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Vital sign documentation in electronic records: the development of workarounds

Jean E. Stevenson[1,2], Johan Israelsson[3,] Göran Petersson[2], Gunilla Nilsson[2], Peter A. Bath[1]

[1]*Health Informatics Research Group, Information School, University of Sheffield, UK;*
[2]*eHealth Institute, Linnaeus University, Kalmar Sweden;* [3]*Cardiology Division, Kalmar County Hospital, Sweden*

Workarounds are commonplace in health care settings. An increase in the use of electronic health records (EHR) has led to an escalation of workarounds as health care professionals cope with systems which are inadequate for their needs. Closely related to this, the documentation of vital signs in EHR has been problematic. The accuracy and completeness of vital sign documentation has a direct impact on the recognition of deterioration in a patient's condition. We examined work flow processes to identify workarounds related to vital signs in a 372-bed hospital in Sweden. In three clinical areas, a qualitative study was performed with data collected during observations and interviews and analysed through thematic content analysis. We identified paper workarounds in the form of hand-written notes and a total of eight pre-printed paper observation charts. Our results suggested that nurses created workarounds to allow a smooth workflow and to ensure patients safety.

Keywords
Electronic records, vital signs, workarounds, patient safety.

1. Introduction

Workarounds can be defined as nonstandard methods for accomplishing work blocked by dysfunctional processes [1] and are common in complex environments such as healthcare settings. Dealing with unexpected situations is common practice for health care professionals and thus they are often masters at workarounds [2]. The introduction of electronic health records (EHR) in healthcare settings may have led to an escalation of workarounds [2].

Increasingly used for all aspects of clinical documentation, EHRs have the potential to improve the quality of health care by facilitating communication and the accessibility of information [3]. Problems with EHRs have also been identified: lack of overview; excessive time to document and retrieve information; and poor navigability [4]. Because of these problems, EHRs do not meet the needs of front-line staff who, in turn, often resort to workarounds in order to achieve their goals [5]. One problematic area is in the documentation of vital signs: for example, temperature, pulse, respiratory rate, blood pressure and oxygen saturation [6]. This is a matter of concern as close 'monitoring' of vital signs is key to early recognition of clinical deterioration in hospital patients. Studies have repeatedly shown that early detection of clinical deterioration and timely management can reduce the incidence of adverse events: for example, cardiac arrest, unplanned admission to intensive care units (ICU), prolonged hospital stay or death [7-12]. A previous study demonstrated a lack of completeness of vital signs documentation in an EHR in patients who had suffered cardiac arrest [6].

1.1 Current study

The current study builds on our previous work by looking more closely at work processes and the flow of information regarding the measurement, documentation and retrieval of vital signs and investigates the extent to which the EHR supports documentation of these. A combination of observational and interview methods were used to collect the data. In this paper we report findings on 'workarounds' that

were used in relation to documentation of vital signs. The aim of this paper, therefore, is to identify and describe workarounds that were related to vital signs.

2. Methods

This study was conducted using a qualitative approach that is appropriate when deeper, richer, more complex meanings are explored [15]. Data were collected between May and September 2014.

2.1 Setting

The research setting was a district general hospital in Sweden with 372 beds. Three clinical settings were involved: the cardiology department consisting of two wards, a cardiac intensive care unit and a high dependency unit; an infection ward; and an emergency department. The hospital began using an EHR in 2007.

2.2 Data collection

There were two separate, but linked, methods used for data collection: an observational study and an interview study. An observational study can be a rich source of information as it enables the researcher to capture what people do rather than what they say they do [13]. It can promote understanding of complex situations through the observation of actions and activities [14]. Semi-structured interviews were conducted to augment the data collected during observations and to provide an in-depth understanding of views and experiences of the personnel [15].

