Evidence-based medicine for occupational health care

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Evidence-Based Medicine for Occupational Health Care

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Chapter 1
General Introduction

1. General Introduction

When a patient visits his physician he expects good quality medical care. He wants to get better as soon as possible and to get a good advice. Consequently, the physician should take an adequate history, examine the patient properly, provide him with a correct diagnosis and give an accurate treatment or a good advice in order to get him well quickly. Likewise, a working patient expects no less from his occupational health physician (OP). This seems logic but in daily occupational health care it is not that easy to define what exactly constitutes good occupational health practice and what are acceptable standards of professional competence.[1] As occupational health care includes numerous risk factors and health impairments, we cannot expect an OP to know everything, but at least we can expect him to make sure he has sufficient expertise about occupational and work-related diseases[a], in terms of how to diagnose and treat these diseases, and also to know how and why these diseases occur and how to prevent them. But what is sufficient expertise? In addition to expertise development through occupational health training and years of experience, it seems logic to expect the occupational doctor to keep up to date with new knowledge when recent research shows new risks, better diagnostics, treatments or preventive strategies. However, as the amount of occupational and general health knowledge grows impressively every year, is it realistic to expect the OP to read everything to keep up-to-date? And if he or she cannot do so, does it mean this physician does not have sufficient knowledge?

Recent years have witnessed a growing emphasis on practicing and teaching Evidence-Based Medicine (EBM) for clinical physicians. This method of practice ensures that physicians combine their clinical expertise with up-to-date scientific knowledge in their field and with the specific complaints, situations and expectations of their patients. This does not mean that physicians have to possess all up-to-date knowledge, but it does mean that they have to realize what they do not know. Then, with the problem for a particular patient at hand, they should know where to find correct up-to-date scientific knowledge. EBM has been accepted and

[a] Occupational *diseases,* having a specific or a strong relation to occupation, generally with only one causal agent, and recognized as such. W*ork-related diseases*, with multiple causal agents, where factors in the work environment may play a role, together with other risk factors, in the development of such diseases, which have a complex aetiology (ILO 1993).

enthused by a large group of clinical physicians all over the world. It requires a change in behaviour of physicians and this in itself is a big challenge for proponents of this method.

In the field of occupational health care this method of practice has been embraced by prominent physicians and researchers alike and it is now starting to reach daily occupational health practice.[2-4] However, the setting and content of occupational health care is somewhat different from general or clinical health care. Therefore it is possible that the method of clinically orientated EBM needs adaptations to be effective and efficient in occupational health practice. The aim of this thesis is therefore to study the opportunities and possible barriers of practicing EBM within occupational health care both on the level of the occupational health care as on the level of the occupational health care professional. In this introduction different aspects of EBM related to occupational health care are explored and the outline of the thesis is presented.

Evidence-Based Medicine

Sir Archie Cochrane, an epidemiologist from Great Britain, is regarded as one of the fathers of EBM. His book "Effectiveness and Efficiency: Random Reflections on Health Services", published in 1972, drew attention to the lack of reliable reviews of available evidence for medical decision-making.[5] Cochrane established a registry of controlled trial studies in perinatal medicine and called for systematic reviews of such trials in all areas of medicine. Cochrane's ideas were adopted and expanded by David Sackett and others at the McMaster University in Canada in the 1970s, which led to two major developments that form the core of EBM as it exists today:

- first was the establishment of the Cochrane Collaboration as an international group to "prepare, maintain, and disseminate up-to-date reviews of randomized controlled trials of health care".[6]
- second was the idea that clinical epidemiological principles should be used to incorporate the latest results of these reviews into the fundamentals of physician training and in the practice of patient care. This second development was presented later in 1992 in a series of articles in the Journal of the American Medical Association.[7]

EBM has been defined as [8]:

"The conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research and patient values".

Good doctors rely on both their expertise and the evidence, says Sackett. "Without clinical expertise, practice risks becoming tyrannised by evidence, for even excellent external evidence may be inapplicable to or inappropriate for an individual patient. Without current best evidence, practice risks becoming rapidly out of date, to the detriment of patients".[9] Due to the ever-increasing literature base of medicine it is simply not possible for a physician to keep up to date with all new evidence that is published every day. Besides, from previous studies it is known that maximum up-to-date knowledge of medicine is reached directly after finishing Medical School.[10] For example, a systematic review on this topic by Choudhry *et al*. concluded that older physicians and physicians who have been in practice for several years possess less factual knowledge, are less likely to adhere to appropriate standards of care, and may also have poorer patient outcomes than younger physicians and physicians who have been in practice shorter.[11] Therefore it is very important for physicians to know how and where to look for information when necessary in order to provide good quality health care.

With the initiation of large databases of medical research like Medline, Embase and PsycInfo, together with easy access to information via the Internet, the practice of EBM has become feasible for all busy physicians. The practice of EBM however does require new skills including efficient literature searching, the application of formal rules of evidence in evaluating the clinical literature and applying the evidence on the individual patient.[12] EBM has also initiated new journals (e.g. "Evidence-Based Medicine for Primary Care and Internal Medicine") and approaches to reporting biomedical research, and is now routinely taught throughout medical schools all over the world. Research and policy institutes committed to EBM have been established across the globe, and evidence-based decision making has emerged as a recurring organizing theme of health-care policy conferences. Mykhalovskiy *et*

al. quoted a colleague remarking on the enthusiasm for evidence within health care, and noted that we live in a time of "evidence-based everything".[13]

The practice of EBM was summarized in the following steps in 2004 by Sackett *et al*.[8]:

Step 1

The physician should convert the need for information (about prevention, diagnosis, prognosis, therapy, causation, etc) into an answerable question.

Step 2

The physician should track down the best evidence with which to answer that question.

Step 3

The physician should critically appraise that evidence for its validity (closeness to the truth), impact (size of the effect), and applicability (usefulness in health practice).

Step 4

The physician should integrate the critical appraisal with health expertise and with the patients' unique values and circumstances.

Step 5

The physician should evaluate the effectiveness and efficiency in executing Steps 1-4 and seek ways to improve them both for next time.

Today, this original model of EBM is considered as not practical for the majority of the physicians. To expect the physician -while the patient is waiting in the exam room- to conduct a literature search yielding multiple articles, select the best articles, evaluate the research, to determine its validity and decide what to do, is not realistic. Instead, physicians are now stimulated to find good secondary sources that summarize the literature and give a useful and practical extraction of available evidence.[14] In other words, these days the promotion of physicians to become '*users of EBM*' instead of '*do-ers of EBM'* is stimulated. EBM users conserve time by seeking out critical appraisals already performed by others who describe explicit criteria for deciding what evidence they selected and how they decided whether it was valid. That is, they leave out the time-consuming Step 3 (critically appraising) and carry out just Step 2 (searching) but restrict the latter to sources that have already undergone rigorous critical appraisal (Cochrane Reviews, Evidence-Based Practice

Guidelines and the like) and go on to Step 4.[15] One of the greatest achievements of EBM has been to foster the development of systematic reviews and meta-analyses, methods by which researchers identify multiple studies on a topic, separate the best ones and then critically analyse them to come up with a summary of the best available evidence.

In the Netherlands, EBM has been welcomed by most disciplines as an important addition to regular medical practice as well. There are many courses on EBM to attend and most medical disciplines have incorporated this method in their training. Furthermore, the Dutch Association of general practitioners (NHG) has worldwide acknowledgement for the development of more than eighty evidence-based practice guidelines (http://nhg.artsennet.nl/). Recently, these practice guidelines have also become available in English. Moreover, the Dutch Institute for Healthcare Improvement (CBO) is developing multidisciplinary guidelines for all physicians working in the Netherlands and they too underline the importance of EBM (http://www.cbo.nl/product/richtlijnen). In the field of occupational health care, the Netherlands Society of Occupational Medicine (NVAB) is active in developing and publishing evidence-based guidelines on the most important issues in occupational medicine such as low back pain and psychological complaints (http://nvab.online.nl). In other countries such as Finland the first practice guideline for occupational health on upper extremity strain disorders was finished in 2006. Within the UK several evidence-based guidelines on occupational health have developed and they can also be freely downloaded (http://www.nhsplus.nhs.uk/clinical-guidelines/guidelines-evidence.asp). Furthermore, occupational health research has recently been given its own field within the Cochrane Collaboration showing that occupational medicine is worldwide acknowledged as an important medical discipline and that its interventions form an important part of health care.[16]

Critique to EBM

Since the start of EBM, criticism on the practice of EBM could be heard and many lively discussions are still held today. Three major categories of negative remarks are:

First, EBM would reduce the autonomy of the doctor-patient relationship. Some have referred to EBM as ‘cookbook’ medicine, because there would be not enough room for the patient for his or her individual circumstances.[17] However, within the definition of EBM it is stated that

the individual circumstances are an important factor to consider and in the end it is up to the physician to make the best judgement together with the patient, among others based on the available evidence. Of course, this is not always an easy process.

Second, EBM would exclude important information, as it focuses mainly on systematic reviews of randomised controlled trials (RCT's). The RCT design is for studies on the effectiveness of therapy and considered as the gold standard. In practice, an RCT is not always feasible and it may not always be the best design possible. Furthermore, the emphasis on evidence within the context of individual patient care requires other information as well, which may be of a contextual or local nature.[18] Another problem of focusing on the evidence with medical decision making is that sometimes evidence is inconsistent. Results may depend on the type of patients or circumstances. Proponents of EBM continue to explain that usage of scientific evidence is only one, but an important, aspect of EBM. If there is no evidence or only evidence from a low level available then at least the physician is aware of this and should take this into consideration.

Third, EBM in itself would not be evidence-based. There are no randomized controlled trials that have proven that the practice of EBM provides better health care or studies on teaching EBM that have evaluated health outcomes. This is true but the "integrated teaching" approach showed that it is possible to change behaviour of professionals, and this holds the potential for improving health outcomes.[19] In addition, incorporation of EBM meetings into routine practice has shown to be effective in the sense that treatment guidelines were more closely based on published evidence and improvements to care of patients.[20-22] It is evident however, that more studies are necessary to show the benefits of EBM on health outcomes.

Occupational Health Care

The aims of occupational health care have been defined by the ILO and WHO in 1950 and updated as follows by the ILO/WHO Joint Committee on Occupational Health in 1995: "The main focus in occupational health is on three different objectives: (i) the maintenance and promotion of workers' health and working capacity; (ii) the improvement of working environment and work to become conducive to safety and health; and (iii) development of work organisations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may

enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking".[23] By the International Code of Ethics for OPs, adopted by the International Commission on Occupational Health (ICOH) in 2002, the duties and obligations of occupational health professionals with regard to the aims of occupational health practice are summarised as: "Occupational health professionals must use validated methods of risk evaluation, propose effective preventive measures and follow-up of their implementation. The occupational health professionals must provide competent and honest advice to the employers on fulfilling their responsibility in the field of occupational safety and health as well as to the workers on the protection and promotion of their health in relation to work".[24] Regarding the professional competence of OPs, the International Code of Ethics from the ICOH describes the following: "Occupational health professionals must continuously strive to be familiar with the work and the working environment as well as to develop their competence and to remain well informed in scientific and technical knowledge, occupational hazards and the most efficient means to eliminate or to minimise the relevant risks".[24] This statement emphasizes the responsibility of OPs to keep up with occupational health knowledge and the necessity to improve their quality of occupational health care.

Occupational Health Care in the Netherlands

In the Netherlands, all Dutch employees have access to occupational health services (OHS) and OPs. Consequently, the Netherlands has a high cover of OHS provision for employers: 96% for organizations >100 employees and 91% for small- and medium-sized entities.[25] The two most prominent fields of attention of OPs in the Netherlands are first, prevention and control of negative health effects as a result of work and second, preservation and recovery of the ability to work.[26] Since 1994, due to changes in legislation, the original focus of occupational health care on prevention and control of occupational diseases and other (related) health hazards changed into activities mainly related to sickness absence management. Tasks concerned with evaluating fitness for work after sick leave now take up most of the time of OPs. With regard to the professional competence of the OPs in the

Netherlands, the professional statute of the Netherlands Society of Occupational Medicine (NVAB) describes the following in line with the ICOH statement on this matter: "Occupational health physicians are independent medical specialists for work and health. They have a (self) critical mind and can use methods and instruments in their field of specialty to keep up and improve the quality of their actions. They recognize the limits of their own expertise and can cooperate with other disciplines, the curative sector and second-line specialists in the field of working conditions and sickness absence management. They are capable to contribute to the development of their field of specialty and to take social responsibility".[26]

Evidence-Based Medicine for Occupational Health Care

An adaptation of the definition of EBM by Sackett *et al*.[8] to a more occupational health-related definition of EBM could be: "*Evidence-based occupational health care is the integration of best research evidence from all relevant disciplines with occupational health expertise and with employee or employer values, needs and demands*".

- by best research evidence is meant occupational health relevant research. Topics are e.g. the accuracy and precision of diagnostic methods (including screening tests), the power of prognostic markers, and the quality, efficacy, effectiveness and safety of therapeutic, rehabilitative, and preventive activities. In addition, economic evaluation and satisfaction studies can be included. As occupational health encompasses all types of risks and work demands, and work-related consequences of all diseases and chronic medical conditions, the field to be covered is wide and includes many disciplines.
- by occupational health expertise is meant the ability to use occupational health skills and developed experience to identify potential health hazards from work environments. Furthermore, the ability to identify each employees' unique health state and diagnosis, their individual risks and potential benefits of interventions, and their personal values and expectations. We can add the ability to identify companies' needs and potential successful interventions at this level.
- by employee or employer values is meant the unique preferences, concerns and expectations each employee or employer brings to an occupational health encounter

and which must be integrated into occupational health decisions if they are to serve the employee or employer.

When these three elements are integrated, occupational health physicians, employers and employees form an alliance which optimises occupational health outcomes and quality of working life.

What is the added value from Evidence-Based Medicine for the quality of occupational health care?

To appraise the benefits from EBM the characteristics of occupational health care need to be considered. First, the setting of occupational health care is somewhat different from clinical care or general practice. Like several other social medicine disciplines, the work of OPs is strongly influenced by its contextual framework, in particular by national legislation on work and health.[27] It has been argued that for specific questions within this context, most of the international EBM databases are only of limited help.[28] If that is actually the case, needs further study. Second, the content of occupational health care is different from clinical care. Clinical questions in occupational health practice are not only dealing with diseases but also with prevention, risks, impairments, disabilities, return to work, lifestyle etc. However, using EBM in occupational health practice could perhaps be even more challenging and rewarding than in clinical care. Because of the great diversity of health problems, and all the social- and work factors to take into consideration this may also mean that a greater diversity of EBM resources is needed. It may be so that additional strategies and tools for access to international and national databases have to be elaborated. Until now, the kind of questions occupational health physicians have in daily practice has not been studied and we do not know which proportion of such questions can be answered with an EBM approach. Third, one fundamental principle of EBM is the hierarchy of evidence to guide clinical decision making. This hierarchy is founded on evidence mostly provided by RCT's. Within occupational health care, most research has focussed on the causes of ill-health at work stemming from cohort- and case-control studies. This has led to an important amount of evidence on the effects of a wide range of exposures at work. In contrast, evaluation studies in occupational health are available to a limited extent and there is an urgent need for well designed effect studies, preferably

RCTs, to distinguish effective from ineffective preventive and therapeutic interventions.[29,30] Consequently, not always sufficient evidence exists to rely on within occupational health. Nevertheless, using the methods of EBM would at least be a good method to show all existing gaps in research that needs to be solved. Besides, the lack of evidence is also current practice in several other medical disciplines.

What is the added value from Evidence-Based Medicine for the quality of occupational health professionals?

So far, it is unknown whether OPs are motivated or capable enough to change their behaviour into evidence-based practice. For this, several questions need to be answered. For example, do OPs see the added value in practicing EBM? What are the biggest hurdles to overcome for the implementation of EBM within occupational health? An obstacle to consider is that OPs in the Netherlands work mostly in limited contact with their colleagues or supervisors as opposed to the majority of physicians who work in a clinical setting. It might be that frequent contact with professional colleagues is a crucial incentive to stimulate OPs to use and keep up with research evidence. Moreover, OPs may be more isolated from evidence-based information resources than their colleagues within clinical care. An important condition to practice EBM is easy access to evidence. In a commercial environment, each OHS in the Netherlands has its own guarded occupational health information provision which may not contain the most recent research in the field. This potential obstacle needs to be studied. Access to the Internet is a necessity for all professionals who wish to keep up-to-date, a facility not (yet) available in every OHS. In conclusion, the knowledge needed for an optimal implementation of EBM within occupation health practice needs to be explored and tested in order to know more about its possible benefits. There is only limited experience so far. Finally, the question needs to be answered once OPs have changed their behaviour into evidence-based practice does this also enhance their quality of professional advice?

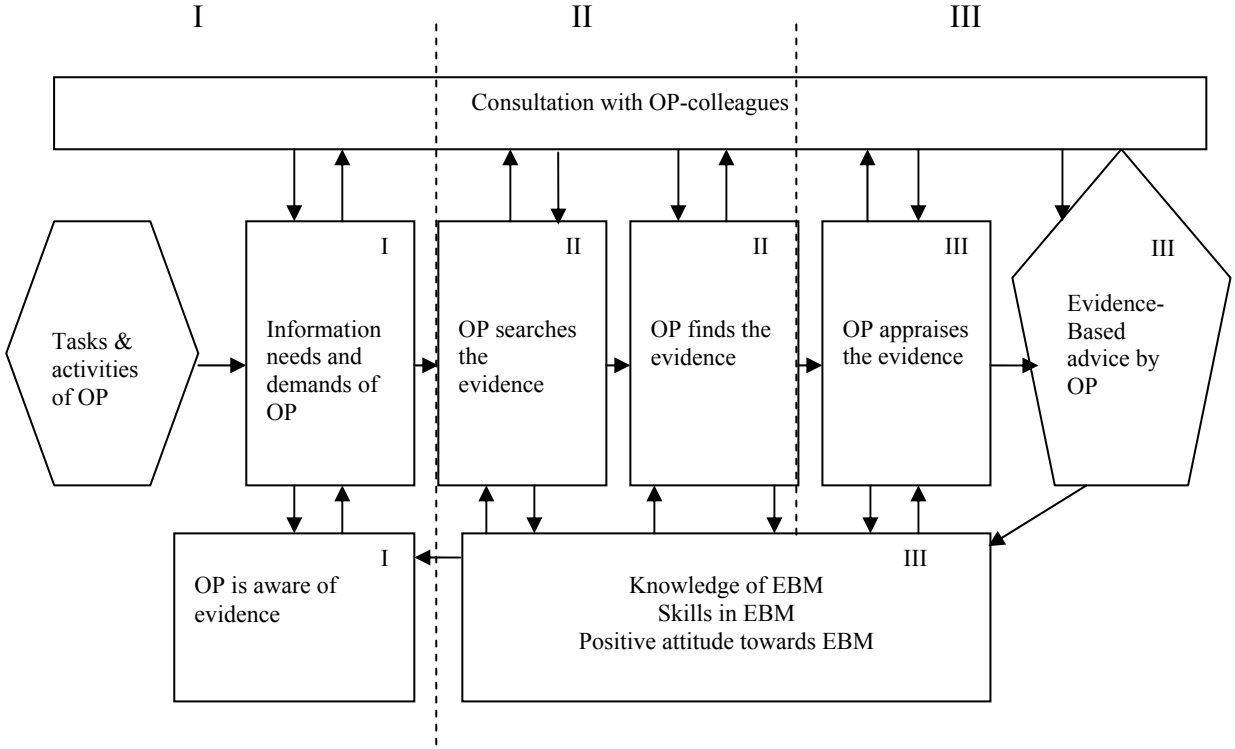
Objectives of the thesis

The main objective of this thesis is to investigate the opportunities and obstacles of EBM for occupational health practice. Potential differences between occupational health care and general health care in terms of information needs, available evidence and applicability of the

methods of EBM are analysed. A new EBM tool is developed and tested on its efficacy and effectiveness. Furthermore, the effects of an active EBM stimulating strategy in practice are studied.

The order of this thesis follows a conceptual model that describes the application of evidence-based occupational health care by an occupational health physician. The model is inspired by Leckie, Fishbein and Sackett (See figure 1).[31,32,8] The starting point is the information demand of an OP depending on the tasks he has within his occupational health environment. He can consult his colleagues to answer his question but he may also be aware of evidence-based sources and start searching in the literature via e.g. databases, websites or textbooks. Depending on his knowledge and skills, he will find any existing evidence and is able to appraise the quality of the source correctly. The OP may discuss these findings with colleagues, but will eventually use the evidence for his advise towards employees and employers.

Figure 1. Conceptual model of the application of evidence-based occupational health care by an OP



Outline of the thesis

This thesis is divided in three parts as showed in the previous model.

Part I Information needs and awareness of evidence

The first part of this thesis focuses on information needs and awareness of available evidence. Chapter 2.1 starts with an assessment of information demands in daily practice of OPs and current actions to answer these demands. The attitude and awareness of these physicians towards EBM are described. In chapter 2.2, more in-depth knowledge about information needs was gained by observing and interviewing OPs in their daily practice. In this study we distinguish manifest and latent questions. The consciously recognized need or questioning behaviour can be entitled as 'manifest' questions: they arise during the consultation hours of the OP, or directly thereafter. At the end of a working day, the OP can easily recall these questions. Information need has been defined as the originally unconscious or unrecognized need, which can be characterized by 'latent' questions: they arise after the topic is brought to the attention of the OP. In chapter 2.3 present use of evidence in occupational health practice is studied using occupational health case-vignettes. A comparison is made between answers of colleagues or experts with answers departing from evidence-based literature.

Part II Searching for evidence

The second part of this thesis focuses on the challenges of searching occupational health evidence. In chapter 3.1 an attempt was made to help overcome one of the biggest hurdles to apply EBM in daily practice, to find the information. Assessment of the occupational origin of a disease was chosen as a topic as this represents one of the main tasks of OPs. OPs in the Netherlands not only have to advise on this to the employee or employer, they are obliged by law to notify occupational disease cases to the Dutch Centre for Occupational Diseases (NCvB). As a result, OPs raise many questions about the notification and subsequently pose them at the helpdesk of the NCvB. In order to support occupational physicians to answer their own questions, a search strategy was developed based on four case-vignettes on possible occupational diseases. In chapter 3.2 the effects of this search strategy are analysed in a controlled trial to what extent this tool might actually help physicians in practice. For this

trial, OPs in training who had just finished an introduction course in EBM were asked to answer a case-vignette using the search strategy developed.

Part III The application of evidence

The last part of this thesis deals with the practice of EBM in occupational health care. Chapter 4.1 presents the results of a randomised controlled trial on the application of EBM in daily occupational health practice. In this study, OPs were trained in the theory of EBM and guided for four months to practice EBM in their occupational health setting stimulated by two-weekly clinical audit with colleagues. During these meetings the steps of EBM were a regular part of discussion. We analyzed the enhancement of knowledge, skills and behaviour towards EBM. The effect of this intervention on actual use of evidence-based sources and on quality of care of OPs is described as final result in the last paragraph 4.2.

In Chapter 5 the results of all studies are discussed and put into perspective. Based on the discussion and conclusions, options and recommendations for future research and practice are given.

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Chapter 2

Information needs and awareness of evidence

2.1 Information demands of occupational health physicians and their attitude towards evidence-based medicine

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Scandinavian Journal of Work, Environment & Health 2004;30(4):327-330

Abstract

Objectives: This study assessed the extent and nature of information demands among occupational health physicians and their attitude towards the application of evidence-based medicine in occupational health.

Methods: A questionnaire survey was carried out among a random sample of 159 physicians practising occupational medicine in the Netherlands. The questionnaire investigated the type and number of questions encountered in daily practice, the actions taken in response, the physicians' experience in using scientific databases on the Internet, and their attitude towards evidence-based medicine.

Results: The occupational health physicians' questions concerned medical, legal, and rehabilitation topics in particular. In pursuing answers to their questions, they generally chose to contact colleagues. Scientific databases were not consulted very often, although, in general, the attitude towards evidence-based medicine was positive. In addition to known barriers for practising evidence-based medicine, occupational health physicians perceive a lack of scientific evidence in their field. The extensiveness of the field of knowledge in occupational health care was not regarded as an obstacle to their application of evidence-based medicine.

Conclusions: Occupational health physicians have a demand for information on a broad range of topics, and, in most cases, their attitude towards evidence-based medicine is fairly positive. Besides education and training in evidence-based medicine, access to the Internet and the presence of a good knowledge infrastructure would help occupational health physicians use evidence-based medicine.

Introduction

The methods of Evidence-based Medicine (EBM) are being adopted on a wide scale in many areas of health care.[1] However, physicians seeking answers to their clinical questions report encountering several barriers.[2-8] For example, for hospital physicians and general physicians, lack of time has proved to be the biggest hurdle to applying EBM in daily practice.

The need for a scientific basis and a further professionalization also exists for occupational medicine. Little is known about the experience of occupational health physicians (OPs) with EBM, or about their attitude towards EBM. Some authors argue that EBM is difficult to apply to problems arising from occupational health practice because the setting of occupational health care is different from clinical care or family practice.[9,10] As in public health, the work of OPs is strongly influenced by its contextual framework, in particular by national legislation on work and health.[11] Furthermore, the content of occupational health care differs from that of clinical care. Clinical questions in occupational health practice are more concerned with risks, impairments, disabilities, return to work, and lifestyle than with diseases. Another hindrance mentioned is the lack of research evidence in the field, in particular evidence on the efficacy or effectiveness of occupational health activities.[12] Finally, an attitude problem is observed, as the majority of the OPs would appear to be 'reluctant readers' of scientific literature.[9]

In contrast to these arguments, difficulty in locating and accessing relevant information should not prevent OPs from using the best evidence in their decision-making. The efforts of individuals and groups working within the Cochrane collaboration and elsewhere, combined with the outstanding advances in information technology, virtually ensure that the amount and accessibility of valid reliable evidence available for use in informed decision-making will continue to grow, and will become increasingly available in the foreseeable future.[13] A specific occupational health-field is currently in the process of becoming registered with the Cochrane Collaboration. Moreover, Verbeek *et al*. (2002) showed that relevant questions from OPs on medical topics can already be answered using EBM, although the feasibility and adequacy of their findings have been questioned by others.[10,14-16]

To improve our knowledge on the possible contribution of EBM in its current form to occupational health, we first need to know the information demands that OPs have in practice, and the strategies they apply when searching for answers. The aim of this study was then to

characterize the type of questions OPs encounter in their daily practice and to study their attitude towards EBM and the perceived obstacles to EBM that exist in daily practice.

Subjects and Methods

A questionnaire was sent to a random sample of 144 registered OPs representing 10% of all registered OPs in the Netherlands. These OPs were randomly selected from a member list of the NVAB (The Dutch Association for Occupational Medicine). This questionnaire was also randomly distributed to 148 physicians, currently in training to become a registered OP, but already employed as such. In the Netherlands a physician is registered as OP after following a four-year training course at one of the two schools of occupational health and working during these four years in an Occupational Health Service (OHS). All non-responders were sent one reminder. There was an average response rate of 54% (51% for registered OPs and 57% for trainee OPs). Two-thirds of all respondents were male. Registered OPs were older than trainee OPs (47 vs 37 years). Not surprisingly registered OPs had substantially more OP working experience than trainee OPs (15 vs 4 years). We found no other relevant professional differences (henceforth in the text we will use the term OP for both registered OPs as trainee OPs). There was a large variety in type of OHS and economic sectors represented. Non-respondents did not differ from respondents with respect to gender or type of OHS.

Questionnaire Design

The items and types of questions could not directly be derived from any already existing questionnaire but were instead designed on the basis of a review of the literature on information demands and determinants of the use of EBM.[2-5,7-9,17]

The questionnaire assessed individual professional characteristics (e.g. age, working experience, type of OHS), extent of the demand for information in practice, information-seeking behaviour, and views on EBM and scientific literature databases on the Internet. The items on the demand for information and information-seeking behaviour were assessed by using closed questions (mostly in the form of multiple-choice items). In a five-point Likert scale (ranging from totally agree to totally disagree) we asked OPs about their views on EBM and scientific literature databases on the Internet. The questionnaire was tested for face validity by five OPs and was adapted accordingly.

Data analysis

The analyses were performed using the SPSS 10.0 software package (SPSS Inc., Illinois, USA). We used Chi-square tests to determine the associations between professional characteristics and perceived professional knowledge, as well as to analyze the awareness of questions arising from practice and views on the use of EBM. Associations between individual items concerning EBM were calculated using Pearson correlation coefficients.

Results

Professional knowledge

The majority of the OPs (65%) reported spending an average of one to four hours a week on maintaining their professional knowledge (27% spent less than one hour a week, and 8% spent more than four hours a week on this). This time was used to read medical or occupational health journals (87%), to consult with colleagues (81%), and to attend courses or conferences (79%). In contrast, scientific databases on the Internet were only for 38% of OPs a source for maintaining their knowledge. Only 39% of OPs had direct access to the Internet from their workplace, whereas about 87% had access to the Internet at home. The most frequently used websites or databases were the Dutch information website on vocational rehabilitation (Stecr) (58%), the website on practice guidelines for occupational physicians by the Dutch Association for Occupational Medicine (NVAB) (57%), and PubMed (Medline) (52%).

Questions in practice

The majority of trainee OPs (61%) had at least once a week a need for extra information (questions) as a result of consultation hours, in contrast to only 35% of registered OPs (difference 26% [95% CI 11% to 41%]). Table 1 shows the categories of these questions in daily practice (questions on medical topics are e.g. prognosis, diagnosis or treatment of a disease). The emphasis on questions concerning legal topics was 20% (95% CI 2% to 33%) higher for trainee OPs than for registered OPs.

Table 1. Categories of questions as a result of consultation hours of OPs (n = 159). Each OP could give a maximum of two answers

	Questions (n=293)	
	n	%
Medical topics	108	37
Legal topics	88	30
Specialized care or referrals on rehabilitation of sick employees[†]	59	20
Questions on statistical or epidemiological topics	33	11
Other types of questions	4	1
'No questions'	1	0

[†] = e.g. "Does my OHS have a contract with a good psychotherapist for this patient?"

Information-seeking behaviour

"Asking a colleague" was the most prevalent action undertaken for seeking an answer to a question (Table 2). In this table we separated the questions concerning medical topics with all other mentioned topics (e.g. questions on legal topics or about referrals on rehabilitation of sick employees). There were no significant differences between registered OPs and trainee OPs.

Table 2. Information-seeking strategies and activities carried out by OPs (n=159) for medical topics (n=219) and non-medical topics (n=259). Each OP could select a maximum of two answers for both topics

	Medical topic	Non-medical topic
	% (n)	% (n)
Ask a colleague for advice	37 (82)	41 (107)
Save the question for a meeting or conference between professionals	10 (21)	19 (48)
Looks for an answer in a medical textbook or journal	22 (47)	13 (34)
No time, looks for a practical solution	18 (39)	12 (31)
Searches for an answer on the Internet	10 (22)	11 (28)
Other…	4 (8)	4 (11)
Total	100 (219)	100 (259)

Evidence-Based Medicine and scientific literature databases

Three-quarters of the respondents indicated to be interested in EBM, but only one-third actually applied EBM methods when possible. Table 3 shows several significant differences between registered OPs and trainee OPs. For example, registered OPs indicated both a higher need to improve their skills in working with the Internet as with the methods of EBM than trainee OPs.

Personal interest in EBM was strongly correlated to the expectation that EBM would become more important for occupational health in the future (r = 0.63 [95% CI 0,52 to 0,71]). Perceived limited skills in using scientific databases was moderately correlated to the desire to learn more about the EBM method (r = 0.41 [95% CI 0,28 to 0,54]). The responses to the statements on EBM were not significantly influenced by gender, type of OHS, or economic sector of the practice of the OP.

