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Evaluation of a computerized problem-oriented medical record in a hospital department: Does it support daily clinical practice?

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ABSTRACT

Purpose: Evaluation of a computerized problem-oriented medical record (CPOMR) for health care work.

Methods: A qualitative study of the daily use of a CPOMR at an internal medicine hospital ward over a period of 3 months, during which 66 patients were treated based on clinical information recorded in the CPOMR though back up by a paper-based record was available. The study is based on participant observation and interviews with the clinicians who had the most profound and extensive experience in the use of the CPOMR. Before and during the test-period the author attended project planning meetings, a training workshop in the use of the CPOMR for nurses and physicians and local coordination meetings. After the test, one focus-group discussion with physicians and nurses (6 participants; duration 11/2 h) was conducted as well as 13 open-ended interviews (5 nurses, 2 social and health assistants, 4 physicians, 2 IT-people; duration: 16–42 min; average of 29 min). The interviewees formed the core group using the CPOMR.

Results: Use of the CPOMR led to more time spent documenting clinical work, fragmentation of patient situation into separate problems, and lack of an overview.

Conclusion: The problem-oriented method for structuring a computerized medical record may provide a description of how physicians think or ought to think, but does not adequately support complex clinical work. While the CPOMR can be used for patients with few, simple problems who are admitted for only a short time, it is not useful for patients with a complex set of problems or for patients admitted for longer periods of time. This is in accordance with criticism of the paper-based POMR, the problematic points of which do not seem to be alleviated through computerization. The problem-oriented way of ordering information should be accompanied by a source- and time-oriented approach.

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1. Introduction

The problem-oriented patient record was proposed in the late 1960s by Weed [1,2] who lamented the then allegedly dismal state of patient record keeping. Instead of organizing data on

patients according to source (X-ray, laboratory, etc.) or chronology (dates), Weed proposed that data be ordered according to the patient's problems. At the front of a patient record, there should be a list of the patient's problems under which all data were to be ordered. The aim of the problem-oriented record

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was, according to Weed, not only proper ordering of data, but also to make the record become a scientific document and encourage clinicians to work in a scientific, problem-solving way. To achieve this, Weed suggested a sequence of steps in clinical practice: gather the patient's own story (Subjective), make clinical observations (Objective), evaluate (Assessment), and make a plan for treatment and care (Plan)(SOAP). Weed's ambition was a patient record that was "concise, cogent, complete (not diffuse, superficial, fragmentary) [as the old record]" [2: pvii]. The problem-oriented approach spread in North America and Europe [3], and though the approach had strong proponents amongst physicians [3–5], it has spread more amongst nurses who have adopted SOAP widely [6].

Weed applied the problem-oriented approach to patient records based on paper, but envisioned that it would only realize its potential through computerization [1: pp. 655–656, 2: pp. 109–122]: "Every phase of medical action will benefit from computerization" [2: p. 109]. Weed has maintained this argument until today: "medical records must be rigorously maintained in electronic form with a structure that permits rapid comprehension, reliable monitoring, and meaningful outcome studies. The structure required is that data and the recording of provider actions be organised around a complete list of the patient's problems" [7: p. 3]. CPOMRs have been used at, for example, the Vermont Hospital (1970–74) in the U.S. [8: p. 15] and the Karolinska Hospital in Sweden (1968–71) [3]. They are not in use any more and since then only few studies have investigated the actual use of a CPOMR (see though [9]).

In Denmark, the National Board of Health has developed a standard for electronic patient records, basic structure for electronic health records (BEHR), based upon the problem-oriented approach. Since 2000, the board has initiated the development of a number of prototypes based on different versions of BEHR in order to test the suitability of the standard for clinical work and for submission of clinical information to a national patient database (see www.sst.dk). This article reports from a test in the autumn of 2004 of a prototype based on BEHR conducted in a department of internal medicine at a university hospital in a county in Denmark over a 3 month period. The article will proceed in the following manner: Section 2 presents the background for the test in question, the standard and the prototype developed; Section 3 presents the qualitative methods applied; Section 4 presents the results of the evaluation, Section 5 discusses the evaluation results with regard to the suitability of the CPOMR and BEHR for clinical work, while, finally, Section 6 summarizes the article.