2.3 Observational study

In the observational study, one of the researchers [JS] spent 62 hours shadowing around 15 nurses and recording detailed information about all aspects of vital signs measurement, documentation and retrieval. All three shifts were observed to increase the reliability of the data by ensuring that any variations in practice from one shift to another were recorded. Hand-written notes were taken in the field. As a supplement to observations, opportunistic interviews were conducted. This meant that the researcher could ask follow up questions during observations in less busy moments to clarify and verify what was being observed, to assess thinking processes and to gain direct views [16].

2.4 Semi-structured interviews

Following the observational study, 13 semi-structured interviews were conducted to investigate the views and experiences of doctors (n=3) and nurses (n=10). The protocol for the semi-structured interviews was created after analysing the observational data, thus questions which might be useful at interview were identified. All interviews were audio-recorded and supplementary hand-written notes were taken. The audio-recordings were translated and transcribed [JS] and a second researcher [GN] validated the accuracy of the translation and transcription.

2.5 Data analysis

To analyse the observational data, content analysis was carried out whereby themes emerged from the coded data, i.e., an inductive qualitative approach. In contrast, the interview data were analysed deductively by using the themes identified in the observational study [17]. Content analysis is a data reduction technique which can reduce large volumes of material into content categories [18]. Throughout the analysis, field notes from observations and interview transcripts were used to corroborate one another.

2.6 Ethical issues

Ethical approval was granted from the Central Ethical Review Board, Linköping, Sweden. Permission to perform the observational study was sought from the managers of the departments involved. Information about the study was given to potential participants. The nurses and doctors who volunteered gave their written consent to participate in the study and were informed that they could withdraw at any time. Anonymity of the participants was guaranteed.

3. Results

Sixty-two hours of observations were carried out in three separate clinical fields. In addition, 13 medical and nursing staff were interviewed. The age range of those interviewed was 27 - 55 years. The mean length of interview was 19 minutes and work experience ranged from less than one year to 20 years.

Since workarounds are deviations from expected work practices, the accepted standard practice for documentation and retrieval of vital signs is described: to document vital signs in the EHR in a table called 'measurements', from which they could also be retrieved.

3.1 Workarounds

We identified several paper workarounds related to the documentation of vital signs. The workarounds were in the form of notes written on scraps of paper, 'post-it' notes and in pocket notebooks or paper observation charts which had been created to suit the clinical requirements of each of the three clinical areas. In the Cardiology unit, there were three paper charts, in the infection ward, there were four paper charts and, in the Emergency Department, one paper chart. The results from each of these three clinical areas are presented separately, in order to illustrate the diversity of the workarounds adopted.

3.2 Cardiology

One of the workarounds in cardiology was hand-written notes on pieces of paper or in notebooks. Frequently, the EHR was not beside the patients when vital signs were recorded. Nurses often left the trolley with the laptop outside the room or at the nurses' station when they checked vital signs. The field note and interview excerpts below illustrate this:

The nurse measures the vital signs, writes the measurements in a notebook, then goes to the trolley in the corridor and transfers her notes on vital signs from the notebook to the measurement table in the EHR. [Field note 2. Cardiac ward. Night shift 06.00]

"We often double document. Most often we write on a paper because it is easier to have a paper with you beside the patient, than the big trolley with the computer on it. You have a little paper where you write down all the vital signs. Then you go out and write it in in the table for measurements in the EHR." [Interview. Nurse 5]

The examples above suggest that the proximity of the EHR in relation to the patient played a role in the use of paper notes. Usually, vital signs from notes were entered into the EHR directly after the nurse left the room but, if there was an interruption, or something more important came up, entry into the EHR could be delayed until the end of the shift indicating possible time lapses and the potential for mistakes to be made. That it was 'easier' to write on paper may imply usability issues with the EHR. The problem of double documentation, i.e., the same information being recorded in separate places, was recognised by the staff. In addition, staff had noted that documenting something a number of times created a risk for error during transcription as seen in the following statement.

"The more often you write the same thing the higher the risk is that it can be wrong".

<div align="right">[Interview. Nurse 2]</div>

This may lead to the potential problem of inaccurate records.

