Embedding trials in evidence-based clinical practice
Oude Rengerink, K.

Citation for published version (APA):

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CHAPTER 10

TOOLS TO ASSESS EVIDENCE-BASED PRACTICE BEHAVIOUR AMONG HEALTHCARE PROFESSIONALS
A SYSTEMATIC REVIEW

Katrien Oude Rengerink, Sandra E. Zwolsman, Dirk T. Ubbink, Ben Willem J. Mol, Nynke van Dijk, Hester Vermeulen

Evidence-based Medicine, 2013;18:129-38
ABSTRACT

Objective - To identify and compare tools to assess Evidence-Based Practice (EBP) behaviour among healthcare professionals.

Design - Systematic review.

Data sources - MEDLINE, EMBASE, Cochrane Library, PsychInfo and CINAHL up to July 2011.

Study selection - Titles, abstracts and eligible full text articles were screened by two reviewers independently.

Data extraction - Relevant data were extracted by one reviewer and checked by a second reviewer. Eligibility criteria for selecting studies: original studies among all healthcare professionals that described the development or use of EBP behaviour assessment tools.

Results - Of 19,310 identified articles, 172 studies were included. We identified 117 questionnaires, 10 interviews or focus groups, nine observational studies, 27 chart evaluations and nine studies used a combination of methods. Psychometric properties of the questionnaires used were reported in about half of the studies, in seven studies that assess a single EBM step and in six studies that assess a combination of EBM steps. One of these assessed all five steps of EBP.

Conclusions - Valid and reliable EBP behaviour assessment tools are available. However, only one questionnaire validly and reliably assessed all five EBP steps, covering the entire concept of EBP.
Chapter 10 | Tools to assess EBP behaviour among healthcare professionals

INTRODUCTION

Healthcare decisions should preferably be based on high-quality research evidence such as clinical guidelines, systematic reviews or randomised clinical trials.\(^1\) Ironically, healthcare professionals often fail to implement clinical procedures that have established efficacy or fail to discard proven ineffective procedures.\(^2\) A study in the USA suggests that approximately 30% of patients do not receive care in accordance with the latest scientific evidence and approximately 25% of patients receive unnecessary or potentially harmful care.\(^3\) The gap between evidence and practice still exists.

To overcome the gap between best practice and actual care, professional organisations worldwide encourage Evidence-Based Practice (EBP).\(^4\) The five steps of EBP—Ask, Access, Appraise, Apply and Assess—equip healthcare professionals with the necessary steps to successfully integrate evidence from research with their clinical decision-making.\(^5\) Competency in EBP has become a prerequisite for (re)certification of healthcare professionals.\(^6,7\) Although EBP has more and more become the standard of care, there are still barriers to overcome that refrain health professionals from teaching or working evidence based, like a lack of time to read evidence, lack of facilities or resources, lack of requirements for EBM, lack of EBM skills, a pyramid hierarchy in healthcare management structure discouraging EBM, and barriers related to the available evidence.\(^8,9\)

To be able to assess whether healthcare professionals and healthcare organisations actually work evidence based, a valid and reliable method for the assessment of EBP behaviour in clinical practice is needed. EBP behaviour can be assessed by considering if, and at what level, individual healthcare professionals use the five EBP steps in daily practice.\(^7\) Alternatively, the application of evidence-based clinical manoeuvres could be assessed.\(^10\) The optimal method for evaluation of EBP behaviour is unclear. Shaneyfelt et al\(^11\) reviewed tools that evaluate EBP, but they focused on evaluating the effect of teaching EBP. To evaluate EBP teaching, most often knowledge and skills were assessed, rather than impact on daily clinical practice.\(^11\) Their review showed that the Fresno Test and the Berlin Questionnaire are valid and reliable for assessing knowledge and skills of individual trainees.\(^12,13\) But, as improvement in knowledge and skills does not automatically lead to an improvement of behaviour in practice, it is important to measure actual EBP behaviour as well.\(^6\) Shaneyfelt et al identified four valid EBP behavior instruments using objective outcome measures, but these instruments did not have the ability to document the EBP
behaviour of individual professionals.\textsuperscript{5, 11–13}

An overview of existing EBP behaviour assessment tools could help to determine the optimal assessment method. Therefore, we systematically reviewed the validity, reliability and feasibility of all existing methods to assess EBP behaviour of healthcare professionals.