2. Background

Various electronic health records (EHR) are currently under construction in different counties in Denmark as part of a national strategy for EHR which was initiated in 1999 when the Danish Ministry of Health published a report on the use of information technology in hospitals. The current aim is to have EHRs at all hospitals by the turn of 2006/2007. As a corollary of the national strategy, the Danish National Board of Health has been working on a "Basic Structure for Electronic Health Records" (BEHR) with a three-fold goal: to ensure that Danish EHRs can exchange information across the formats of

individual county EHRs; to ensure that information about diseases and treatments can be submitted to the central registry of the National Board of Health; and to ensure continuity of multi-professional health care across all sectors [10]: Section 4. The first version of BEHR was published in 2000 and led to the first national basic structure (version 1.01) in January 2002. The basic common structure has two levels: a conceptual level called 'Clinical Process' for documenting clinical information and a computer-science level called 'Reference Information Model'. Clinical Process is seen as the application of a general method of problem solving to the medical domain by the National Board of Health, and it was developed with explicit reference to Lawrence Weed's problem-oriented approach [11]. The BEHR reflects Weed's division of clinical decision-making into steps: the clinician obtains information about the situation of a patient; makes a diagnosis as to the patient's problems; plans examinations and/or treatment; and subsequently conducts an evaluation of the examination and/or treatment results. Having performed this series of steps, the clinician can engage in a new round of information-gathering, diagnosis, planning, and evaluation (Fig. 1, below). In the wording chosen by the National Health Board to make BEHR multi-professional, Clinical Process includes at a generic level 'Consideration' leading to identification of a 'Health State' (i.e. a diagnosis of physician or a nurse's care problem). 'Planning' leads to 'Health Activity' (e.g. care activities, or prescription of treatment, medication or examination), the 'Execution' of which produces 'Intervention Results' that can be subjected to 'Evaluation' in comparison to 'Operational Health Goals' (see Fig. 1).

Importantly, the BEHR (version 2.0) prescribes all health states to have 'Focused Information' as their basis in order to document the reason why this health state was entered. If necessary, a 'Diagnostic Note' can be attached to the health state. Similarly, all health activities must have 'Focused Information' as an indication in order to document why an intervention has been planned and a health activity must also have a stated 'Intention' to document the goal of the intervention. If necessary, a 'Planning Note' can be attached to the health activity.

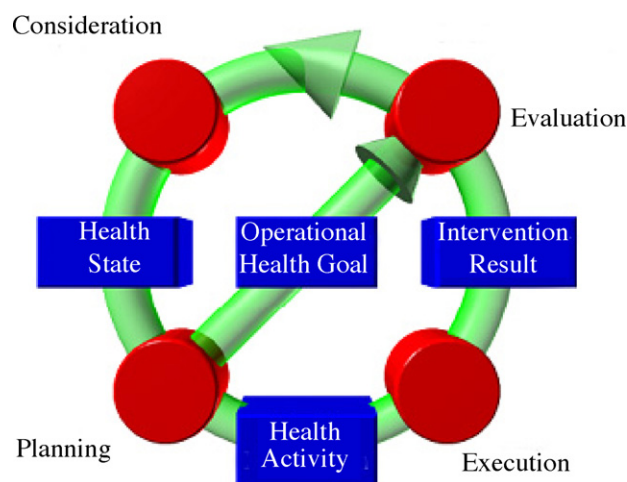


Fig. 1 – Visual representation of the interdisciplinary Clinical Process. From BEHR Version 2.0, see [12] (author's translation).

In connection with 'Execution' an 'Execution Note' can be attached. Health states and health activities are listed separately and can be placed in a hierarchy so that the main state or activity is uppermost, and can furthermore be ordered into main states under which secondary states are subsumed [12] (Figs. 2 and 3).

The National Health Board acknowledges that modelling the mental processes of clinicians "calls for a fair amount of humbleness with an equal amount of uncertainty attached to the result", but has nevertheless had a sufficient confirmative response from healthcare providers to believe that the model and concepts of Clinical Process are applicable by all clinicians. According to the National Health Board "Even though most practitioners document time-oriented and often source-oriented as well, their method of work is basically problem-oriented" [13: p. 3].

The National Board of Health acknowledges that the problem-oriented approach has been found wanting on several points, but argues that these – at least partly – will be solved by computerization.

The problem-oriented record has been criticized for being too cumbersome and incompatible with the free mode of expression demanded in relation to clinical work. A part of these difficulties is no doubt connected to documentation on paper, where the model's possibilities cannot be unfolded fully. There should, however, not be anything alien in the mode of thinking compared to physicians' clinical problem-solving, and it is likely that application of IT in the form of EHR will meet a part of the criticism raised [14: p. 6] (author's translation).

