Clinical question

Scand J Work Environ Health 2002;28(3):197-204

doi:10.5271/sjweh.665

Evidence-based medicine for occupational health

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The following articles refer to this text: 2002;28(5):358-359; 2002;28(5):359-360; 2004;30(2):164-168; 2004;30(4):327-330; 2003;29(1):78-79; 2003;29(1):79-80; 2011;37(6):494-501

Key terms: asthenopia; behavior therapy; burnout; clinical question; computer; employment; evidence-based medicine; hepatitis A; hypertension; occupational health; pregnancy; sewage

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/12109560

Scand J Work Environ Health 2002;28(3):197–204

Evidence-based medicine for occupational health

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Verbeek JH, van Dijk FJ, Malmivaara A, Hulshof CT, Räsänen K, Kankaanpää EE, Mukala K. Evidence-based medicine for occupational health. *Scand J Work Environ Health* 2002;28(3):197–204.

Objectives This study attempted to determine the feasibility and utility of methods used in evidence-based medicine for some common questions in the practice of occupational medicine.

Methods The following clinical questions were generated that were representative of the type of problems encountered by occupational health physicians: is work a cause of health problems and is impaired health a cause of diminished work capacity for a specific job? Answers were generated according to the method used in evidence-based medicine by formulating an answerable question, searching the literature, critically appraising the results, and applying the results to the clinical question.

Results Answers were found to all the questions in a reasonable amount of time. The searches revealed a need for more systematic reviews and studies that use work-related health outcomes like return to work. However, there is more evidence available in Medline than is generally assumed by occupational health physicians. Using this evidence led to better clinical decisions. Pitfalls during the literature search were typing mistakes, problems in using medical subject headings, and unreliable search strategies. With the use of the abstracts only, most clinical questions could be answered satisfactorily, but concrete risk estimates were often lacking. The lack of availability of full text journals decreased the reliability of the critical appraisal and risk estimation.

Conclusions Evidence-based medicine is a feasible and useful method for occupational medicine. Instruction and training is needed for most occupational health physicians to increase their searching and critical appraisal skills. More research is needed to determine the information needs of occupational health physicians and to develop tools that facilitate literature searches.

Key terms asthenopia, behavior therapy, burnout, computers, employment, hepatitis A, hypertension, pregnancy, sewage.

In the past decade, evidence-based medicine has become a generally accepted method of linking the results of research to the practice of medicine. In the area of occupational medicine the use of evidence-based medicine has been advocated (1–3).

However, searching Medline with the phrases or subject headings "evidence-based medicine" and "occupational medicine" yielded only nine articles in November 2001. Authors of all the articles were in favor of applying methods of evidence-based medicine to occupational medicine. Most of them advocated a systematic review of the literature and subsequent development of guidelines based on these reviews. However, evidence-based medicine goes beyond the development of guidelines and urges practitioners to find the best evidence for any clinical problem (4).

Little is known about the clinical problems that occupational physicians encounter in their daily practice and the information needs that these problems raise, in contrast to the situation in general practice (5, 6). Methods of evidence-based medicine could be difficult to apply in this field because occupational medicine

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differs from general clinical medicine. Some argue that the application of evidence-based medicine is hampered because occupational medicine is, to some extent, dependent on government regulations. As another impediment to the application of evidence-based medicine, it is mentioned that there is a lack of research evidence (1). For all these reasons, we wanted to study the possibilities of applying the method of evidence-based medicine to occupational medicine.

We generated questions from clinical problems that we had encountered in practice and that we considered common in occupational medicine. Subsequently we tried to answer the questions by means of methods used in evidence-based medicine. The objective of this article is therefore to describe the possibilities and pitfalls of applying evidence-based medicine in the field of occupational medicine.