METHODS

This review was performed and described according to the PRISMA statement, using a prespecified protocol.\textsuperscript{14}

ELIGIBILITY CRITERIA

We included original studies among all healthcare professionals (i.e., physicians, dentists, nurses and other allied healthcare professionals such as physiotherapists, speech-language therapists, occupational therapists and dental hygienists) that described the development or use of EBP behaviour assessment tools.

We excluded studies about adherence to guidelines and studies about evidence-based care or quality indicators regarding one particular disease, since these tools address specific behaviour regarding the guideline or disease evaluated and outcomes of these studies would likely be hard to extrapolate to other (general) settings. Furthermore we excluded studies about the evaluation of preclinical students, as they are not working in practice yet. To optimise applicability of the results we excluded randomised controlled trials (RCTs) that evaluate strategies for improving EBP behaviour, because the evaluation used to assess the strategies may not be feasible outside the trial. Proceedings of conferences were not included as they contained too little information about the assessment methods used.

INFORMATION SOURCES AND SEARCH

A search for eligible studies was performed in MEDLINE (Pubmed), EMBASE (Ovid), the Cochrane Library, CINAHL (EBSCOhost) and PsychINFO (EBSCOhost) without any restrictions to language from the earliest available date until July 2011. The search terms are listed in online supplementary appendix 2. We did not restrict our search to studies evaluating psychometric properties of instruments, as we expected not to find many validated instruments while this restriction would result in the possible exclusion of relevant, but not yet validated instruments.
STUDY SELECTION
In pairs, two reviewers independently reviewed the titles and abstracts of the retrieved studies for eligibility. Of the selected studies, the full articles were appraised by two reviewers to determine eligibility for inclusion. In the case of persisting disagreement during any step in the review process, a third reviewer was consulted.

DATA COLLECTION PROCESS AND DATA ITEMS
A structured data extraction form (see online supplementary appendix 3) was used to collect the following relevant data from the included studies:

1. Characteristics of the participating healthcare professionals: number, discipline, training level;
2. Description and development of the EBP behavior assessment tool as described by the study authors;
3. The classification of the tool regarding the five EBP steps (Ask, Access, Appraise, Apply and Assess) or patient outcomes;
4. Psychometric properties of the tool as described in the original study with a notification whether reliability, validity and responsiveness had been tested;
5. Any previously developed methods on which the behaviour assessment tool had been based;
6. Description of whether the assessment is subjective (i.e., self-reported measures) or objective (formal assessment or actual observations in practice).

We also extracted the country in which the instrument was developed. Countries were plotted on a world map using R 2.14.0, package Maptools (version 0.8-21). The data of the included studies were extracted by one reviewer and confirmed or corrected by a second reviewer. Disagreements during data extraction were resolved during a consensus meeting. A third reviewer was consulted in case of persisting disagreement.

RISK OF BIAS ASSESSMENT OF INDIVIDUAL STUDIES
We did not perform a quality assessment of the included studies, as a well-performed study does not guarantee good quality of the assessment tool used and vice versa.
RESULTS

STUDY SELECTION
The search resulted in 19310 titles and abstracts. Of 326 abstracts the full articles were retrieved, of which 172 studies met all inclusion criteria, representing 156 different behaviour assessment tools. A flowchart of study inclusion is shown in figure 1.