The board, however, did not want to rely on this hope alone and initiated the development of several BEHR prototypes that were to be evaluated through use in daily clinical practice in 2003 and 2004. The aim of the project was three-fold: First, to test whether the conceptual model derived from the problem-oriented approach suited the core needs of clinical documentation and exchange of information in daily clinical practice; second, to ensure that data between different EHRs can be exchanged and submitted to a central register, and, third, to ensure that the technical as well as organizational preconditions for the implementation of BEHR have been discussed and described. Two large-scale prototype tests were conducted and this article reports on one of these. All projects suffered from delays because of difficulties in the construction of the prototypes, in planning the training of clinicians while taking care of patients, and in making the technical networks run smoothly. The BEHR prototype in focus in this article was no exception: Initially, the test was run in the autumn of 2003, but because of additional work on the development of clinical systems of categorization (similar to ICD-10) and the implementation of these in the prototype, the test was postponed to the spring of 2004. By May 2004, 120 clinicians had been trained in the prototype (12 h) and the test was started. To the disappointment of all, however, the prototype turned out to be working too slowly and had several bugs of which some were serious. In addition, many clinicians did not consider themselves sufficiently well-trained enough to work with the BEHR prototype, which can be attributed to unfamiliarity with the application itself and a lack of experience with the problem-oriented mode of record keeping. In the end, the first test was terminated in

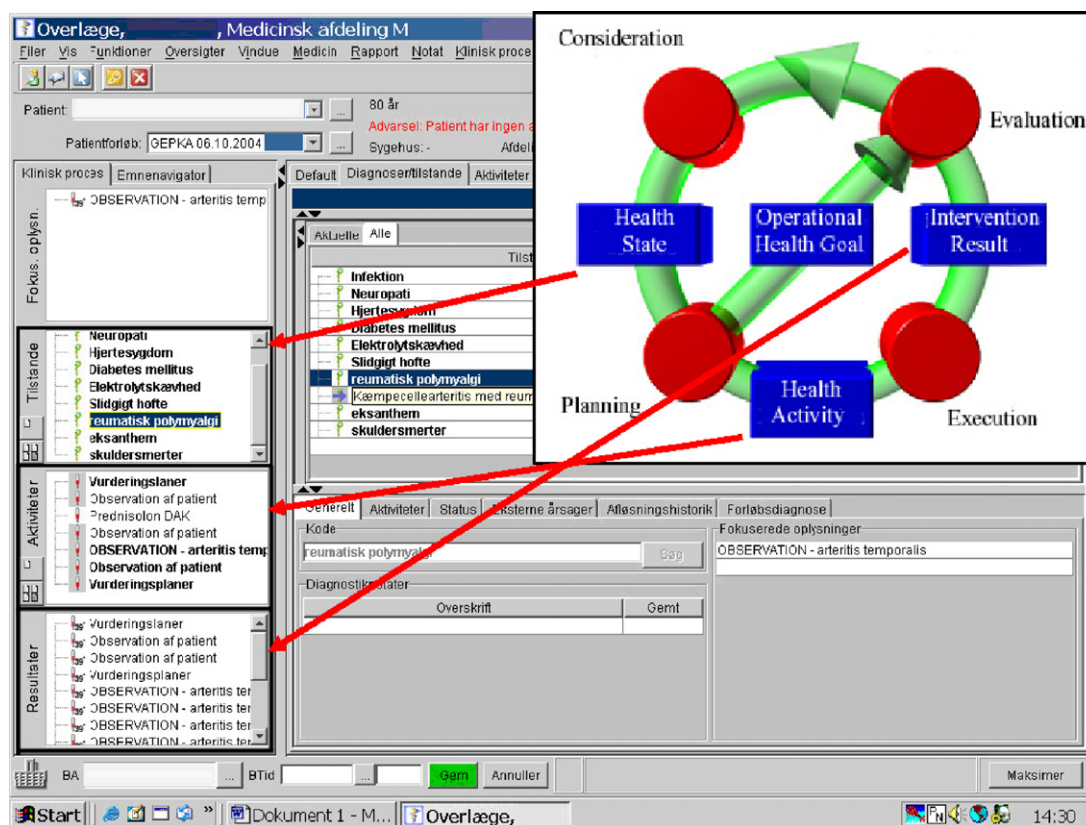


Fig. 2 – The BEHR model and its relation to the prototype developed.