Methods

Occupational medicine

Occupational medicine is the medical specialty concerned with the promotion and maintenance of the physical and mental health of employees in occupational settings. This work is related to two fundamental problems that are the subject of occupational medicine, work causing occupational diseases or work-related disorders and health problems leading to the impairment of work ability. The questions about occupational disease are mainly etiologic in nature and sometimes concern the diagnosis or effectiveness of interventions. The questions concerning impaired work ability are more diverse and can be related to diagnosis, etiology, prognosis, and the effectiveness of interventions.

Clinical problems

We selected four clinical problems for which we had no answer and which were typical for occupational medicine:

1. A 52-year-old female psychologist, working most of the day at the computer screen, complained of a burning sensation in her eyes and asked if a better screen would solve her problems. We did not know whether work with visual display units could cause eyes to burn. If it were a plausible cause, we would send an occupational hygienist or ergonomist to offer advice about workplace assessment and improvement.

2. A 30-year-old male worker in municipal sewage services had a colleague who contracted hepatitis A. He had heard that it is an occupational disease and wanted to know if something could be done about it. We did not know if sewage workers are exposed to a higher risk of acquiring hepatitis A and, if so, what the relative risk would be. If the relationship were plausible, we would have to consider advice about a costly vaccination policy.

3. A 45-year-old male teacher was referred by his general practitioner because he had been diagnosed with burnout and the occupational health physician was thought to be the best-equipped professional to help. He wanted to know what treatment would best help him to get back on the job. We had a vague idea about cognitive behavioral therapy being the most successful treatment, but we could not give a precise estimate of its effectiveness.

4. A 35-year-old female nurse was sent to us by her gynecologist to confer about sick leave because she was in the 12th week of her first pregnancy and had a diagnosis of pregnancy-related hypertension [140/95 mm Hg (18.6/12.6 kPa)]. She wished to continue to work and wanted to know what the risks would be for her and her unborn child. We knew about elevated risks with physically demanding work; however, we could not provide precise risk estimates. If the risk were considerable, continuing work would be unwise.

Evidence-based medicine

Evidence-based medicine is a process of systematically finding, appraising, and using up-to-date research findings as the basis for clinical decisions. Evidence-based medicine asks questions, finds and appraises the relevant data, and harnesses that information for everyday clinical practice. It uses the following four steps (i) formulate a clear clinical question from a patient's problem, (ii) search the literature for relevant articles, (iii) evaluate (critically appraise) the evidence for its validity and usefulness, and (iv) implement useful findings in clinical practice (4, 7).

Search strategy

We followed instructions for a well-built clinical question that consists of the following three or four parts (leading to the acronym PICO): (i) the patient or problem of interest, (ii) intervention defined in a broad sense, being any determinant for a relevant outcome (exposure, treatment, diagnostic test, or prognostic characteristic), (iii) comparison intervention if relevant, and (iv) outcome of interest.

Several literature databases contain relevant evidence for occupational medicine, for example, Medline, Embase (http://www.elsevier.nl; accessed on 29 October

2001), Psycinfo (http://www.apa.org; accessed on 29 October 2001), CINAHL (Cumulative Index to Nursing and Allied Health Literature; http://www.cinahl.com; accessed on 29 October 2001), or OSHROM (http://www.silverplatter.com; accessed on 29 October 2001). However, only Medline is available free of charge through the Internet with the search tool PubMed. Therefore, we used PubMed as the most convenient access to Medline at http://www.ncbi.nlm.nih.gov/PubMed. It not only contains references to original studies, but also references to databases of systematic reviews, like those of the Cochrane Collaboration.

We followed the guidance given on retrieving the appropriate amount of articles by Allison et al (8) and also general guidelines (7). These guidelines advocate starting with a well-built clinical question. The search terms from the literature search are then derived from the PICO instructions. Next, the search terms are matched with the medical subject headings (MeSH) used for indexing in Medline. By the use of search limits, the right balance must be found between too few and too many articles. According to the authors, retrieving 50 articles would be about the right balance.

In this paper, we describe the process of posing an answerable question and searching the literature, the number of articles retrieved, the critical appraisal of the abstracts, the article(s) used to answer the clinical question, and the clinical decision made.

