles apply to any field including occupational hygiene. I would venture that there is a need for a similar document with occupational hygiene examples and information sources”

—**Kevin Renton**, Senior Occupational Hygienist,
National Institute of Occupational Health, South Africa

“The guide is an informative and concise document which we believe will help in educating physicians and other medical personnel on evidence-based medicine research techniques”

—**Dianna Smith**, Assistant Director, Research Section,
National Strategy Branch, Office of the Australian Safety
and Compensation Council and colleagues

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