Figure 1: Flow chart of the search strategy and number of articles retrieved.\textsuperscript{14}

<table>
<thead>
<tr>
<th>Identification</th>
<th>Nr of records identified through database searching 28,080</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Screened 19,310</td>
</tr>
<tr>
<td></td>
<td>Excluded 18,984</td>
</tr>
<tr>
<td>Eligibility</td>
<td>Nr of full text articles assessed for eligibility 326</td>
</tr>
<tr>
<td></td>
<td>Excluded reasons:</td>
</tr>
<tr>
<td></td>
<td>10 full text not retrieved</td>
</tr>
<tr>
<td></td>
<td>9 duplicate</td>
</tr>
<tr>
<td></td>
<td>59 no original peer reviewed study</td>
</tr>
<tr>
<td></td>
<td>68 no clear description of method measuring EBM</td>
</tr>
<tr>
<td></td>
<td>1 randomized trial</td>
</tr>
<tr>
<td></td>
<td>7 adherence to 1 organ, guideline, disease</td>
</tr>
<tr>
<td>Included</td>
<td>Nr of studies included in qualitative synthesis 172</td>
</tr>
</tbody>
</table>

STUDY CHARACTERISTICS
These studies were retrieved from nearly every continent (figure 2). Tools to measure EBP behaviour were first developed in 1992. In online supplementary appendix 1 an overview is presented of all tools in which a description of validity or reliability was included and in which validity and reliability were tested and/or established.

The remaining tools were used to assess other healthcare professionals: dentists, dental hygienists, pharmacists, physiotherapists, mental health practitioners, public health workers, speech-language pathologists, social health workers, occupational therapists, ambulance officers, dieticians or a mix of professionals.

Mostly, the EBP behaviour assessment was part of a broader assessment tool, for instance a tool that also assesses EBM knowledge, skills or attitude. The methods used to evaluate
behaviour were questionnaires, interviews and focus groups, observations or registration of healthcare professionals, evaluation of charts or a combination of methods.

QUESTIONNAIRES
Of the EBP behaviour assessment tools described in the various studies, 117 concerned questionnaires. Table 1 shows 42 EBM questionnaires for which validity and/or reliability have been tested and described—not necessarily confirmed.\(^{16-57}\) Two of these questionnaires concerned translations of existing tools.\(^{28,55}\) A list of questionnaires or tools in which validity or reliability have not been tested (if applicable) is available on request. Of these 42 studies, 16 studies assessed only one step of EBP: two assessed step 1 (Ask),\(^ {16,17}\) nine step 2 (Access)\(^ {18-27}\) and five step 4 (Apply).\(^ {28-32}\) In 26 questionnaires multiple EBP steps were assessed,\(^ {33-57}\) mostly a combination of steps 2 and 4 (Access and Apply). Most questionnaires were to be completed by the respondent. Some were structured telephone surveys conducted and filled in by a researcher. In about 60% of the identified questionnaires previously reported questionnaires were used for further development, of which the questionnaire by McColl et al\(^ {58}\) was most frequently used. The psychometric properties of the questionnaires were reported in only about half of the studies: 28 studies tested validity and 20 tested reliability, of which 11 tested both validity and reliability.

**Figure 2:** Map showing all countries of origin for instruments included in the table assessing Evidence based Practice behavior.
Table 1: Overview of EBM questionnaires of which validity and/or reliability have been tested (not necessarily confirmed).