Results

Table 1 summarizes the results of formulating answerable questions, and table 2 gives the results of the literature search. Here, we give a description of the

Table 1. Answerable questions derived from clinical problems encountered in the practice of occupational medicine.

Problem	Patient or worker	Intervention or exposure	Comparison	Outcome
1. Work with visual display units and burning eyes	52-year-old healthy female psychologist	Exposure to work with visual display units most of the day	No or limited exposure	Burning eyes
2. Sewage work and hepatitis A	30-year-old healthy male blue-collar worker	Work in a sewage plant with frequent exposure to waste water	No or limited exposure among blue-collar workers	Hepatitis A
3. Effective treatment of burnout and return to work	45-year-old male teacher with burnout	Cognitive behavioral therapy	Another or no treatment	Return to work
4. Work and hypertension in pregnancy	35-year-old nurse, 12th week of pregnancy with hypertension	Physically and mentally demanding work and pregnancy-related hypertension	No work, other work, rest	Pregnancy outcome

Table 2. Results of the literature search in Medline using PubMed for four occupational health problems.

Problem	Search terms and PubMed settings	Articles retrieved	Problems encountered	Final articles
1. Work with visual display units and burning eyes	computers AND asthenopia; limit English	53, of which 4 reviews	How to translate clinical problem into search words	Thomson, 1998 (9), Eichenbaum, 1996 (10), Mocci et al, 2001 (11), Ziefle, 1998 (12)
2. Sewage work and hepatitis A	sewage AND hepatitis A AND occupation*; limit English	19, of which no reviews	No reviews and many original studies with contradictory findings and advice	Bonanni et al, 2000 (13), Weldon et al, 2000 (14), Levin et al, 2000 (15), Trout et al, 2000 (16), Brugha et al, 1998 (17), Cadilhac & Roudot-Thoraval F, 1996 (18), DeSerres et al, 1995 (19), Heng et al, 1994 (20), Skinhoj et al, 1981 (21),
3. Effective treatment for burnout	burnout AND behaviour therapy; Limit Review	14 reviews	Too many original articles No articles about return to work	Murphy, 1996 (23)
4. Work and hypertension in pregnancy	hypertension AND pregnancy outcome AND work; blood pressure AND pregnancy AND employment; hypertension AND pregnancy AND employment	10 articles, of which 2 reviews, 13 articles, and 23 articles	Work as a cause or aggravation of disease, misspellings, different search terms for work	Mozurkewich et al, 2000 (24), Walker et al, 2001 (25), Meis et al 1998, (26), Eskenazi et al, 1991 (31), Frazier et al, 2001 (28)

search process, the critical appraisal of the results, and the use of the results to answer the clinical questions posed.

Work visual display units and burning eyes

Literature search. "Visual display unit" is not a MeSH term, but "computers" is. Burning eyes was also not a MeSH term, but the MeSH browser led us to the relevant term "asthenopia", which is used for functional eye complaints, including a burning sensation of the eyes. This term yielded 53 articles. Setting limits to "review" and "English" restricted the results to four reviews. Two of these were on asthenopia and had abstracts (9, 10).

Critical appraisal. A critical appraisal of the abstracts showed that neither of the reviews was systematic. The abstract of the first review stated that these complaints occur in 10–15% of patients. The other review stated that there is an enormous variation in the prevalence estimates of eye problems related to the use of visual display units but that most authors agree that eye problems are common in such use. We concluded that this was only very limited evidence.

We decided to return to the 53 original studies to see if there was any recent evidence of a controlled study in which exposure was associated with asthenopia. The third article in the PubMed list concerned a study in which psychosocial factors explained 30% of the variance of complaints of asthenopia (11). The 11th article in the list presented the results of an experiment in which the influence of different display resolutions on visual fatigue was examined (12). The authors recommended higher resolution screens to prevent visual fatigue.

From this search it can be concluded that there is limited evidence for a relation between burning eyes and the use of visual display units but that also psychosocial factors can be a cause of asthenopia.