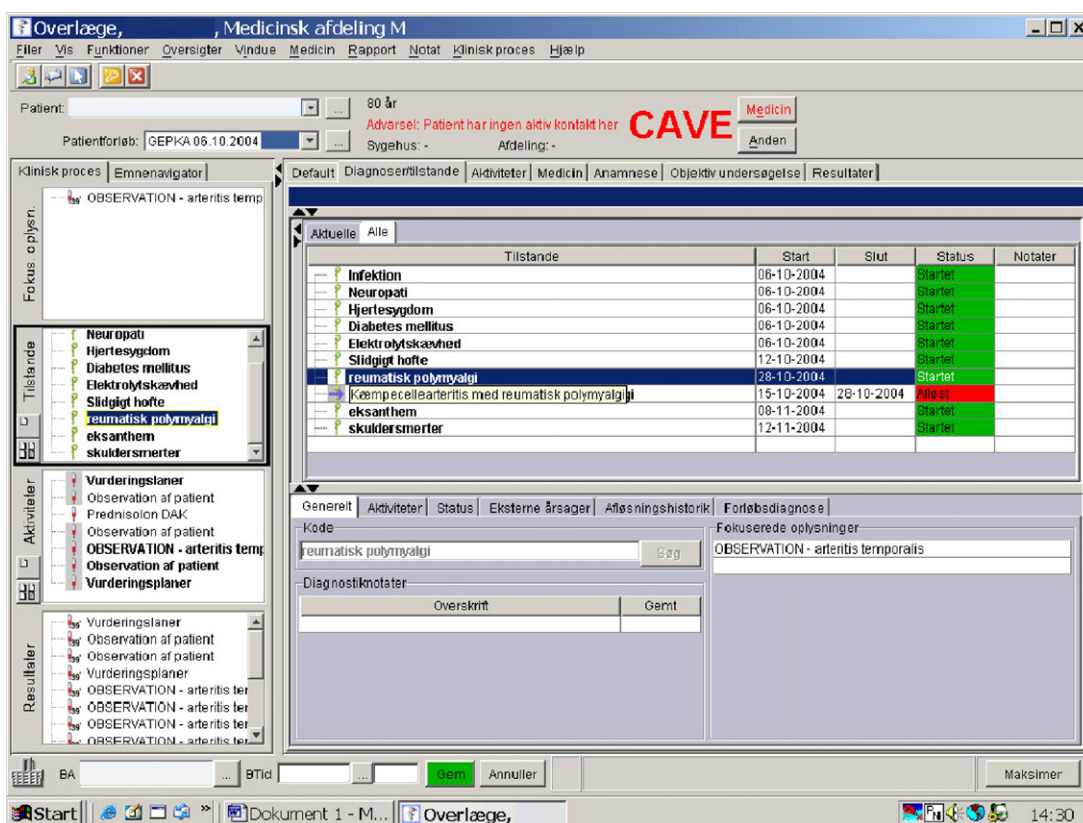


Fig. 3 – Health-state hierarchy. 10 health states have been entered over a 1 month period. A health state can be marked and all associated activities listed.

early June 2004 without the prototype having become part of daily, clinical practice. Over the summer the prototype was further developed, most bugs were resolved, the network and servers were adjusted, and clinicians received a new round of training (4 h). A second test-period was then commenced 13th September and it ended 20th December 2004. Though not all problems had been overcome, the CPOMR was used in daily clinical practice. This article reports the results of this second period.

3. Methods

This article builds on an ethnographic case-study applying qualitative methods such as participant observation and interviews [15] and conducted between January 2004 and 2005. During the first test-period the author participated in planning meetings (11), training in using the prototype based on BEHR (2 days), observation of use (4 days) and interviews with clinicians (25; 14 nurses, 6 physicians, 1 secretary, 4 IT-people). The duration of interviews varied between 13 and 80 min; all in all 13 h 5 min.; average 31 min. During the second test-period, the author attended 8 planning meetings, conducted 1 focus-group interview with physicians and nurses (6 participants, 11/2 h) and 13 interviews (5 nurses, 2 social and health assistants, 4 physicians, 2 IT-people). The duration of the interviews varied between 16 and 42 min with an average of 29 min. Interviewees from the second test-period constitute the core

groups of clinicians involved and represent the most profound and extensive practical knowledge available of the CPOMR from the test. Interviews were transcribed and coded by the use of a computer program for qualitative analysis (Nvivo 4.0) into 43 categories, which were ordered into two groups. One group pertains to the process of the pilot test (16 categories; 180 passages) while the other pertains to the BEHR model (27 categories; 224 passages). The latter group was analyzed for significant statements and observations (passages per code were: 'Overview' 44; 'Support for clinical work' 34; 'Redundant documentation' 16; 'Notes' 15; 'Indications' 13; 'Finding information' 11; 'More work' 11; 'Cross-professionalism' 10; plus 19 additional categories with less than 10 remarks).

4. Results

During the second trial period, 66 patients had their records maintained on the prototype based on BEHR most with a back up paper-based record: i.e. the prototype was used in daily clinical practice at the department. Of the 66 patients, most were admitted for 1–2 days, while around 10 patients were admitted during a period of 3 weeks. Despite the technical improvements and renewed training, the prototype still had some bugs and several clinicians still felt uncomfortable working with the prototype. Working with the BEHR prototype was cumbersome and demanded more time than the paper-based patient records with which the clinicians were better

acquainted. Hence, the test was only accomplished through the dedication of a core group of 20 clinicians, good technical support, and support by the department's management, which was involved in the trial on a daily basis.