<table>
<thead>
<tr>
<th>EBM step</th>
<th>Author</th>
<th>Healthcare professional</th>
<th>Description of the instrument</th>
<th>Based on</th>
<th>Reliable</th>
<th>Valid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carter²⁹</td>
<td>433 physical therapists</td>
<td>Reading the literature without a question.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Karlsson²⁷</td>
<td>429 occupational therapists</td>
<td>Read occupational therapy research literature to update knowledge.</td>
<td>Eckerling 1988</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hendricson³³</td>
<td>16 dental faculty</td>
<td>KACE: Evidence Based Practice Knowledge, Attitudes, Access, and Confidence Evaluation. Accessing evidence: frequency of accessing the Cochrane Library.</td>
<td>Taylor 2001; Fritsche 2002; Johnson 2003; Bradly 2004;</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Ross³⁰</td>
<td>128 anaesthesia nurses</td>
<td>Information Literacy for Evidence-based Nursing Practice: information seeking and resource use.</td>
<td>Pravikoff 2005</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chiu²⁰,²¹</td>
<td>1156 MD and nurses</td>
<td>Frequency database access to search for medical information.</td>
<td>Yu 2001; Wong 2005; Bennett 2005</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Thiel²²</td>
<td>121 registered nurses</td>
<td>Frequency of searching information, using modified Information Literacy for Evidence-based Nursing Practice.</td>
<td>Pravikoff 2005; Pierce 2000; Tanmer 2000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shirkhedkar²³</td>
<td>106 medical officers</td>
<td>Accessibility, frequency of use and preference for electronic databases.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phua²⁹</td>
<td>154 MDs various disciplines</td>
<td>Time spent on UpToDate and other information resources.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carney²⁷</td>
<td>129 community clinical teachers</td>
<td>Use of information sources for patient care decisions: the Internet, Medline, MD consult.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jette²⁶</td>
<td>488 physiotherapists</td>
<td>Frequency of reading articles, use of databases, literature and access to practice guidelines.</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Philibert²⁷</td>
<td>328 occupational therapists</td>
<td>Reading journals and sources used.</td>
<td>Kirk 1976; Mckee 1987</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4</td>
<td>Forsman²⁸</td>
<td>2621 nurses</td>
<td>Use of research: direct research use, indirect research use and persuasive research use (questions unclear)</td>
<td>Estabrooks 1997,1999, Formans 2009 (translation Estabrooks)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Cobban²⁷</td>
<td>161 dental hygienists</td>
<td>Research utilization.</td>
<td>Estabrooks 1998</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Olade²⁷</td>
<td>106 nurses</td>
<td>Utilization of nursing research and type of research.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Veeramah²⁷</td>
<td>173 nurses and midwives</td>
<td>Frequency of using research findings in practice.</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Lacey²⁷</td>
<td>20 nurses</td>
<td>Research utilization; reading more than or equal to 11 English articles in past 6 months.</td>
<td>Champion 1989</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2</td>
<td>Chernick²²</td>
<td>56 MDs: paediatric interns and residents; EBP experts</td>
<td>Self-reported practice of EBP: frequency of searching articles to answer clinical question, generation of clinical questions applicable patients’ diagnostic or therapeutic plan.</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>EBM step</td>
<td>Author</td>
<td>Healthcare professional</td>
<td>Description of the instrument</td>
<td>Based on</td>
<td>Reliable</td>
<td>Valid</td>
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<tr>
<td>2,4</td>
<td>Fillipini(^{24})</td>
<td>449 of 923 nurses</td>
<td>Frequency of reading guidelines and scientific journals; having modified practice last year; frequency of using EBP.</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Profetto-McGrath(^{25})</td>
<td>94 nurses</td>
<td>Cross sectional telephone survey: frequency of accessing written or people-based evidence; and how evidence is used.</td>
<td>Profetto-McGrath 2007</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Abeysana(^{26})</td>
<td>315 MD</td>
<td>Number of articles read per month and use of EBP in the management of patients.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Guindon(^{27})</td>
<td>1499 GPs, specialists, nurses, health workers</td>
<td>Access to evidence and use of sources; use of evidence and change in practice attributed to particular sources of research evidence.</td>
<td>Landry 2003; McCol1998; Calverton 2004; Page 2003; Prescott 1997; Wilson 2001 and 2003; WHO 2002 and 2004; Canadian Health Services Research Foundation 2001</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>McEvoy(^{28})</td>
<td>105 (mixed)</td>
<td>Tracked down relevant evidence once a question formulated; integrated research evidence with expertise;</td>
<td>Kamwendo 2001; Green 2002; Jette 2003; Iles 2006; Bridges 2007</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Adams(^{29,30})</td>
<td>386 school nurses</td>
<td>SN EBP questionnaire: which sources used when information needed.</td>
<td>Titler 1999; Rodgers 2003</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>247 school nurses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ahmad(^{31})</td>
<td>332 primary care MDs</td>
<td>Self-reported amount of EBP; frequency of use of different sources.</td>
<td>McCol1998; McKenna 2004</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Kahveci(^{32})</td>
<td>375 primary care physicians</td>
<td>Use of resources and percentage of practice evidence based.</td>
<td>McCol1998; Al-Ansary 2002; Al-Almaie 2004</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Melnyk(^{33})</td>
<td>160 nurses</td>
<td>Use of Cochrane Database; amount of practice evidence-based.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Tranmer(^{34})</td>
<td>235 nurses</td>
<td>Research Utilization Questionnaire</td>
<td>Champion 1989</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Johansson(^{35})</td>
<td>99 head nurses</td>
<td>Searching and EviPraQ about evaluation of care.</td>
<td>Champion 1989</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,5</td>
<td>Wallin(^{36})</td>
<td>119 nurses</td>
<td>Seeking new research literature and research use in daily practice.</td>
<td>Humphris 1999; Champion 1989; Pettengil 1994</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>4,5 patient outcomes</td>
<td>Brown(^{37})</td>
<td>696 paediatric occupational therapists</td>
<td>KAP survey: research knowledge, attitudes and practices</td>
<td>van Mullem 1996</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2,3</td>
<td>Amin(^{38})</td>
<td>348 MDs</td>
<td>How frequently do you encounter information gaps; what proportion of practice is evidence based.</td>
<td>McCol1998; Olantunbosun 1998; Fritsche 2002.</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Thomas(^{39})</td>
<td>59 paediatric dieticians</td>
<td>How often do you encounter a knowledge gap and what domain; literature search yes/no; information sources used most often; criteria taken into consideration when critically appraising paper.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* SN EBP, School Nurse Evidence Based Practice Questionnaire
The remaining studies did not report any psychometric properties, although some studies mentioned that their questionnaire was based on literature—without any further specifications—or a pilot study was performed.