Clinical decision. On the basis of this information, we would decide to have the workplace of the patient examined by an occupational hygienist, and, at the same time, we would explain to her that also psychosocial conditions, like job satisfaction, could contribute to these problems.

Exposure to sewage and hepatitis A

Literature search. Both "sewage" and "hepatitis A" were MeSH terms. The combined use and the restriction to English resulted in 51 articles, not all about occupational exposure. Therefore, we added the term "occupation*", the asterisk indicating the retrieval of all possible words that contain the fragment "occupation", such as "occupations" and "occupational". This procedure resulted in 19 articles, which showed an interesting debate on the question of whether sewage workers should be vaccinated or not, the initial debate dating as far back as 1981. This finding indicated the need for a systematic review, but we did not find one. Using only the abstracts of the studies, we were able to perform our own substitute for a review.

Critical appraisal. There were nine original epidemiologic studies on the risk of acquiring hepatitis A through occupational exposure to sewage due to work in a sewage plant (13–21). Cohort studies would have provided the best evidence, but we found only cross-sectional studies. Four authors reported no association between work in a sewage plant and hepatitis A. Five authors reported an association. Some of them advised the use of vaccination and some advised against this practice. The recommendations seemed to be independent of the results of their own study. We concluded that the quality of the studies performed was low and that the results were contradictory for both a higher risk of acquiring Hepatitis A and for vaccination.

Clinical decision. On the basis of this information, we decided that the subject had been studied relatively extensively and that there was insufficient evidence to advise the employer to vaccinate all employees. However, if a worker were worried about the risk, he could be offered the opportunity for vaccination.

Burnout and cognitive behavioral treatment

Literature search. Using the mapping facility of PubMed, we found the MeSH terms "burnout" and "cognitive therapy", the latter of which is a subheading of behavior therapy. A search with these terms revealed only one article, by Azart (22), which was assessed as not being relevant to our clinical problem. To increase the number of relevant articles, we used the broader MeSH term "behavior therapy" one level above "cognitive therapy". This procedure increased the number of articles to 70, which we considered too large. Therefore we limited our search to reviews. This limitation yielded 14 articles, of which 8 were about nurses, 3 were about nonwork settings, and 2 had no abstract. Therefore only the review by Murphy (23) remained.

Critical appraisal. The abstract indicated that the author had systematically reviewed the literature on stress-management interventions that were worksite-based and had used a health outcome. This criterion somewhat differed from the setting of our patient, who was on sick leave. The authors concluded that a combination of techniques

(eg, increasing cognitive behavioral skills and muscle relaxation) seemed to be the most effective treatment.

Clinical decision. Unfortunately, we could not provide our patient with a precise estimate of the effectiveness of cognitive behavioral therapy. However, on the basis of this information, we would tell him that this type of treatment was considered to be the most effective and that it would be recommendable to combine it with relaxation techniques to be better able to cope with stress symptoms.

Hypertension in pregnancy and work

Literature search. The mapping feature of PubMed showed that both "pregnancy outcome" and "hypertension" were MeSH terms. Combining these with "work" resulted in 10 articles, of which the first was a review by Mozurkewich et al (24) on the influence of physical work conditions on pregnancy outcome. It did not include risk of the combination of high blood pressure and work. Therefore we continued our search with different search terms. More or less by accident, we left out the word "outcome" and searched with "pregnancy", "work", and "hypertension". The result was 125 studies, of which the fourth was a study on blood pressure and work outside the home by Walker et al (25) and several were cohort studies on prognostic factors, one of which was "work", for an adverse pregnancy outcome (26, 27). A look at the MeSH headings used with these articles revealed that also the term "employment" was used. Therefore, we performed a last search with "blood pressure" and "pregnancy" and "employment". This procedure yielded 13 highly relevant articles, of which the first was the one by Frazier et al (28) on medical recommendations to stop work during pregnancy.

Because most articles gave only relative risk estimates, we also searched for articles that would give absolute risk estimates of adverse pregnancy outcomes.