Table 3. Percentage of registered OPs (n=74) and trainee OPs (n=85) that agrees with propositions presented concerning EBM

	OHP %		Difference	95% CI
	Registered	Trainee	%	
Knowledge and experience with EBM (and the use of the Internet)				
When possible, I work according to the method of EBM	34	29	5	-10-19
I am interested in working with the method of EBM in my work as an OP	84	67	17	4-30
There is no added value in searching for occupational health information on the Internet as opposed to conventional medical textbooks or journals	7	2	5	-2-11
I regularly search on the Internet for occupational health information	23	38	15	1-29
My skills in using the information available on the Internet could be improved	91	71	20	10-33
I need a course on working according to the method of EBM	64	45	19	4-34
Need or interest in scientific information for occupational health				
There should be more scientific information on the effectiveness of occupational health care available for the OP	92	93	1	-9-7
Working according to the method of EBM will become more important for OPs in the future	73	71	2	-12-16
If an easy-to-use-search engine for the Internet were to be developed for OPs, I would expect to use the available occupational health information on the Internet more	84	73	11	-2-23
Possible barriers to using EBM or the Internet				
I do not expect to find adequate answers for my occupational health questions on the Internet	26	21	5	-9-18
The field of knowledge of an OP is too wide to justify working according to the method of EBM	8	8	0	-9-8
Lack of time is a barrier for me to look for occupational health information on the Internet	66	60	6	-9-21

Discussion

This questionnaire survey was a first exploration of the demand for information and attitude towards EBM among OPs. Similar studies on information demands of OPs have yet to be published - either in the Netherlands or in other countries. The response rate to the questionnaire was 54%. The respondents were similar to the non-respondents with regard to gender and type of occupational health services. However, it is possible that those with a more positive attitude towards EBM were more likely to respond to this questionnaire. The results concerning the use of the Internet and the attitude towards EBM may therefore be biased in this direction.

For general practitioners, Ely *et al*. (2000) developed a taxonomy of questions in practice to enhance the probability of satisfying the need for information. In this taxonomy, most questions concerned diagnosis and treatment.[8,18,19] The emphasis of our taxonomy was on the division between medical and non-medical questions. In addition to questions on medical topics, respondents reported also a considerable portion of questions on legal and rehabilitation topics. We found that many questions arising in everyday practice were left unanswered with OPs looking for a pragmatic solution. This is comparable to what Gorman *et al*. (1994) and Smith (1996) concluded in their survey among doctors working in primary care or hospitals.[8,19] The attitude of OPs towards EBM was positive but they mention the same barriers for using EBM as is found in the literature for other professionals.[6,7] OPs might differ from other physicians in that they also perceive a lack of scientific evidence in the field of occupational medicine. This finding is in line with the conclusions of Hulshof *et al*..[12] In contrast to our expectance beforehand, the wide range of contextual aspects in the work of an OP was not perceived as a barrier to implement EBM.

Currently, seeking information via scientific databases and websites on the Internet plays only a limited role in the everyday practice of an OP. Only 39% of the responding OPs had direct access at their workplace to scientific databases (like Medline and OSHROM). A problem regarding further implementation of EBM, could also be the unstructured growth of websites and databases on occupational health. A good system of knowledge infrastructure is still lacking.

In conclusion, we found that OPs have a demand for information on a broad range of topics and the attitude of most OPs towards EBM is fairly positive. In addition to known barriers for practising EBM, OPs perceive a lack of scientific evidence in their field. We think that even if this is partly true, the presence of a good knowledge infrastructure, access to the Internet, easy-to-use search engines, and well-organised overviews of existing scientific information would be very helpful to overcome this perception. Furthermore, there is a need for education and training in EBM. The claim that OPs perceive that the field of knowledge is too wide to implement EBM, was not substantiated in this research. We are continuing our research on EBM in occupational health with an observational study in OHS to gain more insight into the types of questions and specific needs for information that OPs in daily practice have.

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2.2 Occupational physicians, what are their questions in daily practice? An observation study

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Abstract

Background: To enable occupational physicians (OPs) to make use of scientific information in the decision-making process, evidence-based occupational health practice is stimulated.

Aims: To study the questions which arise in daily practice of OPs, and to evaluate the possible contribution of evidence-based medicine strategies to answer these questions.

Methods: Observation of 20 OPs during two consecutive half-day periods, followed by an interview to explore the topics that arose during the preceding period. The conscious or manifest and unconscious or latent questions by OPs were analyzed, and the number of questions suitable for performing a search in scientific medical literature databases was assessed.

Results: After 40 half-day periods, the OPs had asked 26 manifest questions and 348 latent questions; the latter were voiced during the interview. Of all the questions, 40% were clinical in nature and considered suitable for a literature search. The emphasis of these questions was on prognosis, susceptibility and diagnosis following individual consultations. A lack of time or 'no necessity to look for an answer' were the most important reasons to leave the questions unanswered.

Conclusions: OPs spontaneously formulated less than one question per working day. However, after an observation of their daily practice followed by an interview, many latent questions were formulated. A substantial number of these questions could be answered by evidence-based medicine strategies. If OPs were encouraged more to improve the quality of their decision-making, they might formulate more answerable questions and feel more inclined to search for answers.

Introduction

To encourage occupational physicians (OPs) to enhance their professional knowledge and competency the introduction of evidence-based medicine (EBM) in their daily practice is desirable.[1,2] Evidence-based practice will enable OPs to use scientific information in the decision-making process whenever relevant but to achieve this we need to understand the barriers that exist. We therefore studied the questions asked by OPs in their current daily practice in the Netherlands, and their behaviour and motivation for finding answers.

OPs in the Netherlands strive to protect and improve the health of employees in relation to their work, acting mostly as an adviser. Tasks concerned with evaluating fitness for work or vocational rehabilitation take up most of their time and generate the greatest demands for information. For these tasks, OPs use several sources of information, including the patient/worker and the employer or company (e.g. medical- and employee data), their own knowledge and experience in occupational health, and the available literature on occupational health issues. The availability of sources and awareness of the presence and accessibility of this information will influence whether information is actually sought.[3]

In an earlier survey, we asked OPs in the Netherlands about their most important information demands.[4] Their questions covered a broad range, although the majority involved medical topics. These questions should have been answerable using evidence-based information sources but we saw that actual access and use of these sources was very limited. OPs preferred to consult colleagues to answer their questions rather than consulting scientific databases or sources. In this respect, they did not differ from other medical doctors.[5-9] In addition, some specific contextual factors within the OP's speciality might influence this behaviour: the culture or organisation of the working environment of the OP, the motivation and competence of the OP, and technical influences (e.g. access to the Internet).[10]

Different definitions for information demands and needs for physicians are in use.[5,11,12] In this study we have distinguished information demand from information need. Information demand is the consciously recognized need or the questioning behaviour, which can be characterized by 'manifest' questions: questions that arise during the consultation hours of the OP, or

directly thereafter. In addition, we defined information need as the unconscious or the unrecognized need, which can be characterized by 'latent' questions: questions that arise after the topic is brought to the attention by an observer. Observing doctors during their daily practice and feeding back to them elicits a substantial higher need for information.[13-15] Collecting both the manifest and the latent questions of OPs in daily practice will provide us with a better understanding of the opportunities and barriers for practising EBM.

Since 'background' questions demand more general knowledge about a topic, these questions might be effectively answered by consulting a textbook or other more general information sources. We therefore focused on the analysis of 'foreground' questions which require more specific knowledge about a topic and which are suitable to being answered by using an EBM-approach.[16]

We therefore set the following research questions: How many manifest and latent questions do OPs ask in daily practice and to what extent does this correspond with their own perception? What proportion of questions can certainly be answered using EBM strategies? What are the major topics of interest of these questions, and what is the influence of the daily activities of OPs? Finally, we will assess the attributed professional value to the formulated question and the intention of the OP to actually look for the answer.

Materials and Methods

Twenty experienced OPs were observed and interviewed by two of the authors (RH, NR) during their daily work for two half-day periods. The majority (n=16) were volunteers recruited during a meeting on the evaluation of occupational health practice guidelines and the remainder were enlisted on the recommendation by colleagues of the authors.

The technique of observation and use of the interview forms were practiced in a training setting and pilot-tested during five daily periods in real practice. At the start of each observation, the aim of the study was explained to the participating OP. The OP was observed during most of his or her daily activities: individual consultations, medical examinations (pre-employment or periodic) and company meetings or meetings with colleagues of the

Occupational Health Service (OHS). The company meetings were with the employer, staff, or supervisors of the company. OP activities and the topics discussed in their context were observed and recorded. This report was used as a starting point for a semi-structured interview, held at the end of every half-day observation period. The OP was first asked if the preceding session had raised any questions. This addressed the manifest information demands. Then, in a search for so called 'latent' questions, the OPs were asked in detail about their potential information needs by elaborating different aspects of the recorded occupational health problems of the preceding session.

Age, gender, and number of years working experience of the OP were noted during the interview as background variables. The OPs were asked to estimate their own questioning behaviour. The following interview addressed two items.[17] First, topics concerning the specific occupational health environment such as: work-related risk, causes, and consequences were discussed. Second, medical issues such as prevention, diagnosis, and intervention of the observed cases were discussed. To reflect on meetings with companies or with professional colleagues we chose a more general interview structure. All OP questions were written down literally and the OPs were then asked how important the question was in relation to their practice. Finally, the OPs were asked about their intention to search for information to answer the question.

First, the authors FS and CH independently assigned the unique questions formulated by the observed OPs on different subjects into categories corresponding with the topics mentioned previously. Second, they independently assessed which questions were considered suitable for seeking an answer by performing a search in medical databases. In case of a difference in opinion, a decision was made based on consensus.
Inclusion criteria for 'suitability' of questions were based on instructions by Sackett[16]:

- Questions about medical knowledge and information, to be sought in medical scientific literature databases. No questions concerning lacks of information in relation to the patient, situation, medical history or findings in particular.
- Questions should be specifically formulated, so as to require a concrete answer. No 'background' questions.

- Questions should be clearly formulated.
- Questions should relate to the medical domain. No legal topics or social security topics.

Questions that did not meet the inclusion criteria were not analyzed further. The proportions of 'suitable' and 'unsuitable' questions were described per category. The number and categories of questions in relation to the different activities of the OP and the topics discussed during these activities were also described. Finally, for each question the attributed professional interest was analyzed, as well as the motivations given whether or not they would seek an answer.

Results

The average age of the 20 participating OPs (14 male, 6 female) was 43 years (± 5.4 years), with 12 years (± 4.5 years) experience as an OP. Prior to the interview, 50% of the OPs indicated requiring information about once a week, the other 50% once a month.

We attended 70 workers' consultations, 11 medical examinations, 13 meetings with company management, and five meetings with professional colleagues. One half-day period per OP included between one and six consultations (or examinations), or one to two meetings. Nine meetings with employers had a focus on rehabilitation issues, the other four concerned issues on prevention and general company policy on occupational health. The workers' consultations concerned predominantly sickness absence (n=59) while 11 had a preventive nature. One OP did not have any individual consultations or medical examinations and seven OPs did not have any meetings with management or colleagues during the observation period.

Table 1 gives information about the number of manifest and latent questions. On average, an OP posed 0.7 (range 0-2) manifest questions and 8.7 (range 4-28) latent questions after one half-day period. Individual consultations resulted in more questions than meetings.

Table 1. Manifest and latent questions asked by the 20 participating OPs during two consecutive half-day periods

Half-day period of: (n=40)	Number of manifest questions	Number of latent questions	Total number of questions	Average number of questions per daily period
Individual consultations or medical examinations (n= 27)	18	265	283	10.5 (283/27)
Meetings with management or colleagues (n=13)	8	83	91	7.0 (91/13)

Tables 2 and 3 show the categories and numbers of questions asked and the numbers of questions considered ‘suitable’ or ‘unsuitable’ for an EBM approach. The distribution of categories of questions asked per OP was fairly equal. In the case of individual workers’ consultations, questions on prognosis (n=38), susceptibility (n=29) and diagnosis (n=28) were most prevalent (Table 2). After meetings, the emphasis was on effectiveness of OHS-recommendations and interventions (n=16), and occupational risk prevention by company management (n=15) (Table 3).

Table 2. Number and categories of questions asked by the participating OPs during two half-day periods (n=20) of consultations with an employee

Type of questions	Total number of questions N	Not-suitable questions N	Suitable questions N	% of total number of (n=114) suitable questions %
Manifest questions	18	9	9	8
Latent questions	265	160	105	92
Total	283	169	114	100
Topics in relation to work environment				
Work-related risk or cause	17	12	5	4
Work-related consequence	17	8	9	8
Prevalence/Incidence	18	5	13	11
Rehabilitation	19	12	7	6
Effectiveness of consultation hours by OP	24	15	9	8
Topics in relation to the disease				
Aetiology	24	21	3	3
Susceptibility	29	13	16	14
Prevention	23	13	10	9
Diagnosis	28	21	7	6
Treatment	25	15	10	9
Prognosis	38	17	21	18
Other questions	12	8	4	4
Questions on legislation and social security regulations	9	9	0	0
Total	283	169	114	100

Table 3 Number and categories of questions asked by the participating OPs during two half-day periods (n=20) of meetings with an employer or with colleagues

Type of questions	Total number of questions N	Not-suitable questions N	Suitable questions N	% of total number of (n= 35) suitable questions %
Manifest questions	8	5	3	9
Latent questions	83	51	32	91
Total	91	56	35	100
General questions related to the topic	10	3	7	20
Work-related causes	7	4	3	9
Work-related consequences	9	6	3	9
Rehabilitation	6	5	1	3
Prevalence/incidence	8	1	7	20
Branch of industry issues	7	5	2	6
Occupational risk prevention by company management	15	11	4	11
Effectiveness of OHS recommendations and interventions	16	10	6	17
Other questions	5	3	2	6
Questions on legislation and social security regulations	8	8	0	0
Total	91	56	35	100

A substantial number of questions (149 out of 374) met our criteria for 'suitability' for an EBM approach. On average, after a half-day period of consultations, 4.2 questions were considered suitable, most on susceptibility and prognosis. As a result of meetings, 2.7 questions were considered suitable, mostly general questions around the topics discussed or on prevalence and incidence numbers. Examples of questions are shown in Box 1. Many questions about diseases were considered not suitable for a literature search, especially questions on aetiology (21 out of 24) and diagnosis (21 out of 28), as they were too generally formulated or they could only be answered by the treating physician. In total, 225 questions did not meet our criteria. The majority (n=110) were considered too generally formulated or not clear or not making sense. Furthermore, 98 questions should have been answered by other physicians, experts in occupational health or the asking OP himself. Finally, there were 17

questions on legislation and social security regulations. Examples of these questions are shown in Box 2.

The medical topics discussed during the consultations were mainly mental health disorders such as stress and depression (n=28), and musculoskeletal problems such as fractures and cumulative trauma disorders (n=19). Various other physical problems were discussed only once or twice. A broad range of topics were discussed during the meetings with company management and/or colleagues. There were discussions for example about company policy on sickness absence, about the prevention of cumulative trauma disorders, about admissible physical load of specific tasks, and the need for pre-employment examinations. We found no correlations between the discussed topics and type of questions posed.

Box 1. Examples of 'suitable' questions (n=149) asked by the participating OPs (n=20)

Examples of suitable questions after workers' consultations:	**Category of questions**
"Do lorry drivers with long sitting hours have a higher risk for developing anal fistulas"?	Work-related cause
"Is the work of a postman a risk factor for a recurrence of inguinal hernia?"	Work-related consequence
"What are the numbers of sickness absence as a result of upper airway infections for refuse collectors?"	Prevalence and incidence numbers
"To what extent and when can someone, recovering from a whiplash in the lower extremity, be rehabilitated to his work as a mechanic in a brewery?"	Rehabilitation
"Does the intervention of an OP have better results than the intervention of a psychologist for overstrained employees?"	Effectiveness of consultation hours by OP
"Are there specific risk factors for developing different types of pelvic instability with pregnancy"?	Aetiology
"Is there a relation between personality traits and the risk of burnout?"	Susceptibility
"What groups of people should I check to prevent visual discomfort?"	Prevention
"What are the diagnostic criteria for pregnancy-related pelvic joint pain?"	Diagnosis
"Does physiotherapy has better results than rest for neck pain?"	Therapy
"What are prognostic factors for a relapse of bursitis subtrochanteria?"	Prognosis
"To what extent should an OP give advice on lifestyle with regard to a patient with obesity?"	'Other'

Examples of suitable questions after company meetings or meetings with colleagues:	
"What is the best course of referral for people with psychological complaints?"	General
"What are the occupational risks of a grocery check-out assistant?	Work-related causes
"To what extent can a welder return to his work after developing health complaints of welding fumes"?	Work-related consequences
"What are the numbers of dermatological complaints within the branch of road transport, in particular for fork-lift truck drivers"?	Prevalence and incidence numbers
"How do other breweries develop policies on worker health and environment?"	Branch of industry issues
"What are the options for prevention of biological risk for the municipal sanitation service?"	Occupational risk prevention by company management
"What interventions are effective for rehabilitation of employees recovering from mental stress complaints?"	Effectiveness of OHS recommendations and interventions
"Are there research studies on the comparison of different types of risk inventory and evaluation of companies?"	'Other'

Box 2. Examples of ‘unsuitable’ questions (n=225) asked by the participating OPs (n=20)

Examples of ‘unsuitable’ questions:	Reason for unsuitability
1) “How do shoulder complaints originate?”	Too generally formulated for a literature search
2) “General information on repetitive strain injury”.	
1) “If rehabilitation does not work out, I will need to know more”.	Not clearly formulated or not making sense (e.g. only a part of a question)
2) “It would be interesting to know more about this topic”.	
“I am curious about the results of the blood test”.	Should be answered by the treating physician
“What machine has caused the accident and how could this happen?”	Should be answered by the employer or employee
“What is the exact content of his job and what are the circumstances?”	Should be answered by the OP himself direct or by visiting the workplace environment
“How is rehabilitation to another employer organised?”	Should be answered by the OHS or by consulting an expert on work
“What is the legal position of the employer in this situation?”	Concerns legislation or social security regulations

After the formulation of manifest and latent questions, OPs were asked about their importance for their work. Manifest questions were considered either fairly important (75%) or very important (25%). Also most latent questions were considered fairly important (62%), or very important (15%). Twenty three percent of these questions were primarily asked out of 'personal interest', especially questions on susceptibility and on prevalence and incidence rates.

The participating OPs claimed to search for an answer to 86% of the questions they considered very important, for 57% of the fairly important questions and for 51% of those asked out of personal interest. With regard to the manifest questions 11 of the 12 OPs claimed they would seek an answer. The intended methods were: consulting a colleague directly or using a meeting with colleagues (three OPs), using textbooks (three OPs), exploring the Internet (three OPs), and consulting the treating specialist (two OPs). One OP said he would not search for an answer because he did not know how to perform a literature search.

The incentive to search for an answer to latent questions depended on various factors. Taking all intended actions together, four OPs said they would not search for an answer to any of the questions, four said they would search for an answer for every question and the other 12 OPs would search dependent on the case and question. We could not find a correlation between the category of latent question and the intention to search. Seven OPs mentioned predominantly 'no priority or necessity' as a reason for not seeking an answer, five OPs mentioned primarily 'no time' as a reason, and three OPs mentioned mainly 'not knowing where to look for an answer' as a reason. Five OPs mentioned various reasons for not searching for an answer. The intended actions for seeking an answer were similar to those mentioned for the manifest questions.

Discussion

After a half-day session observation OPs posed 0.7 manifest questions on average. During the interview, OPs expressed on average another 8.7 latent questions, which is 12 times as many. Therefore, OPs underestimate their information demands since 50% of the OPs stated asking only one question per week prior to the interview. A substantial portion (40%) of all questions

was considered suitable to be answered by a search in a medical database. Many questions on medical topics were too general in nature, reflecting a need for background information, or were not clearly formulated (n=110). More questions were generated after a half-day period with individual workers' consultations or medical examinations (10.5) than after a half-day period with one or two meetings with company management or colleagues (7.0). The majority of 'suitable' questions were dealing with issues of prognosis and susceptibility. The importance attributed to a question positively influenced the intention to search for an answer.

The results presented extend our knowledge on information demands and needs in occupational health care and stimulate discussion on possibilities of, and limits to, an evidence-based approach. By including latent questions in our study, we were able to broaden the scope of OP-information needs of which they are mostly unaware. After prompting the OP, many questions were voiced, demonstrating what OPs actually need to know in order to enhance the quality of their daily practice.

We chose a selected sample of 20 experienced OPs. Studying this sample can demonstrate particular opportunities for developing best practice in terms of making use of EBM-strategies. However, the external validity of this study towards all present OPs in the Netherlands (n=1913) and other countries is limited and might be biased in a positive direction. The presence of an outside observer may also have affected the OPs' questioning behaviour to some extent. Although it was made clear that there would be no ruling of any kind, we know that presence alone of observers can have had an effect on behaviour under investigation (Hawthorne effect).[11,18,19]

The inclusion criteria for questions 'suitable' for a literature search complied with the instructions by Sackett et al. about formulating answerable questions.[16] We considered background questions as being not 'suitable' for this approach. However, some background questions can be answered by a search in a medical database. For example, narrative reviews can give an excellent overview on a specific medical topic and might provide an adequate answer to a background question. Therefore, the calculated proportion of 'suitable' versus 'not-suitable' is a rather conservative approach.

The distribution of tasks performed by the OP was comparable with the tasks of OPs in general in the Netherlands.[20] This confirms our expectation that OPs in the Netherlands are more involved in sickness absence management than in activities related to prevention of (work-related) disorders. We expect a different distribution of tasks in other countries and realize that the results of this study would have been different if we had chosen to observe the OPs during more preventive activities.

Many questions were considered not suitable for a search in medical databases, reflecting a substantial need for background information and difficulties in formulating a complete question. We recognise four reasons for this need. Firstly, this finding is comparable to the questioning and answering behaviour of family doctors.[21] OPs, like family doctors, are general practioners and therefore they need to know the essentials of a broad range of topics. Second, due to the tasks of OPs and the focus on sickness absence management, there might be a limited need for OPs to have up-to-date medical knowledge, and a lesser level of knowledge on certain medical topics is then sufficient. This also explains the emphasis on prognosis questions and, in a broader sense, rehabilitation to work since this is the main focus of advice given by these OPs. Thirdly, the main focus of the commercial interests of managers of OHS might not be the improvement of professional medical quality. Finally, the OPs have no long-standing tradition, as is the case in many clinical settings, to discuss the medical content of their work on a regular basis with colleagues. If OPs were to have regular meetings in which their patients are discussed in a more structured way, as promoted by Sackett *et al.*, they would probably feel more need to expand their knowledge about a relevant topic.[16]

These reasons may also explain why many questions asked were not considered ‘important’ enough to search for an answer. The lack of necessity was illustrated with the typical response that: “There is no need, the patient will soon return to work”. Other barriers to searching for answers were ‘lack of time’, or ‘not knowing where to look’. This confirms that a lack of awareness of the potential contribution or value in the decision-making processes of research-based information sources could be a reason for not generating questions about research-based information.[22] We have indicated before that the existence of a good knowledge

infrastructure would be helpful in stimulating OPs to retrieve information from scientific resources using the Internet.[4]

The information demands and needs of OPs in daily practice are for a substantial part (40%) directly suitable to be answered using evidence-based strategies. The large number of latent questions confirms our belief that there is potential to use research-based information sources more often. Both the information demands and needs of OPs focused on medical or related topics, which can be answered directly using these sources.[23-25] However, further development of evidence-based practice will meet some serious barriers. An important reason being that present role and tasks of the OP in the Netherlands do not really stimulate the use of evidence-based information. We conclude that there is a need for more education on available information sources, and on how to pose an answerable question. The knowledge infrastructure and ICT facilities should be improved in order to offer adequate support to professionals. Furthermore, we recommend that OPs organize regular meetings with colleagues to discuss occupational health topics in a structured way in order to stimulate a more fruitful and challenging questioning behaviour.

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2.3 Caution required when relying on a colleague's advice; a comparison between professional advice and evidence from the literature

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Abstract

Objectives: Occupational physicians rely especially on advice from colleagues when answering their information demands. On the other hand, Evidence-based Medicine (EBM) promotes the use of up-to-date research literature instead of experts. To find out if there was a difference between expert-based practice and EBM we compared professional advice on occupational health topics with best evidence from the literature.

Methods: We asked 14 occupational physicians to consult their usual information sources on 12 pre-conceived occupational health problems. The problems were presented in the form of case vignettes which contained sufficient clinical information to be used by the occupational physicians for the consultation of their experts. We had searched the literature for the best available evidence on the 12 problems, which made it possible to answer the clinical questions with a clear yes or no.

Results: The cases could be used by the occupational physicians as arising from their own practice. All together the occupational physicians consulted 75 different experts. Almost half of the consulted experts were near colleagues, 10% were industrial hygienists, 8% medical specialists and the rest had a varied background. Fifty three percent (95% confidence interval 42% to 65%) of all professional advice was not in line with the research literature. In 18 cases (24%) professional advice explicitly referred to up-to-date research literature as their used source. These cases were substantially less incorrect (17%) than advice that had not mentioned the literature as a source (65%) (difference 48%, 95% confidence Interval 27% to 69%).

Conclusions: Advice that occupational physicians routinely get in their daily practice differs substantially from best evidence from the literature. Occupational physicians who ask professional advice should always ask about the evidence of this advice.

Background

Occupational physicians (OPs) in their daily routine are confronted with a large variety of occupational health problems. From previous research we know that in attending these problems OPs mostly rely on their own experience and on information from consulting an experienced colleague.[1] On the contrary, Evidence-Based Medicine proposes to use evidence from the up-to-date research literature as most reliable source. Reasons for OPs to still prefer working experience- or authority-based are the relatively easy way to obtain and the attributed validity of the information. Evidence-based medicine, although much-supported, is still not a customary way for occupational physicians (OPs) to address problems that arise in their daily work.[2] OPs like other physicians do not quite see its benefits. Relying on your own or on others' expertise knows some drawbacks. For example, Slawson *et al.* described that the information can be out of date and that there could be the matter of reverse gullibility.[3-5] In this study we want to challenge the belief of OPs that asking for professional advice from a colleague, even if this colleague is considered an expert on the subject, is a good source for information. We will compare professional advice given by experts to answers based on best evidence derived from the literature.

Methods

We asked a convenience sample of fourteen acquainted OPs working scattered over four different regions of the Netherlands to collect data for us. Our main criteria to ask a physician to participate were that he or she had to be professionally sufficiently experienced. Next, we took care that there was variation in location to avoid the situation that the same professional expert would be asked about the same case vignette by different OPs. Even though we tried to vary age, gender and professional experience, the majority was over 40, male and had a long standing professional experience and three OPs had achieved a doctor's degree. (Table 1)

Table 1: Personal characteristics of occupational physicians (N = 14) involved in the study

	N (%)
Age (> 40 years)	10 (71)
Gender (male)	12 (86)
Geographical location	
North	4 (29)
South	3 (21)
West	4 (29)
East	3 (21)
Certified occupational physician	12 (86)
Professional Experience (> 10 years)	12 (86)
Occupational Health Service	
ArboUnie	7 (50)
Other	7 (50)
Academic Status (PhD)	3 (21)

All OPs were considered experienced and professionally motivated, and agreed to participate. The OPs were requested to obtain two professional advices on each of three case vignettes which would lead to a maximum of 84 cases. To be able to show that a relevant 15% of the answers would not be in line with the literature with $\alpha = 0.05$ and $\beta = 80\%$ we would need about 53 cases. A professional advice was defined as an advice from a person who was considered by the OP to be an expert on the subject and who would also be consulted in the normal course of daily routine.

Twelve cases were selected on the basis of a clear occupational health problem, resemblance to daily practice for an OP and assumption that there would be sufficient literature (Table 2, See Additional file 1).

The cases represent a broad variety of occupational health practice ranging from return to work interventions in workers with musculoskeletal disorders to the causality of stress in case of a myocardial infarction. The case vignettes ended in a clear clinical question that could be answered by a simple yes or no. For example, 'does continuous years of work stress increase the risk of a myocardial infarction?' and 'is it useful to take melatonin to prevent jetlag?'

The OPs were asked to draw their own conclusion on the case vignettes and to provide the professional advice of all the experts that were consulted. The OP could decide for himself whether or not to rely on the advice received. All cases had to be advised on by the experts with yes or no accompanied by a motivation for the answer. The experts were kept unaware by the consulting OP that the cases presented were fictive.

These professional advices were compared to evidence from the literature in the form of a critically appraised topic (CAT). Critically appraised topics are considered as the best way to retrieve an answer to a question arising from practice from the literature. We followed the guidelines for making critically appraised topics as formulated by Sacket *et al*..[6] We used Medline, the Cochrane Library and the Dutch clinical guideline database (CBO) to search for relevant evidence to the clinical questions. We used the best available evidence that we could find on a certain topic. In three cases we could use a Cochrane systematic review, in four cases we could use a systematic review and in 5 cases we relied on original studies as the best evidence because no systematic review was available. We felt that for none of the cases the evidence was novel or surprising, but that the available recent literature all pointed in the same direction. All CATs are described in the appendix together with the search strategy and the evidence that was used to answer the clinical question. (See Additional file 1)

A professional advice was considered correct if both the 'yes or no answer' and the motivation were in line with the evidence from the literature as summarised in the CAT. The conclusions of the OPs were assessed only by their 'yes or no answer'.

The first two authors (FS and JV) checked and evaluated both the professional advices and the answers from the OPs separately. We measured the proportion of advices and answers that were not correct.

Table 2. Summary of the case vignettes and correct evidence-based answer

1.	For a 36-year old caretaker at a secondary school with a lateral ankle ligament rupture treated with tape for three weeks, is it safe to resume work? Yes
2.	Can a rash on the inside of the forearm of a 43-year old production worker be caused by exposure to PVC during the production of bathroom doors? Yes
3.	Can continuous years of work stress be the cause of a cardiac infarct in a 54-year-old bank employee with only a slightly raised cholesterol level? Yes
4.	For a 38-year old laboratory worker with epicondylitis lateralis, does electro shock wave therapy (ESWT) produce better results in reducing complaints than conventional treatment with physiotherapy and analgesics? No
5.	Is a 38-year old sewage worker subject to a higher risk of contracting Hepatitis A as a result of occupational exposure? No
6.	For a 48-year old archivist with extrinsic allergic alveolitis, is it useful to investigate the archive more closely for fungal cultures as a possible cause for the lung disease? Yes
7.	Is it safe for a 42-year old parking attendant suffering from a whiplash as a result of a car accident to return partially to work after some 10 days? Yes
8.	Is Cognitive Behaviour Treatment more effective than other therapies for a 45-year old teacher diagnosed with burnout? Yes
9.	Is it effectively useful to take melatonin to prevent jetlag for workers of an ICT firm travelling to Asia? Yes
10.	For a 45-year old female teacher diagnosed with mild depression, is St. John's Wort more effective than placebo? Yes
11.	Does a return to his physically demanding work after an operation on a lumbal hernia nuclei pulposi in a 45-year-old carpenter, six weeks after the operation, give a higher risk of a recurrence than returning to only light work? No
12.	Can a 42-year old male nurse, working on the ambulances safely return to full time work three weeks after his inguinal hernia operation? Yes

Results

The occupational physicians consulted 84 different experts of which 75 answered (89% response; 75 out of 84). This resulted in 39 answers to the case vignettes from the 14 participating OPs (93% response; 39 out of 42) on the 12 cases. All cases were perceived as being from daily practice by both the OPs and the consulted experts. Each individual case was advised on at least five times by an expert, except for one case where we had only two advices from experts. Table 3 shows the profession of the consulted experts which are comparable to the type of experts occupational physicians usually consult in daily practice.[1]

Table 3 Frequency of consulted colleagues

Profession of the consulted colleague	Number of consultations N (%)
Occupational Physician	34 (45.3)
Occupational Hygienist	8 (10.7)
Medical Specialist from a local hospital	6 (8.0)
Physiotherapist	6 (8.0)
Professional at a specialized occupational health centre or clinic	6 (8.0)
Psychologist	4 (5.3)
Other	11 (14.7)
Total	75 (100.0)

Most experts were consulted via e-mail (37.3%), by telephone (28.0%) or directly (13.3%). Of the 75 professional advices, 28 (37 %, 95% Confidence Interval from 26% to 48%) were incorrect. If we also took the motivation related to the answers in consideration, 40 answers were incorrect (53%, 95% Confidence Interval from 42% to 65%). Of the 39 conclusions of the OPs, based on the experts' advice 17 (44%, 95% Confidence Interval from 28% to 59%) were incorrect. There was no difference in the rate of incorrect advice per type of profession per consulted expert or per case vignette.