Another workaround was the use of paper charts: there were three paper observation charts used to support the documentation of vital signs. These were in the format of a table [19]. First, there was an observation chart for patients who were recovering from a coronary angiography or a percutaneous coronary intervention (PCI). This chart was used after these procedures to check several factors including the insertion site, distal pulse, and one vital sign, i.e., blood pressure [19]. The following field note is an example of its use:

Patient returns from angiography. BP and pulse checked frequently - 5, 10 and 15 minutes then half hourly. The nurse explains that with these frequent recordings, the table in the EHR would become far too long. Therefore a paper chart is used and later scanned into the EHR.

<div align="right">[Field note 4. HDU]</div>

A second observation chart was specifically for observing patients who had been prescribed certain medications, such as a nitro-glycerine infusion. This chart was for recording pulse, blood pressure, urinary output, oxygen saturation and oxygen therapy [19]. These interview comments illustrate its purpose.

"Well if I started up a nitroglycerine infusion, maybe I'd take 10 blood pressures, but I would never put 10 blood pressures in the EHR, I would enter a few of them to show how it was when we started and how it went.   [Interview. Nurse 3]

The third observation chart was for all other patients who needed frequent vital signs, e.g., if their condition had deteriorated or had become unstable. Here, pulse, blood pressure, respiratory rate, oxygen saturation and urinary output could be recorded as well as extra notes regarding medications and treatments [19]. The following interview excerpts illustrate its use:

"Then it can be that you have an acutely sick patient and you don't have time to document all this (in the EHR). Then it is paper charts that are suitable. "   [Interview. Nurse 5]

"On paper it is certainly easier to see. Then you don't need to click in the EHR, . . . so if you have it there on paper, then you can see it quickly."   [Interview. Nurse 6]

"Then we enter the first and the final BP in the EHR instead of filling in each pulse and blood pressure in the table . . . it would be really long"   [Interview. Nurse 1]

The examples above have several implications: first, that the table in the computer could not accommodate frequent vital sign recordings; second, that it took less time to document on paper, third, that it took less time to view vital signs on paper and finally, that it was easier to write by hand on paper than to use the EHR.

During the interviews, nurses described the procedure for documentation of vital signs as being time consuming and cumbersome, e.g., it took approximately 20 'clicks' to enter one blood pressure in the EHR. For doctors, retrieval of vital signs was problematic as the following interview excerpts describe.

"It is very hard to get to this information from the EHR . . . I must make many clicks to see those vital signs I need, to find them in the EHR. They are not easily accessible."

<div align="right">[Interview. Cardiology consultant]</div>

A second doctor said that it was difficult to get an overview of the patient's vital signs and that it took many clicks to see anything in the EHR:

"If a patient deteriorates, it's quicker to ask the registered nurse (RN) what the vital signs are than it is to find them in the EHR".

[Interview. Cardiology doctor]

This suggests that there may be usability problems with the EHR, and the necessity to adopt another workaround - verbal communication - because of difficulties in retrieving information [4].

3.3 Infection Ward

There were four paper charts related to vital signs in the infection ward, two in the form of tables and two as 'fill-in' forms [19]. The first of these was similar to the observation chart in the cardiology ward, for patients requiring frequent vital sign recording [19]. An RN explained this:

"I mean, you don't write everything in the EHR when it might be 10/12 times a day. Then we have a paper that is later scanned in. We would write some recordings in the EHR, e.g., when we finish a shift . . . there is a paper for this, just so you can write it in quickly. Maybe you are measuring the signs every 15 minutes . . . you maybe add the highest sign and the lowest sign to the EHR so you can see how it has been. We don't have time to go to the EHR every time . . . There would be an awful lot if we wrote all the recordings every time in the table (meaning the table in the EHR).