Critical appraisal. In a cohort of 1635 pregnant women, Frazier et al (28) found that the advice to stop work was given to 28%. The advice seemed to have a medical base, because low birthweight was more frequent among women that were advised to stop work. Walker et al (25) showed that being at work increased the mean blood pressure of 100 pregnant women. The higher the rise, the greater the risk of pregnancy-related hypertension. In the prognostic study of Meis et al (26), being at work was a risk factor for preterm birth [odds ratio (OR) 1.49] independent of other medical risk factors. Being at work was also an independent risk factor for preeclampsia in the cohort study of Eskenazi et al (OR 2.1) (27). The outcome for a pregnant cohort of army personnel was worse when they were on active duty in spite of work adaptations. The review by Mozurkewich et al (24) turned out to be a systematic meta-analysis including studies on women with physically demanding work. The authors' conclusion was that physically demanding work is related to hypertension (OR 1.60), small size for gestational age (OR 1.37), and preterm birth (OR 1.22). There was also an association between shift work and preterm birth (OR 1.24).

The absolute risk of an adverse pregnancy outcome was estimated to be around 10% if it is defined as preeclampsia and 23.9% if it includes all different outcomes, such as preterm birth, small size for gestational age, and emergency cesarean section (29, 30).

Clinical decision. On the basis of this information, we would have explained to the patient that her hypertension may be caused by work, especially physically demanding or stressful work. We would also explain that being at work during pregnancy is found to be an independent risk factor, which increases the risk of an adverse pregnancy outcome by more than 50%. Because the absolute risk of an adverse pregnancy outcome is high, 10% to 25%, this absolute risk increase is substantial, leading to 1 adverse outcome in 8 to 20 pregnant women exposed to such work conditions. In line with the recommendations by Witlin et al (31), we would have discussed the results with the patient. We would have offered her the possibility of continuing work with adaptations: no physically demanding work, shift work, or prolonged standing. If blood pressure would not decrease within two weeks, we would advise her to stop work completely.

Discussion

We defined four clinical questions pertinent to occupational medicine, searched for evidence from the literature to find answers to the questions, and succeeded to a considerable extent in formulating satisfying answers. The method of evidence-based medicine seems to be feasible also for occupational medicine.

The strength of our study is that we not only had theoretical considerations about the use of evidence-based medicine, but that we used real relevant questions from the practice of occupational medicine to test the use of the method. We used only PubMed, as any occupational health physician could, because it is freely accessible through the Internet. We did not keep track of the amount of time it took to formulate a question and to carry out a search, but we estimate that the first three searches took less than 30 minutes. Because we had difficulties in finding the right search terms, the fourth search took more time. Therefore it seems that the method

is feasible for any occupational health physician with access to the Internet anywhere in the world.

The weakness of our study was that it was descriptive and did not allow inferences about whether the effectiveness of care is indeed increased by using evidence-based medicine. A randomized clinical trial would be needed to determine whether the method leads to improved quality of care, as can be measured by improvement in health outcomes, more patients being satisfied, or more physicians being satisfied with their work. Another weakness of our study was that we used abstracts only and not the full text articles. This practice was adopted to show that even with the simplest means it is possible to improve clinical decision making. This type of approach is especially important because many occupational health physicians would argue that retrieving full text articles takes too much trouble or that it is too costly to order through the Internet. However, we would like to stress that these practical constraints should not withhold us from looking for the best evidence. It is a relatively small investment that pays off in frequently occurring patient encounters like those described in this article. For the occupational health physician who wants to practice evidence-based medicine, using abstracts could be a simple first step that, we hope, will lead to a more extensive practice of critically appraising the literature.

A serious drawback of evidence-based medicine is that the search methods are not always reliable, and different strategies can lead to different results. In our third case we used the PubMed criterion review to limit the search results to reviews alone. This approach did not include meta-analyses. In the question about effective therapies for burnout, we knew of a recent meta-analysis because one of us was a co-author of the paper (32). This meta-analysis was not retrieved by our search. Fortunately it would not have altered the advice to our patient. In the fourth case we changed the search words for work into employment and for hypertension into blood pressure. The change yielded a different set of highly relevant articles.