The motivations of the experts for their advices were based 18 times (24%) on the literature. The rate of incorrect advices by experts was 17% if their advices were explicitly based on the up-to-date research literature versus 65% incorrect if these advices were not based on the literature (difference 48%, 95% Confidence Interval from 27% to 69%).

Discussion

This is a first empirical study about the difference between research literature and the knowledge of professionals within occupational health. The results substantiate the claim by previous authors that physicians should be more aware of the limited value of the information obtained from experts.[3] Less than half of the given professional advice by experts to a practical occupational health problem was in line with evidence from the research literature.

The strength of our study is that we used the information retrieval process such as it occurs in real daily practice of occupational physicians. From our previous study, we know that the information sources that occupational physicians used in this study do conform to the sources they use in general. About half of them ask a colleague, 20% ask other professionals in the occupational health area and another 20% consults medical specialists or other clinical experts. None of the participants in the study commented on the nature of the cases or the questions asked. They were all perceived as relevant and important for clinical occupational health practice. The occupational physicians were situated in different parts of the country and had similar training as occupational physicians in general. There was an overrepresentation of physicians with a doctor's degree in our sample. This might have positively influenced the results in a way that more academic professionals could have been consulted. In turn, we assume this would have resulted in answers more in line with the literature. However, we did not find indications for such a mechanism. The power of the study was sufficient to show at least a 15% deviance from evidence from the literature. Therefore, we feel that there is no reason to believe that the practice of professional advice studied here is different for other OPs or even in other medical disciplines as argued by various authors.[3-5] Answers to clinical questions arising from practice should not only depend on the available evidence but also on the clinical situation, the patient's preferences and the resources available. The selected case vignettes all required dichotomous answers from the experts and OPs. This obviously distorts to some extent the clinical reality. However, the decision making was rather obvious in all

cases with a clear patient preference, and the cases were perceived as being from daily practice even by the experts who were unaware of the fictive nature. As to the resources available, we considered leaving this open for the consulted expert to resemble daily practice most.

The evidence we used to answer to the cases is a selection following the guidance given by the experts.[6] For most cases we found good systematic reviews which can be considered as high quality evidence. However, in some we had to rely on single original studies that were not always evaluation studies. This leaves some room for discussion about the credibility of the evidence. However, none of the results of the studies used as evidence were really novel or surprising but all were in line with general trends in the literature such as the approach to musculoskeletal diseases or advice about return to work. Moreover, the results were not related to the type of case and therefore not to the quality of the evidence provided.

Conclusions

Our findings urge for more and better research into professional knowledge management. For now we conclude that better use of the available research literature is possible and should be stimulated among occupational physicians. If professionals considered an expert on the subject, are asked for advice, occupational physicians should still make sure that the expert also provides the evidence for his advice.

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Additional File 1

CAT I

1. Question: Is it necessary for someone with a lateral ankle ligament rupture, treated with tape, to avoid putting pressure on the ankle for at least six weeks? Profession: caretaker at a secondary school.

2. Answer: No, it takes on average six weeks for complete recovery and after two weeks, on average, it is possible to start walking again and return to work.

3. Background: A 36-year old man is working full time as caretaker at a secondary school. While playing soccer the previous week, he ruptured his lateral ankle ligament. The First Aid personnel treated the injury with tape. This tape must stay in place for six weeks. The patient indicates to the occupational physician that he certainly will not be able to return to work within six weeks. His tasks involve walking around the school building at irregular intervals, and sitting in his office. He is more or less free to choose when he performs these tasks

4. PICO: P: lateral ankle ligament rupture, I: tape, C: - , O: recovery/return to work

5. Search terms and results: PUBMED search: "Lateral Ligament, Ankle"[MESH] AND rupture AND tape. Results: 4 articles: 1 systematic review.

CBO guidelines: Consensus-based diagnostic strategy and treatment of the acute ankle injury 1998.

6. Research and quality: CBO guidelines: Two RCTs compared different methods of functional treatment with each other. In the first study, three weeks with a plaster cast was compared with six weeks with an air cast and six weeks with tape. In the second study, six weeks with an air cast, six weeks with tape, six weeks wearing a special shoe, and six weeks wearing an elastic sock were compared with each other. Systematic Review: 9 RCTs are compared with 892 patients.

7. Results: CBO guidelines: The average period before return to work for functional treatment with tape is 15 days as opposed to 38 days with plaster. The results in the first RCT of the three groups were similar. The results in the second RCT of the aircast, tape, and shoe were also similar. The elastic sock gave a higher 'giving way' and pain percentage, while the return to work lasted the longest (25 days compared with 16 days in the tape group). In the summary of the guidelines: with functional treatment with tape, it is possible to walk normally after two weeks.

Systematic review: Comparison of symptoms (amongst other things, swelling) between lace-up ankle support with semi-rigid ankle support: RR 4.2 (95% CI 1.3-14)
Elastic bandage: RR 5.5 (95% CI 1.7-18), Tape: RR 4.1 (95% CI 1.2-14)
Conclusion with respect to return to work: the use of tape results in a more rapid return to work and sports activities than the use of elastic bandage, but causes more complications (such as skin irritation).
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Signed: Frederieke Schaafsma, Email: f.g.schaafsma@amc.uva.nl. May 2003

CAT II
1. Question: Is it possible that a rash on the inside of the forearm of a 43-year old production worker is caused by exposure to PVC in the production of bathroom doors?
2. Answer: Yes, in the plastics industry, the risk of self-reported rash with exposure to PVC is four times higher than without exposure to PVC. This can also be caused by additives to PVC.
3. Background: A 43-year old production worker in a manufacturing plant of plastic doors has a rash on the medial side of both forearms. The rash consists of erythema with small vesicles. During the surgery hours of the occupational physician, he asks whether this could be caused by working with PVC. The PVC is delivered in granula form and is moulded into a door with the aid of a cast. He has frequent direct skin contact with the granula. His manager assured him that there was no reason for him to become anxious about working with plastic.
4. PICO; P: 43-year old production worker in a doors/plastic factory. I/E: exposure to PVC. C: no exposure. O: dermatitis / erythema
5. Search terms and results: PubMed: pvc [mesh] AND dermatitis [mesh]
Results: 29 articles, case reports and surveys of companies.
6. Research and quality: a. 122 employees from four different companies in the USA were asked to complete questionnaires to determine the risk of skin disorders, and employees were

assigned into groups according to exposure, such as exposure to chemicals, or the use of soaps and creams. An Odds Ratio approaching 1 would indicate the greatest chance of bias in the results. b. In various case studies, the possibility of an allergy to additives such as pyridine and phtalates is indicated.

7. Results: With respect to exposure to PVC there were 10 complaints from a sample of 25 employees, as opposed to 16 of 97 without exposure. The rough OR was 3.38 (95%CI 1.16-9.84). In a logistic regression comparison in which corrections for gender, age, protective creams, cleaning products, and exposure to formaldehyde were made, the OR was 4.08 (95%CI 1.19-14.06).

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Socie EM, Gromen KD, Migliozzi AA, Geidenberger CA. Work-related skin disease in the plastics industry. *Am J Ind Med* 1997 May; 31(5):545-50.

Signed : April 2003, Jos Verbeek. Email: j.h.verbeek@amc.uva.nl.

CAT III

1. Question: Does continuous years of work stress increase the risk of a myocardial infarction?

2. Answer: Yes, corrected for biomedical variables such as smoking, cholesterol, BMI, and hypertension, the HR was 2,2 for the group that experienced a lot of work-related stress with respect to the group that experienced little stress.

3. Background: A 54-year old bank employee attends surgery hours of the company doctor after six weeks of sick leave as a result of his first infarct. The only risk factor he has is a slightly raised cholesterol level. He has discussed this with the family doctor and together they have come to the conclusion that work stress is the most important cause of the infarct. He works in a department that has been constantly under fire for a period of years and where reorganisations have constantly taken place during the previous ten years. A recent PAGO (periodic health appraisal examination) demonstrated high scores on the work stress scale. He asks the company doctor to confirm that his condition is an occupational disease.

4. PICO: P: 54-year old administrative employee, I/E: exposure to psychosocial stress, in particular work stress, C: little or no exposure to psychosocial stress, O: cardiac infarct

5. Search terms and results: cardiovascular diseases [mesh] AND stress, psychological [mesh] AND occupational diseases [mesh]; 254 articles, of which no. 12 is used.
6. Research and quality: No 12 is a cohort study in Finland among employees at a metal factory with a 25 year follow-up. Stress was measured using validated questions. After correction for occupation and biomedical variables (smoking, cholesterol and hypertension) an elevated risk for the group that scored high for stress variables remained.
7. Results; The Hazard Ratio for dying from cardiovascular diseases was 2,2 (95%BI 1,2-2,4) for the group that was exposed to high work stress with respect to the group that indicated little work stress.
8. Reference:
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 Oct 19; 325(7369):857.
Signed: July 2003, Jos Verbeek, j.h.verbeek@amc.uva.nl

CAT IV

1. Question: Is electro shock wave therapy (ESWT) more effective in reducing complaints resulting from epicondylitis lateralis than conventional treatment with physiotherapy and analgesics?
2. Answer: No, there are conflicting outcomes in the various studies. No relevant difference has been established between the two treatments. In view of the costs involved, the conventional treatment is still preferred. There is no reason for the employer to choose ESWT in favour of standard therapy with physiotherapy and analgesics.
3. Background: A 38-year old female employee of a hospital blood collection section has restrictions in using her right arm as a result of epicondylitis lateralis. The employer is willing to offer her ESWT so that she can return to work as soon as possible. He asks the occupational physician for an advice.
4. PICO: P = 38-year old female employee of a hospital blood collection section with epicondylitis lateralis, I = ESWT, C = conventional therapy, O = reduction in complaints
5. Search terms and results: Cochrane Library: Shock wave therapy, lateral elbow pain
Three hits, one systematic review.

6. Research and quality: Two trials of ESWT versus placebo have been included in the review. Both trials consisted of comparable populations of patients with chronic complaints that did not respond to conventional therapy. The frequency of ESWT, the dosage and the technique was similar in both trials. The first trial produced significantly better results for ESWT compared with placebo; the second trial produced no significant improvement.
7. Results: After pooling the results of the two trials, the positive significant results of the first trial disappeared. RR for "treatment failure" of ESWT (defined as Roles-Maudsley score of 4) with respect to placebo was 0.40 (95% CI: 0.08-1.91) at six weeks and 0.44 (95% CI: 0.09-2.17) at one year.
8. Reference:
Buchbinder R, Green S, White M, Barnsley L, Smidt N, Assendelft WJ. Shock Wave Therapy for lateral elbow pain. *Cochrane Database Syst Rev*. 2002;(1):CD003524.
Signed: F.G. Schaafsma, Email: f.g.schaafsma@amc.uva.nl. June 2003

CAT V

1. Question: Are sewage workers subject to an increased risk of contracting Hepatitis A as a result of occupational exposure?
2. Answer: Exposure to sewage work does not produce a higher risk of a clinically observable form of Hepatitis A. It is possible that the seroprevalence of anti-HbA is increased.
3. Background: A 30-year old employee of a sewage purification installation company asks the occupational physician if he should be vaccinated against Hepatitis A. The employees have been talking about it amongst themselves. After all, all kinds of bacteria and viruses exist in sewage water. While he is performing his work there are spray and spatters, in which these organisms could be living.
4. PICO: P: 30-year old healthy employee of a sewage water company, I/E: exposure to sewage water C: no exposure, O: hepatitis A
5. Search terms and results: Hepatitis A [Mesh] AND sewage [Mesh]
67 articles, of which number 6 is a systematic review.
6. Research and quality: In a systematic review, 17 studies were found of which 1 was historical prospective, 15 were cross-sectional and 1 was descriptive.

7. Results: In 4 of the 5 studies that measured a reliable clinical outcome, no relation was found between exposure and the appearance of clinical symptoms of Hepatitis A. In 14 cross-sectional studies and 20 comparisons that measured the seroprevalence of HbA antibodies, there were only three comparisons with a definitely increased odds ratio. In most studies there was a high suspicion of publication bias and confounding.

8. Reference:

Glas C, Hotz P, Steffen R. Hepatitis A in workers exposed to sewage: a systematic review. *Occup Environ Med*. 2001 Dec; 58(12):762-8.

Signed: May 2003, Jos Verbeek; j.h.verbeek@amc.uva.nl

CAT VI

1. Question: Is it useful to screen an archive for fungal cultures as a possible cause for extrinsic allergic alveolitis?

2. Answer: Yes, if there are damp areas with fungi, there could be a relation. Closer investigation is useful.

3. Background: A 48-year old archivist has been on sick leave for some time due to lung complaints. His complaints have persisted for the previous 18 months, and he had spent periods sick at home on different occasions. His last official sick leave episode was a month ago. He has been treated by the lung specialist and, after a thorough examination; he has noted a diagnosis of extrinsic allergic alveolitis. A serum test shows a weak positive reaction to cladosporium. The lung specialist phones the occupational physician to ask whether there are indications for investigating his workspace more closely. The occupational physician knows of the existence of an old RI&E (Risk, Inventory, and Evaluation) report from 1999 that states that the archive where he works is very old-fashioned and that the maintenance of the building is far from optimal. There is no further useful information.

4. PICO: P: man, I: fungus/cladosporium, C:-, O: extrinsic allergic alveolitis

5. Search terms and results: PubMed search: Alveolitis, Extrinsic Allergic AND Cladosporium

Result: 8 articles, no meta-analysis or review; 3 case reports.

Up to Date: reference to Occup Med 1992 Apr-Jun;7(2):271-86 in which there is a description of possible routes of lung infection and the relation with water.

6. Research and quality: 3 case reports of pneumonia.

7. Results: The three case reports describe cases of persons with symptoms of severe pneumonia whereby later research shows that traces of cladosporium were found in the home. Usually as a result of damp, and therefore fungal cultures.

8. References:

1. Jacobs RL, Andrews CP. Hypersensitivity pneumonia-non-specific interstitial pneumonia/fibrosis histopathologic presentation: a study in diagnosis and long-term management. *Ann Allergy Asthma Immunol*. 2003 Feb;90(2):265-70.

2. Jacobs RL, Thorner RE, Holcomb JR, Schwietz LA, Jacobs FO.
Hypersensitivity pneumonitis caused by Cladosporium in an enclosed hot-tub area. *Ann Intern Med*. 1986 Aug;105(2):204-6.

3. Schwarz H, Wettengel R, Kramer B. Extrinsic allergic alveolitis in domestic environments (Domestic allergic alveolitis) caused by mouldy tapestry. *Eur J Med Res* 2000 Mar 27;5(3):125.

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CAT VII

1. Question: Is someone suffering from a whiplash as a result of a car accident allowed to return partially to work as a parking attendant after 10 days, depending on his/her complaints?

2. Answer: Yes, early mobilisation is an aid towards successful recovery from complaints.

3. Background: A 42-year old male driver of a car was hit from behind by a car travelling at 40 km/hour, where he himself was able to brake in time. He did not lose consciousness. X-CWK showed no abnormality. After two days, he developed serious neck complaints accompanied by headache. Diagnosis of the general physician: whiplash. General physicians' provisional advice: rest and Ibuprofen. The person involved started moving about after 2-3 days of his own accord and has already performed some neck exercises. He was suggested these exercises by a friend who is a physiotherapist. He would now like to get back to work partially. His complaints have eased but are still present. He uses Ibuprofen when necessary. His general physician does not support his wishes.

4. PICO: P: whiplash; I; early mobilisation C; rest O: recovery

5. Search terms and results: PubMed: Clinical Queries: Whiplash AND systematic review

Result: 29 systematic reviews.

6. Research and quality: A systematic review on the effectiveness of different exercise methods for the treatment of various types of neck complaints. 16 trials have been included. Four RCTs studied whiplash-associated disorders (WAD). One RCT (Mc. Kinney 1989) focused on the effects of early mobilization exercises (6 PEDscore).

7. Results with respect to early mobilization:

Mc. Kinney (1989): 170 pt with WAD, three different groups:

Recovery was significantly better in patients given advice on early mobilisation to do at home, than in other patients (x2 =5, 43 df =1 p= 0,02). Early mobilization was found more effective in reliving neck pain in acute neck sprains, than physiotherapy or rest.

8. Reference:

Sarig-Bahat. H; Evidence for exercise therapy in mechanical neck disorders

Manual Therapy (2003) 8 (1), 10-20.

Signed: Frederieke Schaafsma, Email: f.g.schaafsma@amc.uva.nl June 2003

CAT VIII

1. Question: Is CBT (Cognitive Behaviour Treatment) more effective than other forms of psychotherapy in the case of burnout?

2. Answer: Cognitive Behaviour Treatment is more effective than relaxation techniques, multi-modal interventions, and organisation-focused interventions for employees exposed to stress.

3. Background: A 45-year old teacher is complaining about tiredness, sleeping badly, concentration disorders, having the feeling that he isn't performing any more, and is not liking the students at school. He is diagnosed by the occupational physician as having a burnout. The teacher agrees and enquires about the best therapy for this problem.

4. PICO: P: 45-year old male teacher with a burnout, I: CBT, C: other forms of psychotherapy, O: reduction in complaints, improvement of his functioning.

5. Search terms and results: "Behaviour therapy" [mesh] AND "Burnout, professional"[Mesh] 72 articles, of which 13 reviews and one meta-analysis.

6. Research and quality: In the meta-analysis, 48 studies were selected according to the effect of interventions in the case of 'occupational stress'. The analysis was performed in a

systematic and controlled manner. Many different outcome variables were combined, not just the functioning. It concerned only preventive interventions. It did not concern employees looking for help.

7. Results: Cognitive behaviour treatments produced the largest effect-size (0.68 95% CI from 0.54 to 0.82), followed by relaxation interventions (0.51, 95% CI from 0.33 to 0.69) and then multi-modal interventions (0.35, 95% CI from 0.22 to 0.48). All were significant. Organisation-oriented interventions had an effect-size of 0.08 (95% CI from -0.03 to 0.19), which was not significant.

8. Reference:

van der Klink JJ, Blonk RW, Schene AH, van Dijk FJ. The benefits of interventions for work-related stress. *Am J Public Health*. 2001 Feb;91(2):270-6.

Signed: June 2003, Jos Verbeek, j.h.verbeek@amc.uva.nl

CAT IX

1. Question: Is it useful to take melatonin to prevent jetlag?

2. Answer: yes, especially when flying across several time zones in an easterly direction. Between 0,5 mg and 5 mg of melatonin is effective.

3. Background: During surgery hours of the occupational physician, a businessman who often travels to Asia for his work asks whether something can be done about the jetlag he suffers after every flight. The occupational physician has read something about melatonin and decides to look this up.

4. PICO: P: flying in an easterly direction, I: melatonin, C: -, O: no jetlag

5. Search terms and results: Cochrane Library: Melatonin AND jet lag

One systematic review.

6. Research and quality: Systematic review on the effectiveness of oral melatonin (in various dosages) to prevent jetlag after flights across different time zones. Nine trials have been included; all compared melatonin with a placebo, and one trial even compared it with Zolpidem (hypnotic).

7. Results: The nine trials indicate that melatonin, when taken around the normal bedtime of the destination, decreased jetlag for flights across several time zones. Daily use of melatonin between 0,5 and 5 mg have the same effect, with the exception that people fall asleep more

quickly and sleep better with a dosage of 5 mg than a dosage of 0,5 mg. It is no use taking more than 5 mg. Slow-release of 2 mg tablets has no added value. NNT is 2. The benefit increases the more time zones are flown across, and if flying in an easterly direction. The exact time at which the melatonin is taken is of importance. If taken too early, this can cause drowsiness and an extension of the time required to get accustomed to local time. Side effects do not occur often. Epilepsy and people who are taking warfarine give a counter indication.

8. Reference:

Herxheimer A, Petrie KJ Melatonin for the prevention and treatment of jet lag Herxheimer A, Petrie KJ. Melatonin for the prevention and treatment of jet lag (Cochrane Review). In: *The Cochrane Library*, Issue 2, 2004. Chichester, UK: John Wiley & Sons, Ltd.

Signed: F.G.Schaafsma, Email: f.g.schaafsma@amc.uva.nl, July 2003

CAT X

1. Question: Is St. John's Wort more effective than placebo for an employee suffering from a mild depression?

2. Answer: St. John's Wort is more effective than placebo and just as effective as standard anti-depressants for treating a mild depression.

3. Background: A 45-year old female teacher in secondary education is off work with complaints of depression, diagnosed by the occupational physician as mild depression. On the recommendation of a colleague, she has started drinking tea made from St. John's Wort, which, according to the package insert, is an energy booster. The occupational physician doubts whether this is adequate therapy. Must the patient be advised to take regular anti-depressants?

4. PICO: P: 45-year old female teacher with a depression disorder, I: St. John's Wort, C: placebo, O: reduction of symptoms and/or improvement of functioning

5. Search terms and results: Hypericum [Mesh] AND Depressive disorder [Mesh]
Clinical query: systematic review.

6. Research and quality: In the systematic review, 47 randomized studies were summarized that met the minimum quality criteria and that all studied the effect of St. John's Wort.

7. Results: Combining the results of 17 trials produced an OR of 2.47 (95% CI: 1.69-3.61) of St. John's Wort versus placebo. In 10 trials the comparison with standard anti-depressants gave an OR of 1.01 (95%CI: 0.69-1.16).

8. Reference:

Linde K, Mulrow CD. St John's Wort for depression. *Cochrane Database Syst Rev*. 2000;(2):CD000448.

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CAT XI

1. Question: Does a return to physically demanding work after an operation for lumbal hernia nuclei pulposi, six weeks after the operation, give a higher risk of a recurrence than returning to only light work?

2. Answer: heavy work does not appear to influence the chance of a recurring hernia, but recurrence is influenced by the type of hernia fragment.

3. Background: A 45-year old carpenter, six weeks after an HNP operation in which a part of the intervertebral disk was removed at the L5-S1 level, asks the occupational physician if he will ever be able to perform the work he was doing before the operation, without there being a big risk of a recurring hernia. He is experiencing a rather tired feeling in his back, but the terrible pain in his leg has totally disappeared.

4. PICO: P: 45-year old carpenter after an operation as a result of lumbal HNP, I: physically demanding work, C: light work, O: recurring HNP

5. Search terms and results: "Intervertebral Disk Displacement"[Mesh] AND "Recurrence"[Mesh]

Number 2 of 378 hits is a cohort of patients that were followed after an HNP operation.

6. Research and quality: This study concerns 187 consecutive patients operated on by a surgeon. Using logistic regression, the influence of, amongst other things, work and other confounders on the occurrence of a recurring hernia was studied. The outcome of the research was determined without knowing the operation result. Follow-up was adequately long with a median of six years.

7. Results: The most important predictor of a recurring hernia was the type of hernia fragment that was found when operating. A recurring hernia varied from 1% via 10% and 27% tot 38%.

The type of work (light, medium or hard) had no influence at all on the logistic regression, but is not reported on in concrete terms of size and number.

8. Reference:

Carragee EJ, Han MY, Suen PW, Kim D. Clinical outcomes after lumbar discectomy for sciatica: the effects of fragment type and anular competence. *J Bone Joint Surg Am*. 2003 Jan;85-A(1):102-8.

Signed: June 2003, Jos Verbeek, j.h.verbeek@amc.uva.nl

CAT XII

1. Question: Can a male nurse, working on the ambulances, return to work two weeks after an inguinal hernia operation?

2. Answer: Yes, but in the first instance with a limit placed on physically demanding actions. For example, lifting patients. This should be possible after about three weeks.

3. Background: A male nurse, aged 43, working on an ambulance was operated on an inguinal hernia two weeks before. He underwent inguinal hernia repair (with a mesh) and this was successful. The surgeon gave no advice with respect to returning to work. For his work, he is expected (together with a colleague) to be able to lift a sick person for a short period. He would very much like to know if he can return to work safely.

4. PICO: P: 43-year old male nurse with an inguinal hernia, I: operation, C: -, O: return to work

5. Search terms and results: PubMed: inguinal hernia [Mesh] AND return to work / inguinal hernia AND absence from work

137 articles: three systematic reviews, various prospective studies/ eight articles; one prospective questionnaire study.

6. Research and quality: Systematic review: from ten different RCTs from Mesh- and non-Mesh inguinal hernia operations, the data were gathered with respect to return to work, or return to full activity, or return to normal activity. Prospective study: through interviews and medical status study, data were gathered on 93 persons who had undergone various types of inguinal hernia operations within one group of surgeons. In this study, the relation between return to work and other possible variables was investigated. Prospective questionnaire study: By means of a questionnaire study among 100 patients that have undergone an elective

inguinal hernia operation (with a local anaesthetic) in one hospital, the duration of sickness absence was enquired about.

7. Results:

- The range in the average result between the various studies is from 4 days (limitation of daily activities) to 44 days (return to work). The conclusion in this systematic review is that a Mesh operation produces on average a more rapid return to work than another operation. The outcomes are not significant. The risk of a recurrence of an inguinal hernia varies.
- The expected return to work period was 10 days, the actual return to work was 12 days (median 7 days, range 2-60 days) and there was no relation to state of health before the operation. Bivariate analysis reveals a relation between return to work with age, educational level, income level, profession, symptoms of depression, and the prior expectations with respect to return to work. These variables account for 61% of the range in return to work.
-The average length of sick leave (including the day of the operation) was 8 days (range:1-16). For light or reasonably heavy work 6 days (range 3-12) and for heavy physical work 25 days (range 21-37). Pain was the most important variable for an extension of the recovery period.

8. References:

1. EU Hernia Trialists Collaboration. Mesh compared with non-mesh methods of open groin hernia repair: systematic review of randomized controlled trials. *British Journal of Surgery* 2000,87,854-859.

2. Jones KR, Burney RE, Peterson M, Christy B. Return to work after inguinal hernia repair. *Surgery*. 2001 Feb;129(2):128-35.

3. Callesen T, Klarskov B, Bech K, Kehlet H. Short convalescence after inguinal herniorraphy with standardised recommendations: duration and reasons for delayed return to work. *Eur J Surg*. 1999 Mar;165(3):236-41.

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Chapter 3
Searching for evidence

3.1 Developing search strategies in Medline on the occupational origin of diseases

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Abstract

Background: In order to support occupational health practitioners and experts when searching the scientific literature in PubMed (Medline) for evidence on the occupational origin of diseases, we developed and evaluated an easy-to-use and effective search strategy.

Methods: We tested different combinations of search terms, in answering four case vignettes calculating sensitivity and precision in retrieving literature from a gold standard. The use of the Clinical Queries filter from PubMed was evaluated. Based on the outcomes, we developed guidelines for a professional search strategy, using a flow chart.

Results: For the occupational health practitioner, we found a sensitivity of at least 65% with a precision of 20%, when terms for occupation and type of industry were combined with terms for disease. For the occupational health expert, a high sensitivity of more than 90% was found adding terms for risk factors to the strategy. Combining the search terms with the sensitive Clinical Queries etiology filter in PubMed, enhanced the precision. Using the specific Clinical Queries etiology filter in PubMed results in a substantial loss of relevant articles.

Conclusions: To search for studies on the occupational origin of diseases in Medline, we propose to start with the proper name for the occupational disease. If this does not exist, use a specific term for the occupation and type of industry in combination with terms for disease. To improve the sensitivity of the search, a search term for the specific risk factor should be added. If there is no relevant occupational title available, it is worth trying the general search terms occupational diseases or occupational risk.

Introduction

Occupational health practitioners play an important task in the prevention, notification and counseling for occupational or work-related diseases. Other physicians are confronted with questions of occupational origins of diseases as well. Experts such as clinical librarians, guideline developers, specialists at helpdesks and researchers are involved too. In order to provide good care and appropriate recommendations to patients or employers, practitioners and experts must have sufficient knowledge of occupational diseases and access to best evidence information sources. In a previous study, we found that textbooks and colleagues are the preferred sources for occupational health practitioners.[1] However, knowledge of adverse health effects of work, work conditions, and the work environment has increased tremendously over the past decades.[2] In addition, the validity of traditional information sources such as textbooks and colleagues has been questioned.[3] This means that practitioners and experts should search primary sources such as Medline to find up-to-date information. This recommendation is in line with the quest for 'Evidence-Based Medicine', which has also been advocated in the area of occupational health.[1,2,4-6]

Searching for evidence in Medline is difficult for most physicians.[7-10] One of the main reasons is the difficulty of finding useful search terms. In a way, the retrieval of relevant articles resembles a lottery, as it so much depends on the search terms used. Searching for articles on occupational diseases can be extra difficult. Physicians do not only have to consider adequate search terms for disease and design of study, they must also reflect on terms for the occupation or risk factor. This can increase the threshold for searching. In the tree structure of 'occupational diseases' in the MeSH-database in PubMed, only 17 diseases are presented. They represent the more 'classic' occupational diseases, such as asbestosis or farmers' lung. Nowadays, in the industrialized countries, other occupational diseases are more prevalent, such as adjustment disorders and repetitive strain injury of the upper extremity.[11,12] Diseases can be found using free text words or MeSH-terms[b] in PubMed. However, one has to combine these terms with an occupation or exposure to get more specific information on a potential causal relation between exposure and disease. Within the Clinical Queries option in PubMed a specific methodology filter has been developed to find etiologic studies.[13] Although the

[b]The term is searched in the list of Medical Subject Headings of the National Library of Medicine (NLM)

retrieval characteristics have been tested using general medical topics, for studies on occupational origin of diseases it is still unclear if this search filter is useful.[14,15]

Occupational health experts at the helpdesk of the Dutch Centre for Occupational Diseases (NCvB) answer daily to questions arising from occupational health practice, and have expressed the need for better search strategies. To confirm our assumption on the significance of the causal relationship in particular between exposure and disease for occupational health practice, we analyzed the questions (n =133) addressed to the centre over a period of three months. We found that many questions (40%) concerned etiology. In the occupational health literature, several strategies have been presented, such as for questions on toxicological issues, occupational health interventions and on issues of chronic diseases at work.[16-18] Also, as part of a pilot project, some pre-formulated searches for occupational health topics have recently been developed by Partners in Information Access for the Public Health Workforce (Partners); a joint project of the National Library of Medicine and the Centers for Disease Control and Prevention (CDC). However, to our knowledge search strategies on finding etiological studies of occupational diseases have not yet been presented.

The aim of this study is to develop and evaluate a search strategy for occupational health experts and practitioners to support them in the search for etiological studies on occupational diseases in Medline. The following questions will be answered:

- Which search terms give the best result in terms of sensitivity and precision when answering questions on occupational diseases?
- Is there an added value of the Clinical Queries option in PubMed?
- What general search approach can be recommended to experts and practitioners?

Methods

Construction of case-vignettes

To operationalize the questions we constructed four case-vignettes with practical relevance for the occupational health field. Cases were selected (Appendix 1) on the basis of frequently reported occupational diseases in the annual report of the Dutch Centre for Occupational

Diseases.[12] The matching occupations or jobs were chosen assuming that there would be sufficient etiologic literature.

The cases resulted in the following etiological questions:

- In an employee at a supermarket, can her carpal tunnel syndrome (CTS) be caused by her work?
- In a hairdresser, is her contact dermatitis caused by work?
- Can half a year work experience as a baker cause asthma in a 19 year old male?
- In a former automotive spray-painter with symptoms indicating chronic toxic encephalopathy (CTE), can his disease be caused by his former work?

Construction of reference files

During five brainstorming sessions and with help of an experienced clinical librarian in the field of occupational health care, and of occupational health physicians working as occupational disease experts at the Dutch Centre for Occupational Diseases, a comprehensive list was compiled containing a large number of search terms for exposure and disease. For this, information from the Dictionary of Occupational Titles, and the thesaurus of Medical Subject Headings was used.[19,20] Search terms for the occupation were combined with disease terms in an effort to find all possible relevant articles in Medline, using PubMed (Appendix 2). For pragmatic reasons, limits were set to: period 1995-june 2004, English articles with abstract and human studies. Studies were selected for inclusion in the reference file in a three-stage process. First, all titles and abstracts found by electronic searches were independently scrutinized on their relevance to the cases by two of the authors (FS and JB). Next, a "snowball method" was used exploring the references of the selected articles and the related articles option in PubMed to find additional articles and search terms. Third, two of the authors (FS and CH) independently assessed all selected articles to judge whether all criteria for inclusion in the reference file were met.