For the assessment of EBP behaviour by means of questionnaire administration, several tools were identified that were shown to be valid and reliable. For the assessment of behaviour of single EBP steps, the valid and reliable tools are: step 2: Hendricson, Chiu, Philibert and Jette and step 4: Cobban and Veeramah.

For the assessment of multiple EBP steps, the following tools were found to be valid and/or reliable: steps 1 and 2: Chernick, steps 2 and 4: Fillipini, Kahveci, Guindon and McEvoy.

To assess all five EBP steps, the questionnaires by Scott and Wallen were tested for reliability, but not for validity. The questionnaire of Boström showed adequate validity, but was not tested for reliability. Six items measuring the respondents’ extent of applying the components of EBP, on a four-point response format (1=to a very low extent, 4=to a

<table>
<thead>
<tr>
<th>EBM step</th>
<th>Author</th>
<th>Healthcare professional</th>
<th>Description of the instrument</th>
<th>Based on</th>
<th>Reliable</th>
<th>Valid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,4</td>
<td>Parahoo</td>
<td>87 nurses</td>
<td>Frequency of reading research studies, info sources, implementation of research findings.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>2,3,4</td>
<td>Prior</td>
<td>55 nurses</td>
<td>Three subscales, 24 items: practice EBP (never-frequently), tracked down evidence; critically appraised; integrated evidence.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>1,2,3,4,5</td>
<td>Bostrom</td>
<td>1256 nurses</td>
<td>Use of EBM: formulate questions; seek relevant knowledge, critical appraisal, implementation, evaluation.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Scott</td>
<td>111 MDs</td>
<td>Number of questions formulated per week; number of searches for evidence performed per week: databases, topics, critical appraisal, efficiency of search in yielding information from patient management; applying in practice, confidence and change in practice; questionnaire evaluating practice.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Romani</td>
<td>459 nurses</td>
<td>Frequency of use of EBM applied in care for individual patients.</td>
<td>Upton 2006 (translation)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Wallen</td>
<td>159 nurses</td>
<td>Questionnaire: EBP implementation scale (EBPI); frequency of EBP implementation behaviour over the past 8 weeks (e.g. used evidence to change clinical practice; critically appraised evidence)</td>
<td>Melnyk 2003</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Estrada</td>
<td>594 nurses</td>
<td>Unclear, the 18 item EBP implementation scale of Melnyk was used.</td>
<td>Melnyk 2008</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
very high extent): (1) formulate questions, (2) seek relevant knowledge using databases, (3) seek relevant knowledge using other information sources, (4) critically appraise and compile best knowledge, (5) participate in implementing research knowledge in practice and (6) participate in evaluating practice based on research knowledge.