The conclusion arrived at by the centrally involved clinicians was that the prototype did not support daily clinical practice, but entailed additional work spent documenting and reading the record. Except for simple patient cases, the prototype led to a critical lack of overview of patient treatment and care. The core group of clinicians also concluded that the difficulties could not be attributed solely to the application prototype or lacking skills of the clinicians, but stemmed from the BEHR model. The criticism of the clinicians can be divided into three issues.

4.1. Fragmentation & loss of overview

One problem encountered by the clinicians using the prototype was the fragmentation of a patient's situation into a number of separate health states and the treatment of the patient into a number of separate health activities (see Figs. 4 and 5). For patients with only few health states and health activities, this was no problem, but as the BEHR prototype was run at a department of internal medicine (typically diabetes) many patients suffered from multiple health states. While, for example, the list of health states enabled physicians to get an overview of all listed states, the list gave no indication of which health state was the most acute, since the most acute prob-

lem may not be identical to the patient's main health state(s) (diagnosis). Nor did the list give any indication about possible interrelations between, for example, diabetes and pneumonia and a heart condition. It was, furthermore, not clear where such information should be placed, since the BEHR does not provide for notices about acute matters or for overview information. Overview information would either have to be placed with the main health states as a 'diagnostic note' or written into all diagnostic notes pertaining to health states. Since diagnostic notes could be sorted chronologically, the latter option would be a way to get the most recent update on a patient's situation in total, but would at the same time circumvent the basic ideas of the BEHR.

Related to the problems of acute matters or interrelations is the problem of getting an overall view of the patient, which would have to be constructed in the physician's or nurse's head from the list of health states, health activities, and intervention results.

4.2. Where to put information?

The division of a patient's situation into a number of states and activities also lead to doubts about where to place information. This was especially acute for nurses whose health activities often cut across different health states. One nurse said: "If a patient has anaemia, appendicitis and a broken leg, where should I then put health activities like personal care? The patient has to be washed, but should I use one or all health

Aktivitet	Status	Start	Slut	Info
Tilstedeværelse	Gennemført	13-12-200...	16-12-200...	
Objektiv undersøgelse	Gennemført	13-12-200...	13-12-200...	✓
Objektiv undersøgelse	Gennemført	13-12-200...	13-12-200...	✓
Vurderingsplaner	Gennemført	13-12-200...	16-12-200...	✓
Vurderingsplaner	Gennemført	13-12-200...	14-12-200...	✓
Modtagelse af akut pt.	Gennemført	13-12-200...	13-12-200...	
Væsketal x 3 ugentligt	Gennemført	13-12-200...	16-12-200...	✓
Medicin for apoplexi	I gang	13-12-200...		
Medicin for depression	I gang	13-12-200...		
Medicin for hypertension	I gang	13-12-200...		
Medicin for svamp	I gang	13-12-200...		
Medicin for vitaminmangel	I gang	13-12-200...		
Medicin for smerter	I gang	13-12-200...		
Ugyldiggjort	Ordineret	13-12-200...		
Medicin for mavesår	I gang	13-12-200...		
Observation af patient -dehydratio	Gennemført	13-12-200...	16-12-200...	✓
Observation af patient -apoplexia	Gennemført	13-12-200...	16-12-200...	✓
Observation af patient -depres.mertis	Gennemført	13-12-200...	16-12-200...	✓
Observation af patient -ulcus vent.	Gennemført	13-12-200...	16-12-200...	✓
Observation af patient -diarre	Gennemført	14-12-200...	16-12-200...	✓
faces til D+R	Gennemført	16-12-200...	16-12-200...	✓
væskeskema	Gennemført	13-12-200...	16-12-200...	✓
Væsketerapi	Gennemført	13-12-200...	16-12-200...	✓
Personlig pleje	Gennemført	14-12-200...	16-12-200...	✓
Mobilisering	Gennemført	14-12-200...	16-12-200...	✓
Observation af hud	Gennemført	14-12-200...	16-12-200...	✓
Kateter-pleje	Gennemført	13-12-200...	16-12-200...	✓
Nakdes til at spise	Gennemført	14-12-200...	16-12-200...	✓
Kostregistrering	Gennemført	16-12-200...	16-12-200...	✓

Fig. 4 – An example of an activity-hierarchy for a patient. In 3 days, 28 activities have been entered. Green signals, ongoing states; red, completed states. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of the article.)