To be included, an article had to meet the following criteria:

- Original articles about the disease or related symptoms in combination with the specific or relevant occupation, the workplace, the type of company, the specific or relevant duties, or specific risk factors. By 'relevant' was meant that duties in the

retrieved article convincingly resembled the duties of the occupation from the case. For example, studies on painters besides those on spray-painters were also included.

- Original articles must meet the methodological criteria described for studies on etiology by van der Windt *et al.*.[21] The emphasis of these criteria was on: independent and standardized measurement of exposure and disease, high response, lack of selective loss to follow-up and correction for confounding in the analysis.
- Systematic reviews that, in addition to the above mentioned criteria, transparently described the literature search and selection criteria for inclusion of articles. Narrative reviews were not included.

Discrepancies on eligibility of studies were resolved by consensus. In general, there was a high agreement. Four files of relevant articles were completed and stored in Reference Manager®.[22]

Selecting and testing appropriate search terms to construct an optimal search strategy

All words in the title, abstract and keywords of articles in the four reference files were analyzed for frequency using 'The Web frequency Indexer'.[23] These words were divided into three categories: terms for the disease, terms for the occupation or exposure, and terms for the type of study. Non-relevant words or words with no importance (e.g. the, and, thus) were left out. We adapted the strategy used by Verbeek *et al*. and Bachmann *et al*., and used the two most frequent disease-terms, and the ten most frequent occupation-terms for further calculations.[18,24]

For each selected word, a new search was performed in PubMed. In all searches the limits were applied as previously described. The words were tested as free text word, as MeSH term, and when possible as a combination of both. The articles retrieved by the search terms were compared with the corresponding reference file using SPSS. The search terms were treated as "diagnostic tests" for relevant studies and the reference files were treated as the "gold standard".[15] We calculated the sensitivity as the number of reference file articles retrieved as a proportion of *all* reference file articles, and the precision as the number of reference file articles retrieved as a proportion of all articles found in a search (analogous to "positive predictive value") per search term.

For a more complete overview the Number Needed to Read (NNR =1/precision) was added.[24] This gives the number of articles that have to be screened to find at least one article of the reference file.

It was assumed that the expert has enough time to go through a large number of studies and that it is important for her to find all possible relevant articles. Therefore, for experts a search strategy with the highest sensitivity was recommended. To limit the number of articles to screen to some extent, the minimum precision was set at 5% (NNR ≤ 20), under the condition that the sensitivity is at least 90%, consistent to what is recommended in the literature.[13-15,18,25-27] The practitioner who may have less time available wants to find a substantial number of relevant articles without too much non-relevant information. Therefore, in an attempt to approach an optimal yield, the highest product of sensitivity and precision was calculated and recommended, with a sensitivity of at least 65% and a minimum precision of 20% (NNR ≤ 5).

Data analysis

We calculated exact binomial 95% confidence intervals for sensitivity and precision as recommended by Deeks and Altman with the computer programme Stata.[28,29] For the expert, the search terms with the highest sensitivity were combined with the Boolean operator "OR" in a search string, stepwise looking for maximum sensitivity and in accordance with the precision thresholds given before. We did this procedure separately for disease terms and exposure terms. Next, both best search strings were combined with the Boolean operator "AND". For the practitioner, the search strings with the highest product of sensitivity and precision were combined.

In addition, the Clinical Queries filter from PubMed was applied together with best search strings for the expert and the practitioner for both a sensitive and a specific search on etiology, to compare the performance with previous results of the optimal search strategy.

From the findings, a general approach was deduced and presented in a flow chart, as a recommendation for experts and practitioners.

Results

Reference files

Table I shows the number of studies found in MEDLINE after the selection on content criteria and on methodological quality. In most of the studies, methodological quality was not high. The number of articles selected was, however, sufficient to develop four reference files, each containing 15 to 20 high-quality relevant articles of different study designs. For the case of the car-spray painter, 18 out of 20 studies used a cross-sectional design.

Table 1. Number of articles on work-relatedness for four diseases retrieved from MEDLINE selected on relevance and quality resulting in four reference files[c]

	Articles that passed content criteria	Articles that passed methodological quality criteria	Type of study			
		Four reference files	Systematic review	Cohort study	Case-control	Cross-sectional
Baker with asthma	72	20	-	8	5	7
Hairdresser with eczema	26	15	-	9	-	6
Car spray painter with chronic toxic encephalopathy	83	20	-	1	1	18
Employee at a supermarket with carpal tunnel syndrome	55	18	3	2	5	8

Search terms

Tables II, III, IV and V show the best combination of search terms per case and the retrieval performance in combination with the Clinical Queries (PubMed). For two cases—the hairdresser and the supermarket employee—two combinations of search terms for the expert are presented, since both combinations had nearly equal results.

[c] Limits: 1995-June 2004, abstract, English article, human.

Table 2. Best combination of search terms for the case of a baker with asthma to retrieve articles from a reference file [d]

Best combination of search terms for disease and occupation for the expert	**Number found in Medline**	**Number matching reference file (n=20)**	**Sensitivity % (95% CI)**	**Precision % (95% CI)**	**NNR**	**Sensitivity x precision**
(asthma [mesh] OR respiratory) AND (bakers OR bakery OR flour)	149	19	95.0 (75.1-99.9)	12.8 (7.9-19.2)	8	1216
Clinical query filter/ etiology						
Sensitive search AND (asthma [mesh] OR respiratory) AND (bakers OR bakery OR flour)	88	17	85.0 (62.1-96.8)	19.3 (11.7-29.1)	5	1641
Specific search AND (asthma [mesh] OR respiratory) AND (bakers OR bakery OR flour)	27	12	60.0 (36.1-96.8)	44.4 (25.5-64.7)	2	2664
Best combination of search terms for disease and occupation for the practitioner						
(asthma[mesh] OR respiratory) AND (bakers OR bakery)	69	15	75.0 (50.9-91.3)	21.7 (12.7-33.3)	5	1628
Clinical query filter/ etiology						
Sensitive search AND (asthma[mesh] OR respiratory) AND (bakers OR bakery)	47	13	65.0 (40.8-84.6)	27.7 (15.6-42.6)	4	1801
Specific search AND (asthma[mesh] OR respiratory) AND (bakers OR bakery)	18	9	45.0 (23.0-68.5)	50.0 (26.0-74.0)	2	2250

[d] [MeSH]: The term is searched in the list of Medical Subject Headings of the National Library of Medicine (NLM).
No addition: The term is searched in all words and numbers in the title, abstract, MeSH-terms and MeSH-Subheadings.

Table 3 Best combination of search terms for the case of the hairdresser with contact eczema to retrieve articles from a reference file [e]

Best combination of search terms for disease and occupation for the expert	**Number found in Medline**	**Number matching reference file (n=15)**	**Sensitivity % (95% CI)**	**Precision % (95% CI)**	**NNR**	**Sensitivity x precision**
Contact dermatitis[mesh] AND hair*	125	14	93.3 (68.1-99.8)	11.2 (6.3-18.1)	9	1045
Occupational dermatitis [mesh] AND hair*	53	13	86.7 (59.5-98.3)	24.5 (13.8-38.3)	4	2124
Clinical query filter/ etiology						
Sensitive search AND Contact dermatitis [Mesh] AND hair*	59	12	80.0 (51.9-95.7)	20.3 (11.0-32.8)	5	1624
Specific search AND Contact dermatitis [mesh] AND hair*	17	8	53.3 (26.6-78.7)	47.1 (23.0-72.2)	2	2510
Best combination of search terms for disease and occupation for the practitioner						
Contact dermatitis [mesh] AND hairdressers	39	13	86.7 (59.5-98.3)	33.3 (19.1-50.2)	3	3164
Occupational dermatitis [mesh] AND hairdressers	32	12	80.0 (51.9-98.3)	37.5 (21.1-56.3)	3	3214
Clinical query filter/ etiology						
Sensitive search AND Contact dermatitis [mesh] AND hairdressers	30	12	80.0 (51.9-98.3)	40.0 (22.7-59.4)	3	3428
Specific search AND Contact dermatitis [mesh] AND hairdressers	10	8	53.3 (26.6-78.7)	80.0 (44.4-97.5)	1	4264

[e] [MeSH]: The term is searched in the list of Medical Subject Headings of the National Library of Medicine (NLM).
No addition: The term is searched in all words and numbers in the title, abstract, MeSH-terms and MeSH-Subheadings.
* : The term is searched with all possible extensions to the given text string.

Table 4. Best combination of search terms for the car-spray painter with symptoms of chronic toxic encephalopathy to retrieve articles from a reference file [f]

Best combination of search terms for disease and occupation for the expert	**Number found in Medline**	**Number matching reference file (n=20)**	**Sensitivity % (95% CI)**	**Precision % (95% CI)**	**NNR**	**Sensitivity x precision**
(neuropsychological OR nervous) AND (paint OR painters OR solvents[mesh])	174	16	80.0 (56.3-94.3)	9.1 (5.3-14.5)	12	688
Clinical query filter/ etiology						
Sensitive search AND (neuropsychological OR nervous) AND (paint OR painters OR solvents[mesh])	101	15	75.0 (50.9-91.3)	14.9 (8.6-23.3)	7	1118
Specific search AND (neuropsychological OR nervous) AND (paint OR painters OR solvents[mesh])	18	5	25.0 (8.7-49.1)	27.8 (9.7-53.5)	4	695
Best combination of search terms for disease and occupation for the practitioner						
(neuropsychological OR nervous) AND (paint OR painters)	47	14	70.0 (45.7-88.1)	29.8 (17.3-44.9)	3	2086
Clinical query filter/ etiology						
Sensitive search AND (neuropsychological OR nervous) AND (paint OR painters)	32	13	65.0 (40.8-84.6)	40.6 (23.7-59.4)	2	2639
Specific search AND (neuropsychological OR nervous) AND (paint OR painters)	7	5	25.0 (8.7-49.1)	71.4 (29.0-96.3)	1	1785

[f] [MeSH]: The term is searched in the list of Medical Subject Headings of the National Library of Medicine (NLM).
No addition: The term is searched in all words and numbers in the title, abstract, Mesh-terms and Mesh-Subheadings.

Table 5. Best combination of search terms for the supermarket employee with carpal tunnel syndrome to retrieve articles from a reference file [g]

Best combination of search terms for disease and occupation for the expert	**Number found in Medline**	**Number matching reference file (n=18)**	**Sensitivity % (95% CI)**	**Precision % (95% CI)**	**NNR**	**Sensitivity x precision**
Carpal tunnel syndrome AND (occupational diseases [mesh] OR occupational risk)	224	18	100.0 (81.5- 100.0)	8.0 (4.8 -12.4)	13	800
Carpal tunnel syndrome AND (occupational diseases [mesh] OR repetitive)	238	18	100.0 (81.5-100.0)	7.6 (4.5-11.7)	13	760
Clinical query filter/ etiology						
Sensitive search AND Carpal tunnel syndrome AND (occupational diseases [mesh] OR occupational risk)	170	17	94.4 (73.0-99.9)	10.0 (5.9-15.5)	10	944
Specific search AND Carpal tunnel syndrome AND (occupational diseases [mesh] OR occupational risk)	34	4	22.2 (6.4-47.6)	11.8 (3.3-27.5)	8	262
Best combination of search terms for disease and occupation for the practitioner						
Carpal tunnel syndrome[mesh] AND occupational diseases [mesh] OR occupational risk	179	17	94.4 (73.0-99.9)	9.5 (5.6-14.8)	11	897
Carpal tunnel syndrome [mesh] AND (occupational diseases [mesh] OR repetitive)	187	17	94.4 (73.0-99.9)	9.1 (5.4-14.2)	11	859

[g] [MeSH]: The term is searched in the list of Medical Subject Headings of the National Library of Medicine (NLM).
No addition: The term is searched in all words and numbers in the title, abstract, MeSH-terms and MeSH-Subheadings.

Clinical query filter/ etiology						
Sensitive search AND Carpal tunnel syndrome [mesh] AND (occupational diseases [mesh] OR occupational risk)	135	16	88.8 (65.2-98.6)	11.9 (6.9-18.5)	8	1057
Specific search AND Carpal tunnel syndrome [mesh] AND (occupational diseases [mesh] OR occupational risk)	29	4	22.2 (6.4-47.6)	13.8 (3.9-31.7)	7	306

For the expert, an adequate combination of search terms with a sensitivity higher than 90% and a precision higher than 5% was found for all cases, except for the car-spray painter case. For this case, there was not a single term or simple combination of terms for disease or symptoms that retrieved more than 80% of the relevant articles. The term chronic toxic encephalopathy is not a MeSH-term and was used only in one article of the reference file. The terms most frequently used in the reference articles were 'neuropsychological' or 'nervous' in combination with various terms (e.g. symptoms, effects, diseases, disorders, system). Simply combining these two words retrieved most of the relevant articles.

For the practitioner, an adequate combination of search terms with a sensitivity higher than 65% and a precision higher than 20% was found for all cases except the case of the supermarket employee. In the absence of particular risk factors, the terms that retrieved most relevant articles were all general terms for occupational diseases or risk, with low precision and rather high NNR.

For all four cases, we found that only using the text word occupation*[h] had a sensitivity of 94-100%. However, the precision was low in all cases, and therefore this term was not used in the final best combination of terms. Other general terms for occupation such as work, work [MeSH], workers, job or industry retrieved only a small percentage of relevant articles. The retrieval performance of terms like occupational exposure, occupational risk, and occupational diseases gave varying results per case. For the case of the supermarket employee, the terms occupational diseases and occupational risk gave the highest retrieval (Table V).

The use of MeSH-terms

If a MeSH-term existed for the disease word: asthma, contact dermatitis, and carpal tunnel syndrome; the strategy to use only the MeSH-term gave the best results in terms of highest product of sensitivity x precision (Table II, III, IV, V). For the occupation or exposure words, it was best to use both the MeSH-term and the free text word, except for the terms 'solvents' and 'occupational diseases' (Table II, III, IV, V).

[h] Truncation of a textword in combination with the symbol * means that PubMed will search for all terms that include this part of the textword.

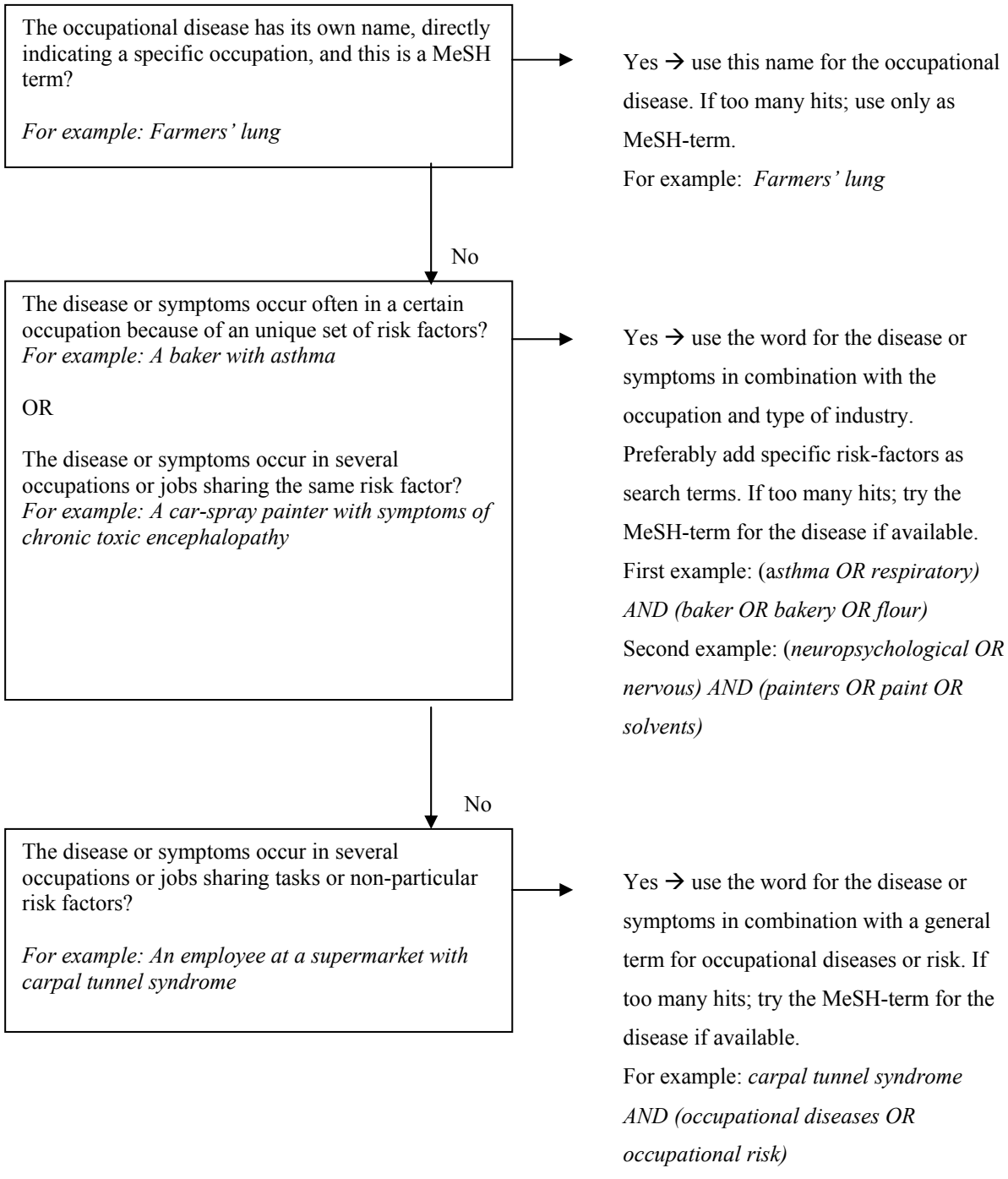
The use of the 'Clinical Queries' option in PubMed

For the four cases, a lower sensitivity was found when in addition to the selected search term combination; the PubMed Clinical Queries filter on etiology was applied. For the expert, the use of this filter implied mostly that the search result did not pass the limits set in advance. For the practitioner, the sensitive search filter on etiology enhanced precision without losing too many relevant articles. This application passed the limits set in advance for all cases and is useful. Since the specific search filter led to a loss of many relevant articles, this option never met the limits set in advance.

General approach to search for studies on the occupational origin of diseases

The result of the best combinations of search terms for the four cases was deducted and simplified into a general search recommendation, put in a flow chart (Figure 1). The first step refers to those occupational diseases that have a particular name and are acknowledged in PubMed as occupational disease within the applicable MeSH-tree. The flow chart can be used by both experts and practitioners in the field.

Figure 1. **Flowchart of search strategies for occupational origins of diseases in Medline (PubMed)**



Discussion

The results of this study have shown that a good combination of search terms retrieved a high number of relevant articles in Medline. We found that using specific terms for the occupation in combination with terms for disease gave a sensitivity of at least 65%. The sensitivity of the search could be improved to more than 90% if a term for the specific risk factor could be included in the search. For both experts and practitioners, the precision norms set in advance could be met for the majority of the cases. If there is no occupational title, it is best to try general words like occupational diseases or occupational risk. A sensitive but not specific approach is using the term occupation*. Combining the search terms with the sensitive search on etiology of the Clinical Queries filter enhanced the precision of the search but lowered the sensitivity.

This study has concentrated on a search strategy to answer four case vignettes of occupational diseases with a specific question. The cases used in this study are rather common and a substantial amount of research is available, therefore we consider the proposed flow chart as applicable and useful for the majority of occupational disease-cases. For less common or less studied occupational diseases a different search strategy might be necessary. So far, most studies on search strategies have concentrated on a specific type of study or a specific study design.[13,15,18,25-27] An asset of this study was the use of four different case scenarios derived from real questions in occupational health practice as a starting point for the search strategy development. The choice to make a reference file by using a trawl of search terms, checking the references in relevant articles and using the related articles option of PubMed is a pragmatic way of constructing a gold standard. The 'gold standard' in similar publications was often constructed by a manual search of a selected number of journals for a limited time period, e.g. one or two years. The advantage of our method is the high external validity using all journals indexed in Medline for a period of 10 years. The test characteristics of the search strategies are therefore completely applicable to Medline. A potential drawback of our approach is that we can not be certain to have found all relevant articles in our sample, an aspect of internal validity. Furthermore, we could not calculate the specificity of the search terms because the number of articles in PubMed between 1995 and June 2004 is enormous compared to the small selection of relevant articles of the reference file.[13,15,25-27] The

calculation of precision and 'number needed to read' is, however, an attractive alternative, giving insight into consequences for daily practice.

Finding the best search terms for a disease or a symptom is a skill that will improve by experience. For example, this study has taught us that the term 'chronic toxic encephalopathy' is still hardly used in articles on this topic. In this study, we focused on finding the best search terms for occupation or exposure in particular. To find the best search terms for this, an occupational health expert or practitioner should consider the kind of risk factor(s) for the occupational disease he is confronted with:

- The disease has its own characteristic name and there is a specific MeSH term available. For example: Farmers' lung
- The risk factor or factors are directly and almost uniquely correlated with one specific occupation. For example: alpha-amylase or flour and bakers
- The risk factor is present in a limited number of occupations. The combination with specific work conditions (e.g. nature and level of exposure, route of intake, use of protective device, and other work conditions that are important because of moderation toward an effect) makes it a specific situation. For example the car-spray painter who is exposed to solvents. Solvents are used in many occupations in different work circumstances. The particular context is related to the type of agent and route of intake (aerosols), the exposure (spray-painting cabin) or the protection (use of airway or skin protection within spray-painting companies). In this situation, the practitioner has to make his own judgment as to whether studies found on the topic are comparable to the situation in car-spray painters.
- The risk factor is not unique to the occupation and the work conditions are not specific. In this case, a specific occupational title can not be used but instead there is a job with several tasks. These tasks may contain risk factors that might elicit an occupational or work-related disorder. For example, the employee at a supermarket whose work includes heavy lifting or frequent repetitive movements.

For the specific study design, the use of the Clinical Queries filter was analyzed. This filter can be helpful for the 'busy' practitioner but one must realize that important studies can be

missed due to the fact that assigned MeSH-terms and Subheadings for design of study are not always accurate in Medline. Sometimes studies which are labeled as 'case-control study' or 'cohort-study' are clearly cross-sectional in design.[15,21,30] Another explanation for this loss of retrieving relevant articles is the exclusion of cross-sectional studies and systematic reviews in the clinical queries filter. The filter for etiology focuses on cohort- and case-referent studies, as its 'Key Methodological Criterion' prescribes.[15,30] However, we are in agreement with van der Windt *et al.* that also cross-sectional studies that comply with certain methodological criteria still can be informative.[21] This is why we have included these in our reference file. As to the inclusion of systematic reviews, they are considered within Evidence-Based Medicine as the highest level of evidence, which is why they were also included in our reference file.[31]

In conclusion, to find studies on the occupational origin of diseases in Medline, we propose to start with the proper name for the occupational disease. If this does not exist, we advise to use a specific term for the occupation and company in combination with terms for disease or symptoms. To improve the sensitivity of the search one should also use the word for the specific risk factor. If there is no relevant occupational title available, we advise to try general words like occupational diseases or occupational risk. In our view, the flow chart presented gives an effective and feasible approach. We recommend future studies to test the value and validity of the flow chart presented in practice and its applicability for different occupational disease cases.

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Appendix 1.

The four case vignettes

Case 1

A 19-year-old male has had regular complaints of tightness of the chest and headaches for the past two months. His family physician has diagnosed him with asthma and given him a prescription for treatment. He finished his baker's training six months previously and has started working in his parent's bakery. His family physician has advised him to see his company doctor because he wants to know if the complaints could be caused by his work. The question the family physician asks: "Can half a year working experience as a baker cause asthma in a 19 year old male?"

Case 2

A 27-year-old female suffers from redness, scaling and itching in the fingers of both her hands. The symptoms look like dermatitis. She is concerned that her complaints have something to do with her work as a hairdresser. She has had these complaints before, especially during a very busy period at work but they would disappear after taking a period of rest like a holiday. She tells the occupational physician that she hardly uses gloves because she feels she cannot work properly then. Her tasks are washing, cutting, and painting, and giving permanent waves to customers. She has not seen her family physician yet. Her hobbies are playing volleyball and going out with her friends. The question is: "Can contact dermatitis be caused by her work as a hairdresser?"

Case 3

A woman is worried about her husband because he has become rather slow in all his actions over the last couple of years. She has to take care of most things in their household, as he does not seem to be able to anymore. For example, she has to repeat everything she asks or tells him to do. Furthermore, he is not the cheerful person she married 25 years ago. She wants to know if the changes she has noticed in her husband have anything to do with his work in the past. Her husband is 56 years old and has had a lot of different occupations. At this moment he is working at a breakers' yard, but he also worked as a car-spray painter for at least 12 years. They do not remember the kinds of paints or substances they used and what the

working conditions were at the time. The occupational physician considers the symptoms described as symptoms that might be an indication for chronic toxic encephalopathy. His question is: “Can this disease or the described symptoms be caused by his work as a car-spray painter in the past?”

Case 4

A 52-year-old female has been diagnosed with carpal tunnel syndrome by her family physician. She works full time at a supermarket spending most of her time at the meat counter. The occupational hygienist has drawn up a report about her working tasks and conditions. In summary, the following risk factors are present:

- predominantly repetitive movements sometimes with force during the whole day: cutting and/or chopping up meat, mechanized cutting of meat products, packing of meat products
- in the morning: lifting more than 5 kilos several times per hour; getting meat out of a cold store, staying in the cold store for not more than several minutes
- in the afternoon; repetitive movements during cleaning tasks, sometimes with force

The question is: “Can carpal tunnel syndrome be caused by the work of a supermarket employee, given the risk factors mentioned?”

Appendix 2.

First set of search terms used for the development of the reference files:

For exposure, step-by-step terms for the specific occupational title (step I), for the trade or type of industry (step II), for the risk factor or agent (step III), and finally for occupation or work in general (step IV) were considered.

Case 1. A baker with asthma

Search terms

Disease: asthma (MeSH + tw[i]) AND

Exposure:

Step I) +II) baker* (tw) OR baking (tw)

Step III) flour (MeSH + tw) OR flours (tw) OR triticum (MeSH + tw) + wheat (tw) OR wheats (tw) OR secale cereale (MeSH + tw) OR rye (tw) OR ryes (tw) OR zea mays (MeSH + tw) corn (tw) OR corns (tw) OR hordeum (MeSH + tw) OR barley (tw) OR barleys (tw) OR soybeans (MeSH + tw) OR soy beans (tw) OR soy bean (tw) OR alpha amylase (MeSH + tw) OR alpha amylas* (tw) OR bakers dust* (tw) OR baker's dust (tw) OR xylanase* (tw) OR cellulose* (tw) OR grain dust* OR bread (MeSH + tw) OR breads (MeSH +tw) OR cereals (MeSH + tw) OR enzymes (tw)

Step IV) occupations (MeSH + tw) OR occupation* (tw) OR employment (MeSH + tw) OR work (MeSH + tw) OR workplace (MeSH + tw) OR job* (tw) OR occupational exposure (MeSH + tw) OR occupational disease (MeSH +tw) OR (occupational risk factor) (tw) OR worksite* (tw) OR work place* (tw) OR workplace* (tw) OR (work related*)OR business (tw) OR profession* (tw) OR trade* (tw) OR vocation* (tw) OR enterprise* (tw) OR industr* (tw)

Case 2. A hairdresser with contact dermatitis

Search terms

Disease: contact dermatitis (MeSH + tw) OR contact eczema (tw) OR contact sensit* (tw)

[i] Text word

OR contact dermat* (tw) OR skin irritation (tw) OR skin allergy (tw) OR contact allergy (tw) AND

Exposure:

Step I) hairdress* (tw) OR hair dress* (tw) OR barber* (tw) OR hair styli* (tw)

Step II) beauty parlor (tw)

Step III) hair dyes (MeSH + tw) OR hair perm* (tw) OR hair color* OR perfume (MeSH + tw) OR perfumes (tw) OR shampoo* (tw) OR soap* (tw)

Step IV) see step IV) case 1.

Case 3. A car-spray painter with chronic toxic encephalopathy

Search terms

Disease: neurotoxicity syndromes (MeSH + tw) OR neurotoxicity syndrome* (tw) OR brain damage, chronic MeSH + tw) OR chronic toxic encephalopath* (tw) OR toxic encephalopath* (tw) OR chronic encephalopath* (tw) OR neuropath* (tw) AND

Exposure:

Step 1) spray painter* (tw)

Step II) spray painting establishment* (tw) OR automotive body repair workshop*

Step III) solvents (MeSH + tw) OR solvent* (tw) OR paint (MeSH + tw) OR paint* (tw)

Step IV) see step IV) case 1.

Case 4. A supermarket employee with carpal tunnel syndrome

Search terms

Disease carpal tunnel syndrome (MeSH + tw) AND

Exposure:

Step I) +II) grocer* (tw) OR supermarket* (tw) OR clerk* (tw) OR store*(tw) OR checker*(tw)

Step III) packaging OR repetitive* (tw) OR repetition* (tw) OR physical stress (tw) OR physical demand (tw) OR physical load (tw) OR posture (tw) OR local pressure (tw) OR strains (MeSH + tw) OR force (tw) OR vibration*(tw)

Step IV) see step IV) case 1.

3.2 Effectiveness and efficiency of a literature search strategy to answer questions on the etiology of occupational diseases, a controlled trial

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Abstract

Objectives: To evaluate the effectiveness and efficiency of a search strategy to find evidence-based answers to questions related to the possible occupational etiology of diseases.

Methods: A controlled trial of 70 occupational health physicians and 55 insurance physicians who were asked to answer one out of four 'occupational disease case-vignettes' following the steps of Evidence-Based Medicine. The intervention group was given the search strategy as a tool.

Results: The intervention group scored significantly better than the control group in answering the main question of the case-vignette correctly (57% versus 37%) using more adequate search terms. The intervention group scored significantly better regarding satisfaction with the applied search strategy (28% very satisfied versus 8%). We found no differences in time spent solving the case nor in the intention of future practice of Evidence-Based Medicine.

Conclusions: The introduction and application of specific search strategies can have a positive effect on the effectiveness of searching literature. Future initiatives for developing and testing specific search strategies in the field of occupational health should be encouraged.

Introduction:

The interest in the application of Evidence-Based Medicine (EBM) for occupational health care is growing. Searching Medline in November 2005 with the phrases or subject headings "evidence-based medicine" AND "occupational medicine" yielded 25 articles in contrast to only nine articles retrieved in November 2001.[1] The development of EBM within occupational health care suggests that occupational health physicians and social insurance physicians, who are both involved in assessing work disability, might feel a need for support in their competence of practicing EBM. In our opinion, both groups of physicians should be thoroughly trained in how to practice EBM.[2] In the Netherlands, an introduction to EBM is incorporated as an integral part of a four-year training course for both occupational health physicians and social insurance physicians at the Netherlands School of Public and Occupational Health (NSPOH). In addition, several national and international workshops have been organized on this topic.

Practicing EBM in daily health care is, however, not the same as being familiar with the theory. An evidence-based practice is the result of enhanced knowledge, skills, positive behaviour and of the overcoming of barriers. A major obstacle for most physicians is in selecting an optimal strategy to search for information in databases.[3-6] It has been shown that practitioners do not search the medical literature effectively when they do try to find information.[7] Several search filters ("hedges") have been developed to help clinicians to improve the retrieval of clinically relevant and scientifically sound studies from MEDLINE (and other bibliographic databases) without missing key studies or retrieving excessive numbers of preliminary, irrelevant, outdated, or misleading reports.[8-13] The use of effective search strategies or filters will especially help researchers who wish to review all the available literature regarding a certain topic. In the field of occupational health, so far four studies have been performed to develop effective search strategies.[14-17] How effective these search strategies are in practice has, to our knowledge, not yet been studied.

Experts at the helpdesk of the Dutch Centre for Occupational Diseases (NCvB) answer questions arising from occupational health practice. In the year 2004, 411 questions were put by occupational health physicians, and 301 by others (general practioners, patients, industrial

hygienists or other occupational health advisors, etc.) and the number of these questions is increasing every year. From an analysis of all 133 questions asked by occupational health physicians (OPs) during one trimester in 2004, we know that the majority of these questions concern a possible causal relationship between a certain exposure and a disease (40%). To answer these questions, several evidence-based facilities are available. As PubMed is the main free online source of access to the worlds health care literature available in Medline, this facility has been chosen as the first essential source for the transmission of knowledge.[9] The NCvB wishes to stimulate OPs to answer most of their questions themselves using an evidence-based search method. With regard to more complex searches, there is the opportunity to use the helpdesk of a specialized occupational health care centre such as the NCvB. Using appropriate search terms in relation to the occupational health problem posed would give a fast and better chance of retrieving useful articles, which are the foundation of an evidence-based answer to the question. An effective and efficient search strategy could lead to a lower threshold to practicing EBM.