The use of different databases also leads to different results. When one searches for articles on mental health problems or stress-related disorders, it is wise to search also Psycinfo, which contains the relevant psychological literature. Psycinfo is accessible through the Internet, but has to be paid for (http://www.apa.org; accessed on 29 October 2001). The same situation holds for the Cochrane Library, which is available on CD-Rom and includes all full text reviews, as well as abstracts of other systematic reviews, and provides the widest coverage on randomized controlled trials.

Searching the literature is something one has to learn. A common pitfall in our searches was that a search retrieved no or only a few articles due to a spelling mistake, which has also been reported elsewhere (33). It can take some time before such a mistake is noticed. For example, typing "bloodpressure" (without a space), yields 18 articles instead of the 217 434 when blood pressure is typed correctly with a space between the words. For non-English speaking physicians the English terminology used by Medline is an extra obstacle to be overcome. It can be made easier by translating the appropriate MeSH terms into the preferred language. Excluding non-English language articles can lead to the failure to retrieve highly relevant articles.

To facilitate searching, other more intelligent search machines have been built, like SumSearch, which is also accessible free of charge through the Internet. In addition to searching the Medline database, this search tool has the advantage of giving guidance on search terms, searching also the Database of Abstracts of Reviews of Effectiveness and the US National Guideline Clearinghouse and presenting the results in a hierarchical manner: first guidelines, then reviews, and finally original studies. However, the SumSearch tool at http://SmartSearch.UTHSCSA.edu/searchform3.htm is often not accessible, which limits its use in practice. It has also been reported that advanced search tools do not lead to better results (33). Therefore we recommend that those interested become acquainted with searching Medline by means of PubMed, as described by Allison et al (8).

Jousimaa (33) reviewed the literature on the use of information retrieval systems like Medline by physicians. He reported that user satisfaction seems to decline over time, that the use is not very frequent (with an average use of 0.3 to 9 times per month), that the average time to find answers is 30 minutes, and that the occurrence of failure to retrieve any articles ranges from 27% to 37%, and that around 50% of the searches leads to changes in decisions about patient care. His general conclusion is that the use of searching Medline leads to a modest but important impact on patient care, but that there are many unanswered questions, for example, about how good the performance is.

Occupational medicine is influenced by government regulations, like the regulation of maternity leave or prescribed health examinations for users of visual display units. This influence has an impact on the autonomy of the occupational health physician. However, it is not really different from health care in general. Evidence-based medicine can contribute to the debate about the desirability of such regulations (34).

Sackett et al (7) advocate the construction of a databank of critically appraised topics (acronym CAT). A CAT has the structured format of a clinical question and all the following steps to find an answer to a question. The idea behind the databank is that questions that some physicians have taken the trouble to find answers to are

also relevant for other physicians and their patients. We welcome this idea, and we will use the CAT format, based on critically appraised full text articles, to elaborate further the clinical questions we examined in this article. They will be put on the website of the ICOH Committee for Health Services Research and Evaluation in Occupational Health: www.occuphealth.fi/e/collaboration.

We already had considerable experience in searching Medline and other databases. Before evidence-based medicine can be widely used, most physicians will need more experience in building answerable questions and searching skills. Moreover, familiarity with the tools of clinical epidemiology is needed to be able to appraise the evidence in more depth. Most occupational health physicians would need instruction and training in both areas (35).

Research is needed on the information needs of occupational health physicians, the best search strategies for problems in occupational medicine, and how to use the retrieved information for decision making or patient information.

It has been shown that primary care physicians are more likely to pursue answers to their clinical questions when they believe that definitive answers exist and when they perceive the patient's problem to be urgent (36). We hope that this article reinforces the belief of occupational health physicians that answers can indeed be found by searching Medline. We conclude that it is a valuable addition to other evidence-based medicine methods, such as the use of guidelines.

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Received for publication: 15 November 2001