states as an indication for this activity?” Using all relevant health activities as an indication for a health activity cutting across them would be contrary to the intention of BEHR, but using only one health state as an indication could on the other hand mean that the activity would be overlooked. This problem was also relevant to physicians. In one case, a patient who was admitted with respiratory problems had an X-ray of the thorax prescribed (health activity ‘X-ray of thorax’ linked to ‘respiratory problem’ as indication). As another physician the next day suspected the patient to have a heart problem as well another X-ray of the heart was ordered (health activity ‘X-ray of thorax’ linked to health state ‘suspicion of heart condition’ as indication), because the physician overlooked that an X-ray of the thorax had already been ordered and received. The result was more money and time spent for another X-ray and delayed decision-making upon the suspected heart condition. One solution would, of course, be to put the X-ray under all health states to ensure that it would not be overlooked. This on the other hand would entail a lot of work for the documenting clinician and entail clinicians reading the record getting the same information over and over again. The choices seemed to be either to place information in one place with the risk of the information being overlooked, or to place the information in several places with redundancy of information and probably loss of overview as a result.

4.3. More work

The use of the CPOMR entailed additional work for all clinicians. Even with physicians dictating anamnesis and objective findings on tape to be written out by a secretary, documenting health states (diagnosis) and health activities (examinations, laboratory tests, medication, etc.) took around 1 h for a physician with good experience with the CPOMR. Compared to the few minutes it took to dictate it all findings and handing on the tape to a secretary to be written out, this was an extensive amount of additional work. Nurses similarly experience spending more time documenting on the CPOMR than previously, though not to the same extent: probably because they already spent more time on documentation (in handwriting) than physicians (dictating). The explanation for the additional time spent on documenting can partly, but not fully, be attributed to a bad user-interface of the CPOMR prototype and slow performance. Another part of the explanation, however, lies in the demand set up in the BEHR-model that every health state and health activity must be based on a documented indication or ‘focused information’. With a lot of health states and health activities such a requirement makes good sense, since diagnosis and interventions should be based on reasons. However, the rule also applied to such routine activities as taking temperature, blood pressure and pulse, which previously were just registered, but now required ‘focused information’ or a ‘health state’ to be written in the CPOMR. Similarly, in the case of a patient getting a rash because of urinary inconsistency, this could be written as “rash because of urinary inconsistency” in the old record, but now requires the physician to enter ‘rash’ as focused information, then to enter urinary inconsistency as a health state, and subsequently to link the focused information ‘rash’ with the health state ‘urine inconsistency’. To put on a cream because

of the rash could in the old record be written as “cream XX applied because of rash because of urinary inconsistency”, but in the BEHR requires the steps spelled out above and then the nurse to enter the health activity “Application of Cream XX”, which has to be linked to the health state “urine inconsistency”. All in all, the BEHR entailed more work in documenting because of the requirement that all health activities and states be linked to focused information and because the BEHR model in itself breaks down practice into separate steps which each have to be documented.

Another feature of the BEHR that led to more work was the lack of a summary overview for all health states and health activities. Overviews had to be constructed in the head of the physician or nurse by going through every single health state and/or health activity separately and making notes on paper if this information was too much to handle by memory alone. Because of the lack of a summary overview, clinicians felt compelled to do this, since they feared missing vital information placed under one of the health states or health activities.

All in all, the conclusion reached by the core groups of clinicians was that BEHR possibly might reflect how clinicians think or ought to think, but BEHR did not provide the information resources needed in daily clinical work. Instead BEHR led to more work, loss of overview and fragmentation of a patient's situation. The problem-oriented approach alone could not satisfy the information needs in daily practice and the clinicians recommended source- and time-oriented modes to be incorporated as complementary modes of organizing data. In this way, the clinicians argued, they could see, for example, whether an X-ray of the thorax had been ordered (and would not be ordered twice because the need arose twice from the problem ‘respiratory problem’ as well the problem ‘heart condition’) or get a chronological overview of the patient's situation with access to the latest summary to provide an overview. An alternative solution would be to make the patient record task-oriented as suggested in efforts at activity-based computing [16].