Romani\textsuperscript{55} translated the questionnaire developed by Upton, which assesses all five EBP steps and has good psychometric properties—as tested by Upton (but this is not further described). This questionnaire consists of three parts, of which the first part focuses on EBM behaviour. It is a self-reported questionnaire that asks how often in the last year: (1) A question was formulated to fill a knowledge gap, (2) how often was searched for evidence, (3) how often critical appraisal was applied, (4) how often the literature that has been found was integrated with own experience and knowledge, (5) the results were evaluated in practice and (6) the knowledge was shared with colleagues.

INTERVIEWS AND FOCUS GROUPS
Interviews or focus groups were used in five studies,\textsuperscript{59–63} a short description of these studies can be found in the online supplementary appendix. A variety of EBP steps was measured in the interviews, most of the interviews included step 2 or 4. Two studies described validation of their tool: Bogdan Lovis\textsuperscript{59} and Rolfe.\textsuperscript{60}

OBSERVATIONS OR REGISTRATION OF HEALTHCARE PROFESSIONALS
The EBP behaviour of healthcare professionals was directly observed in nine studies,\textsuperscript{64–72} an overview of these studies can be found in table 2. Observation commonly entails the mean logins to the library or database,\textsuperscript{64} the use of articles, or (a change in) decision-making as a result of searches,\textsuperscript{67} information seeking behaviour,\textsuperscript{65,68} a portfolio\textsuperscript{65} or the evidence base for expert opinions.\textsuperscript{70} None of the identified tools mentioned aspects of validity and reliability; however, it can be discussed whether it is necessary to do so when using observations. Tilburt et al\textsuperscript{67} did test interobserver agreement regarding the observation of EBP steps 1-3.

EVALUATION OF CHARTS
Evaluation of charts was performed in 27 studies to assess the evidence base underlying diagnosis-intervention pairs, surgeries or interventions during pregnancies,\textsuperscript{73–99} an overview of these studies can be found in the online supplementary appendix. In 12 of these evaluations the level of evidence had been based on the criteria according to Ellis
et al\textsuperscript{10}: evidence from RCTs (level 1), convincing non-experimental evidence (level 2), interventions without substantial evidence (level 3). The classification by Kingston et al\textsuperscript{10} was also frequently used. Three studies tested the validity of their tools: Kenny\textsuperscript{81} (also tested reliability); Nordin-Johansson\textsuperscript{96} and Straus.\textsuperscript{76}