[Interview. Nurse 8]

In this instance, the paper chart provided a medium in which vital signs could be entered quickly. There could be a time lapse before vital signs appeared in the EHR. Furthermore, all of the vital signs recorded were not documented in the EHR. This suggests that the table in the EHR was not suitable for such frequent documentation. The need for this paper chart was confirmed by an infection ward doctor at interview.

"If we have a sepsis patient who is unstable in the ward, then there is a paper chart which is left in the room with the patient, so that you don't need to run back and forth between the computer and the patient. You have it close by and then you can use that chart instead... maybe taking vitals every 15 minutes during several hours. It can then be valuable to have it like this . . . especially in an infection ward when you maybe have an infectious patient. You don't need to run out and in or take in a laptop. Instead you have a paper that is there all the time."   [Interview. Doctor 3]

This shows that it was important for the documentation of vital signs to be close to the patient to allow both easy entry and easy retrieval of information. Staff had found that the best means of achieving this was to adopt the use of paper charts.

The second paper chart used in the Infection ward was the 'temp list' [19]. The routine was to record temperatures twice daily, at 06.00 and 18.00. At 06.00 temperatures were written on the 'temp list' and added to the EHR afterwards. Then the day nurse referred to the paper 'temp list' when she went round the patients. She would take vital signs on any patients who had been asleep at 06.00 or had had unstable results earlier. This is seen in the following field note:

At 07.30 the 'temp list' is on the trolley, along with a laptop which is being used for administering medications. The nurse checks the oxygen saturation of a patient which the night nurse had said was labile. She adds the measurement of the oxygen saturation to the paper 'temp list'. After she has been round all the patients, she sits down at the EHR and transfers the new information she has added to the paper 'temp list' to the EHR.   [Field note 9: Nurse. Day shift.]

Thus, the paper 'temp list' was used to enable the most previous record of vital signs to be at the nurse's fingertips. Although called a 'temp list' other vital signs were sometimes noted here if

necessary. The following interview excerpts describe how and why a 'temp list' was considered necessary.

(The RN shows me a temperature list [19]). "With us, all patients have their temperature checked. That's what we are interested in and then we BAS the patients too [this means to check blood pressure, respiratory rate and oxygen saturation], then write it on that temp list too in the first place. So if we have BAS-ed a patient we write it like this" (the RN shows me how more vital signs have been added in small handwriting at the side of the temperature slot, in the same slot as the patient's name).

[Interview. Nurse 8]

The temperature list only had a slot for temperature and when other vital signs were squeezed in beside the patient's name it could be hard to read, compromising effective communication.

"We have the list so that we have it when we go round (the patients). You don't always have time to stand at the computer. We write it in later. It's easier to write it on a paper and then put it in the EHR when you have time. We have a routine that it is written in the EHR before we go home."

[Interview. Nurse 8]

This suggests that nurses found it easier to write on paper and that it saved time. The concept of 'time' is also significant because of possible time lapses between measurement of vital signs and entering these in the EHR and explains why doctors found it necessary to ask nurses about the latest vital signs as noted in this quote:

"First I ask the nurse for the latest vital signs. They can often be given orally."

[Interview. Doctor. Infection Ward]

Verbal communication was therefore another workaround to overcome the problem of delayed entry of vital signs to the EHR. An RN expressed that the EHR did not fit well with work routines suggesting reasons for workarounds:

" . . . it (documentation) has to fit in with how we work . . . go smoothly. We can't have it that we stand at the computer the whole time and only write things. It's more important that we look after the patients, then document when we have time. Sure, we must document, but *when* we document is not the most important, just that everything is documented." (italics added for emphasis)

[Interview. Nurse 8]

This suggests that official documentation in the EHR was considered something that just had to be done, whilst paper workarounds were included in the actual process of care, and that the priorities of the staff for recording important information were different from those for which the EHR was developed.