5. Discussion

The results of the trial test of the BEHR prototype can be and were (see below) contested. Several clinicians, most of whom were nurses or social and health assistants, did not feel that they knew enough about, or had sufficient experience with, the BEHR model and the prototype, and they similarly felt that the prototype was lacking in functionality or usability. These clinicians expressed the opinion that at least some of the difficulties encountered might have been less if they had had more training than the 12 h already received and if the interface of the prototype had been better designed. While the nurses' paper-based care records were problem-oriented, the physicians' patient records were not, and for the latter the test meant a two-fold shift from traditional to problem-orientation and from paper to electronic records. This two-fold shift and some technical difficulties with the prototype poses a challenge to the attribution of causes. Should the difficulties experienced by the clinicians when working with the prototype be attributed to insufficient training, a technically incomplete prototype or the basic BEHR model? However, the

clinicians who had been using the BEHR model and the prototype most argued that the problems encountered were neither due to lack of training nor the acknowledged insufficiencies of the prototype. Amongst these critics was, for example, a senior physician who was intensively involved in the development BEHR model for a long period of time and who before the trial had been a strong supporter of the model. He had also been intensively involved in the development of the prototype. Commenting on the difference between the CPOMR and a the previous paper-based record, he states: "Instead of having chronological view based on which you know that this is the patient's situation is now and that is what I have to act upon, you now have to read different kinds of health states and in your head form a description of a patient. That is what you have to base your actions on, and you cannot." Another critic was a resident hired specifically to take some of the extra work-load in connection with the trial and who had developed extensive experience with the prototype during his daily use of it during the trial. He stated that "BEHR is technically difficult to approach. Even if it may be OK as a model, the lack of overview is its deathblow. It is simply not good enough. If you came to an acutely ill patient, where you had to form an overview quickly, this was not possible."

There are two arguments in support of the criticism raised by the core group of clinicians against the BEHR model. First, the BEHR model itself has a number of characteristics that seem directly linked to the difficulties encountered. The model, for example, involves more documentation than the present paper-based record because it demands documentation in each of the four steps (consideration, planning, execution, and evaluation) and demands explicit 'focused information' for every health state and an explicit 'indication' and 'intention' for each health activity. In the old record, the physician or nurse could see the patient, look at results and make new prescriptions and plans in one process before documenting a summary of it all in the patient's record. Furthermore, the BEHR model has individual states or activities as the basic entities and demands that all information is ordered under these, thus leading to fragmentation of the patient's situation and to uncertainty about where to put information that is relevant for more than one state or activity (leading to either redundancy of information or danger of oversight of vital information as described above). While it is possible to make general summaries for a patient, the model does not support them, nor provide a specific place to put them.

Second, the critical points raised by the core group of clinicians against the BEHR are in accordance with the criticism that has been raised against the problem-oriented approach in general. Weed himself was aware of the danger of fragmentation, but argued that "One must learn how to move easily from a single-minded focus on one problem to attention to the total list and interrelations of multiple problems" [1: p. 653]. The problem list would solve the danger of fragmentation through the progress notes of the individual problems and lack of an overview had, he argued, its basis in misapprehension of single elements: "If a complete analysis is done on each finding, integration of related ones is an automatic by-product. Failure to integrate findings into a valid single entity can almost always be traced to incomplete understanding of

all the implications of one or all of them." [1: p. 654]. Weed was, however, countered on this issue by several critics. Alvin Feinstein, for example, argued that problems lists augmented fragmentation, since physicians could focus on single issues without having to consider the overall situation of a patient: "Each specialist can approach the chart, find his section of it, review and augment its data, and depart—without having to be exposed to or to become aware of any problems beyond the boundaries of that specialty. In a properly maintained old-style record, the specialist could not avoid seeing accounts of all the things that had happened to the patient . . . In the new-style record, the specialist can be spared all this distracting information and can concentrate exclusively on his own problem" [17: p. 757–758]. The danger of fragmentation was further aggravated since "no routine demand is made for diagnostic summations, inferences, and explanations. In the old-style procedures diagnostic explanations were required for all findings, and the ability to sort the findings into single or multiple diagnoses was a vital constituent of clinical wisdom.", [17: pp. 757–758 and p. 759]. Another critic, argued that "the emphasis on compartmentalization, so important to the POR system, has the potential of negating synthetic thinking" [18: p. 607–608]. This criticism from the 1970s is echoed in a recent trial in Hong Kong of a CPOMR, where "All the doctors, except the two visiting fellows, disliked the POMR. The reason given by most of them was that patient problems were inter-related and so breaking down the record by problem was not possible" [9].

Finally, critics argued that the problem-oriented approach led to more work. "To list and catalog each item properly in the original data base and to add each new item appropriately in a suitable indexed fashion is a time-consuming activity" [17: pp. 757–758 and p. 758]. Similar experiences were encountered in the Hong Kong trial: "Although some doctors said that the structured notes were easier to read, they felt that they would not help much in the consultation because they usually needed to review the whole note in order to be sure they had not missed out any important information. On the other hand, some doctors found the new records difficult to use because each record had many pages, and each page had only one note" [9: p. 54].