**Table 2:** Overview of real time observation or registration of healthcare professionals EBM behavior in practice

<table>
<thead>
<tr>
<th>EBM step</th>
<th>Author</th>
<th>Healthcare professional</th>
<th>Description of the instrument</th>
<th>Based on</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Haynes\textsuperscript{64}</td>
<td>203 MDs</td>
<td>Mean registered logins to the library per user: use of PLUS (peer-selected articles): percentage users and minutes/month.</td>
<td></td>
</tr>
<tr>
<td>2,3,4</td>
<td>Van Duppen\textsuperscript{65}</td>
<td>2920 doctor patient contacts, 365 searches, 5 GPs</td>
<td>Online on the spot searching. Number of searches; number of databases consulted; answer found, change of decision.</td>
<td>Shaughnessy 1994; Slawson 2005</td>
</tr>
<tr>
<td></td>
<td>Fung\textsuperscript{66}</td>
<td>41 residents in obstetrics and gynaecology</td>
<td>Learning portfolio: questions reported and directly forwarded to searching strategy; whether or not a change in practice occurred.</td>
<td></td>
</tr>
<tr>
<td>2,3,4</td>
<td>McKnight\textsuperscript{67}</td>
<td>6 registered nurses</td>
<td>Participant observation and in-context interviews were used to record in detail fifty hours of the information behaviour of a purposive sample of on-duty critical care nurses on critical care unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tilburt\textsuperscript{68}</td>
<td>70 general internal medicine residents</td>
<td>Resident behaviour was observed and resident–attending doctor interactions audio taped looking for themes of information exchange, using the method by Bernard 1995.</td>
<td></td>
</tr>
<tr>
<td>1,2,3</td>
<td>Darst\textsuperscript{69}</td>
<td>10 paediatric cardiologists</td>
<td>Ten paediatric cardiologists recorded every clinically significant decision made during procedures, test interpretation or delivery of inpatient and outpatient care. The basis for each decision was assigned to one of 10 predetermined categories, ranging from arbitrary and anecdotal, to various qualities of published studies, to parental preference and avoiding a lawsuit.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Linthorst\textsuperscript{70}</td>
<td>25 cases of exotic expert opinion, department of internal medicine</td>
<td>Of 25 exotic expert opinions, based on careful literature review of 8 the statements were evidence based, contradicting literature was found in 13 and no literature in 4.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qian\textsuperscript{71}</td>
<td>599 women from obstetrics ward</td>
<td>Using Cochrane Library 6 procedures were selected which should be avoided as routine and two that should be encouraged. The procedure rate was determined by exit interviews with women, verified using hospital notes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coffey\textsuperscript{72}</td>
<td>22 gerontological nurses</td>
<td>Portfolio: documentation of identification of ways for improvement, documentation of sources of research and evidence for practice.</td>
<td>Fensom 2000</td>
</tr>
</tbody>
</table>
COMBINATION OF MULTIPLE METHODS

A combination of the assessment methods as aforementioned was used in six studies being mostly a combination of interviews with observations or questionnaires.\textsuperscript{100–105} Luker et al\textsuperscript{101} combined observations, individual interviews, group discussions and records. Only Cullen established validity and reliability for steps 2 and 3.\textsuperscript{104}

DISCUSSION

This review identified 172 studies representing 160 different tools that assess EBP behaviour. Most of these subjectively assessed a single step of EBP without establishing psychometric properties. Valid and reliable tools for the assessment of a single EBM step or a combination of EBM steps were identified, but no tool with established validity and reliability assesses all five EBP steps. For one questionnaire measuring all five steps validity has been established.\textsuperscript{53}

Strengths of our review are that it includes assessment tools for all health professionals, reducing the chance of missing a potential important assessment tool that could be extrapolated from one health setting to another. Moreover, it focuses on behaviour in clinical practice, which has a more direct effect on patient outcomes than knowledge and skills.

This review has some points which require a remark. First, the definition of EBP as used worldwide is not always congruent: sometimes EBP is defined as the adherence to guidelines, whereas others regard EBP as the integration of all components of EBP in clinical practice. Second, we could have missed studies during the review process. Since EBP behaviour is a broad concept, we added search terms to our search strategy to decrease the number of retrieved studies. However, as we searched the literature with a broad search strategy revealing over 19,000 hits we think it is unlikely we missed any ideal and frequently used method. Lastly, in this review we did not explore the relation between the use of EBP and the level of knowledge and skills of the professional in the varying healthcare settings. These should, however, also be considered when choosing the optimal method for measuring EBP behaviour. Enacting EBP behavior without the proper knowledge and skills can lead to wrong conclusions.\textsuperscript{106} When the instrument will be used to assess health professionals and/or institutions for their EBP behaviour, this might be combined with a measurement of EBP competency, like knowledge, skills and/or attitudes. However, this review did not focus on these domains.
Tools measuring EBP behaviour of healthcare professionals should assess the use of (one of the) EBP steps in practice, the performance of evidence-based clinical manoeuvres and/or the effect of EBP on patient outcomes. Tilson et al. stated that all five EBP steps a clinician would use in practice need to be considered. The tools identified in this review most frequently appreciate accessing evidence (step 2), which allows only a narrow view on EBP behaviour neglecting the integration of evidence with patient values and clinical expertise.