There were two further paper forms which had been created specially by the infection ward personnel. These were used during admission. The first of these was a blue form called a 'worksheet' filled in for all patients on admission [19]. It was mainly to assist the ward secretary with administration and contained information about blood tests etc., as well as vital signs, i.e, temperature, pulse, blood pressure, respiratory rate, oxygen saturation, taken on admission. Here is an example from the field notes:

On admission, the nurse uses the blue 'worksheet' form to note the vital signs at the bedside. She says it is convenient to use this form as it must be filled in anyway. Afterwards, the nurse goes to the nurses' station and enters vital signs to the table in EHR.   [Field note 9. Nurse. Day shift.]

In this instance, the worksheet was used as a means of noting vital signs before entering these into the EHR. The second form was a paper check list used sometimes by nurses, particularly if they were

new to the ward or newly qualified, to remind them of what to ask patients on admission, and included vital signs: temperature, pulse, blood pressure, respiratory rate, oxygen saturation and oxygen therapy [18]. The following interview excerpt describes this:

" . . . that's a check list we use when a patient is admitted, because of the new nurses . . . so that they can tick off what needs to be done."   [Interview. Nurse 8]

These pre-printed forms were used in a similar way to paper notes. Sometimes paper note pads were used as well.

An assistant nurse checks a patient's vital signs and writes them down on a paper notepad. Back at the nurses' station, he writes these vital signs on a blue 'worksheet' form [19]. He then adds the vital signs to the table of the EHR.   [Field note 9. Assistant nurse. Day shift]

In this action, vital signs are written twice on paper before being entered to the table in the EHR, an example of triple documentation.

3.4 Emergency Department

The Emergency Department had only one paper form [19]. It was a form used for writing down details of patients when they were admitted and included vital signs:

A paper form is used to write the vital signs, with boxes for temperature, pulse, blood pressure, respiratory rate, oxygen saturation. Then the signs are added to the EHR. The paper form was put in a plastic folder and placed at the nursing station and a nurse related that it was not really needed but that the doctors liked to have these vital signs on a piece of paper and with them when they examined a patient.   [Field note 8.]

This suggests that doctors found it more convenient to have a paper form at hand rather than to retrieve vital signs from the EHR.

4. Discussion

In this investigation, we found several workarounds that were directly related to the flow of information relating to vital signs. There were eight paper-based workarounds and some verbal workarounds also emerged. Previous studies have recognised that paper use can persist after implementation of electronic systems if they do not support clinical workflow [1,20]. Essentially, clinical staff had created these workarounds because they felt it would ensure patient safety and the flow of normal work processes. The justifications and consequences of workarounds are discussed in this section based on four aspects: technical, operational, cultural and organisational, in line with Ser et al. [21].

4.1 Technical aspects

Lack of adequate technological design led to workarounds in the form of paper charts for documenting vital signs because of the perceived efficiency of paper over the corresponding function in the computer [16]. In the EHR, there was a bespoke table for vital signs, which could accommodate routine, infrequent documentation. However, when more frequent vital signs were required, the table was considered unsuitable. Staff complained of excessive clicking to enter vital signs, so it was quicker to write by hand. Moreover, the paper chart had space for as many vital signs as it was necessary to record and it was easy to view at a glance implying, as noted in previous studies [4,16], that there were problems with usability.

These findings may explain results from a previous study in which the vital signs were incomplete in the EHR [6]. When staff used paper workarounds only some of the vital signs documented on paper were added to the EHR. Further, it was never stated in the EHR that supplementary paper records were available or, that for discharged patients, paper charts were scanned and stored in the EHR. Thus, someone checking the EHR retrospectively would only see the information that staff had selected to be in the EHR. This may have caused fragmentation and inconsistency in the electronic record [20]. In addition, nurses frequently reported that vital signs were only added to the EHR 'later' or at the end of a shift. Delayed entry, as well as the use of paper charts, had implications for staff who wanted to check vital signs in the EHR. Doctors, in particular, expressed frustration that vital signs were so difficult to find and to compound this problem, when they located vital signs they could not be sure these were the latest. Thus a further workaround emerged in the form of verbal communication - doctors asking nurses for the latest vital signs.