Related criticism can be found of the problem-oriented approach with regards to redundancy of information arising from the difficulty of placing data relevant to several problems and even defining what constitutes a 'problem' [17: pp. 757–758; 18: pp. 607–608; 3: pp. 17–18; 19]. In the successful case of a CPOMR at Karolinska, the problem-orientation was supplemented by chronologically ordered information in order to overcome the problem of redundancy when information may pertain to several problems [17: pp. 757–758]. The CPOMR at Vermont similarly supported chronological and source-oriented views on the record in addition to problem-orientation [8: p. 47]. This supports this trial's result that chronology and source-orientation were needed as additions to problem-orientation.

5.1. Response from the National Health Board

The results presented in this article were written up in a report submitted to the National Health Board in 2004. The

board, however, disagreed with the findings and relied on two counter-arguments. Firstly, the board pointed to a report written by a body assigned with the task of collecting experience and conclusions from the different BEHR trials conducted in 2003 and 2004. This report pointed to the delays and technical difficulties in the trials and argued that the BEHR prototype in this test was technically insufficient to a degree that seriously undermined any attempt to draw conclusions. It was, according to this alternative report, impossible to decide whether the difficulties with lack of an overview, more work, redundancy of information etc. should be accorded to the user-interface, the application or the BEHR model itself. All in all the report concluded, the BEHR model was not compromised [20]. As argued above, there is however a good case to the extent that the core groups of users of the prototype did have sufficient insight into the BEHR model and the prototype to believe their attribution of the causes of difficulties to the BEHR model.

Second, in a public debate that arose after the criticism levelled against the BEHR model, the National Board of Health pointed to the other BEHR trials in which different prototypes based on the BEHR had been run and in which the conclusions had been in favour of the model. However, in some of these trials the prototypes were either not tested as part of daily clinical practice, which is crucial since it is in practice that the perception of BEHR as depicting clinical thinking has to prove its truth. The other trials were carried out on surgical or other wards (e.g. cardiology, geriatrics), where patients most often suffer few (though of course often serious) problems. Here the problems of fragmentation, redundancy of information, etc. do not arise to the same extent as they do on an internal medicine ward, because the number of health states and activities are relatively few. These other trials are then actually in accordance with the conclusion of the BEHR trial described here: BEHR works for patients with few problems and admitted for only short periods of time, but not for patients with a complex set of problems and/or admitted for longer periods of time.

After a hearing in 2005 with clinicians from the various BEHR trials, the National Board of Health has softened its stand on extensive documentation ('focused information' and 'indication' are not compulsory for all health states or activities (e.g. measuring of blood pressure, pulse and temperature)), but maintains the BEHR model. Since 2005, BEHR has been a normative standard for EHRs in Denmark.

A computerized problem-oriented medical record may be made to work, of course, as has been proven on the gynaecology ward, Vermont Hospital, USA, (1970–1974) and at Karolinska Hospital, Sweden, (1968–1971). However, all BEHR trials in Denmark were, as mentioned, delayed, which suggests that the development of a CPOMR is not easy (probably no EHR is). Furthermore, a recurrent conclusion in the reports on the BEHR trials is that the need for training of clinicians had been underestimated, because the shift from paper- to computer-based medical records and the shift from source- and time- to problem-orientation were more difficult than anticipated. Additionally, with the inherent difficulties in the problem-oriented approach in mind, the introduction of a CPOMR

Summary points

What is known about the subject

- Problem-oriented medical records were suggested by Lawrence Weed in the 1960s as a way to enhance record-keeping and clinical learning.
- Computerization has been envisioned to alleviate the negative consequences of problem-oriented medical records: fragmentation of patient cases, loss of overview and more work for clinicians.
- Studies of computerized problem-oriented medical records applied in clinical practice are few.

What this paper adds

- A study of a computerized problem-oriented medical record in use in clinical practice.
- Computerization does not in itself solve the problems of fragmentation, loss of overview and more work for clinicians.
- Problem-orientation should be supplemented with chronological, source-oriented and possibly task-oriented ways of organizing the record in order to support clinical work.

seems to require large investments in human, organizational and financial capital.

6. Conclusion

This article has reported on the trial test of a computerized problem-oriented medical record (CPOMR) in a hospital department. The trial showed that use of the CPOMR led to more time spent documenting clinical work, fragmentation of patient situation into separate problems, and lack of an overview. It is concluded that the problem-oriented method for structuring a computerized medical record may provide a description of how physicians think or ought to think, but does not adequately support complex clinical work. While the CPOMR can be used for patients with few, simple problems who are admitted for only a short time, the CPOMR is not useful for patients with a complex set of problems or for patients admitted for longer periods of time. This is in accordance with criticism of the paper-based POMR, whose problematic points do not seem to be alleviated through computerization. The problem-oriented way of ordering information should be accompanied by a source- and time-oriented approach or the possibilities of task-orientation should be explored.

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