In this study we wish to study the effectiveness and efficiency of a search strategy tool for occupational health. The core of the tool is a simple flowchart that can help physicians to find useful search terms when searching PubMed, see appendix 1. The development of the tool is described in detail elsewhere.[17] Effectiveness ("does it work in practice?") assesses whether an intervention does more good than harm when provided under usual circumstances of healthcare practice. Efficiency ("Is it worth it?") measures the effect of an intervention in relation to the resources consumed.[18] By means of a controlled trial among trainee occupational health- and social insurance physicians, we tested the effectiveness of the search strategy tool of OPs in giving better answers to a case-vignette about an occupational disease by using more appropriate search terms and finding more relevant articles. We tested its efficiency by assessing the gain in time of searching for evidence.

Methods

Participants

Four mixed groups of occupational health physicians (n=70) and social insurance physicians (n=55) in their second year of training at the Netherlands School of Public & Occupational

Health (NSPOH) were invited to participate. They all participated in an EBM-introduction course of four days in either 2004 or 2005. All physicians were involved in work disability assessments and they had had at least two years of professional experience in the field of occupational health (occupational health services or social insurance bodies). For practical reasons, they all will be referred to as occupational health physicians (OPs).

Design

All physicians had completed a knowledge test on EBM prior to taking the course. The course consisted of a theoretical introduction in which basic steps of EBM were explained, a practical hands-on training in searching the Internet with a focus on finding information on evidence-based guidelines and using Medline via PubMed, and a training in critical appraisal of the literature. Physicians who completed the course were asked to answer one out of four 'occupational disease case-vignettes' following the steps of EBM and to note down these steps in a log. The main question based on the case-vignette referred to the probability, given the presence of a disease or illness and the presence of an occupation, that there was a possible (0-50%), probable (50-80%) or very probable (80-100%) chance of a causal relation between work and the disease. The four presented cases were a case of bakers' asthma, hairdressers' eczema, a car-painter with chronic toxic encephalopathy, and a supermarket employee with carpal tunnel syndrome.[17] The cases were randomly assigned to each physician. The intervention group also received a flowchart of search strategies. This flowchart helps the physician in a step-by-step way to consider the relation between relevant risk factors, the occupation and the disease in mind. Following this relation, different search terms are suggested. The intervention group did not receive further information about the flow chart or any extra stimulants to use it.

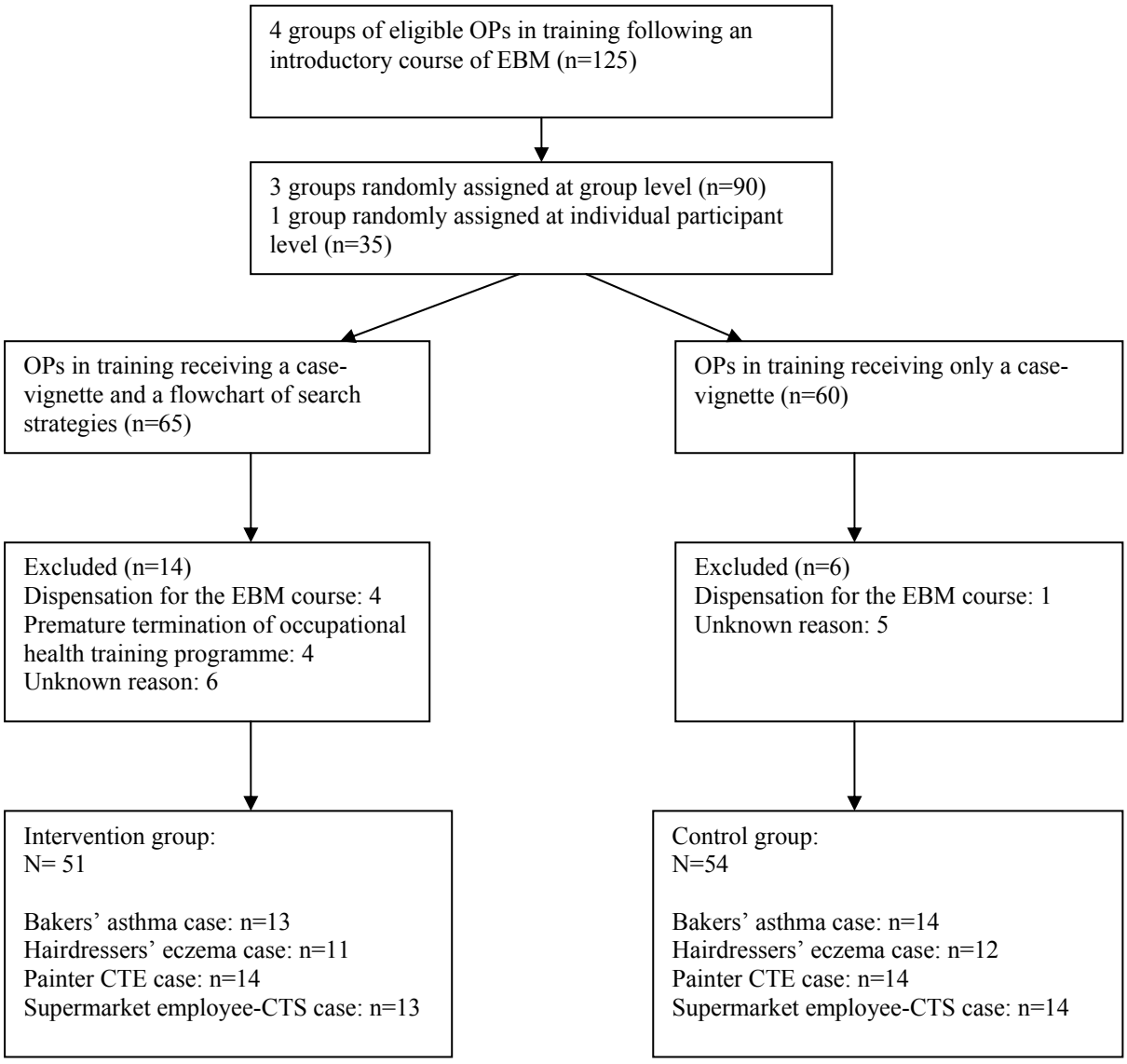
The number of physicians per course group varied, depending on the number of physicians that had enrolled in the four-year training course at the school. To lower the risk of contamination between physicians within a group, we randomized at group level in the year 2004, following the order of the first date of the course. Because of an imbalance between the number of intervention and control physicians in favour of the control physicians, we decided to randomize the last course group in September 2005 at the level of the individual participant

to achieve a more equal number of physicians (Figure 1). By then we presumed that the risk of contamination was negligible. All physicians were aware of, and agreed to, the assignment for educational and research purposes.

Development of the log

The log we used was adapted from an earlier version developed by the Coronel Institute in collaboration with the NSPOH and the TNO Quality of Life Institute. The physician has to answer nine questions following the steps necessary when applying EBM: 1) formulating an answerable question, 2) characterizing the question (prognosis, therapy, diagnosis, etiology), 3) making a PICO partition of the question: Patient, Intervention, Comparison and Outcome, 4) considering possible national and 5) international practice guidelines to answer the question, 6) application of adequate search terms, 7) actually using relevant original articles or systematic reviews from electronic medical databases, 8) appraising the literature on its methodological quality and its appropriateness for the occupational health situation, 9) and using this information to answer the original question. For the purpose of our study, participants were asked to search only in PubMed. We added questions about the satisfaction with the applied search strategy, time spent searching PubMed and answering the question, and about obstacles and intention to the practice of EBM in the future.

Figure 1. Flow diagram showing the randomization of the participants



Scoring the log

For all four case-vignettes, a gold standard log with model answers to the questions was developed by two of the authors (FS and CH), both experienced OPs and EBM experts. The gold standard articles used for these case-vignettes were all screened for relevant content and good methodological quality. All answers from the participants were compared with the appropriate standard log. For the first five questions of the log, answers were considered incorrect (0 points), limited (1 point) or good (2 points). For instance, the first question

required the respondent to write a focused occupational health question in relation to the case-vignette. Responses were scored based on their inclusion of a patient population, an intervention, a comparison, and an outcome. The maximum score would be 2 points. If one of the essential parts was missing, the score would be 1 point, if the answer had no agreement or 'fit' with our standard answer, the score would be 0 points. The subsequent two questions in the log concerning formulation of useful search terms and presentation of articles retrieved were given two points for every search term or relevant article that complied with our 'model log'. Question eight, concerning the critical appraisal of retrieved articles, was divided into three judgment categories: a) identifying correctly the study design, b) assessing correctly the level of evidence, c) evaluating the information retrieved in order to answer the original question of the case-vignette. For the categories a) and b) we took answers into consideration only if they dealt with a relevant article. One point was given for each correctly appraised article, up to a maximum of 3 points per judgment category. For category c) the answers were considered incorrect (0 points), limited (1 point), good (2 points) or excellent (3 points). The final question of the log was the correct evaluation (yes/no) to what extent (possible, probable or very probable) the case-vignette dealt with an occupational disease.

Data analysis

To assess the internal reliability of the log, we calculated the inter-rater reliability between two of the authors (FS, CH) using Cohen's kappa. This ranged from 0.70 to 0.97 for individual questions (with a mean of 0.75). Differences were resolved by consensus. All statistical analyses were performed according to the intention-to-treat principle. Primary outcome was a correct evaluation of the probability of an occupational disease, which was analyzed using a Chi-squared test. Chi-square tests were also used to calculate significant differences between the intervention and control group with regard to the formulation of the search question, the formulation of a PICO, satisfaction with the search in PubMed, and intention to practice EBM in the future. For the number of adequate search terms, the number of relevant articles retrieved, the scores for the critical appraisal of articles retrieved, and the time in hours spent in solving the case and searching in PubMed, T-test analyses or Mann-Whitney U-tests were performed to calculate differences between the intervention group and

the control group. All analyses were performed using SPSS (version 11). P-level was set at 0.05.

Results

The response of the participants was 78% for the intervention group and 92 % for the control group. There were no significant differences in sex (49% male and 50% male) or mean age 37.8 (SD 7.8) and 38.7 years (SD 8.0) between both groups. Prior knowledge of EBM before the introductory course did not differ, mean scores were 42.5 points (SD 3.1) in the intervention group and 42.2 points (SD 4.7) in the control group. The four case-vignettes were equally divided between both groups. As is shown in Table 1, no differences were found in the scores between either group with regard to the formulation of an answerable question, understanding the type of question (etiology, prognosis, etc.) and formulating a PICO. The scores for finding useful guidelines for the case-vignette, especially international guidelines, were equally low in each group.

Table 1. Scores of the intervention (n=51) and control group (n=54) in formulating an answerable question, characterizing the question (prognosis, therapy, diagnosis, etiology), making a PICO, considering practice guidelines to answer the question (national and international)

		Intervention group			Control group		
		Incorrect	limited	Good	Incorrect	Limited	Good
1	Formulation of an answerable question n (%)	6 (12)	21 (41)	24 (47)	5 (9)	21 (39)	28 (52)
2	Correct characterization of the question n (%)	4 (8)	23 (45)	24 (47)	7 (13)	22 (41)	25 (46)
3	Formulation of a correct PICO n (%)	7 (14)	18 (35)	26 (51)	2 (4)	25 (46)	27 (50)
4	Finding one or more useful national guidelines n (%)*	16 (31)	29 (57)	6 (12)	21 (39)	23 (43)	9 (17)
5	Finding one or more useful international guidelines n (%)*	36 (71)	13 (26)	2 (4)	44 (82)	9 (17)	0 (0)

* 1 OP missing in the control group

The intervention group used significantly more search terms in correspondence with our model, as is shown in Table 2. There was no significant difference in retrieval of relevant articles between either group. The intervention group scored significantly better than the

control group in answering the main question of the case-vignette correctly (57% versus 37%). There were no significant differences between the four case-vignettes.

Table 2. Scores of the intervention (n=51) and control group (n=54) for using good search terms, retrieving relevant articles, and using this information to answer the original question

		Intervention group	Control group
6	Mean score using corresponding search terms (SD)	4.5 (1.9) *	3.7 (1.4)
7	Mean score retrieval of corresponding research articles (SD)	3.6 (3.4)	3.0 (2.6)
9	Correct answer to the case n (%)	29 (57) #	20 (37)

* $p < 0.05$ Mann-Whitney test

# $p < 0.05$ Chi square

The control group scored better in the correct characterization of the study design. A complication was that scores for both the correct design of the study and the assessment of the correct level of evidence could not easily be interpreted without appraising the article chosen by the OP. Therefore, only the judgment of relevant articles as defined by our ('gold standard') model was taken into consideration. Answers related to other articles were not included and therefore noted as missing values. As a result, critical appraisal scores for the study design and the level of evidence were available from only 28 OPs in the intervention group and 35 OPs in the control group (Table 3). We found no differences between both groups. The overall evaluation of the information retrieved was evaluated for all OPs (n=105), again, no significant differences between both groups were found in these scores - the majority of both groups (55% and 56%) scored limited. 'Excellent' or 'good' was scored by 10% or 28% of the intervention group and 2% or 26% of the control group. No points were scored by 8% of the intervention group and 17% of the control group.

Table 3. Critical appraisal scores 8a and 8b of the intervention (n=28) and the control group (n=35)

	Intervention group				Control group			
	0 pnts	1 pnt	2 pnts	3 pnts	0 pnts	1 pnt	2 pnts	3 pnts
8a. Correct characterization of study design n (%)	9 (32)	16 (57)	2 (7)	1 (4)	17(49)	14(40)	4 (11)	0(0)
8b. Assessment of the level of evidence n (%)	13 (46)	14 (50)	1 (4)	0 (0)	20(57)	13(37)	2(6)	0(0)

Satisfaction with the search strategy was significantly higher in the intervention group than in the control group, as is shown in Table 4.

No differences were found between either group in mean time spent searching PubMed (2.2 hours SD 1.5 and 2.1 hours SD 1.6) or mean time spent solving the whole case following the steps of EBM and answering all questions of the log (6.1 hours, SD 3.5 and 5.3 hours, SD 2.9).

Table 4. Satisfaction of the intervention (n=51) and the control group (n=53, 1 missing OP) with the applied search strategy

	Intervention group	Control group
Very satisfied n (%)	14 (27)	4 (8)
Quite satisfied n (%)	21 (41)	33 (62)
Moderately satisfied n (%)	14 (27)	16 (30)
Not satisfied n (%)	2 (4)	0 (0)

* $p < 0.05$ Chi square

A higher satisfaction with the applied search strategy did not result in an enhanced intention for further future use of EBM (Pearson correlation 0.189, p=0.08), nor in a difference between either group. The majority, 67% of the intervention group and 64% percent of the control group, perceived this experience of practicing EBM and searching PubMed as very stimulating and challenging and indicated that they were willing to practice EBM more often. Twelve percent of the intervention group and thirteen percent of the control group were also

enthusiastic but saw time constraints as a major obstacle to practicing EBM on a daily basis. However, they would be willing to use this method for difficult cases. Eighteen percent of the intervention group and nineteen percent of the control group indicated that it was nice to try for this occasion but they did not expect to practice EBM again soon. No participants indicated that EBM was not at all interesting or had no value for professional performance.
Major obstacles for future practice of EBM mentioned by the participants (n= 105) were lack of time (42 times), difficulty of retrieving full text articles (25 times), insufficient skills in searching PubMed (25 times), no access to the Internet (15 times) and the translation of relevant Dutch terms into English (9 times).

Discussion

The results of this controlled trial demonstrated a positive effect of a flowchart of search strategies for the etiology of possible occupational diseases on the effectiveness in giving a correct answer to a case-vignette. The flowchart leads to the use of better search terms and improved the satisfaction of OPs with their search of PubMed. We did not find a positive effect on the search efficiency or an enhanced intention for further future use of EBM as a result of the use of the flowchart.

Potential limitations of this study

The effectiveness of the applied search strategy depends on the level of competence in practicing EBM and, therefore, in this study also on the quality of the introductory course. For example, most of the participating OPs in both groups were not adequately informed about the substantial difference between systematic reviews and narrative reviews. As a consequence, many articles retrieved by the participants were narrative reviews and were not considered correct by our gold standard log. This could explain why, even though better search terms were used by the intervention group resulting in more correct answers, we did not find a significant difference in the number of relevant articles retrieved by the intervention or control group. After the study was completed, we considered this aspect of our judgment as debatable. Evidently, information from narrative reviews could also result in correct answers to the case-vignettes. The effect of the course on the competence was assumed to be equal in both groups, as the prior knowledge of EBM was similar. A practical drawback in the set-up

of our study was that some OPs were not able to retrieve full text articles from their workplace or home and based their appraisal and answers only on the abstracts of the articles. This especially influenced the quality of the critical appraisal of articles and therefore these scores gave limited information on the actual skills of critical appraisal in both groups. The limited number of OPs that could be included for the first two aspects of the critical appraisal was another shortcoming of our assessment of critical appraisal skills. Nonetheless, the scores of all aspects of critical appraisal are predominantly low and therefore do require extra attention in future EBM courses given by this school.

Implications of findings

The dissemination of medical knowledge today is enormous and therefore finding a correct answer to a medical question quickly is difficult.[19] Proper training and continuing experience with searches in electronic databases is an important aspect of improving quality of a physician, and the added value of tools to simplify searching is just one part of this complex of practicing EBM.[20,21] This study has shown that 43% of the intervention group still did not give a correct answer to the case-vignette. This means that more training and exercise in evidence-based practice is still necessary for these OPs. Moreover, a helpdesk of a specialized occupational health care centre such as the NCvB is also required for complex searches.

Gradually, the idea is growing that instead of expecting doctors to read the original medical literature to find out about current best care, the accent has to be laid on finding the right pre-assessed research evidence. Consequently, the doctor in daily practice has to concentrate on judging whether the answer applies to the health problem at hand, and then on working the evidence into the decision that must be made.[22] Therefore, the most efficient strategy might perhaps not be to stimulate doctors to become ‘do-ers of EBM’, but rather ‘users of EBM’, which in its essence means that physicians in practice should be stimulated to read especially pre-appraised literature.[23] However, in the field of occupational health care the availability of pre-assessed research evidence or guidelines is still limited. Research evidence about etiology of occupational diseases is mostly available in original medical articles or in narrative reviews, and that is probably why participants could not find more systematic reviews or practice guidelines to solve their case-vignette. Therefore, tools simplifying the search process in the literature are not only important for researchers but also for practitioners in the

field of occupational health care who wish to practice evidence-based medicine and improve their professional quality. This line of thought is supported by the Healthy People 2010 Information Access Project, whose purpose is to make information and evidence-based strategies related to the Healthy People 2010 objectives easier to find (http://phpartners.org/hp/index.html). The National Library of Medicine and the Public Health Foundation staff have recently started to work together to develop pre-formulated search strategies for selected focus areas, including Occupational Safety and Health.

Satisfaction with the applied search strategy did not result in an increased intention for future use of EBM compared with the control group. This is in contrast to the conclusion of the study by Bradley *et al.*, who found that, besides active instructions from librarians, EBM search hedges clearly improved and maintained searching skills and demonstrated positive changes in attitudes towards searching.[24] There may be two reasons for this. First, a ceiling effect may exist as the majority of both groups was very positive about future use of EBM. Secondly, other factors such as major time constraints overruled the differential positive experience of searching for information in PubMed. Our study has shown not only that much time has to be invested, but also that there is a broad variety in time spent solving the case (mean time 5.7 hours, SD=3.2). Although the reported time might be an overestimation since participants were assigned for two working days to solve this case and to do other obligatory EBM coursework, it is understandable that taking six hours to solve one case is not an incentive to practice EBM on a regular basis. The tested search strategy, although effective, did not result in a reduction of the time spent. We now realize that our search strategy, as opposed to more familiar hedges like the clinical queries option in PubMed, do not always limit the number of articles retrieved. Our search strategy is intended to help physicians to determine relevant search terms. The clinical queries option is used after search terms have been formulated. Future studies should also think of occupational health hedges as having a positive effect on efficiency as well. Although English translation of search terms was a minor problem for the Dutch OPs in this study, future research should also focus on language issues. The World Health Organization has recently published a practical guide for the use of research information to improve the quality of occupational health practice, in which a glossary of relevant occupational health MeSH- terms can be found in English.[25]

Conclusions

The purpose of the study was to determine if the previously developed search strategy tool for questions related to the occupational etiology of diseases would be effective and efficient in daily practice. OPs who received the flowchart used more adequate search terms, gave better answers to the case-vignette problem, and were more satisfied with the search. Therefore, specific search strategies can have a positive impact on the effectiveness of searching literature. We think that if such a flowchart of search strategies were to be easily available for OPs in practice, this could stimulate them to perform their own searches for research evidence to answer questions on the aetiology of occupational diseases. We found no positive result of the search strategy tool on efficiency as there was no effect on the time spent in solving the case-vignette problem. Further initiatives are needed to develop and test search strategies and hedges in the field of occupational health.

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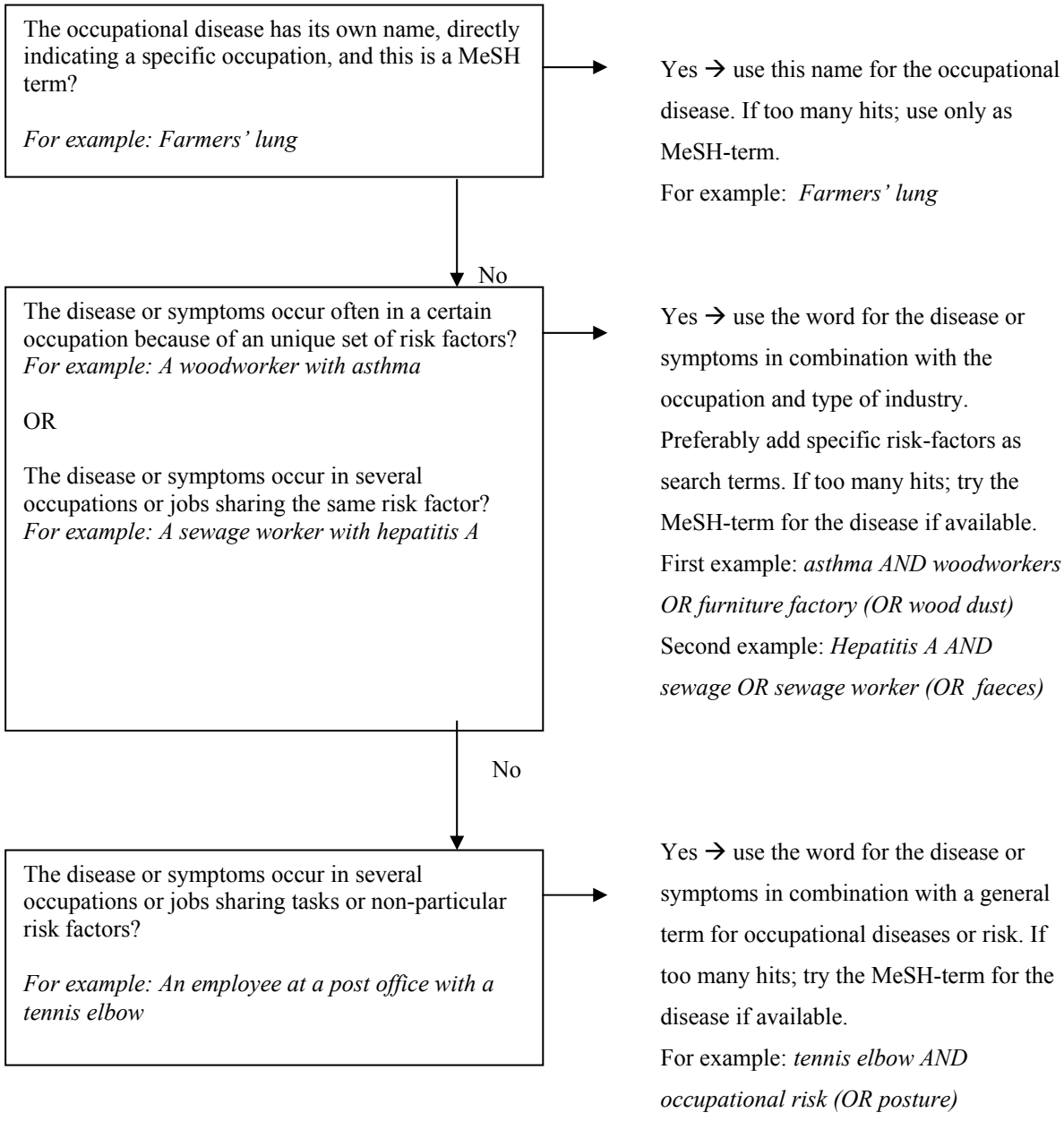
Appendix 1.

Flowchart of search strategies for occupational origins of diseases in Medline (PubMed)



Chapter 4
The application of Evidence

4.1 Knowledge, skills, and behaviour towards Evidence-Based Medicine in a non-clinical setting: a cluster randomised controlled trial

Frederieke Schaafsma, Nathalie Hugenholtz, Angela de Boer, Carel Hulshof, Frank van Dijk

Submitted

Abstract

Objective: To study the effectiveness of an Evidence-Based Medicine (EBM) implementation programme to increase knowledge and skills, and EBM behaviour in a non-clinical setting.

Design: A cluster randomised controlled trial.

Setting: Sixteen Occupational Health Services and eight private occupational physician practices. *Participants:* 106 occupational physicians

Intervention: A course in EBM for one and a half day, followed by a four month period of case method learning sessions in small peer groups once every two weeks. During these sessions, participants discussed their everyday cases concerning sickness-absence advices, in particular regarding the existing evidence for prognosis and for effectiveness of various interventions. Participants performed searches in PubMed and other databases to develop their skills in EBM.

Main outcome measures: Primary outcomes were changes in knowledge and skills, and behaviour in EBM. Secondary outcomes were changes in attitude towards EBM, social context, self-efficacy and intention to perform EBM behaviour.

Results: Both knowledge and skills of EBM as well as EBM behaviour scores improved significantly for the intervention group over time and in comparison to the control group (both $p<0.0001$). Three months after the intervention scores were 103.9 versus 71.8 and 66.6 versus 55.4, respectively. The intervention group also scored significantly better over time in attitude towards EBM ($p=0.016$), social context ($p=0.02$) and self-efficacy ($p<0.0001$) compared to the control group. Three months after the intervention scores were 79.5 versus 77.8, 60.1 versus 56.4, and 55.6 versus 37.5. We found no significant effect on intention to EBM behaviour.

Conclusions: Our intervention has shown a significant and lasting increase of both knowledge and skills, and EBM behaviour. EBM enhancing interventions which include regular peer meetings and case method learning could be promising in non-clinical settings.

Trial registration: Clinical Trials ISRCTN06357602 [ClinicalTrials.gov]

Introduction

In recent years efforts in various medical domains have been made to stimulate the practice and teaching of Evidence-Based Medicine (EBM). Within clinical settings, several trials have been conducted to test the effect of educational interventions on knowledge and skills, attitudes and behaviour of physicians.[1-3] A promising intervention study showed that teaching EBM skills can actually change physicians' behaviour if a multi-component EBM intervention is used and evidence-based resources are provided on the hospital network.[4] However, within a non-clinical setting such as public health, the effect of a theory-based multifaceted intervention to enhance EBM practice did not result in a change of professional behaviour.[5]

The difference in success of these EBM enhancing interventions could be that within clinical settings it is routine practice to have regular meetings with colleagues e.g. morning reports, ward rounds or house staff conferences. The influence coming from these social networks showed to be substantial on whether new scientific findings were adopted and EBM behaviour was stimulated.[6,7] Moreover, some clinical settings were found to have journal clubs in which peers discuss relevant articles to their specialty. These journal clubs also appeared to be effective in increasing knowledge and skills of EBM.[8] In non-clinical settings, such as occupational health care, most physicians are not familiar with regular and frequent meetings with colleagues or journal club traditions.[9] This could be an important extra barrier for the successful implementation of EBM in the daily practice. In addition to regular peer meetings, case-method learning appeared to be an effective method to change knowledge, attitudes and performance of physicians as well.[10] Furthermore, case-method learning implicitly necessitated peer meetings, a good fit with both the physicians' day-to-day work routine and the local and organizational context.[11]

The aim of our study was to asses whether the combination of an educational intervention on EBM with case-method learning sessions involving regular peer meetings, has a positive effect on knowledge and skills, and EBM behaviour for occupational physicians (OPs). Our intervention was theoretically based on the conceptual framework of the Attitude, Social context, and Self-efficacy-model (ASE-model) for behaviour change (Appendix 1).[7,12,13]

Therefore, we were also interested in the different influences of attitude towards EBM, social context and self-efficacy on behaviour change of these professionals.

Participants and Methods

Randomisation and blinding

We recruited registered OPs within occupational health services or private practices in the Netherlands via written invitations and information sessions about the study during three months. OPs from the same occupational health service or closely situated services and practices were clustered in peer groups of 6-10 members. An independent research assistant provided a computer generated blocked randomisation sequence with randomisation on group level. All OPs who agreed to participate in the study and completed the baseline questionnaire entered the trial according to the treatment group their group was assigned to. The participants were not blinded to treatment assignment. However, the researchers who scored the study outcomes were blinded to treatment allocation at all times.

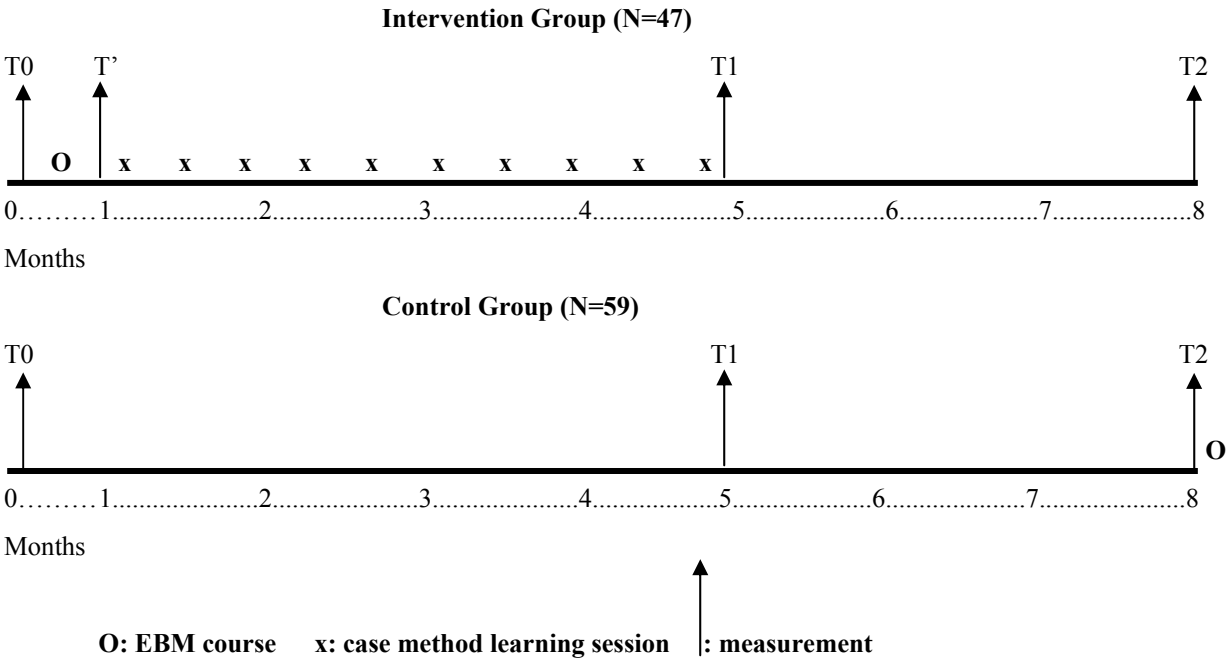
Intervention

First, a theoretic course on EBM was given of one day and a half during a period of two weeks. In this course participants learned the basics of EBM: how to formulate answerable questions, search the literature with a focus on using PubMed, and appraise the methodological quality and occupational health relevance of articles. The participants received a syllabus on EBM for occupational health and during the course they received a homework assignment on critical appraisal. Second, the OPs were obliged to attend case-method learning sessions once every two weeks in groups of 6 to 10 colleagues. During these sessions real cases of sickness absent employees from daily practice were discussed in a pre-structured way following the instructions of Sackett for presenting a patient at follow-up rounds.[14] At least once every four weeks the OPs were obliged to perform a literature search for evidence on their own cases. Third, to diminish possible barriers for behaviour change, the OPs received several incentives on EBM e.g. newsletters, articles on EBM and several search strategies for PubMed during the intervention period of four months. During this period, OPs could request full text articles and they could contact a helpdesk for questions on searching

the literature. The control group also had access to full text articles but, in contrast to the intervention group, participants were not actively stimulated to make use of this facility.