4.2 Operational factors

A laptop was used where possible to record information in the EHR. However, it was not always possible to take a laptop into the room, for instance, if no laptop was available, if a patient was being barrier nursed or if there was other equipment needed at the bedside, such as a blood pressure machine. Therefore, nurses used hand-written paper notes for vital signs or charts, which were kept at the bedside if patients required more frequent recordings. Later, some of these vital signs were entered into the EHR, which introduced the issue of double documentation and risk for error during transcription, as well as delayed entry in some cases. Thus, from the staff perspective, the EHR did not integrate with their existing work practices.

4.3 Cultural factors

The workarounds used in two of the three clinical areas revealed a kind of subculture in relation to the types of patients cared for. For instance, in the infection ward, a paper chart used twice daily was called a 'temperature list', presumably because of the relationship between infection and fever. The chart had only one slot for recording vital signs, i.e., for temperature. If other vital signs were thought necessary, these were squeezed in at the side of the temperature slot. As this happened quite often, it is perhaps surprising that a more suitable chart with space for supplementary vital signs had not been designed. In the Cardiology unit, observation charts also reflected that specific vital signs were of more importance than others, e.g., blood pressure was the focus in the post-angiography chart. Although, these examples show initiative and resourcefulness on the part of clinical staff, as they strive to ensure safe patient care despite an inappropriate system, these home-spun paper charts were not in accordance with current thinking on patient monitoring, which recommends the recording of complete sets of vital signs in order to detect clinical deterioration [22]. In addition, research on paper observation charts emphasises the importance of plotted graphs and colour coding to maximise cognitive ability of users [23], but these features were not apparent in the home-spun, tailor-made paper charts used on these wards. Paper charts may be an appropriate workaround [20] but it could be important that high quality paper charts be used if maximum benefit is to be gained.

4.4 Organisational issues

It has been shown that EHR systems often serve the needs of strategic and managerial users but do not meet the needs of frontline workers [5]. Nurses have alerted managers to problems of documentation in the EHR but perceived that they were not listened to [4], or that inadequate solutions were initiated to alleviate the problems they encountered. For example, the 'measurements table' was a vast improvement on the tool used in a previous study [6] but still did not meet the requirements of vital signs documentation. Therefore, it is not surprising that workarounds persist and that there are homemade solutions at ward level. When systems are not adequate, workers address problems head on and, over time, solutions become part of the work routine [24]. However, organisations have a responsibility to guarantee patient safety and should not depend on frontline workers to solve problems created by inadequate technological design. The downside of workarounds is that although

they work well for frontline staff, and become embedded as routines, they may cause organisational inertia, and the reason they were needed in the first place becomes forgotten. This can mean that organisations do not learn from or solve these inadequacies which, in the longer term, can be inefficient and expensive [24].

4.5 Limitations of the study

This study provided valuable insights, although it is important to note that there are limitations to be considered in relation to the findings. The study took place in one setting and examined one EHR system so the results may not be transferrable to all settings. However, the study identified workarounds that staff found necessary to circumvent problems of an EHR widely used in Sweden and could provide the basis for similar studies in other locations.

5. Conclusion

Our study suggests that nurses created workarounds to get the job completed efficiently and to provide their patients with safe care responsibly. There was an air of acceptance that the EHR was the way that it was, their voices had not been heard and they had found their own solutions. To be safe, electronic record systems should be correct, consistent and current [20], but the risk of error during transcription, or incomplete and delayed entries make it increasingly unlikely that these positive benefits will be realised. On the one hand, resilient frontline staff may find ways to serve their information needs and to mitigate potential perceived risks to patient safety by creating workarounds in the form of tailor-made paper charts. On the other hand, locally-developed paper charts may take many forms, may not necessarily be based on current evidence, but may be based on tacit knowledge [25]. Conclusively, organisations and system providers should embrace system design flaws as learning opportunities to improve patient safety and efficiency.

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