Because we did not restrict our review to specific healthcare settings, the tools presented here could be applied to a wide range of healthcare professionals. However, each group of healthcare professionals might have specific needs or barriers for EBP. For example, a study shows for non-English speaking nurses understanding English articles can be a large barrier, while for physicians this seems a less important problem. Therefore, the selection of the optimal or most appropriate tool might be tailored to the group of healthcare professionals.

When choosing the optimal method, the feasibility of the instrument should also be considered: interviews and observations are more time-consuming for the evaluator than questionnaires. However, interviews and observations may give more in-depth information. In this study we did not assess the feasibility of instruments, although little information on this aspect was reported in the included studies.

The questionnaire of Boström showed adequate validity, which seems promising, but was not tested for reliability. However, EBP behaviour is measured using only six items. As the questionnaire is self-reported, this might introduce bias, because of social desirable answers. The questionnaire is constructed to assess the EBP level of Swedish nurses, so its generalizability should be assessed before adopting it in practice.

In conclusion, this review identified tools that validly and reliably assess single steps of EBP behaviour. One tool measures all aspects of EBP behaviour validly, but the reliability of this tool has not been established yet.

For future developmental studies this tool should be evaluated more extensively and/or existing valid and reliable tools could be combined into an instrument that covers all EBP steps. Evaluating EBP behaviour is important to deliver optimal healthcare. For proper evaluation it is necessary to predetermine the EBP behaviour that is to be expected, the aim of the assessment and the context and setting of the healthcare profession to be assessed.
Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/eb-2012-100969).

Appendix 1
Overview of EBM behavior assessment tools of which validity and/or reliability have been tested (extension table 1).

Appendix 2
Search strategy used to retrieve selected articles.

Appendix 3
Data abstraction form.
REFERENCES


55. Romani S, Forni C. Know-how, attitudes and obstacles to the implementation of evidence-based prac-
57. Estrada N. Exploring perceptions of a learning organization by RNs and relationship to EBP beliefs and
59. Bogdan-Lovis EA, Sousa A. The contextual influence of professional culture: certified nurse-midwives’
60. Rolfe G, Segrott J, Jordan S. Tensions and contradictions in nurses’ perspectives of evidence-based
62. Milner FM, Estabrooks CA, Humphrey C. Clinical nurse educators as agents for change: increasing
63. Montori VM, Tabini CC, Ebbert JO. A qualitative assessment of 1st-year internal medicine residents’
intervention to accelerate clinical use of evidence-based information from digital libraries. *J Am Med
Inform Assoc* 2006;13:593-600.
65. Van Duppen D, Aertgeerts B, Hannes K. et al. Online on-the-spot searching increases use of evidence
66. Fung MF, Walker M, Fung KF. et al. An Internet-based learning portfolio in resident education: the
67. McKnight M. The information seeking of on-duty critical care nurses: evidence from participant
68. Tilburt JC, Goold SD, Siddiqi N. et al. How do doctors use information in real-time? A qualitative study
70. Linthorst GE, Daniels JMA, Van Westerloo DJ. The majority of bold statements expressed during grand
study to explore clinical practice, women’s preferences and provider’s views. *BMC Pregnancy
73. Kachuie MA, Sadeghizadeh A, Taheri H. et al. Is our clinical decision making based on the best research
74. Ayre S, Walters G. Are therapeutic decisions made on the medical admissions unit any more evidence-
75. Waters KL, Wiebe N, Cramer K. et al. Treatment in the pediatric emergency department is evidence
76. Lee HY, Ahn HS, Jang JA. et al. Comparison of evidence-based therapeutic intervention between
77. Straus SE, Bail C, Balcombe N. et al. Teaching evidence-based medicine skills can change practice in a
78. Moyer VA, Gist AK, Elliott EJ. Is the practice of paediatric inpatient medicine evidence-based?
79. Hui AC, Mak J, Wong SM. et al. The practice of evidence-based medicine in an acute medical ward:
83. Gill P, Dowell AC, Neal RD. et al. Evidence based general practice: a retrospective study of


Glasziou PP. How often does searching improve or mislead us? A systematic review. Conference abstract. *5th International Conference Evidence Based Health Care Teachers and Developers Sicily 2009; Oct 28-Nov 1.*