Questionnaires were sent to all participants at three time points; the first questionnaire (T0) was sent at baseline, one month after the randomization process. The second questionnaire (T1) was sent directly after the intervention period of four months and the last questionnaire (T2) was sent three months after the intervention period. To check the quality of the EBM course we asked the intervention group to complete a test on knowledge and skills in EBM at the end of the course (T'). As this was only two weeks after the baseline questionnaire we considered it not useful to ask the control group to complete this part at T'. See Figure 1 for the time frame of the study.

Figure 1. Time frame of the intervention study



T0 : Baseline questionnaire for all participants
T' : Questionnaire on knowledge and skills for intervention group just after their EBM course
T1: Questionnaire for all participants after the intervention period
T2: Follow-up questionnaire for all participants, three months after the intervention period

Baseline and outcome measures

The baseline questions asked at enrolment included demographics of participants (age, sex), MD and OP experience and information of previous training in EBM, and experience with research or critical appraisal. To assess knowledge and skills in EBM, we used the validated Fresno Test (2,15). For our study we adapted this test with respect to language and changed the scenarios into occupational health-related situations. The last part of the test was changed into yes/no questions on critical appraisal. We used a similar set of correct answers and maintained the standardised grading system of the Fresno Test (scores 0-212 points).

To assess behaviour in EBM we used a 5-point Likert scale test for 22 statements that referred to the five variables within the ASE-model (Appendix 1)[12,13]: 1) 5 items measuring attitude towards EBM (e.g. "using EBM in daily practice improves the quality of the physician"); 2) 5 items measuring social context (e.g. "management of my occupational health service stimulates use of EBM"); 3) 5 items measuring self-efficacy (e.g. "I often don't know how and where to find good occupational health information via the Internet"); 4) 4 items measuring the intention to use EBM in the near future (e.g. "I have the intention to practice EBM in the near future whenever appropriate"); and 5) 3 items measuring actual EBM-behaviour (e.g. "whenever appropriate I search the literature for evidence"). Participants strongly agreeing with a 'positive' statement were given a score of '5'. Conversely, those strongly disagreeing with a positive statement or strongly agreeing with a 'negative' statement were given a score of '1'. For each of the five variables, a sum score was calculated to obtain an overall score. These sum scores were subsequently converted into scores between zero and hundred to facilitate comparison between the sum scores.

Sample size and statistical analysis

Our target sample size was 100, 50 in both the intervention and control group, which was chosen for practical reasons given the intensity of the intervention. All participants that entered the trial were analysed. Differences in baseline characteristics were tested with t-tests for continuous variables and Chi-tests for categorical variables. To analyse if the intervention had an effect on knowledge and skills, and EBM behaviour, mixed model analyses based on repeated measurements with adjustments for the cluster randomization were performed. First, an overall effect of the intervention over time (intervention*time) comparing the intervention

group and the control group was calculated for knowledge and skills, attitude, social context, self-efficacy, intention to behaviour and behaviour. Second, if a statistically significant overall effect was found, post hoc analyses were performed for each time-point. Third, subgroup analyses were performed within the intervention group to investigate potential predictors for high scores on knowledge & skills of EBM or EBM behaviour. We analysed the effect of gender, experience as an OP (more or less than the median of 12,5 years), and experience in the past with either EBM, research or critical appraisal. Finally, a mixed model analysis was performed for the relationship over time between scores in knowledge and skills of EBM, and all ASE-variables with EBM behaviour. Statistical analyses were carried out using SPSS version 12.0.

Results

Overall, 131 OPs were recruited from sixteen occupational health services and 8 private practices between May 2005 and September 2005. However, 25 OPs from both groups already withdrew before we started the actual intervention mainly due to company policy of the OHS and due to the expected time-consuming elements of the intervention. The dropout rate during the intervention period of four months for the intervention group was 17 OPs, and for the control group 15 OPs. Main reason for the dropouts in the first group was the time-consuming aspect of the case-method learning sessions. (see Flow chart).

Flow of participants through trial

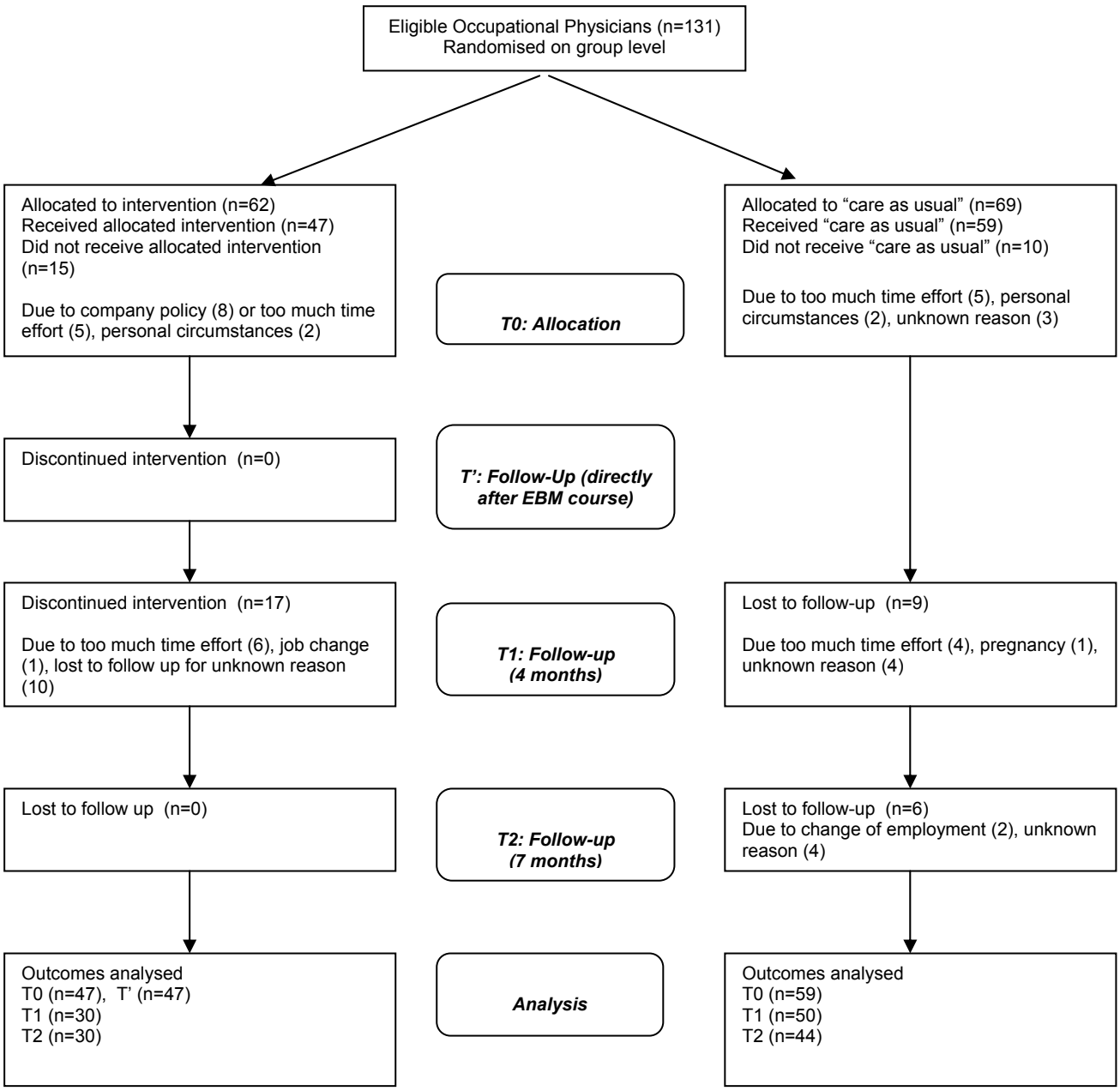


Table 1. shows the baseline personal characteristics of the 106 actual participating OPs. The participants in the intervention group were older (45 versus 48 years) and had more previous experience as a physician (17 versus 20 years) than those in the control group. There were no other differences especially not in previous experience with EBM.

Table 1. Baseline characteristics of OPs

Characteristics	Intervention group (n=47)	Control group (n=59)
Mean age in years (± SD)*	48 (±6)	45 (±7)
Women n (%)	23 (49%)	21 (36%)
MD experience years (± SD)*	20 (±6)	17 (±7)
OP experience years (± SD)	14 (±6)	13 (±7)
Previous experience with EBM education	11 (23%)	10 (17%)
Previous experience with critical appraisal	14 (30%)	14 (24%)
Experience with research	23 (49%)	23 (39%)
N of groups	7	9
Mean n of OPs within the groups	6.7	6.5

*$p<0.05$ T-test

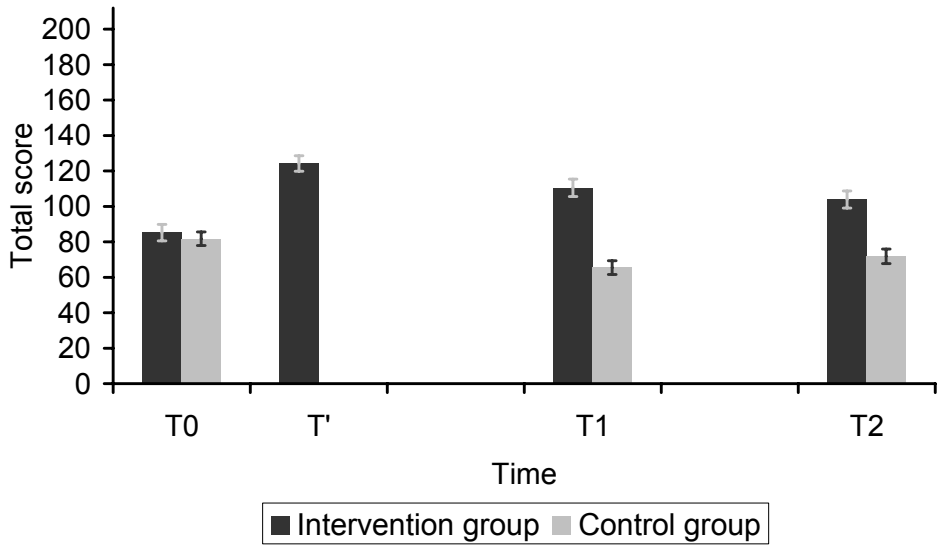
All OPs randomised to the EBM intervention received the EBM course at the beginning of the intervention. After four months, they attended on average 7.2 case-method learning sessions and carried out on average 3.3 literature searches. Ninety one full text articles were requested from the support facility by 27 OPs of the intervention group. Five full text articles were requested by three OPs of the control group.

Knowledge and Skills of EBM

Figure 2 shows the knowledge and skills in EBM scores. The overall effect of the intervention over time of knowledge and skills comparing the intervention group with the control group was significant ($p<0.0001$). No effect of the groups on the individual scores was found. Post hoc analyses indicated that participants of the intervention group scored significantly higher

on the test for knowledge and skills of EBM compared to those of the control group at both T1 (mean score 110.5 (95% CI 100.7-120.3) versus 65.5 (95% CI 57.7-73.2), p<0.0001) and T2 (mean score 103.9 (95% CI 94.3-113.6) versus 71.8 (95% CI 63.7-79.9), p<0.0001). The highest score of the intervention group was seen directly after the course at T'(mean score 124.2, 95% CI 113.7-134.7), which was significantly higher than the score on baseline (p<0.0001).

Figure 2. Knowledge & Skills in EBM of participants
T0 (n=47, n=59), T' (n=47) T1 (n=30, n=50), and T2 (n=30, n=44)



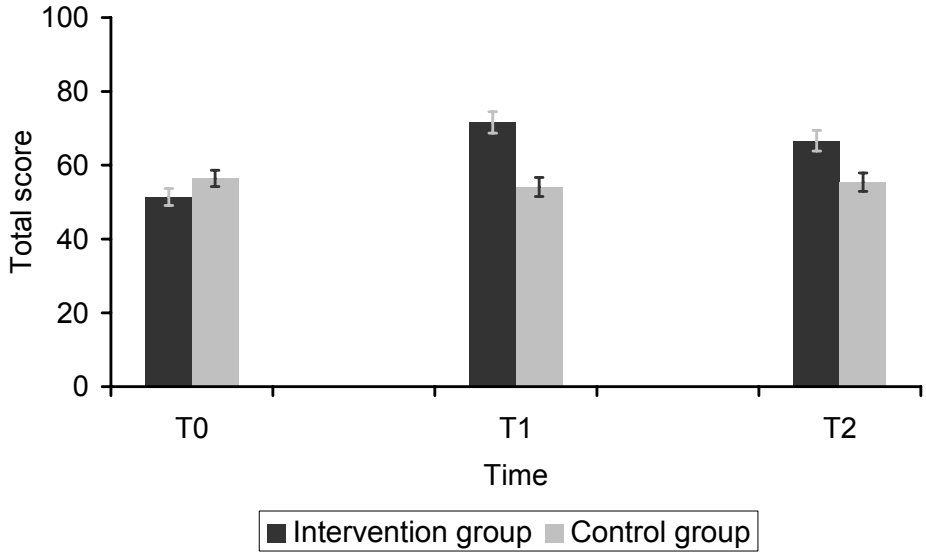
EBM Behaviour

The overall effect of the intervention over time for EBM behaviour comparing the intervention group with the control group was significant p<0.0001. Again, no effect of the groups on the individual scores was found. Figure 3 shows that the intervention group scored significantly more positive on behaviour compared to the control group at both T1 (mean score 71.6 (95% CI 65.6-77.6) versus 54.1 (95% CI 49.2-59.1), p=0.001) and T2 (mean score 66.6 (95% CI 60.8-72.4) versus 55.4 (95% CI 50.6-60.2), p=0.01).

Table 2 depicts the scores of attitude, social context, self-efficacy and intention to behaviour. Overall, highest scores were found for attitude towards EBM (75.9-80.1), while lowest scores

were found for self-efficacy (37.0-56.0). The results show that attitude (p=0.016), social context (p=0.002), self-efficacy (p<0.0001) changed significantly over time in the intervention group compared with the control group. No effect of the intervention over time comparing the intervention group with the control group was found for intention to behaviour (p=0.18). Further post hoc analyses at each time point specified that the intervention group scored significantly higher on self-efficacy than the control group at both T1 (mean score 56.0 (95% CI 49.2-62.7) versus 37.0 (95% CI 31.2-42.7), p<0.0001) and T2 (mean score 55.6 (95% CI 49.0-62.1) versus 37.5 (95% CI 31.9-43.1), p=0.001).

Figure 3. EBM behaviour of participants
T0 (n=47, n=59), T1 (n=30, n=50), and T2 (n=30, n=44)



Subgroup analysis

To investigate potential predictors for high scores over time on knowledge and skills of EBM, or EBM behaviour separate analyses were performed within the intervention group. Gender, experience as an OP (> 12.5 years of experience), and experience in the past with either EBM, research or critical appraisal were not significantly related over time to scores of knowledge and skills of EBM, or EBM behaviour.

Attitude, social context, self-efficacy, and (intention to) EBM behaviour

Within the intervention group we found a significant positive relationship over time of attitude ($p<0.0001$), social context ($p=0.005$), self-efficacy ($p<0.0001$), and intention to EBM behaviour ($p<0.0001$) with EBM behaviour. No effect of the groups on the individual scores was found. We also found a significant relationship over time between high scores on knowledge and skills of EBM and EBM behaviour ($p=0.009$). Attitude and social context had a significant positive relationship over time with intention to EBM behaviour ($p<0.0001$, $p=0.045$).

Table 2. Scores in attitude, social context, self-efficacy and intention to behaviour at T0 (n=47, n=59), T1 (n=30, n=50), and T2 (n=30, n=44)

Variables^	Time point#	Intervention Group		Control Group	
		Mean	(95% CI)	Mean	(95% CI)
Attitude*	T0	75.9	(72.2-79.6)	80.0	(76.7-83.3)
	T1	80.1	(75.8-84.4)	76.0	(72.5-79.7)
	T2	79.5	(75.3-83.7)	77.8	(74.2-81.4)
Social Context*	T0	49.1	(41.3-57.0)	53.4	(46.5-60.4)
	T1	62.8	(54.4-71.2)	51.8	(44.5-59.0)
	T2	60.1	(51.8-68.4)	56.4	(49.3-63.6)
Self-efficacy**	T0	40.5	(34.6-46.4)	40.5	(35.3-45.8)
	T1**	56.0	(49.2-62.7)	37.0	(31.2-42.7)
	T2**	55.6	(49.0-62.2)	37.5	(31.9-43.1)
Intention to behaviour	T0	67.6	(63.9-71.2)	68.8	(65.6-72.1)
	T1	69.4	(64.9-74.0)	69.9	(66.1-73.7)
	T2	65.9	(61.5-70.3)	73.0	(69.4-76.7)

^ Overall tests on trends in time of the intervention comparing the intervention group with the control group

Post hoc tests on T1 and T2 for differences between intervention and control group

*P<0.05, ** P<0.01. High score correspond with favourite outcomes (0-100)

Discussion

The goal of our intervention was to asses whether the combination of an educational intervention on EBM with case-method learning sessions involving regular peer meetings in a non-clinical setting has a positive effect on knowledge and skills of EBM of physicians and changes their professional behaviour towards more evidence-based practice. We have found a significant and lasting increase of both knowledge and skills, and EBM behaviour for the intervention group compared to the control group. Furthermore, we found a greater enhancement of attitude, social context and self-efficacy towards EBM in the intervention group than in the control group.

Strengths and Limitations

This study is unique as it is the first randomised controlled trial in a non-clinical setting to enhance knowledge, skills and EBM behaviour by including an EBM course with regular peer meetings and case-method learning. The point of departure of our intervention was daily practice of occupational health and we succeeded in lowering barriers such as lack of time, no easy access to full text articles and not enough stimulants from their social context to provide optimal evidence-based health care.[9] OPs' attitude, social context and self-efficacy, all had a significant positive relation with EBM behaviour. However, the successful change in behaviour maybe mostly explained by the significant increase of knowledge and skills, and self-efficacy. The influence of management of occupational health services or the social influence of employees and employers was overruled by the positive influence of the small group learning sessions resulting in an improvement of scores for social context. Possibly the local context for occupational health care, in which evidence-based policies are agreed, is similar to clinical settings, also largely dependent of social influences of peers and opinion leaders.[6,16,17]

A correct sample size could not be assessed in advance as literature on EBM behaviour change using statements referring to the ASE-model was not available. No sample size or design effect was therefore calculated but beforehand a maximum of 100 participants was decided for practical reasons because of the intensity of the intervention planned. EBM behaviour was assessed through self-assessment comparable with other studies on this

topic.[18-20] This method is susceptible for bias of giving desirable answers by the participants in the intervention group and the change of behaviour towards the application of EBM in daily practice might therefore be an overestimation. Intention to behaviour, also rather high at the start, did not increase significantly over time and had no relation with self-efficacy. This variable may therefore not be of necessary value in explaining the success of our intervention. Another noticeable result was the increase of intention to change behaviour at T2 for the control group. This result can most likely be explained that soon after the last questionnaire was sent, the control group would receive the theoretic course on EBM. The participants were apparently enthusiastic showing actual intentions to practice EBM.

Comparison with other studies

The original Fresno Test had scores between 95.6 for the novices and 147.5 for the experts.[15] The scores at baseline in our study were relatively low (T0:82.7) showing the lack of knowledge and skills in EBM of these OPs even though researchers in the occupational health field have increasingly embraced the idea of evidence-based occupational health practice.[8,21,22] Following the recommendations by the Society of General Internal Medicine Evidence-Based Medicine Task force, we concentrated in this study on stimulating participants to become users instead of do-ers of EBM.[23] Our participants were all OPs working in daily practice and we aimed in this study that they would start using more (pre-appraised) evidence on a regular basis. This meant that the focus of both the theoretic course at the beginning of the intervention as the instructions for the case-method learning sessions was more on the asking, acquiring and applying of evidence than on the critical appraisal of evidence. As a considerable part of the Fresno Test had questions about critical appraisal of evidence for do-ers of EBM or EBM experts, the scores on average up to 124 points (at T') of our participants was considered encouraging.

Other randomised controlled trials of educational interventions to enhance knowledge and skills, and behaviour in EBM mostly used journal clubs or EBM teaching rounds for general practitioners or hospital physicians, and problem-based small group learning for medical students or postgraduate trainees.[1-3] Our intervention was effective as opposed to the intervention studied by Forsetlund *et al.* probably because we used case-method learning

sessions in which the practice of EBM was integrated in occupational health decisions to fit the local and organizational context and day-to-day routine of OPs.[5,11] The physicians performed actual searches during the four months period by themselves, downloaded or requested full text articles and were actively involved in the learning sessions every two weeks. Unfortunately, there were a considerable number of dropouts during the intervention period especially for the intervention group mainly because of time-constraints. This finding is however in line with other studies reporting on barriers for EBM implementation in practice.[24,25]

Meaning of the study and indications for further research

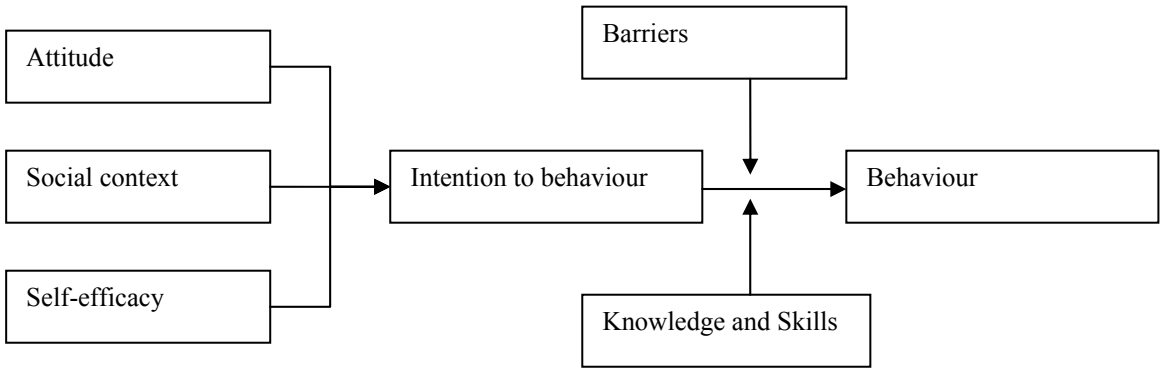
In non-clinical settings, such as occupational health care, the barrier of limited meetings with peers and a non-stimulating environment to practice EBM is more pertinent than in clinical settings. A theoretic course in EBM in combination with case-method learning sessions and continuous positive stimulants for evidence-based practice enhances knowledge, skills and behaviour in EBM in non-clinical settings. The use of the ASE-model for behaviour change as a conceptual approach was helpful in addressing and explaining important influences and barriers. It appears that creating a stimulating environment and addressing most of the existing barriers by regular meetings with peers, proper ICT facilities, aids and tools to find specific evidence about the topics of interest are effective to enhance the practice of EBM. As the wish to practice EBM will grow even further in non-clinical settings more research on the mechanisms for change of professional behaviour and social context in these settings will be necessary.

Conclusion

Our multi-faceted intervention was successful in enhancing knowledge and skills in EBM and changing professional behaviour towards EBM. EBM enhancing interventions which include regular peer meetings and case-method learning could be promising in non-clinical settings.

Appendix 1.

ASE-model



Within the ASE-model, it is assumed that intention and behaviour are primarily determined by three variables: attitudes, social influences and self-efficacy expectations. Moreover, the model postulates that intention predicts behaviour. A person's attitude towards a specific behaviour is a result of the consequences that a person expects from performing the behaviour. Social influences can be described as the processes whereby people directly or indirectly influence the thoughts, feelings, and actions of others. Self-efficacy expectations can be seen as a person's belief in his or her ability to perform the desired behaviour. The ASE-model can be extended to include external factors which also have an influence on the intention to behaviour or behaviour itself, for example barriers (e.g. lack of time or no internet access) and knowledge and skills in EBM.[12,13]

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4.2 Evidence-based advice of occupational physicians; a cluster randomised controlled trial

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Submitted

Abstract

Objective: To enhance the quality of evidence-based advice given by occupational physicians in sickness absence episodes.

Design: A cluster randomised controlled trial

Setting: Sixteen Occupational Health Services and eight private occupational physician practices. *Participants:* 106 occupational physicians (OPs)

Intervention: A course in EBM for one and a half day, followed by a four month period of case method learning sessions in small peer groups once every two weeks. During the sessions, participants discussed their patients concerning sickness absence, in particular regarding the existing evidence for prognosis for return to work and for effectiveness of therapy. Participants had the assignment to perform a literature search in PubMed or other databases at least once every four weeks.

Main outcome measures: Primary outcome measure was the quality of advice based on correct assessment of prognosis for return to work or correct choice of therapy. Secondary outcome measures were the quality of searches performed by the intervention group, use of evidence by all OPs during the intervention period and potential predictors for advice quality.

Results: A significant higher percentage of correct therapy choice was found for the intervention group compared to the control group after two months (88% versus 67%), which decreased after four months (76% versus 62%, not significant). The majority of searches of the participants had a good quality (T1 83% and T2 73%) and resulted in an answer to the question (T1 90% and T2 82%), mostly using original articles via PubMed. Good searching was a significant predictor for a good choice of therapy (p=0.03). Without specific search assignments no significant increase of evidence use was found.

Conclusion: The quality of evidence-based advice by OPs in sickness absence episodes can be improved with a multifaceted intervention. The actual searching for evidence is an essential element.

Trial registration: Clinical Trials ISRCTN06357602 [ClinicalTrials.gov]

Introduction

An employee or employer in need of advice from his Occupational Health Physician (OP) expects optimal occupational health care and a high standard of professional performance.[1] To ensure such a high standard, the use of scientific evidence in the decision making process of OPs has been advocated by researchers in the occupational health field and by international bodies as the ICOH and the WHO.[2-4] However, several studies in the occupational health field showed there is ample room for improvement of the quality of care and they give clear indications that use of available evidence in scientific literature or evidence-based guidelines could be an important vehicle for this.[5-8] While applying evidence in the decision making process of OPs is still not routine in daily practice, the potential impact of the use of evidence in the decision making process of clinical physicians has already been illustrated by several studies showing up to 60% improved decisions if evidence was searched or provided.[9-11] Therefore, we strive to stimulate the implementation of EBM practice in occupational health to further enhance professional performance of OPs and improve occupational health care.

Recently, a promising intervention study showed that teaching EBM skills can actually change physicians' behaviour to use more evidence-based therapies if a multi-component EBM intervention is used and evidence-based resources on the hospital network are provided.[12] In line with this we developed and evaluated a multifaceted intervention existing of a combination of an educational intervention with case-method learning sessions involving recurrent peer meetings. During these meetings, cases of daily occupational health practice were discussed. To further stimulate EBM practice, OPs were obliged to regularly search for evidence related to their case. We expected this multifaceted intervention to overcome barriers for the adoption of new behaviour in the occupational health setting.[13] Besides enhancing competence in EBM, we aimed at improving performance in EBM demonstrated by the quality of advice in sickness absence episodes.[14] Within the Netherlands a substantial part of daily routine in occupational health practice is involvement in advising patients and their supervisors in return to work. To do this OPs need to have adequate knowledge of durations of sickness absence in relation to work circumstances and they need to advice employees or their supervisors in such a way that optimal rehabilitation or therapy is realized. In this study good quality advice was based on either correct assessment of prognosis for

return to work or correct choice of therapy of the OP. Good choice of therapy was expressed as the optimal choice of all possible actions or advices the OP can give to the employee or his supervisor to optimize healthy return to work.

The purpose of this study is to answer the following questions:
1) Does the intervention improve the quality of the OPs' assessment of prognosis for return to work or choice of therapy by the OP for sick-listed employees compared to the control group?
2) What is the quality of searches for evidence performed by the OPs and can answers be found?
3) Does the intervention enhance also the use of evidence also without specific search assignments?
4) Are OP characteristics, their scores in knowledge and skills in EBM, or search qualities predictors for better advice quality?

Material and Methods

Participants

We recruited registered OPs within occupational health services (OHS) or private practices in the Netherlands via written invitations and information sessions about the study. OPs from the same OHS or geographically closely situated services and practices were clustered in peer groups of 6-10 members. An independent research assistant provided a computer generated blocked randomisation sequence with randomisation on group level. All OPs who agreed to participate in the study and completed the baseline questionnaire entered the trial according to the treatment group their group was assigned to. The participants were not blinded to treatment assignment. However, the researchers who scored the study outcomes were blinded to treatment allocation at all times.

Intervention

First, the OPs in the intervention group were trained in EBM for one day and a half during two weeks. In this course, participants learned basic steps of EBM, e.g. OPs were stimulated to start with a search for relevant practice guidelines and, if necessary, to continue searching for an answer in PubMed. In addition, during the follow up period the OPs received several

stimuli on the application of EBM e.g. newsletters, articles on EBM and several search strategies for PubMed. Furthermore, they were facilitated by access to full text articles and they could contact a helpdesk for questions on searching the literature. Second, obligatory case-method learning sessions took place with 6 to10 peers every two weeks during a period of four months. During these sessions, own cases of sick-listed employees from daily practice were discussed in a pre-structured way with an emphasis on available evidence for all occupational health aspects, following the instructions of Sackett *et al*. for presenting a patient at follow up rounds.[15] Third, at least once in every four weeks the OPs were obliged to perform a literature search for evidence with regard to one of their own cases.

The control group also had access to full text articles during the intervention period but, in contrast to the intervention group, participants were not actively stimulated to make use of this facility. After the intervention period the control group also received the theoretic EBM course of one and a half day.

Measurements

The baseline questions included demographics of participants (age, sex), MD and OP experience, information of previous training in EBM, and experience with research or critical appraisal. The participants of the intervention group were asked to send in every two weeks the case-files used at the case-method learning sessions. The participants of the control group were also asked to send in two case-files at the beginning, after two months and after four months. All case-files were documented on a pre-structured form with a clear description of the case, the prognosis about return to work and the therapy advised by the OP to facilitate the return to work process. One researcher (FS) selected at random three cases per OP which were sent at the start of the intervention period (T0), after two months (T1) and after four months (T2) from all cases that were sent by both groups. Case-files had to be filled in completely to be considered usable. In addition, participants of the intervention group were asked to send us the literature searches they performed. These searches were documented on a pre-structured form with a clear description of the search question, the used search strategy, the critical appraisal of the literature and the answer to the search question (see Appendix 1).

Based on the diagnosis or problem orientation of the selected case-files, a panel of three authors with expertise in EBM and occupational health (FS, CH, and PS) searched for evidence on the prognosis of return to work and preferred choice of therapy. The evidence retrieved was divided in four level grades of which grade 1 was considered highest (see Appendix 2). From all case-files background details from the sick-listed employee were noted: age, sex, job, period of sick-leave and diagnosis. Second, the level of evidence referred to by the OP on return to work prognosis or therapy was compared with the level of evidence retrieved by the panel of EBM-experts. Third, all case-forms were blindly appraised by all three authors for the correct assessment of prognosis and choice of therapy advised by the OP. The final evaluation of correctness was decided in consensus. Fourth, all searches at T1 and T2 of the intervention group were scored for the type of question searched, the quality of search (Appendix 1), and possible adjustment to the original prognosis or therapy. Finally, the after-search prognosis or therapy advice was again appraised by all three authors for its correctness.

Statistical analysis

The data of all participants who entered the trial were analysed. Differences in baseline characteristics were tested with t-tests for continuous variables and Chi-tests for categorical variables. First, to analyse if the intervention had an effect over time for the correct assessment of prognosis and for the correct choice of therapy, a mixed model analysis based on repeated measurements with adjustments for the cluster randomisation was performed comparing the intervention group with the control group. We analysed differences between the two groups on both the original and after search correct assessment of prognosis and correct choice of therapy of the same patient case to measure the additional effect of the obligatory search. If a statistically significant overall effect was found, post hoc analyses were performed for each time-point. We described the type and quality of the searches performed. Second, we analysed the level of evidence referred to by all participants on their case-files using the mixed model analysis for repeated measurements to compare the two groups. Third, separate analyses were performed within the intervention group to investigate potential predictors for the correct assessment of prognosis for return to work and for the correct choice of therapy. We performed a subgroup analysis on the effect of gender, experience as an OP

(more or less than the median of 12,5 years), and experience in the past with EBM, research or critical appraisal. We used the scores of the intervention group from our previous study on knowledge and skills in EBM after the EBM course to analyse differences in quality of search and quality of advice over time within the intervention group.[14] Statistical analyses were performed using SAS 9.1.

Results

Sixteen OHS and 8 private practices supplied eligible OPs. Overall, 131 OPs were recruited to the trial between May 2005 and September 2005. However, 25 OPs from both groups already withdrew before we started the actual intervention mainly due to the time-consuming elements of the intervention. After two months (T1) we selected 46 case-files from the intervention group of which 41 were usable, and 53 from the control group of which 49 were usable. After four months (T2) we selected 46 case-files from the intervention group of which 45 were usable and 53 from the control group of which all were usable (see Flow chart).

Table 1 shows the personal characteristics of the 106 participating OPs at baseline. The participants in the intervention group were older (48 versus 45 years) and had more clinical experience (20 versus 17 years) than those in the control group. No differences in previous experience with EBM or other baseline measurements were found. Table 2 shows the characteristics of sick-listed employees described in the selected case-files of all OPs. The employees selected for the cases by the intervention group had a longer sickness leave duration at the moment of presentation (21 versus 15 weeks, $p<0.05$) and had more variety in disorders compared to the employees selected by the control group.

Flow of participants through trial

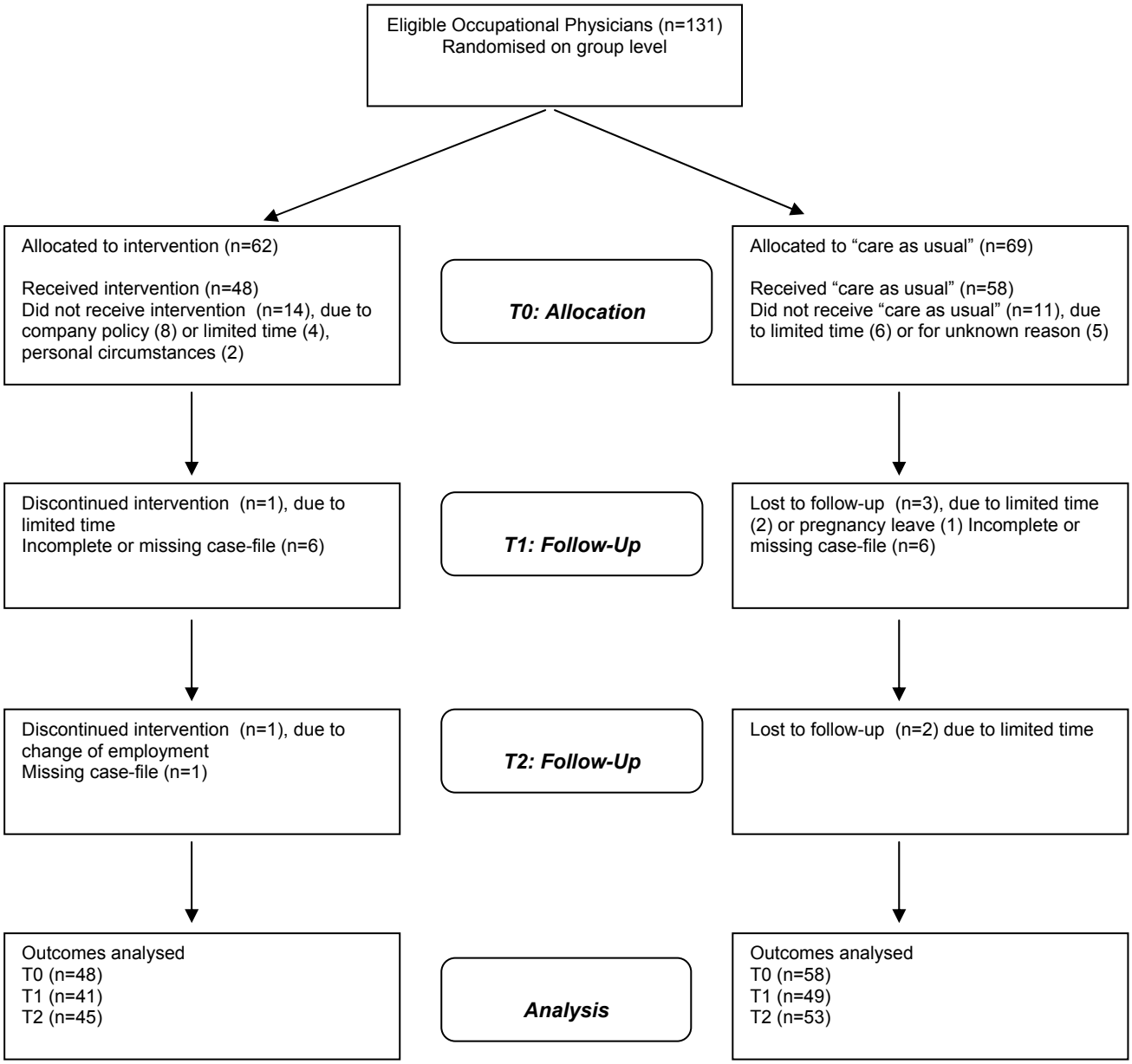

Table 1. Baseline characteristics of OPs

Characteristics of OPs	Intervention group (n= 48)	Control group (n=58)
Mean age in years (SD)*	48 (±6)	45 (±7)
N of Women (%)	23 (48)	22 (38)
Doctor experience in years (SD)*	20 (±6)	17 (±7)
OP experience in years (SD)	14 (±6)	13 (±7)
Previous education in EBM? N Yes (%)	12 (29)	10 (19)
Previous education in critical appraisal? N Yes (%)	12 (28)	14 (26)
Any research experience? N Yes (%)	22 (51)	23 (44)

*P<0.05 T-test

Process variables

All OPs randomised to the intervention group received the EBM course at the beginning of the intervention. On average, each OP attended 7.2 case-method peer group sessions and turned in an equivalent number of cases. Consequently, on average 3.3 literature searches (half of the number of cases) were performed by every OP. Ninety one full text articles were requested by 27 OPs of the intervention group. Five full text articles were requested by 3 OPs of the control group.

Quality of advice before and after searching for evidence

Table 3 shows the evaluation of the assessment of prognosis for return to work and proposed therapy based on the case-files before the search for evidence for both groups and after the search for the intervention group. Before the search assignment, we found no significant differences over time between the two groups with respect to a correct assessment of prognosis or choice of therapy based on the diagnosis of the case-file. After the search assignment, we found a significant difference over time between the two groups for correct therapy choice (p=0.01), but not for correct prognosis assessment. Post hoc analyses showed an enhancement of 17% at T1 and 18% at T2 of good therapy advice for the intervention group. This resulted in a significant difference of good therapy advice with the control group at T1 (88% versus 67%, p=0.03), and no significant difference at T2 (76% versus 62%). Taken all adjustments on the cases by the intervention group together (prognosis assessment

and therapy advice) we found an improvement in 10 out of 41 cases at T1 (24%) and in 9 out of 45 cases at T2 (20%).

Table 2. Characteristics of the combined selected case-files of both groups at T0, T1 and T2

Characteristics of the employees in the case-files	Intervention group (n= 134)	Control group (n= 160)
Mean age employee years (SD)	42 (±10)	43 (±10)
Sex employee (%male)	41	47
Type of disorder*:		
• Musculoskeletal (%)	32	30
• Psychological (%)	16	33
• Cardiovascular (%)	5	11
• Neurological (%)	10	7
• Respiratory (%)	4	2
• Digestive (%)	6	2
• Urological & Genital (%)	6	4
• Non-specific (%)	11	4
• Other (%)	9	7
Occupational determinants for sickness absence		
• Physical (%)	38	30
• Psychological (%)	20	30
• Both physical and psychological (%)	19	16
Mean duration of sickness absence in weeks at the moment of presentation of the case (SD)**	21 (±25)	15 (±19)

* P<0.05 Chi-square **P<0.05 T-test

Availability and use of evidence

Before the search assignments we found no significant differences over time between control and intervention group for the level of evidence on which OPs based their assessment of prognosis or choice of therapy. The majority of OPs in both groups did not use any evidence or evidence-based sources for their cases.

The expert panel found a high level of evidence for the majority of selected case-files (see Appendix 2). For prognosis on return to work, grade 1 evidence was found for 57% of the case-files based on the diagnosis mentioned by the OP while grade 2 evidence was found for

19%, grade 3 for 11% and no evidence for 13% of the case-files. For therapy the expert panel found grade 1 evidence for 53 % of the case-files, grade 2 for 14%, grade 3 for 12% and no evidence for 21%. The provision of high grade 1 evidence was significantly higher for the cases handed in by the control group than for the ones handed in by the intervention group (64% versus 37% $p<0.0001$).

Table 3. Evaluation of assessment of prognosis and choice of therapy before searching for evidence for the intervention and control group, and after searching for the same case for the intervention group at T0 (n=48, n=58), T1 (n=41, n=49) and T2 (n=45, n=53)

	Intervention group		Control group
Correct assessment of prognosis	Before searching % (n)	After searching % (n)	% (n)
T0	65 (31)	n.a.	59 (34)
T1	65 (26)	73 (29)	53 (26)
T2	71 (30)	74 (31)	67 (35)
Correct choice of therapy			
T0	58 (28)	n.a.	74 (42)
T1	71 (30)	88 (37)*	67 (33)
T2	58 (26)	76 (34)	62 (33)

* p=0.03 ; n.a.: not applicable

Searching for evidence

Table 4 shows the literature searches performed by the intervention group. Overall, 86 searches were performed mostly on questions about therapy or prognosis for return to work at both time points. However, some OPs also searched for etiology questions (T1 n=6, T2 n=4). The quality of the searches was considered good by the experts for the greater part of cases: 83% at T1 and 73% at T2. For the majority of questions an answer was found (T1 90% and T2 80%) and in that case, original articles of PubMed were used most often. Besides for several websites, the guidelines and textbook used by the OPs were similar to the sources the experts had used. The Cochrane database was mentioned only twice as a source by the OPs

while the experts used it seven times. As was to be expected (Table 5), we found a significant increase in level of evidence comparing before and after the search assignment using the experts as 'gold standard'.

Table 4. Type and quality of searches performed by the intervention group at T1 (n=41) and T2 (n=45)

	T1 % (n)	T2 % (n)
Type of question:		
- Therapy	37 (15)	53 (24)
- Prognosis	49 (20)	38 (17)
- Etiology	15 (6)	9 (4)
Quality of search:		
- Good	83 (34)	73 (33)
- Moderate	12 (5)	18 (8)
- Not good	5 (2)	9 (4)
Sources used to find an useful answer:		
- Practice Guidelines (CBO, NHG, NVAB)[j]	12 (5)	11 (5)
- Cochrane Database	0 (0)	4 (2)
- PubMed	61 (25)	53 (24)
- Dutch Websites	5 (2)	2 (1)
- Textbooks	2 (1)	7 (3)
- Other sources (not used by the experts)	10 (4)	2 (1)
- No evidence found	10 (4)	20 (9)

Subgroup analysis

Gender, experience as OP, and experience in the past with EBM, research or critical appraisal were not significantly related over time to correct prognosis or therapy within the intervention group. Over time, we found that good searching was a positive predictor for a correct choice of therapy (p=0.03). We did not find a relationship over time between good searching and correct prognosis. We found no relationship between high scores on knowledge and skills, and good quality of searching for evidence for the intervention group. Neither did we find a relationship between high scores on knowledge and skills and correct prognosis or therapy before or after the search assignment.

[j] Guidelines authorized by national professional associations of respectively medical specialists, general practitioners and occupational physicians.

Table 5. Level of evidence recorded by OPs in comparison with the level by EBM experts before and after the search assignment for searches about prognosis and therapy at T1 (n=35) and T2 (n=41)

	T1*		T2*	
	Before search % (n)	After search % (n)	Before search % (n)	After search % (n)
Level of OPs equal with experts	31 (11)	74 (26)	37 (15)	73 (30)
Level of OP< level of experts	3 (1)	26 (9)	2 (1)	15 (6)
No evidence mentioned by OP	66 (23)	0	61 (25)	12 (5)

* P<0.05 Chi-square

Discussion

The multifaceted intervention tested in this trial produced a significant difference of correct therapy choice for the intervention group compared to the control group after two months (88% versus 67%), which decreased after four months (76% versus 62%, not significant). No significant effect was found for the assessment of prognosis for return to work. The level of evidence improved substantially comparing before and after searching in the intervention group. Good quality searching was a positive predictor for a good therapy choice (p= 0.03). Without the specific search assignment we found neither significant increase of evidence use by OPs nor an enhancement of the quality of advice on the case-file.

Strength and limitations

This study is unique in the sense that real cases from daily practice are used to study performance in EBM and its potential effect in enhancing quality. The generalisability is therefore high although its internal validity may be weakened due to differences in case-files handled in by the two groups.[16] The cases of the intervention group are probably more complex as there is a broader variety in disorders and the sickness absence episodes are significantly longer. Most likely, the intervention group preferred to discuss those cases which raised difficulties or questions in practice during the case-method learning sessions. In addition, the control group handed in more case-files for which evidence-based practice guidelines (evidence grade 1) existed as opposed to the intervention group. Within the

Netherlands, evidence-based occupational health guidelines are available for most prevalent disorders. Possibly, the case-files from the control group are a selection of best practice.
Overall, our estimation of availability of evidence for these case-files could be an overestimation as all case-files or patients taken together were the denominator in the calculation instead of separate prognosis assessments or therapy choices analogous with other studies.[17-20]

The evaluation of prognosis and therapy as well as the evaluation of the search quality was done using an expert-panel. The expert-panel used the available evidence on different topics and decided in consensus about the assessment of prognosis and choice of therapy to overcome the problem of inter-individual variability.[21] Moreover, the evaluation by an expert-panel of available evidence and search quality is in line with previous experiences on evaluating searches for evidence following the steps of EBM and with other similar studies on this topic.[17-20,22] The searches performed by the intervention group concentrated on finding original articles in PubMed. This result is probably caused by the information given during the theoretic EBM course with a major focus on PubMed, even though the instruction on the search file suggested to start with a search for relevant guidelines. This is in line with the latest insight that practitioners should be stimulated to become more *users* not *do-ers* of EBM.[23] It is possible that these OPs were not sufficiently made aware of all evidence-based information sources as is shown by the limited use of the Cochrane database as opposed to its use by the experts. Although searches for prognosis and therapy were equally divided, we especially found an enhancement of the correct choice of therapy predicted by good searching. This finding can probably be explained that some OPs who had searched for prognosis- or etiology questions still changed their choice of therapy instead of e.g. their originally assessed prognosis.

Comparison with other studies

This study is the first trial in occupational health to test the effect of EBM implementation in improving professional quality in daily practice. Within other medical disciplines randomised controlled trials have been performed with good results in changing professional behaviour into more evidence-based practice. However, most of these randomised controlled trials tested EBM behaviour via self-assessment, while only a few have studied the effect of EBM practice

on a specific outcome variable.[24,25] Furthermore, several cross-sectional studies have been performed within various medical disciplines on the extent on which daily practice was based on sound evidence. These studies searched evidence for the diagnosis-therapy combination within hospital wards or practices of general physicians during a limited period of time.[17-20] In our study the experts not only searched for best evidence on diagnosis-prognosis on return to work and diagnosis-therapy combinations, but also compared the results with the evidence used by the OP. In addition, we evaluated progress after specific search assignments. One of the main findings of our intervention, the adaptation of the original therapy choice due to retrieved evidence, is in line with findings in clinical settings. For example in oncology, studies have shown that if evidence was provided when needed the decisions could have been different 30-60% of times.[9]

In our previous study on competence of EBM we concluded that case-method learning sessions with peers in combination with a theoretic course in EBM and continuous positive stimulants to practice EBM enhances knowledge, skills and behaviour in EBM for non-clinical settings.[14] However, the results in this study have shown that the predictive value of competence in EBM is low with regards to actual performance in EBM as has been shown by others.[26] An improvement of quality of professional advice needs concrete searches for evidence as only then professional quality in daily practice will be enhanced.

Policy implications and indications for further research

To ensure high professional quality actual EBM practice is essential, for which frequent searching and applying the findings is necessary. This study has shown that a substantial amount of evidence is available for OPs to use in their daily practice when advising on sickness absence. A good search resulted for the majority of cases in an answer to the question that could enhance the quality of advice of the professional. To what extent the case-method learning sessions with peers have contributed to stimulate EBM practice needs further research. OPs and management of OHS should invest in learning EBM practice and feel obliged to do real searches of good quality. For this repeated sessions of PubMed tutorials can be helpful, and more information on available evidence-based sources and support by a good knowledge infrastructure is essential.[27]

Conclusion

Professional performance of OPs can be improved with a multifaceted intervention combining an EBM-course with repeated case-method learning sessions with peers and regular search assignments. The actual search for evidence proved to be an essential element in enhancing the quality of advice by OPs in sickness absence episodes.

Acknowledgement

We would like to thank Hendriek Boshuizen for her support in the statistical data-analysis.

Appendix 1.

Search assignment

The pre-structured form used for the search assignments was adapted from an earlier version of a search log developed by the Coronel Institute and used in a previous study on search evaluations.[25] The physician had to answer eight questions following the steps necessary when applying EBM: 1) formulating an answerable question, 2) characterizing the question (prognosis, therapy, diagnosis, etiology), 3) making a PICO partition of the question: Patient, Intervention, Comparison and Outcome, 4) considering possible national and international practice guidelines to answer the question, 5) application of adequate search terms, 6) actually searching for relevant original articles or systematic reviews from electronic medical databases, 7) appraising the literature on its methodological quality and its appropriateness for the occupational health situation, 8) and using this information to answer the original question. For the purpose of our study, we added two questions: 1) whether the information found by the search had changed the original assessment of prognosis or choice of therapy advised by the OP and 2) if yes, what had been changed in the advice.

Evaluating the search

Based on the selected cases the experts (FS, CH and PS) searched for evidence as described in Appendix 2. The search assignments based on these cases were evaluated by the same expert-team. Every question on the log had to be answered and the evidence found with the search had to be in line with the available evidence according to the experts. The optional adjustment to the original assessment of prognosis and /or choice of therapy had to be an improvement according to the experts. An overall evaluation for the whole search assignment was then given by the expert-panel: 1) good, if all questions were answered correctly, 2) moderate, if the search was considered good but the final conclusion was not in line with the retrieved evidence, and 3) not good, if neither the questions were answered correct nor the final conclusion was considered an enhancement of the original advice.

Appendix 2.

Evidence was searched limited to English or Dutch literature of the last 10 years. Searches were done from January 2006 until April 2006. If adequate evidence was found the search was stopped. The following sources were searched:

1. Practice Guidelines by the Dutch Institute for Healthcare Improvement (CBO), the Netherlands Society of Occupational Medicine (NVAB) and the Dutch Association for General Practioners (NHG).
2. The Cochrane Database
3. PubMed; we used a MeSH-term for the diagnosis and combined this term with the Boolean operator AND with "Work"[MeSH] OR (work capacity) OR "Work Capacity Evaluation"[MeSH] OR (vocational rehabilitation) OR "Occupational Health" [MeSH] OR "Occupational Medicine" [MeSH] OR "Sick Leave"[MeSH] OR (absenteeism) OR (return to work) OR (retirement) OR (employment status) OR (work status) OR "Disability Evaluation"[MeSH] OR "Occupations"[MeSH] OR "Employment"[MeSH].
4. Two Dutch websites on occupational health issues: www.stecr.nl, www.Laboretum.nl
5. One Dutch textbook on occupational health: '*Handboek arbeid en belastbaarheid'* (Handbook on work and working capacities).

The evidence retrieved was then divided in four categories; in correspondence with the categorization used by the Dutch Institute for Healthcare Improvement (CBO) for guideline development:

- Evidence Grade 1, Strong level of scientific evidence
- Evidence Grade 2, Moderate level of scientific evidence
- Evidence Grade 3, Limited level of scientific evidence
- No Evidence, Insufficient scientific evidence

With respect to the level of evidence of a therapeutic advice, Evidence Grade 1 requires a practice guideline or at least two randomised controlled trials (RCT) of high quality or a systematic review including several RCTs. Evidence Grade 2 requires at least one randomised controlled study. Evidence Grade 3 requires information from lesser quality evidence but still

convincing, e.g. case-control design studies or textbook information. Regarding the levels of evidence of studies on prognosis for return to work we searched in particular for high quality cohort-studies.

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General Discussion

5. General discussion

The main objective of this thesis was to develop opportunities for practising EBM in occupational health care and to study its effectiveness. We believed that the quality of occupational health practice could be improved by a more systematic use of the information from scientific research in the daily practice of occupational health physicians (OPs) and we wanted to test if application of EBM was beneficial for their professional quality. In this chapter, the main findings of this thesis will be discussed. The two questions posed in the introduction will be answered: what is the added value of EBM for the quality of occupational health care and what is the added value for the quality of the occupational health professional. Thereafter, recommendations for future research are suggested and a final conclusion is drawn.

Main findings

Information needs and available evidence

In the development of an individual OP to apply the principles of EBM in daily practice, different stages can be distinguished. First, the professional should be aware of the importance and added value of using up-to-date research information in the decision-making process on occupational health matters. Secondly, awareness of one's own concrete information needs in daily practice is necessary. Next, knowledge about available evidence or evidence-based sources is required.

From the questionnaire study in chapter 2.1 we learned that most OPs were aware of the importance and added value of using research information as their attitude towards EBM was fairly positive. However, their awareness did not result in actual EBM practice. The OPs had questions concerning medical, legal and rehabilitation topics but when pursuing answers to their questions, the most common way was to consult colleagues while scientific databases were rarely consulted. From the observation study described in chapter 2.2 it was learned that OPs were aware of only a small portion of their actual information needs. Most medical or occupational health-related questions related to individual consultations, especially concerning long-term sickness absence issues, were concerned with prognosis, susceptibility and diagnosis. Forty percent of all questions were considered suitable for a literature search in

scientific databases. Again, searching for an answer using international medical databases was not a widespread method. 'No time available' and 'no necessity to look for an answer' were important reasons not to search but to ask a colleague or an expert for an answer. However, this latter strategy might give fallacious results as the comparative study of chapter 2.3 showed. The quality of advice of the consulted colleague or expert was in general found to be higher when they could provide the source of evidence on which their advice was based on.
Moreover, OPs perceived a lack of scientific evidence in their field, which was an obstacle that should be addressed (see chapter 2.1). We learned from the questionnaire study in chapter 2.1 that basic skills to use the Internet, especially of older OPs, need much improvement. As existing information on the Internet is growing enormously, it is crucial that OPs need to be well informed about its availability and educated how to search effectively and efficiently.

The search for evidence

Within occupational health care, adequate knowledge about occupational diseases is essential for the occupational practitioners when advising employees or employers.[1,2] Therefore, the topic in chapter 3.1 was facilitating the search for evidence on aetiology of occupational diseases in Medline. We used four occupational health case-vignettes to search for the best available evidence. Next, we studied what combination of search terms yielded the best result in retrieving the evidence. Finally, a flow chart was developed to select the best strategy for different conditions. In chapter 3.2 we tested the effectiveness and efficiency of the flow chart in a controlled trial with OPs in training after an introduction course in EBM (see chapter 3.2). All participants were asked to answer to an occupational disease case-vignette following the procedures of EBM. The intervention group received the flow chart to select a search strategy while the control group did not. With help from a log in which all the steps of EBM practice were recorded, we evaluated the quality of the searching and the evidence found. The flow chart had a positive result on the effectiveness of searching literature, illustrated by better answers to the main question of the case-vignette. The OPs in the intervention group were more satisfied with the applied search strategy than the OPs in the control group. No effect was found in the time spent to find an answer in the literature (chapter 3.2). An interesting result was the positive intention of both groups to practise EBM in the future.

The application of evidence

The last step of practising EBM is applying the evidence in daily practice in the decision-making process. Within occupational health, especially in the Netherlands, an important task of the physician is to advice the employee and employer about fitness for work after sick leave. For this the OP needs to draw a medical diagnosis and to assess possible restrictions for work. Furthermore, the OP will be interested in the prognosis for return-to-work and in effective therapies or interventions he can suggest to improve the rehabilitation and actual return-to-work. In chapters 4.1 and 4.2 the effect of a multifaceted EBM intervention within daily occupational health practice was studied. The intervention comprised a theoretic course in EBM, regular case-method learning sessions with peers and obligatory search assignments. We aimed at improving both competence and performance of OPs and studied the effectiveness of the intervention using a cluster randomised controlled design. As reported in chapter 4.1, the intervention was successful in increasing knowledge, improving skills in EBM, and changing professional behaviour towards EBM. However, this enhancement of EBM competence did not prove to be a reliable predictor for the quality of actual EBM performance or practice. Chapter 4.2 described the results of the trial concerning actual use of evidence in daily practice of the same participants. Cases of sick-listed employees were evaluated for the quality of the occupational health advice given to them by the OPs and the references to evidence-based sources the OPs provided. Without the obligatory search assignments no effect of the intervention could be found. We concluded that discussing cases with peers creates a stimulating environment to evaluate own occupational health performance and may enhance quality by exchanging tacit i.e. implicit knowledge such as on how to cope with difficult situations in practice. For converting to actual EBM practice and looking for explicit knowledge, only a stimulating environment was not enough. In our RCT, the fact that OPs were obliged to search for and apply the evidence regarding his case made the difference as subsequently the quality of advice improved substantially. This effect decreased however after four months, possibly indicating that the initial enthusiasm would need repeated stimulance or courses in either PubMed or EBM to continuously enhance quality.

Methodological considerations

The methodological strengths and limitations of the studies included in this thesis have been discussed in the previous chapters. However, a selection of methodological issues in relation to the study design, selection of the study populations and choice of outcome measures warrant further exploration.

Study design

The main study of this thesis was a cluster-randomised controlled trial (RCT) (chapters 4.1 and 4.2). A RCT is in general the strongest and most transparent research design for establishing a causal effect of an intervention because it is less susceptible to selection bias and confounding than other designs.[3] In our study we had to randomise at group level as randomisation at OP level was not possible. The case-method learning sessions with peers were organised every two weeks and for practical reasons it was therefore best to organise these meetings within one occupational health service (OHS) or at least in geographically closely related OP practices. Furthermore, the risk of contamination if OPs from one OHS location would be assigned to different treatments groups was considered real. Because of this multilevel structure, outcome at OP level could be influenced by characteristics at the group level and could therefore be correlated. For example, if a certain group of OPs would have been more enthusiastic for EBM practice, this could have influenced the competence or performance of OPs at the individual level. Ignoring this dependency of the observations on OP level may lead to an overestimation or underestimation of the effect and of significance when data are analysed at OP level. Therefore, we performed a multi-level analysis of the data to account for the 'hierarchical' structure of the data. The analysis in both studies (chapters 4.1 and 4.2) revealed no significant effect from the groups on the outcome measures. Apparently, the influences from various OHS or settings did not differ much in influencing their OPs to learn the practice of EBM.

Selection of the study population

The participants of the observation study were a selected sample of 20 motivated and experienced OPs (chapter 2.2). If a random sample of OPs would have been selected, the result of the study could have generated less appropriate questions for EBM practice. In this

study we focused on what could be the added value of EBM for occupational health questions, deliberately departing from a relatively good professional practice where we expected most interest in gaps in occupational health knowledge. We might have underestimated the positive attitude and interest towards EBM for all OPs.
The participants of the RCT (chapters 4.1 and 4.2) all volunteered in the study. It is possible that these OPs were already more positive towards EBM practice. The measured attitude towards EBM in chapter 4.1 tends to confirm this. Due to the character of the study, using a random sample of the Dutch population of OPs was however thought to be not feasible. The design of the study required much time and effort of the participant (e.g. attending the case-method learning sessions and doing search exercises) and needed therefore highly motivated OPs. This selection leads to carefulness in generalisation of the results toward less motivated OPs.

Outcome measures
Currently, occupational health care in the Netherlands mainly focuses on sickness absence management. In other countries, the focus can be more on the prevention of occupational or work-related diseases. In the UK a recent Delphi study with OPs showed that competence of occupational hazards was considered of more importance than competence in disability and fitness for work.[1] The results of the studies performed in this thesis may therefore be limited in generalisability to other topics most relevant in other countries. For example, the information needs and demands as described in the observation study in chapter 2.2 showed a high amount of questions on prognosis and susceptibility illustrating the interest of these OPs on return to work issues. Furthermore, the RCT described in chapter 4.2 used advice in sickness absence episodes as outcome measure to evaluate enhancement in quality. Within the Dutch situation this measure is clearly relevant but to what extent the findings can be extrapolated towards advices on prevention must be met with caution.

In chapter 3.2 and chapter 4.2 an expert panel of occupational health physicians with much expertise in EBM evaluated the quality of the searches performed and the correctness of advices given. The evaluation has been done blind, transparent and following a strict protocol. The use of a panel was chosen, as no reliable measures to assess these variables exist without

interference of expert judgements. A drawback of this measure is the sometimes weak reliability. However, in the controlled study of chapter 3.2 the inter-rater reliability of the two experts was calculated using Cohen's Kappa which had a mean of 0.75. This result demonstrates that the reliability was quite high. For the evaluation of the quality of advices in relation to sickness absence (chapter 4.2) we discussed every single case-file with the related retrieved evidence and finally decided in consensus. Our method is in line with the conclusions of a consensus exercise performed in Canada that stated that aspects of both expert and good research evidence can successfully be combined.[4] Especially for the areas of clinical practice in which evidence about risks and benefits is incomplete or conflicting, expert panels can be useful to decide about appropriate care.[5]

In chapter 4.2 the expert panel searched for evidence in relation to the disorder of the selected case-file from the OPs. Per diagnosis two searches were performed: evidence for best occupational health therapy and evidence for the expected prognosis for return to work. Searches were performed in national and international guidelines, systematic reviews, original articles, websites and textbooks, in this order. We found a high level of evidence for a substantial number of case-files, especially those selected from the control group. This result may be biased towards an exceptional positive image of available evidence for occupational health issues because of two reasons. First, the case-file was considered the denominator in the calculation instead of e.g. separate disorders. As evidence-based practice guidelines (level 1 evidence) exist for the eight most prevalent disorders, and many searches are related to those disorders, the amount of available evidence for all possible disorders within occupational health may be overestimated. The same probably applies for other medical disciplines: a relatively small amount of disorders fills the majority of daily encounters between patient and physician. For these disorders most research is performed and most guidelines have been developed.

Second, all relevant information was considered useful by the experts, not only the information from occupational health sources. For example, if a guideline from general practice could give an answer to the occupational health question this was considered relevant and was appointed as level 1 evidence. However, the results from studies with general health care populations may not always be directly applicable for occupational healthcare

populations. In fact, within occupational health care the generalisability of research can also be limited because of its sensibility to context. To illustrate, a study on employment status after cancer survival at child age gave different results for the USA opposed to Europe.[6] This vulnerable generalisability of occupational health studies actually needs further study.

Comparison with the literature

Ely *et al*. studied the information needs of family doctors using a similar observational design as described in chapter 2.2, in which investigators visited doctors for two half days and collected their questions afterwards in an interview.[7] However, Ely *et al*. used a random sample of 103 physicians and directly recorded all questions during consultation hours instead of using an interview afterwards. They found that the three most common types of questions were about diagnosis, cause and treatment. A comparable finding to the study result of chapter 2.1 and 2.2 was that most of the physicians in their study did not (immediately) pursue an answer to their question. In a follow-up study they found that an important reason for this was that physicians thought there would not be any usable information to answer their questions.[8] This result is consistent with a study by Gorman *et al*. who found that physicians only pursued an answer when the problem was perceived as urgent and when a definitive answer was thought to exist.[9] In our study we found that OPs did not frequently look for answers to their questions for similar reasons, mainly because they felt there was no need.

Other trials measuring the effect of EBM implementation within clinical practice differed from our RCT described in chapter 4.1 and 4.2 as most trials focused on only one aspect of EBM implementation. Many studies analysed the effect on treatment or control of one specific disease, others focused on effects of teaching on residents or medical students.[10-17] For example, Cabell *et al*. performed a RCT with medical residents in internal medicine with a focus on searching and finding of evidence.[10] They found a positive effect on these two steps of EBM practice. Langham *et al*. concentrated on the effect of practice-based training in EBM or information management on secondary prevention of cardiovascular disease in primary care.[15] They found an improvement on adequate recording of three risk factors for the combination of the training in EBM with the course on information management. McGinn *et al*. assessed the utility and practicality of an evidence-based format in internal medicine

attending rounds with residents and medical students.[16] They concluded that the formal EBM approach positively had changed the medical management of the patient during the admission and the attitudes of residents and students towards future patients.

In contrast with these studies, our RCT study focused on all aspects of the practice of EBM, for various occupational health topics and targeting occupational health practitioners instead of residents or students (chapter 4.1 and 4.2). Nevertheless, we found similar positive results with respect to searching, finding and appraisal of evidence, and also for the care of patients as was illustrated by the better choice of therapy in the intervention group (chapter 4.2). A study that resembled to some extent our method and intentions was a study performed by Ozuah *et al*. in 2002.[18] They used the ambulatory morning reports to enhance evidence-based practice among paediatric house staff. Selected cases from the previous week were discussed during sessions every two weeks, using a case-method approach comparable with the sessions described in our RCT. The amount of high quality EBM questions formulated was tested and a significant enhancement after one year was found. The authors concluded that this format provided a forum for case-based learning and can be successfully used to enhance the quality of EBM among residents. In our RCT we also concluded that the case-method sessions can create a stimulating environment for the evaluation of own occupational health performance but to convert to actual EBM practice, regular searches for evidence are essential.

Similar studies to evaluate the scientific evidence-base of therapies given by physicians in various medical disciplines used comparable methods.[19-23] In these studies evidence was hand searched by researchers for the intervention given in relation to the primary diagnosis. These studies categorized the level of evidence in (i) intervention based on evidence from randomised controlled trial; (ii) intervention based on convincing non-experimental evidence; (iii) intervention without substantial evidence, not meeting criterion (i) or (ii). For example, Ellis *et al*. and Gill *et al*. found that more than 80% of interventions in general medicine were evidence-based (meeting criteria (i) or (ii)).[19-20] A different result was found by Suarez-Varela *et al*. who found only 42% of the interventions in general practice had a sound evidence-base. This different result was explained by the authors due to the different setting being a rural setting of Spain.[21] Lee *et al*. compared the therapeutic interventions between community- and

hospital-based primary care clinics in Seoul and found a significantly lower proportion of interventions was based on evidence in community settings than that of the hospital settings (58% versus 79%).[22] Nordin-Johansson *et al*. estimated the proportion of routine clinical interventions in internal medicine that were supported by scientific evidence or consensus amongst experienced internists.[23] They found that 50% of the diagnosis-intervention combinations were supported by RCTs and another 34% were supported by consensus amongst clinicians. In our RCT the expert panel hand searched for evidence for the best possible therapy, they did not evaluate evidence for the therapy given by the OP. Another difference was that we categorized the level of evidence in four grades following the classification used by the Dutch Institute for Health care Improvement (CBO). With this evidence in mind and the specific circumstances described in the case-file, it was decided if the given advice was appropriate. For therapy, we found evidence (grade 1 up to 3) available for 79% of the case-files. In comparison, the participants of the trial gave a good therapy advice varying from 58% up to 88% (after searching for evidence) according to the experts, based on both evidence and consensus.

Implications for practice

What is the added value from Evidence-Based Medicine for the quality of occupational health care?

In the first place, the method of EBM is applicable in occupational health practice. Compared to clinical practice, occupational health care has a different context that might broaden the component of patient preferences towards preferences of several stakeholders and this may consequently alter the relation between evidence, expertise and stakeholders' preferences.[24] The different content of occupational health care resulted in a broad variety of questions of OPs in daily practice, but a substantial amount of questions could be answered using an EBM strategy (chapters 2.2, 3.1, 4.2). The need for and use of relevant information will increase if EBM is more frequently practised in occupational health care (chapter 4.2). This will help to expose gaps in current research and will presumably stimulate to conduct more trials on effectiveness of occupational health interventions carried out both in occupational health care and in health care in general. Although a recent review of evidence on the effectiveness of occupational health interventions showed that high quality evaluation studies have been

conducted in all areas of occupational health care, the amount of evaluation studies is still small compared to the number of etiology studies.[25] As a result, there lays a challenge to conduct more trials on effectiveness in particular within occupational health care. This development can also contribute to clarify and show the added value of occupational medicine within the whole medical domain and may help to improve the image of this medical specialty which may still be necessary.[26]

The practice of EBM within occupational health care will also stimulate the development of pre-appraised literature. The growing number of published evidence-based practice guidelines in the field of occupational health care is a reflection of this development.[27] The question if practitioners should become *users* instead of *do-ers* of EBM seems to be settled in favour of the first one. However, especially within occupational health, a lot of available and useful evidence is not yet summarized in systematic reviews or practice guidelines.[28] The currently small group of OPs with sufficient skills in finding and appraising original literature still has a forwarded position compared to the majority of OPs who is lacking these skills. Thus, additional strategies and tools for searching the evidence on occupational health-related topics can have a substantial beneficial effect and should be stimulated. Recently, the World Health Organization has published a practical guide for the use of research information to improve the quality of occupational health practice (http://www.who.int/occupational_health/publications/pwh7/en/index.html).[29]
In this guide, a glossary of relevant occupational health MeSH-terms can be found in English. Furthermore, The National Library of Medicine and the U.S. Department of Health and Human Services have recently started to collaborate to develop pre-formulated search strategies for selected focus areas, including Occupational Safety and Health (http://phpartners.org/hp/index.html). Initiatives from the Cochrane Occupational Health Field to produce more systematic reviews on occupational health topics are obviously welcomed (http://www.cohf.fi/).

Finally, the practice of EBM stresses the necessity of a good knowledge infrastructure in occupational health care (chapter 4.2). In the Netherlands, parts of the infrastructure are already initiated with the development of evidence-based practice guidelines and a network of

expert groups on occupational health topics such as reproduction and work, infectious diseases and work, mental health and work. In addition, a high quality virtual scientific library through a central portal for OH professionals is aimed for.[30] In the international field, a close collaboration between ICOH, ILO, WHO and the Cochrane Occupational Health Field is necessary to improve the knowledge infrastructure for occupational health and safety.

What is the added value from Evidence-Based Medicine for the quality of occupational health professionals?

OPs in the Netherlands have shown to have a positive attitude towards evidence-based occupational health practice (chapter 2.1). They are aware of its added value for good quality performance as a professional. The RCT in this thesis confirmed that when OPs are stimulated to increase their knowledge and skills in EBM, to actually search for evidence and to use the evidence in their advice towards employees and employers, the quality of their advice could be enhanced. Their advice became more in line with available evidence especially on therapies that have been demonstrated to improve outcomes in occupational health (chapter 4.1 and 4.2).

Motivating OPs to go to an EBM course is not such a big hurdle and it is already organised to some extent as all OPs in training in the Netherlands nowadays receive such a course within their vocational training. The biggest challenge is how to stimulate OPs to actually practise EBM. Four main obstacles have to be solved: 1) serious time constraints, 2) lack of knowledge and skills in EBM, 3) unfamiliarity with existing evidence-based information sources also caused by restricted access to literature databases and full text articles, and 4) lack of incentives stimulating EBM based practice. The first three obstacles also exist within other medical domains.[8,31,32] The last reason may be more evident for OPs as they may not always be motivated to provide up-to-date occupational health care in their advisory role towards their stakeholders (employee, company management, sometimes insurance companies). In this role, especially regarding sickness-absence management, they may perceive the problems confronted with as not urgent or life-threatening enough to consequently search for evidence when necessary (chapter 2.2). In some other medical domains incentives may come more directly from patients because they might die or get obviously more ill if the physician does not provide optimal care.[33] Moreover, in many

hospitals especially in settings where medical students are trained, physicians need to account far more for their actions because of the routine of daily reports, morning sessions and ward rounds. Although independent working physicians e.g. within primary health care do not need to account to the extent that is custom in these clinical settings, they may face more apparent consequences from their actions towards patients. In contrast, OPs often do not have to account towards their peers for most of their advice and they do not have a long-standing tradition to discuss the medical content of their work with colleagues on a regular basis. Nowadays in the Netherlands, occupational health care is largely organised in a commercial setting in which managers of OHS might not be primarily focused on improving professional medical quality. Within such a context, only stressing importance of EBM practice by scientific journals and research institutes will consequently not change the OPs behaviour. Another consequence of the commercial setting of occupational health care is the importance of a good relationship between the OP and his or her client, being either the employer or the employee.[1] Although professional independency is formally guaranteed, the OP might still have a preference not to jeopardise this relationship when an evidence-based advice is not in line with the preferences of the client. In other medical domains a good relationship with the patient is certainly also crucial, but in occupational health care the employee is the patient and the employer is the person paying. This emphasizes the importance that evidence-based occupational health care should be supported by management of OHS and all other parties involved. With such support to practice EBM the OP can more easily resist some of the challenges to his or her professional autonomy.[34]

The results of the RCT (chapter 4.1 and 4.2) showed that OPs need to have access to the Internet to consult electronic scientific literature databases and they should also have easy access to full text articles. They need to be educated and trained properly with continuous experiences in searching for evidence. Consequently they should be supported by EBM experts or specialised librarians to improve the quality and efficiency of actual searching. Initiatives should come from OPs themselves, their professional associations and their management. Influences from peers and opinion leaders could also be used to stimulate OPs to practice EBM.[35] Furthermore, pressure to improve the professional quality could be organised via certified audit and feedback constructions.[36-38] Parties involved in occupational

health care should collaborate in recognizing the need for improving the facilities and for finding ways to guarantee and develop evidence-based occupational health care. There should be adequate notice for the essential place of EBM within contemporary knowledge management of occupational health care, that will result in good health care for employees and companies.

Recommendations for future research

More research on the effectiveness of major activities within occupational health care is obviously necessary. Not only do we recommend conducting more studies on effectiveness of therapies or interventions in general related to occupational health outcomes but we also suggest to stimulate research on impairments caused by diseases and on return-to-work issues in various health care settings such as internal medicine, surgery, obstetrics/gynaecology, audiology, psychiatry and family practice. For other non-clinical settings we would like to ask more attention for studies in insurance medicine.[39] Not only in the Netherlands but also in other countries there is a great interest in more knowledge on the relation between health, disabilities and working capacity. Furthermore, our studies show the importance of the development of pre-appraised literature in occupational health e.g. evidence-based practice guidelines and systematic reviews. Although it has been argued that synthesizing the evidence on occupational health interventions is often more complicated than in clinical medicine, it is shown that with help from the categorization of occupational health interventions, it can be done.[40,41] In addition, suggestions have been made how to synthesize evidence from non-randomised trials.[42] A good initiative that is currently in preparation is the publication of a list of available and downloadable evidence-based guidelines for occupational health care on the website of the ICOH committee on health services research and evaluation in occupational health (www.icohweb.org).

Secondly, EBM also needs evidence-based implementation. Therefore, we suggest more research on implementation of EBM practice in non-clinical settings like occupational health. It is necessary to learn more about the factors that trigger OPs and other occupational health professionals to change their behaviour towards evidence-based practice. In this thesis, emphasis was put on the evaluation of the potential added value of well structured regular peer meetings. Within occupational health practice there is no long-standing tradition of peer

meetings critically discussing the evidence of decisions taken or advices given. In line with the literature on the positive influences of peers and opinion leaders in the implementation of research findings into practice we expected this aspect in our intervention study to be of utmost importance.[43] The results so far showed however that the obligatory search assignments have the strongest effect towards an evidence-based practice. This leaves us with the question what is the extra added value of such peer meetings. Evaluation on aspects of professional attitude, self-confidence and self-efficacy of OPs are in progress and will be published. We hope that future research by others on behaviour change and influences of peers may help to answer this question.

Finally, evidence-based occupational health practice needs further investigation on output and outcome measures. Prevention of occupational and work-related diseases plays a big role in most countries instead of sickness absence advice. Studies should investigate the potential effect of evidence-based practice on preventive actions and advices in occupational health care, including health surveillance and screening methods. Furthermore, the benefits for employees and employers receiving evidence-based occupational health care need more study. For example, do employees prefer to be informed about the evidence-base of a given advice or treatment? Are sick-listed employees returning to their work more quickly when given an evidence-based advice? Is evidence-based occupational health care leading to a healthier working life with less risk of an occupational or a work-related disease? What are the benefits for companies of an EBM approach? These fundamental questions should be addressed in future discussions and research.

Final conclusions

In this thesis it was shown that EBM can be used to answer occupational health questions. An effective tool was developed to help OPs search for evidence, and knowledge and skills in EBM can be stimulated by education and training. Furthermore, we demonstrated that applying EBM in daily occupational health practice improved the quality of their professional advice.

The barriers found in this thesis were not very different from those in other medical disciplines because time was the biggest hurdle for practising EBM. More specific for occupational health care is the strong influence from legislation, from management of

occupational health services and the presence of different stakeholders i.e. employees, employers and sometimes insurance companies. In this context, sufficient pressure on OPs to search for evidence in the literature to substantiate their advice does not always exist. However, their attitude towards evidence-based care was proved to be positive and thanks to the development of practice guidelines and the increasing external pressure to adhere to these, this situation is already slowly changing. In conclusion, great opportunities and challenges for evidence-based occupational health care exist. They should be further explored and stimulated.

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Summary

Summary

The main aim of this thesis is to investigate the opportunities and obstacles for Evidence-Based Medicine (EBM) in occupational health practice. In addition, it is studied if the quality of occupational health care is enhanced when EBM is practiced. EBM is health care practice that is based on integrating knowledge gained from the best available research evidence, clinical expertise, and patients' values. The order of this thesis follows a conceptual model that describes the application of evidence-based care by an occupational health physician (OP) in an ideal way. The starting point is the information need of an OP that depends on the tasks he has and the context of his work. Information questions may arise from a health problem of an employee visiting the physician or a company asking an advice. He can consult his colleagues or other experts, but he may also consider using scientific evidence to answer his question. If so, he will start searching in the literature via databases, websites or textbooks. Depending on his knowledge and skills, he may find existing evidence and will be able to appraise the quality of the source correctly. The OP can discuss these findings with colleagues, and he will eventually use the evidence in his advice towards employees and employers.

In **chapter 2.1** a questionnaire survey was used to explore the information demands among OPs. The questionnaire also investigated the actions OPs took to answer their questions, their experience in using scientific databases on the Internet, and their attitude towards EBM. OPs' questions concerned in particular medical, legal, and rehabilitation topics. In pursuing answers to their questions, the most common policy was to consult colleagues. Scientific databases were rarely consulted, although in general the attitude towards EBM was positive. OPs perceived a lack of scientific evidence today available in their field, in addition to well-known barriers for practising EBM for all physicians, such as time constraints. Nevertheless, the extensiveness of the field of knowledge in occupational health care was not regarded as an obstacle to apply EBM. The results of the survey suggest that besides education and training in EBM, access to the Internet and the presence of a good knowledge infrastructure should help OPs to work according to the method of EBM.

The study in **chapter 2.2** looked at the daily questions of OPs in greater depth, and evaluated the contribution of EBM strategies to answer these questions. By means of observation in daily practice, followed by an interview of 20 OPs during two half-day work periods, the topics that arose were explored. The conscious (manifest) and unconscious (latent) questions by OPs were analyzed, and the number of questions suitable for performing a search in scientific medical literature was assessed. Immediately after the observation, OPs spontaneously formulated less than one question per working day. However, after the interview, many latent questions were formulated. A substantial number of these questions could be answered following EBM strategies. The results imply that if OPs were encouraged to improve the quality of their decision-making, they might formulate more answerable questions and feel more inclined to search for answers.

Chapter 2.3 compares professional advice on occupational health topics with best evidence from the literature. OPs were asked to consult their usual information contacts or colleagues, on pre-conceived occupational health problems presented in the form of case-vignettes. The literature was searched for the best available evidence on the problems and compared with the answers the OPs received. The findings show that the advice OPs routinely get in their daily practice differs substantially from best evidence from the literature, with the exception of those contacts who provided the sources in the literature on which their advice was based. It was concluded that OPs who ask professional advice should also ask about the evidence supporting this advice.

In **chapter 3.1** an easy-to-use and effective search strategy was developed and evaluated in order to support OPs and experts when searching the scientific literature in PubMed (Medline) for evidence on the occupational origin of diseases. Different combinations of search terms were tested in retrieving literature to answer the four case-vignettes. In addition, we evaluated the use of the Clinical Queries filter for studies on aetiology from PubMed. Based on the outcomes, we developed guidelines for a professional search strategy, using a flow chart. It was advised that to search for studies on the occupational origin of diseases in Medline, one should start with the characteristic name for the occupational disease. If such a typical name does not exist, a specific term for the occupation and type of industry in

combination with the MeSH term for the disease should be used. To improve the sensitivity of the search, a search term for the specific risk factor should be added as well. If there is no relevant occupational title available, it is worth trying the general search terms “occupational diseases” or “occupational risk”. Our advice is not to use the narrow (specific) search option of the Clinical Queries filter.

In **chapter 3.2** the effectiveness and efficiency of the previous developed search strategy was evaluated in finding evidence-based answers to questions related to the possible occupational etiology of diseases. In a controlled trial, participants were asked to answer one out of four ‘occupational disease case-vignettes’ following the steps of EBM. The intervention group was given the search strategy as a tool to support them (chapter 3.1). The results showed that the intervention group scored significantly better than the control group in answering the main question of the case-vignette correctly using more adequate search terms. The intervention group also showed a higher satisfaction (rate) with the applied search strategy. We found no differences in time spent in solving the case and all physicians scored high on positive intention of future practice of EBM.

Chapter 4.1 involves a cluster randomised controlled trial to study the effectiveness of an EBM implementation programme to increase knowledge and skills in EBM, and EBM behaviour in a non-clinical setting, such as occupational health care. The intervention existed of a course in EBM for one and a half day, followed by a four month period of case-method learning sessions in small peer groups every two weeks. During these sessions, participants discussed their everyday cases concerning return-to-work advices, in particular regarding the existing evidence for prognosis and for effectiveness of various interventions. In addition, participants were obliged to perform searches in PubMed and other databases to develop their skills in EBM. Changes in knowledge and skills, and behaviour in EBM were tested. Secondary outcomes were changes in attitude towards EBM, social context stimulating EBM or not, self-efficacy and intention to perform EBM behaviour. The intervention showed a significant and lasting increase of both knowledge and skills, and EBM behaviour. It was concluded that EBM-enhancing interventions which include regular peer meetings and case method learning could be promising in non-clinical settings.

Chapter 4.2 shows the results of the same randomised controlled trial (as in chapter 4.1) regarding the quality of evidence-based advice of OPs in sickness absence management. Primary outcome measure was the quality of advice based on correct assessment of prognosis for return to work or correct choice of therapy. Secondary outcome measures were the quality of searches performed by the intervention group, use of evidence by all OPs during the intervention period and potential predictors for advice quality. After two months the results show an improvement of the advice quality for sickness absence, mainly as a result of better therapy choice. After four months this effect decreased, possibly indicating that the initial enthusiasm would need repeated incentives or courses in either PubMed or EBM to continuously enhance quality. The majority of searches had a good quality and resulted in an adequate answer to the question, mostly using scientific articles via PubMed. Good quality searching was a positive predictor for a good choice of therapy. Without specific search assignments no significant increase of evidence use was found.

Chapter 5 addresses the main findings of this thesis and discusses methodological aspects of study design, the selection of participants and the outcome measures of the performed studies. Next, the added value of EBM for occupational health care and for occupational health physicians is discussed. EBM can have a positive value for occupational health care even though the context and content are different from clinical or general health care. This can result in different types of questions but they are in most cases still applicable for EBM methods. Furthermore, searching evidence in medical scientific literature may need extra search tools as occupational health terms are less common and less familiar. The practice of EBM may stimulate further research especially evaluation studies and can be regarded as an essential element in an improved knowledge infrastructure for occupational health care. OPs can be successfully stimulated to practice EBM and if they do this can enhance the quality of their advice. For the implementation of EBM within occupational health care, facilities are needed such as enough time for the OPs, a good knowledge infrastructure, and positive incentives from the environment, such as occupational health services, employees and companies. In conclusion, great opportunities and challenges for evidence-based occupational health care lay ahead.

Samenvatting

Samenvatting

Met Evidence-Based Medicine (EBM) wordt de geneeskundige praktijk bedoeld die gebaseerd is op de integratie van kennis uit het best beschikbare wetenschappelijk onderzoek, klinische expertise en met de waarden en normen van patiënten. Het doel van dit onderzoek is te bestuderen welke mogelijkheden en barrières er zijn voor het toepassen van EBM in de bedrijfsgezondheidszorg. Daarnaast wordt bestudeerd of de kwaliteit van de bedrijfsgezondheidszorg verbetert wanneer EBM wordt toegepast. De opbouw van dit proefschrift is gebaseerd op een conceptueel model dat de toepassing van evidence-based zorg door een bedrijfsarts beschrijft. Het startpunt is de informatiebehoefte van een bedrijfsarts die afhankelijk is van de taken die hij heeft en de concrete situaties waar hij mee te maken heeft. Vragen kunnen voortkomen uit een gezondheidsprobleem van een werknemer of uit een adviesvraag van een bedrijf. Hij kan voor het beantwoorden van zijn vragen vaak terecht bij zijn collega's en experts, maar hij kan ook bewust kiezen voor het zoeken in de wetenschappelijke literatuur. Afhankelijk van zijn kennis en vaardigheden in EBM zal hij beschikbare informatie vinden en zal hij in staat zijn de waarde daarvan te beoordelen. Zijn bevindingen kan hij bespreken met collega's en toepassen in zijn advisering aan of zorg voor werknemers en werkgevers.

In het onderzoek, beschreven in **hoofdstuk 2.1** werd met een vragenlijst nagegaan hoeveel en welk soort vragen bedrijfsartsen in de praktijk hebben. Er werd ook gevraagd welke activiteiten bedrijfsartsen ondernemen om deze vragen beantwoord te krijgen, naar de ervaring in het gebruik van wetenschappelijke databestanden via het Internet, en naar de houding ten opzichte van EBM. De vragen van de bedrijfsartsen hadden vooral betrekking op medische, juridische en reïntegratie onderwerpen. Voor het beantwoorden van deze vragen werden vooral collega's geraadpleegd. Wetenschappelijke databestanden werden hierbij vrij weinig gebruikt, hoewel de houding ten opzichte van EBM positief was. Behalve de bekende barrières voor het toepassen van EBM, zoals een gebrek aan tijd, hebben bedrijfsartsen het idee dat er te weinig wetenschappelijk onderzoek is verricht op hun terrein. De breedheid van het vakgebied en daardoor ook de breedheid van de kennis die nodig is voor de bedrijfsgezondheidszorg werd niet gezien als obstakel voor het toepassen van EBM. De

resultaten suggereren dat toegang tot het Internet en een goede kennisinfrastructuur van belang zijn om bedrijfsartsen in staat te stellen om volgens de methode van EBM te werken. Daarnaast is opleiding en training in EBM noodzakelijk.

In het onderzoek in **Hoofdstuk 2.2** werden de vragen van bedrijfsartsen uit de dagelijkse praktijk via een observatieonderzoek nog grondiger bestudeerd. Tevens werd gekeken naar de mogelijk toegevoegde waarde van EBM strategieën om deze vragen te beantwoorden. Bedrijfsartsen werden door een observator gedurende twee opeenvolgende halve werkdagen geobserveerd en geïnterviewd waarbij ingegaan werd op de onderwerpen van het voorafgaande dagdeel. De bewuste (manifeste) en onbewuste (latente) vragen van bedrijfsartsen werden geanalyseerd en er werd nagegaan hoeveel vragen er geschikt waren om te gaan zoeken in de wetenschappelijke literatuur. Direct na de observatie, stelden bedrijfsartsen spontaan één vraag per werkdag. Na het interview werden veel latente vragen geformuleerd. Een substantieel aantal vragen kon beantwoord worden door middel van EBM strategieën. De resultaten doen vermoeden dat bedrijfsartsen meer beantwoordbare vragen zouden stellen en meer geneigd zouden zijn antwoorden daadwerkelijk op te zoeken als zij meer gestimuleerd zouden worden om de kwaliteit van hun beslissingen en adviezen te verbeteren.

Hoofdstuk 2.3 vergelijkt het professionele advies over een aantal aan de praktijk ontleende bedrijfsgeneeskundige onderwerpen gegeven door een collega of expert met het beste bewijs uit de wetenschappelijke literatuur. Bedrijfsartsen werden gevraagd experts of collega's om advies te vragen bij het beantwoorden van een specifieke vraag aan de hand van een aantal fictieve problemen. In de literatuur werd gezocht naar een antwoord gebaseerd op evidence en dit antwoord werd vergeleken met de antwoorden die de bedrijfsartsen ontvingen van hun adviseurs. De resultaten laten zien dat het expert advies dat bedrijfsartsen in de praktijk kregen substantieel verschilde met de evidence uit de literatuur. Veel adviezen bleken niet juist te zijn. De conclusie is dat bedrijfsartsen die professioneel advies krijgen ook moeten vragen naar de wetenschappelijke onderbouwing voor dit advies.

In het onderzoek in **hoofdstuk 3.1** werd een gemakkelijk te gebruiken en effectieve zoekstrategie ontwikkeld en getest om bedrijfsartsen en experts te helpen bij het zoeken in PubMed (Medline) naar wetenschappelijke literatuur over werk- of beroepsgebonden oorzaken van ziekten. Verschillende combinaties van zoektermen werden getest op het vinden van literatuur voor het beantwoorden van vier fictieve problemen. Daarbij werd ook het gebruik van de Clinical Queries filter voor etiologische studies in PubMed getest. Op basis van de resultaten, werden richtlijnen ontwikkeld voor een professionele zoekstrategie in de vorm van een stroomschema. Bij het zoeken van studies over beroeps- of werkgebonden oorzaken van ziekte, zou men moeten beginnen met het invoeren van een specifieke naam voor de beroepsziekte. Als die niet bestaat, wordt aanbevolen om een specifieke term voor het beroep of branche in te voeren in combinatie met een MeSH-term voor de ziekte. Om de sensitiviteit van de zoekactie te verbeteren zou een zoekterm voor de risicofactor toegevoegd moeten worden. Als er geen relevante naam is voor het beroep, is het zinvol om een generieke zoekterm te gebruiken voor “beroepsziekte” of “beroepsrisico”. Bij de Clinical Queries filter wordt het gebruik van de optie voor specifieke (smalle) zoektocht afgeraden.

In het onderzoek in **hoofdstuk 3.2** werd de effectiviteit en efficiëntie van de eerder ontwikkelde zoekstrategie getest in het vinden van evidence-based antwoorden op vragen in relatie tot de mogelijke beroepsgebonden etiologie van ziekten. Door middel van een gecontroleerde studie werden deelnemers gevraagd om één van de vier beroepsziektecasus te beantwoorden volgens de methode van EBM. De interventiegroep kreeg de zoekstrategie als hulpmiddel. De resultaten laten zien dat de interventiegroep de belangrijkste vraag van de casus significant beter beantwoordde dan de controlegroep door het gebruik van meer adequate zoektermen. De interventiegroep was ook significant meer tevreden over de gevolgde zoekstrategie. Er werd geen verschil gevonden in de tijd die nodig was om de casus op te lossen en alle bedrijfsartsen scoorden positief in hun intentie tot toepassing van EBM in de toekomst.

Hoofdstuk 4.1 beschrijft een cluster-gerandomiseerd en gecontroleerd onderzoek naar de effectiviteit van een EBM implementatieprogramma. Het programma was gericht op kennis, vaardigheden en EBM gedrag in een niet-klinische setting. De interventie bestond uit een

EBM cursus van anderhalve dag gevolgd door een periode van vier maanden waarin elke twee weken gestructureerde patiëntenbesprekingen werden gehouden in kleine groepen. Tijdens deze sessies bespraken de bedrijfsartsen hun casus uit de eigen praktijk, gebruikmakend van beschikbare literatuur voor de prognose en de effectiviteit van verschillende interventies bij ziekteverzuim. De deelnemers zochten naar literatuur in PubMed en andere databestanden. De veranderingen in kennis, vaardigheden en EBM gedrag werden getest met behulp van een aangepaste versie van de 'Fresno-test'. Secundaire uitkomstmaten waren verandering in houding, sociale context die EBM gedrag kan stimuleren, 'self-efficacy' en intentie tot EBM gedrag. De interventie liet een significante en blijvende verbetering van zowel kennis en vaardigheden in EBM als in EBM gedrag zien. De conclusie is dat EBM- stimulerende interventies met regelmatige bijeenkomsten van collega's veelbelovend kunnen zijn in de niet-klinische praktijk.

In **Hoofdstuk 4.2** wordt in dezelfde trial, zoals beschreven in 4.1, het effect van de bovenbeschreven interventie nagegaan op de kwaliteit van het advies bij ziekteverzuim. De primaire uitkomstmaat was de kwaliteit van het advies gebaseerd op een goede inschatting van de prognose voor terugkeer naar werk en een goede therapiekeuze. Secundaire uitkomstmaten waren de kwaliteit van de zoekacties door de interventiegroep, het gebruik van evidence in beide groepen en mogelijke voorspellers van een verbeterde advieskwaliteit. De resultaten laten na twee maanden een verbetering van de advieskwaliteit zien bij verzuimspreekuren, vooral door een verbetering van de therapiekeuze. Na vier maanden is deze verbetering verminderd wat mogelijk aantoont dat het enthousiasme bij aanvang van de studie toch meer herhaaldelijk stimulansen of cursussen in PubMed dan wel EBM nodig heeft. De meerderheid van de zoekacties was van goede kwaliteit wat resulteerde in een adequaat antwoord op de vraag, meestal door gebruik te maken van wetenschappelijke artikelen via PubMed. Goed zoeken bleek ook een positieve voorspeller voor een goede therapiekeuze. Wanneer geen zoekopdracht werd uitgevoerd, werd ook geen verbetering in het gebruik van evidence gevonden.

Hoofdstuk 5 geeft de belangrijkste resultaten van dit proefschrift weer. Aansluitend worden een aantal methodologische aspecten van de uitgevoerde onderzoeken uitgebreid

bediscussieerd. Vervolgens wordt de toegevoegde waarde van EBM voor de bedrijfsgezondheidszorg en de bedrijfsarts bediscussieerd. EBM heeft toegevoegde waarde voor de bedrijfsgezondheidszorg ook al is de context en inhoud verschillend van andere medische disciplines. Hierdoor wordt inderdaad een ander soort vragen gesteld maar een groot aantal praktijkvragen kan via EBM- methoden adequaat worden beantwoord. Het zoeken van evidence in de literatuur heeft wel wat extra hulpmiddelen nodig omdat specifiek bedrijfsgeneeskundige zoektermen nog vrij ongebruikelijk of onbekend zijn. Het toepassen van EBM kan onderzoek stimuleren, in het bijzonder evaluatiestudies, en maakt onderdeel uit van een betere kennisinfrastructuur voor de bedrijfsgezondheidszorg. Bedrijfsartsen kunnen worden gestimuleerd tot het uitvoeren van EBM waardoor de kwaliteit van hun werk kan verbeteren. Voor het invoeren van EBM in de bedrijfsgezondheidszorg zijn een aantal randvoorwaarden te formuleren zoals beschikbaarheid van voldoende tijd, een goede kennisinfrastructuur en positieve stimulansen uit de omgeving zoals vanuit arbodiensten, werknemers en bedrijven. De conclusie is dat er goede mogelijkheden en uitdagingen zijn voor het toepassen van EBM in de bedrijfsgezondheidszorg.

Dankwoord

Dankwoord

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